



European Association  
of Research and Technology Organisations

# Impact Delivered



**TECHNOLOGY FOR A BETTER WORLD**

[www.earto.eu](http://www.earto.eu)

# Technology for



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# a better world

## Innovation is the key to changing actual economic trends

By the time this year's edition of Impact Delivered reaches you, new EU decision-makers will have taken their seats: the new Members of the European Parliament will have started working in their respective Committees looking at future EU policies and the new European Commission would have been nominated ready to tackle the challenges ahead.

Europe is in a grim global economic context, where there is still a widespread feeling in Europe that we are being out-challenged on global markets. **As clearly recognised by the European Commission, we are facing a situation of 'innovation emergency': EU faces today the very real risk of falling behind the US and Asia in terms of innovation performance.** Europe is spending 0.8% of GDP less than the US and 1.5% less than Japan every year on Research & Development (R&D). There is today a clear understanding that while Europe creates excellent research it is not able to capitalise enough on the knowledge created in terms of economic success, new products and jobs.

This publication illustrates RTOs focus on solving real-world problems and delivering innovations that have real-world value, and demonstrates that RTOs have so much more to contribute to keep Europe innovation performance afloat aiming at supporting the industry in creating jobs and growth that Europe so badly needs.

Innovation is the key to changing actual economic trends and the EU has launched Horizon 2020 as the main vehicle for such change. However, it is clear that Horizon 2020 will not solve the European 'innovation emergency' alone. To be competitive Europe needs: Strong European Value-chains & Innovation Eco-systems, Impact Delivered from National & European R&I Investments as well as Smarter & Lean Innovation Policy. **EARTO Members will be discussing such issues and their recommendations during EARTO Policy Event in October this year. We very much hope that it will lead to further strategy discussions with EU-decision makers to find impactful solutions to today's innovation challenges.**

Today, the 350 RTOs members of EARTO are clearly ready to support the new EU-decision makers to tap into the impressive European resource that they represent in Europe to further set up ambitious European Innovation and Industrial policies.

Hoping that you will enjoy the reading,

**Maria Khorsand**  
EARTO President



# Welcome to the world

23 COUNTRIES



350 RTOs

WHAT ARE  
RTOs



KEY PLAYERS  
IN THE  
INNOVATION CHAIN



NETWORK  
150 000  
RESEARCHERS  
ENGINEERS &  
TECHNICIANS  
SHARING IDEAS  
& INFORMATION

ROAD TO  
EXCELLENCE



IN RESEARCH

# of RTOs



**BRIDGING GAP  
BASIC RESEARCH  
AND PRACTICAL  
APPLICATION**

**ECONOMIC  
IMPACT  
40 BILLION  
€**



**SUPPORT  
100 000  
COMPANIES  
PER YEAR**



**SUPPORT NATIONAL GOVERNMENTS**

**INNOVATIVE SOLUTIONS**



**HEALTH, DEMOGRAPHIC  
CHANGE AND  
WELLBEING**



**FOOD SECURITY,  
SUSTAINABLE  
AGRICULTURE, MARINE  
AND MARITIME  
RESEARCH,  
BIOECONOMY**



**SECURE, CLEAN  
AND EFFICIENT  
ENERGY**



**SMART, GREEN  
AND INTEGRATED  
TRANSPORT, INCLUSIVE,  
INNOVATIVE  
AND SECURE SOCIETIES**



**CLIMATE ACTION,  
RESOURCE EFFICIENCY  
AND RAW MATERIALS**



# IMPROVING CANCER DIAGNOSIS WITH 'THE DOCTOR'S GOOGLE'

An innovative search engine enabling clinicians and researchers to search millions of biopsy samples in thousands of biobanks worldwide by visual relevance rather than written description is set to dramatically enhance research capability to look for new tools for cancer diagnosis and treatment. Developed by EARTO member Tecnia in the context of the BIOPOL European project, BIOSIMIL is based on pathologists' expertise and uses an advanced image processing technique so samples histologically similar to the searcher's patient's samples can be retrieved, along with an associated diagnosis, paving the way for earlier detection, personalised therapy and higher survival rates.



Cancer is now the world's biggest killer: 1.75 million people died from the disease in 2012 in Europe alone. The cost to society is equally high, with every cancer patient costing health services €39,607, employers €205,847 and families €41,984. Final clinical diagnosis relies on histopathological biopsy assessments, yet research shows these can contain errors mainly related to lack of information during diagnosis. Giving clinicians easy access to the information they need, in the form of tissue samples for comparison and matching, presented a number of seemingly insurmountable problems. **Despite the fact that there are more than 225 biobanks in Europe, storing around one billion samples, they did not have the bioinformatics tools to integrate and make this information widely available.** In addition, each image was only described with the identified pathology and not the particularities

Tecnia's expertise in computer vision enables BIOSIMIL to automatically analyse microscope images to identify the histological features that help doctors make a diagnosis.

of the image, making searches for specific samples an almost impossible task.

## Expert search

Working with six partners in the Biopool project ([www.biopoolproject.eu](http://www.biopoolproject.eu)) led by Basque Biobank-BIOEF of the Basque Health System, **Tecnia used its computer vision expertise to develop an image search engine which automatically analyses the digitalised images that pathologists use in their daily diagnostic work to identify the relevant elements from an expert clinical point of view.** Combining Tecnia's experience in feature extraction, colour theory, machine learning and image enhancement with its collaborators' expertise in fields from sample collection to computing has enabled challenges of scale, speed and security to be overcome. A high capacity computing cluster is used to accommodate the DVD-sized biosample images. Compact descriptors, visual similarity metrics and scaleable architecture enable search results from millions of images in a few seconds. Use of a dedicated facility ensures the high level of confidentiality required for medical information.

## Better treatments

BIOSIMIL is a key enabling healthcare technology for both disease survivability and cost efficiency. **The system has the potential to reduce the cost per patient through early and more accurate diagnosis as well as the scale of misdiagnosis.** It will be especially useful in the case of rare pathologies with which most clinicians are unfamiliar. BIOSIMIL will also reduce by 60% the time taken by medical universities, research centres and pharmaceutical companies to find relevant samples for

their research, helping to generate more relevant results, new clinical guides and knowhow and ultimately more appropriate treatments for patients. Based on BIOSIMIL technology, Tecnia and the Basque Biobank-BIOEF will promote the creation of a network of biobanks whose members estimate a 200% increase in sample requests.

## Profitable future

A BIOSIMIL prototype has validated its capabilities for the fast interaction of large biobank databases and provision of clinically relevant image searches on colon, lung and breast pathologies. The solution has also been tested and validated by pathologists from eight European hospitals. **Commercialisation is planned for early 2015 and more than 25 biobanks have shown interest in the system's functionalities.** Participants will also include hospitals, universities, research organisations, software developers and biotechnology companies, who will pay an annual fee forecast to generate income of around €5.7m over the next four years. The system also opens up opportunities for new services for the medical sector such as automated medical screening, second medical opinions, and remote pathology analysis. Tecnia has already sold a BIOSIMIL-derived technology to a leading European biochemical company and received interest from European organisations involved in biobanking and clinical technologies.



**'This innovative use of computer vision will help Europe reach the forefront in personalised medicine and healthcare and will become a tool to provide unison in the field of biobank image retrieval.'**

Bas de Jong, Associate Manager, Erasmus MC Tissue Bank

**BIOSIMIL's breakthrough is to identify and retrieve images which are similar to the clinician's patient according to an experienced pathologist's definition of similarity.**

**tecnia** Inspiring Business

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 30 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.

[www.tecnalia.com](http://www.tecnalia.com)

# TURNING WOOD INTO FISH FEED

SP Processum, part of EARTO member SP Technical Research Institute of Sweden, has developed a new kind of fishmeal substitute for farmed fish made from wood-derived sugars rather than wild fish byproducts. It could help answering growing global demand for farmed fish without further depleting the oceans' wild fish stocks. GreenFeed has the potential to help reduce overfishing in the future and to boost the efficiency, growth and sustainability of two European industries: aquaculture and forestry.

With around 80% of the world's wild fish stocks fully exploited, over-exploited or depleted, greater reliance than ever before is being placed on fish farming. Already, aquaculture accounts for 50% of the fish supply for human consumption. Traditional fishmeal made from fish bones and offal might be the preferred source of protein for fish feed but it's becoming an unsustainable source. **It can take 3 kilos of wild fish material to produce 1 kilo of farmed fish and, with fishmeal production stable and aquaculture production increasing, demand is outstripping supply and sending prices rocketing.** Most alternative protein sources are of plant origin and have drawbacks, such as antinutritional substances that can be detrimental to fish, which rule them out as the primary solution. What is now in the frame is single cell protein (SCP) made up of protein-rich microorganisms such as yeast, bacteria, algae and fungi.

## A feed for growth

While there is a long history of looking to single cell protein for food production – the mycoprotein used to produce meat-substitute Quorn is extracted from a fungus, for example – a fishmeal substitute has never before been the focus of this search. **SP took up the challenge. Making use of its expertise in new product development based on wood raw material and its fermentation facilities,** it evaluated a number of microorganisms on different residual streams from Swedish wood-



Protein-rich GreenFeed was tested on Tilapia, one of the most commonly cultivated freshwater fish, and found to promote similar or better growth than traditional fishmeal-based feed.



based biorefineries and carried out cultivation experiments with the most promising combinations to optimise conditions for biomass production. The resulting fish feed, which contains amino acids very similar to fishmeal, was tested on the freshwater fish Tilapia and found to promote similar or better growth than fishmeal-based control feed.

## A sustainable solution

GreenFeed means that potentially fish will no longer be needed to grow fish, greatly contributing to the sustainability of the aquaculture industry. After 40 years of 8% year-on-year growth, during which time fishmeal production has remained static, fish farmers will be able to look to Europe's growing biorefinery industry for mutually-beneficial, environmentally-friendly and enduring supply partnerships. **The new feed also contains high amounts of  $\beta$ -glucans, some of which are anti-microbial, anti-viral and immune-stimulating, which help to reduce disease and infection and reliance on antibiotics.** For the forestry industry, particularly the pulp and paper sector which is suffering decreasing demand, GreenFeed has the potential to meet the need for new profitable products. And by enabling the production of food directly from forest trees, it lowers pressure on agricultural land, avoiding the 'fuel vs food' dilemma facing the biofuel industry by opening up a positive alternative route of 'forest for food'.

## A profitable reality

With value chain, regulatory framework and plant design evaluation currently underway, co-production of GreenFeed in a biorefinery could be a reality within a few years. It's estimated that, per production unit, this could result in 50 to 200 new jobs and turnover of up to €50m. **Sweden's 35 pulp mills alone are capable of producing between 25 and 33% of the single cell protein needed to match the current quantity of fishmeal produced globally.** The cellulosic ethanol production industry - emerging to meet the growing need for advanced biofuels - could provide even greater potential than the pulp industry for co-production of GreenFeed in the future.

**\_ Increased demand for fish together with over-exploitation of the oceans' fish stocks has led to a conundrum: how to enable continued growth of the fish farming industry at a time when fishmeal supplies are declining.**

**\_ A new plant dedicated to GreenFeed production would be expected to generate about 50-200 new jobs and a turnover of €50.**



SP Processum is a leading biorefinery initiative operating nationally and internationally. It conducts R&D related to biotechnology, energy technology, inorganic and organic chemistry and raw materials with a focus on sustainability and works with other initiatives and universities to develop new products, energy solutions and fuels based on wood raw material.

[www.processum.se](http://www.processum.se)

SP Processum is owned by SP Technical Research Institute of Sweden, a centre for research and innovation which develops, tests and evaluates technologies, materials, products and processes for national and international customers. Providing an effective link between research and commercialisation, the Institute takes a holistic approach based on interdisciplinary cooperation to innovation in its core areas of building and construction, electronics and ICT, fire, risk, safety and security, foods, materials technology and chemistry and measurement technology and calibration.

[www.sp.se](http://www.sp.se)

# LIFETIME PROTECTION FOR DIGITAL DATA

A data usage control infrastructure that goes far beyond today's access control mechanisms to enable the protection of sensitive or secret information on any device and in any format throughout its lifetime heralds a new dawn for digital security. Developed by the Fraunhofer Institute for Experimental Software Engineering IESE, IND<sup>2</sup>UCE rises to the growing security challenges associated with technological interconnection and dependency. It helps prevent disclosure of confidential information, identity theft and loss of reputation and so makes the digital world safer and more robust for business and for society at large.

With huge amounts of business-critical and personalised data being processed and exchanged continuously, across system boundaries, via mobile devices and in Cloud environments, classic data access control mechanisms can no longer solve today's security and privacy problems. Concerned solely with granting initial access to data, they lack sufficient functionality to protect how, where and when information can be disseminated, modified and used thereafter. Pressure for a big shift in security sophistication in response to today's com-



At the IND<sup>2</sup>UCE laboratory, Fraunhofer researchers have developed a component-based framework with a policy decision point at its centre which determines the legitimacy of security-related events and enforcement and with execution points that ensure adherence to security policies and can perform additional actions.

plex IT landscape is rising, driven by issues such as the increasing overlap of private and business device usage, the emergence of socially important health-care solutions with challenging privacy requirements, and compliance with legal regulations such as the Federal Privacy Act.

## On track

**Capitalising on its expertise in industrial software and systems development, the Fraunhofer Institute IESE set about developing a distributed data usage control framework for the comprehensive prevention of data misuse, whether malicious or unintentional.** The result is the IND<sup>2</sup>UCE framework, which can be easily integrated into existing infrastructures and fully customised thanks to its component-based architecture and flexible approach to the specification and enforcement of security usage policies. Another fundamental reason for the success of the project was the team's leveraging of the latest multiple data-flow tracking technology and usage-control enforcement monitors. Having one monitor at each layer of abstraction (operating system, web browser etc) means that the underlying security and data protection system automatically tracks and takes into account all of the different representations data may assume.

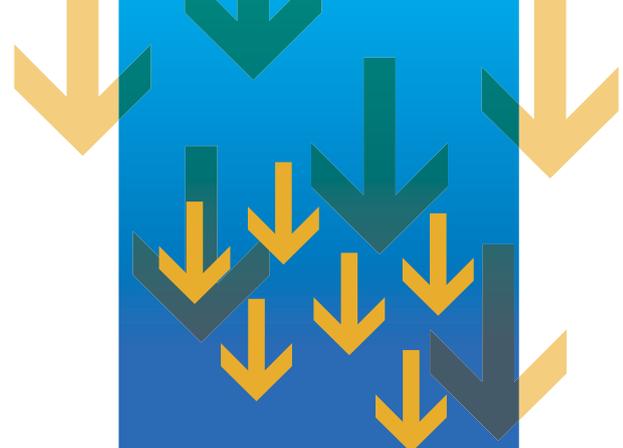
## In control

IND<sup>2</sup>UCE puts data owners in control right from the start, enabling them to predefine exactly what can and what must not happen to data after access has been granted, and what action will be taken when the system is alerted to security-related events – actions such as allowing, modifying or rejecting the event or deleting data, recording operations or sending messages. This free-

dom to implement rigorous security strategies through tailored security measures means that data owners can, for example, disallow certain data to cross system or company boundaries, grant data access to third parties for a specific purpose or period of time, make confidential areas of data anonymous, or prohibit a movie being played more than twice even if several copies have been created.

## Out to market

Prototype IND<sup>2</sup>UCE implementations involving the financial sector, smart farming, assisted living and the safe integration of smartphones into the business environment have proved the framework's feasibility. **A demonstrator laboratory and showroom integrating the components and results of these projects is being created at the Fraunhofer Institute IESE.** The short-term goal is to identify key partners and develop individual solutions, The longer-term objective is developing licensing models. These could provide a solid basis for a spin-out to initially target logistics and trading companies, service and Cloud infrastructure providers, ERP solution developers and social community providers.



**IND<sup>2</sup>UCE could be integrated into ambient assisted living systems monitoring elderly people's behaviour and health in their homes to prevent undesired usage of personalised data allowing, for example, access to all health monitoring data via a smartphone inside the patient's home while disallowing access to or anonymising everything apart from health-critical information outside the home.**



The Fraunhofer-Gesellschaft is the leading organization for applied research in Europe. Its research activities are conducted by 67 Fraunhofer Institutes and research units in over 40 different locations throughout Germany. The Fraunhofer-Gesellschaft employs a staff of around 23,000, who work with an annual research budget totaling 2 billion euros. About 70 percent of this sum is generated through contract research on behalf of industry and publicly funded research projects. Branches in the Americas and Asia serve to promote international cooperation.

[www.fraunhofer.de](http://www.fraunhofer.de)  
[www.iese.fraunhofer.de](http://www.iese.fraunhofer.de)

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The Keck 1 telescope in Hawaii makes use of CSEM's novel Configurable Slit Unit mechanism and enabled a team of scientists from the University of Texas to observe 43 galaxies in just two nights.

*© W M Keck Observatory on the summit of Mauna Kea*

# ENABLING MODERN ASTRONOMERS TO DISCOVER THE OLDEST GALAXIES

Flexure structure technology, developed by EARTO member CSEM, is transforming the capabilities and costs of high-end scientific instruments and has already led to the discovery of the oldest galaxy in the universe. The technology is based on elastic components which are capable of the kinematic functions required in precision mechanisms and have game-changing advantages over traditional rigid alternatives, FlexTec structures have been combined by CSEM with miniaturised optical systems to enable a new approach to complex instrument design for modern astronomy and large science projects.

Conventional mechanisms for transferring or transforming motion, force or energy to guide and position devices are rigid bodied with rigid connections at movable joints. The limitations of this kind of structure are many, including the need for precision machining of multiple parts as well as lubrication or special coatings. Compliant mechanisms in which deformable structures form flexible bridges between stiff structural parts have long been seen as the solution to these issues as they have fewer parts and joints, reduced friction and wear and far greater precision. With rapid progress and rising ambitions in scientific instrumentation calling for large quantities of ever-smaller and smarter mechanisms, there was a need

to overcome the remaining challenges in analysing and designing flexure-based miniaturised systems for advanced applications such as astronomy, a field that continues to push the limits of optical systems.

## Flexible focus

CSEM leveraged its FlexTec expertise in line with its long-term activity in MEMS (micro-electromechanical systems) and MOEMS (micro-opto-electromechanical systems) **research to pave the way for a new generation of opto-mechanical precision systems.** These involve not only the flexure stages, for linear or rotary degrees of freedom, but also the inclusion of actuators, sensors, fine mechanics and control loops for fully integrated operational systems. In terms of the flexure components, researchers focused on critical design issues such as frictionless motion transmission, guiding accuracy, minimising mechanism size and reducing unwanted dynamic effects. They also applied advances in areas such as the fabrication of large optics for vacuum-cryogenic instruments to the domain of precision mechanisms. As a result, they opened up a wide range of new and innovative applications extending into space and back down to earth, for weather forecasting and medical instruments.

## Unsurpassed performance

CSEM's development of compliant mechanisms for use in space exploration has led to quantum leaps in performance compared to existing methods, and to remarkable results.



Assembly and control of the reconfigurable slit mask of the Multi-Object Spectrometer for Infra-Red Exploration (MOSFIRE) instrument in CSEM's cleanroom lab.

**The systems' advantages include highly precise and reproducible movement patterns and dynamic motions, a far smaller number of movable parts enabling easier and less costly manufacture and a lack of friction and wear which increases longevity and reduces the requirement for maintenance** – a particularly valuable characteristic for applications where the mechanism is not easily accessible. Thanks to high cross-stiffness achieved by choosing the right flexible degrees of freedom, they are also directly compatible with extreme environments such as space, ultra-high vacuum and clean environments.

## Invaluable contribution

Several complex and advanced versions of the new mechatronic systems have been designed and manufactured for prestigious space programmes and international observatories. CSEM's novel Configurable Slit Unit (CSU) mechanism is an integral part of the Keck 1 telescope's MOSFIRE multi-object spectrometer, which allows astronomers to take an infrared image of a field of view and observe many objects at once. The CSU incorporates novel flexible elements which endow it with outstanding precision and optical features and allow configuration changes in minutes rather than hours. The technology is installed on NASA's Stratospheric Observatory for Infrared Astronomy (SOFIA), the world's first civil airborne telescope which enables observations impossible from Earth or space and has already observed never-before-seen heat emitted from Jupiter. Unique CSEM systems can also be found on SILEX, the first European optical communication terminal in orbit, and EUMETSAT's meteorological MetOp satellite, which helps scientists better understand climate change.

**‘Astronomers have been waiting for decades for a configurable instrument like the MOSFIRE spectrometer which contains CSEM's flexible technology to study the origin and evolution of the first galaxies to form in the universe.**

**‘CSEM's approach was very interesting because this is an intricate and highly mechanical structure - like a Swiss watch - and the 92 bars that must be moved back and forward to make a mask of tiny slits implies a lot of mechanisation. However, they came up with an exceptionally compact design, and a design that could be highly replicated’**

Professor Ian McLean, University of California Observatories (UCO), one of the leaders of the MOSFIRE instrument

# csem

CSEM is a Swiss research and technology organisation specialising in micro and nanotechnology, information and communication technology and system integration, addressing small series production when necessary for industry. CSEM creates a dynamic link between research and high-tech industries, such as medtech, industrial controls, watchmaking, aerospace, cleantech and environmental monitoring, and also collaborates with other innovation centres to provide solutions for cutting-edge products and applications.

[www.csem.ch](http://www.csem.ch)

# DIGITALISED EXPERTISE MAKES MACHINERY MAINTENANCE EASIER AND SAFER



The system automatically monitors the work carried out and tints the user's hand green in the 3D overlay when a maintenance step is carried out correctly.

**An interactive digital handbook combined with Augmented Reality (AR) data glasses displays step-by-step instructions for industrial maintenance tasks directly into the user's field of view. It is the first such system in the world to be cost-effectively customisable for widespread adoption. Developed by The German Research Centre for Artificial Intelligence (DFKI), an EARTO member, the system's automatic creation of procedure assistance and validation of task execution put it in a unique position to improve training, productivity and safety in industry and agriculture and act as a modern do-it-yourself manual for consumer goods.**

Maintaining complex machinery requires even the most experienced operator to refer to manuals for procedures, component data and safety information. But this isn't ideal: as operators continually switch their focus from these references back to the repair area they have to synthesize information and apply it spatially and conceptually to their view of the equipment, identifying and allowing for variations between the two. While electronic technical manuals bringing information together in one



place can make a difference, they are still external to the interaction between the maintainer and the equipment, increasing cognitive overload, repair time and errors. **Augmented Reality manuals that overlay real-time 3D computer graphics onto the actual equipment to overcome these issues have been created** but, until now, they have been hindered by highly complex and costly creation procedures for interactive task assistance.

## Giving clear guidance

In DFKI's solution, head-worn motion-tracked displays supplement the real world with computer-generated graphics from the user's perspective, **showing them exactly what they need to do at each step of a task, tinting their hand green if they perform the step correctly and red if its incorrect, and displaying the next instruction when needed.** Underpinning the system are two true innovative leaps: the ability to automatically analyse the structure of manual workflows from live-stream reference videos and then to extract and display relevant intuitive instructions. The system also displays context-aware overlays, like service intervals for parts in view of the camera, and enables users to make hand gestures to acquire additional information such as specification sheets and to order replacements for parts in view of the camera easily and quickly online.

## Adding extra value

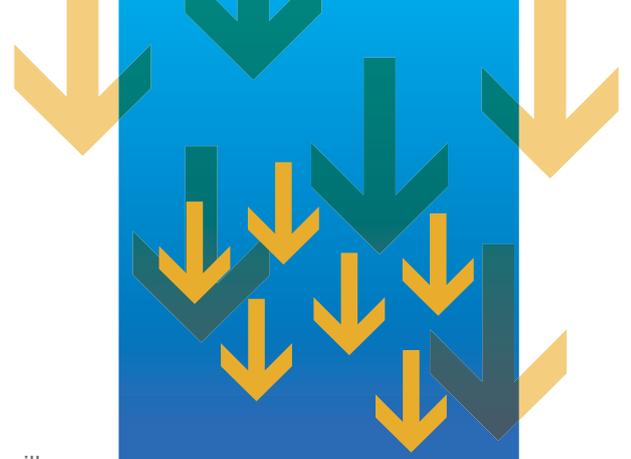
As the system enables workflow reference sequences to be recorded on the

go, during everyday work, there will no longer be the need for costly manual authoring and content creation. This makes Augmented Reality maintenance assistance economically viable for many more organisations and applications than ever before. **The system's ease of use means that even workers not trained in a specific workflow can carry out complex maintenance tasks.** And its immediate warning of mistakes gives it a key role in industrial health and safety procedures. Its integration of real-world knowledge bases with detailed 3D models also opens up the opportunity for use as a simulator/training tool for maintenance, repair, overhaul and assembly tasks. As the system can be implemented on consumer-grade hardware, it can also be used for home and office tasks such as changing printer ink cartridges - with the added benefit that because it learns from observation it could even include instructions for finding the replacements in the cupboard.

## Entering multiple markets

**The new Augmented Reality Maintenance Assistance System has been tested and validated with several industry partners, including tractor manufacturer John Deere.**

These demonstration projects have provided feasibility studies and prototypes as part of DFKI's preparation for market entry through a dedicated spin-off which will be launched later this year. This will initially target large German manufacturers in industrial, medical, consumer, automotive and agricultural markets, expected to be worth around €12 million, and subsequently SMEs and large firms in national and international markets, where potential business has been valued at €170 million.



**\_If you think of all the maintenance, repair and overhaul procedures undertaken in a single factory or car repair shop, it is easy to see that the expertise, time and cost of setting up each maintenance procedure within previous Augmented Reality systems profoundly limited their use - and why DFKI's cost-effective automatic procedure removes this barrier.**

**\_The potential value of the markets to be targeted by the DFKI spin-off that will commercialise the Augmented Reality Maintenance Assistance System is €170 million.**



The German Research Centre for Artificial Intelligence is the world's largest research centre in its field and focuses on innovative software solutions in knowledge management, multi-agent technology, simulated reality, language technology, intelligent user interfaces, image understanding, pattern recognition, robotics, secure cognitive systems, augmented reality and computer science. Its 390 employees and 360+ students from 53 countries are involved in application-orientated basic research to market and customer-orientated development of product functions.

[www.dfki.de](http://www.dfki.de)

# SHAPING THE FUTURE OF CERAMIC COMPONENTS

**A technique for creating 3D printed ceramic parts for industrial applications with greater speed and flexibility than any other method is opening up a new world of high performance production solutions. Developed by a consortium of the Energy Research Centre of the Netherlands (ECN) and Formatec Industrial Ceramics, the innovative process fuses the strengths of ceramics with the advantages of additive manufacturing to make previously unimagined complex shapes and has already been successfully commercialised by a spin-out, Admatec, which is meeting fast-growing demand from the process industry and beyond.**

The characteristics of ceramics, which include high density and stiffness, excellent hardness, wear resistance, thermal stability and low surface roughness, make them one of the most attractive materials for industrial components. Although they have been used everywhere from the automotive and medical to the engineering and semi-conductor industries, their full potential remained untapped: the additive manufacturing revolution of layer-by-layer construction to create three-dimensional solid objects from digital models made little use of ceramic materials. That has now changed.



The ADMAFLEX technique processes ceramics into all kinds of shapes that were previously impossible or involved prohibitively expensive post-processing.



## Seeing the light

ECN and Formatec Industrial Ceramics believed there could be a way of transforming the fabrication and economics of ceramic components by using ECN's ceramic injection moulding knowhow with a digital light processing-based (DLP) 3D forming technology, rather than conventional 3D printing techniques. They joined forces with Innotech to explore this idea and made a breakthrough in months. **The partners developed a procedure, called ADMAFLEX, in which powdered ceramic materials mixed with a photopolymer layer are exposed to light layer by layer to cure.** Once the photopolymer is baked out and a sintering treatment applied, the result is a dense microstructure with similar properties to traditional ceramics which is ready to be made into all kinds of high-grade parts.

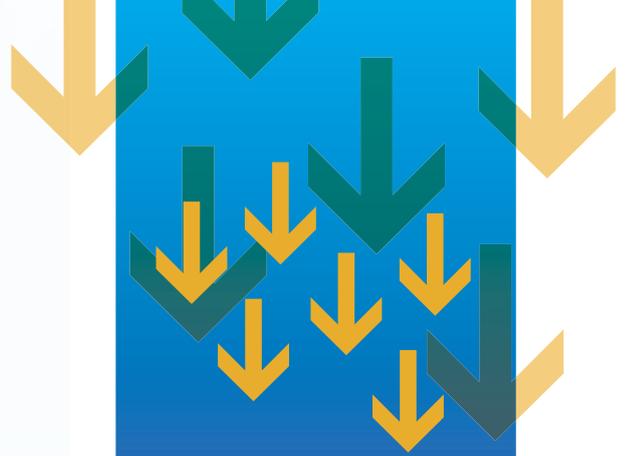
## Boosting the benefits

While ADMAFLEX allows every object produced to be unique and specifically tailored to the needs of the customer, it also endows every object with the same advantages of additive manufacturing. These include **no need for moulds or dies, elimination of tooling and machining constraints, quick, easy design changes and on-demand**

**manufacture of even the shortest runs, which add up to faster time to market and better end products.** The materials used in the process can range from less hard alumina ceramics to hard, abrasion-resistant zirconia ceramics, both of which can be made into semi-hollow parts for weight and cost reduction and incorporate threaded inserts added during fabrication. ECN has also proved that the same process can be used to provide a higher quality alternative to existing 3D metal-shaping techniques.

## Leading the way

ADMATEC, the company founded in November 2013 by the three project partners to commercialise the new process, has secured orders valued at €400,000 for fully functional ceramic components for, among a range of applications, integrated reactors, heat exchangers and analytic devices. It is also focusing on widening the range of materials and size of components that can be achieved with the technology and developing a similar approach for metal products as a better quality and more cost effective way to make metal parts than existing 3D metal-shaping techniques.



**'We think this technology, which is based on our expertise in building up thin layers of material and in powder metallurgical shaping, will make a large number of new applications possible that could not be produced, or could hardly be produced, in the past'**

Jan Opschoor, Researcher in Materials, Testing & Analysis, ECN.

**\_The ADMAFLEX process produces complex engineering grade ceramic components with a 90% shorter lead time and at much lower cost than traditional techniques.**

**\_ADMAFLEX produces materials constructed in a superior way to existing 3D technologies which ensures homogenous and stress-free material properties.**



Energy Research Centre of the Netherlands (ECN) is the largest energy research institute in the country, with 500 employees active in joint projects with industry, government and research institutes at home and abroad to support and enable the transition to a more sustainable energy system. The ECN's current core fields of activity are solar power, wind energy, biomass, energy efficiency, environment and energy engineering and policy studies.

[www.ecn.nl](http://www.ecn.nl)

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# A REFRESHING NEW APPROACH TO COOLING DRINKS

Based on breakthroughs in rotation, motion path and control algorithms, the V-TEX cooling system is a completely new innovation occupying a unique position with no market rivals.

A new kind of rapid, energy-efficient drinks cooling system that chills canned and bottled drinks faster than any other known technology could herald the demise of the commercial chiller cabinets whose annual global energy consumption equates to around 25 million households. Enabled by a pulsed rotation concept that prevents carbonated liquids from fizzing as they're cooled, the Rapidcool innovation developed by EARTO member Pera Technology means drinks can be stored at room temperature until the moment of purchase or consumption, replacing the need for costly refrigeration in shops, restaurants and homes.



Current drinks chillers, from vending machines to display cabinets, are hugely inefficient in terms of energy, space and capital equipment costs. Yet there was a complete lack of viable alternatives until now. Because drinks, unlike many chilled and frozen foods, don't need to be kept at a certain temperature ahead of consumption, **there was clearly an opportunity to explore novel methods of 'chilled-on-demand' drinks dispensing.** The key challenge was to find a way of meeting demand for extremely fast cooling without 'slushing', which is caused when the outer layers of liquids freeze before the inner liquid is cooled.

## Perfect mix

As part of an EU-funded collaborative project called Rapidcool, Pera Technology discovered that rotation of a drink at a certain speed and motion profile creates what is known as a 'Rankine vortex' and enables carbonated drinks to be mixed without disruption to the bubbles of carbon dioxide. The unique spinning profile, including a multi-axis spin, increases the rate of heat transfer without over-agitating the can or bottle contents, avoiding fizzing when the drink is opened. The project's second advance relates to mathematical control algorithms which govern the rate at which the drink should rotate to maximise cooling efficiency. **Together, these innovations enable rapid, uniform chilling from room temperature to 5°C in 45 seconds or less.**

## Big chill

The Rapidcool innovation means that consumers will be able to choose a drink from the shelf - anything from a 150ml can to a litre bottle of wine - place it in a machine and get it back chilled in seconds. At home, new parents will be able to cool baby feeds down from boiling in under a minute. The development of a multi-can system

which can chill up to six cans at a time will cut the cooling time down to as little as 15 seconds per can. **And all with energy savings of up to 90% compared with standard open front drinks chillers and 54% with glass door coolers - adding up to cost savings of €750m a year.** In addition to the technology's low operating costs, energy requirements and chemical coolant use, it also introduces a hygiene element that fridges don't offer. Drinks are exposed to all sorts of contaminants, from dust to germs, on their journey from factory to shopfloor: Rapidcool incorporates a UV cleaning process and so delivers drinks that are clean and bacteria-free as well as cold.

## Star power

The Rapidcool technology, patented and known as V-Text, is being commercialised by Enviro-Cool (UK) Ltd, which plans to launch four products. Two commercial units, for single and multiple drinks, are designed for shops, restaurants, bars, hotels and airports. For the domestic market there's a worktop-sized appliance and a version that can be built into existing fridge designs. Enviro-Cool has firm interest from leading global drinks manufacturers and has established a strong pipeline of manufacturing partners in Europe, South and North America and Asia. The company is launching the units in Israel to evaluate consumer response. It anticipates annual sales of over 1.5m commercial units and 6.8 million domestic systems and expects to generate revenue of over €400m from royalties within the next five years. Customer interest is being helped by media coverage - notably when the system was requested by the American Academy Awards in 2013 to keep Oscar nominees and guests cool and refreshed.



**'This is a product that will preserve the financial resources of the business, the environment and create jobs. The Commission undertook to strengthen the allocation of funds to projects that can make a real difference in people's lives'**

Michael Jennings,  
European Commission for Research,  
Innovation and Science, which  
provided funds to commercialise  
the Rapidcool technology

**The new cooling technology enables energy savings of 80-90% compared to commercial open front coolers, saving around €800 a year in electricity costs per machine.**



Pera Technology in the UK is a leading new product development contractor, working with companies of all sizes across Europe to reduce the risks and improve the profitability and competitive advantage of innovation and commercialisation. Over the past decade it has created 600 innovative technology projects, with a market value of around £20 billion by challenging thinking, carrying out R&D, introducing technical, commercial and funding partners from its global network and managing projects from start to finish.

[www.peratechnology.com](http://www.peratechnology.com)

# A NEW WAVE OF WATER MONITORING TOOLS



HydroChip consists of a DNA chip with attached probes which measure the presence and quantity of different diatom species.

**A completely new kind of device for measuring the quality of surface freshwater with unprecedented simplicity, speed and low cost provides a valuable means of monitoring the implementation of the EU's Water Framework Directive. Using a DNA technology-based method that outperforms optical microscopic analysis in the detection of algae whose presence is a good indicator of water quality. The HydroChip tool developed by EARTO member TNO enables public authorities to protect the ecological condition of waters vital for human consumption, the fishing industry and recreational activities.**

Surface water makes up around 4% or 368,000m<sup>2</sup> of the European Union and its quality significantly impacts public health and commercial enterprises as well as flora and fauna. As this water is under continuous pressure from contamination by heavy metals and nutrient overload from fertilisers and pesticides, it has to be regularly monitored to enable timely interventions. Previously, field samples of a group of single-celled algae known as diatoms, whose species and volume are highly sensitive to changes in water composition, were

collected and analysed in laboratories. The level of specialist knowledge and length of time this needed, particularly as only one sample could be analysed at a time, made this an expensive, time consuming - and also a subjective - process.

## Biodiversity basis

TNO saw that it might be possible to do things better by making use of its expertise in microarray and next-generation sequencing technology, which it had already applied to the development of novel tools for determining bacteria populations in the human body. Working with the Dutch water authorities and end users in an innovation programme, **TNO overcame two major challenges – obtaining a large range of diatom-specific DNA sequences and isolating diatoms and their DNA from real water samples – to develop a microarray which can determine water quality using diatoms as indicator organisms.** The HydroChip microarray device contains specific biomarkers based on



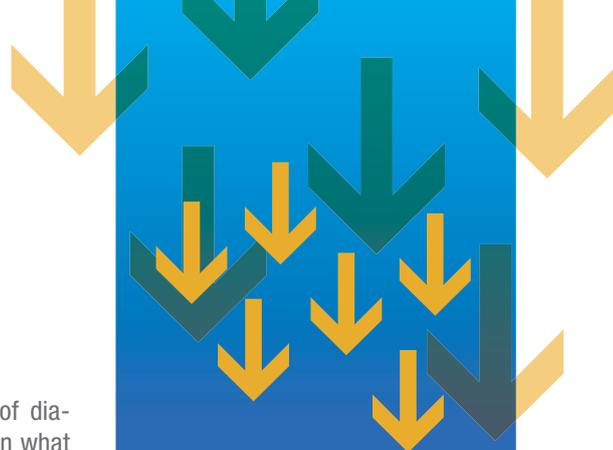
the genes of different species of diatoms which are used to ascertain what kinds of diatoms are present in the water and translate this into a precise assessment of the ecological quality of the water.

## Reliable results

**HydroChip has transformed the economics and execution of surface water monitoring while maintaining compliance with established water control rules, standards and protocols.** By allowing parallel analysis of large series of samples, the innovation enables up to 100 a day to be evaluated instead of just three to four using the classic microscopic analysis alternative, enabling water administrators to take early decisive action to comply with EU and national water quality guidelines. By providing a direct indication of the presence of a broad spectrum of diatoms it makes the results more objective and reliable than human assessment alone. Additional diatom-specific DNA probes can be added to the chip to extend the range of algae and bacteria it can detect and thus the types of water it can monitor.

## Project progress

A follow-on EU LIFE+ project aimed at implementing the HydroChip technology throughout the European Union is currently underway, acting as a demonstrator project for potential clients among water authorities and laboratories. Within this project the innovation is being further developed into a ready-to-use product for Dutch water authorities and it is expected that international applications will follow. As part of this programme, consortium partner Vitens is setting up a HydroChip service laboratory to analyse samples within the existing framework of water monitoring programmes.



**HydroChip uses biodiversity as a fast, cheap and reliable way of measuring surface water quality.**

**When HydroChip was nominated for the Dutch Water Innovation Prize, the jury cited as key reasons its introduction of modern technology into a sector mainly built on laboratory techniques developed over many decades and its huge potential given the importance of water control around the world.**

**HydroChip delivers results in six hours compared to up to six months using the old measuring methodology.**

**TNO** innovation  
for life

TNO is an independent Research and Technology Organisation whose expertise and research make an important contribution to the sustainable competitiveness of companies and organisations, to the economy and to the quality of society as a whole. TNO's unique position is attributable to its versatility and capacity to integrate its knowledge. The organisation works in seven core areas: healthy living, defence, safety and security, industrial Innovation, energy, built environment, transport and mobility and information society.

[www.tno.nl](http://www.tno.nl)

# A NEW WAY OF ENSURING COMMUNICATION NETWORK SECURITY



EARTO member CRP Henri Tudor has developed the world's first risk-assessment software tool, TISRIM Telco, designed specifically to ensure the security and integrity of public telecommunications networks.

Created with the Luxembourg Regulation Institute, TISRIM Telco is modelled on business processes and information system architecture unique to telecommunication services and allows fast, simple and robust risk assessment.

This results in ongoing improvement of communication security, protecting networks and users against service interruptions and security breaches enabling compliance with a new EU telecommunications security directive.

The way we live now depends on continuous, high-quality telecommunications services. Protecting these services from threats ranging from malicious attacks to network disasters requires information security management systems with, at their heart, a relevant risk-management approach. Adapting risk-management processes and practices to the telecommunications sector is, however, a huge challenge. Research among Luxembourg's telecommunication service providers (TSPs) shows that very few - 19% - perform security-risk analysis and that many - 54% - have no knowledge about information security. **TSPs in all EU member states are now required by law to take appropriate technical and organisational measures to manage security risks.**

## Responding to regulation

Following Luxembourg's transposition of the new EU regulation into national legislation, CRP Henri Tudor worked with the Luxembourg Regulation Institute to help TSPs implement the new guidelines. **The challenge was to adapt information-security risk-management processes and practices to the telecommunications sector.** The key issues were mapping TSPs' business processes, modelling their information-system architecture, defining relevant threats, vulnerabilities and impacts, and selecting the most appropriate security

controls. Working directly with TSPs, CRP Henri Tudor developed an innovative package fully customised to the sector made up of a fine-tuned tool containing models and training that TSPs can use to carry out standardised risk assessments.

## Enabling easy compliance

TISRIM Telco brings together everything needed to achieve more efficient and accurate risk management in the telecommunications sector, even for smaller organisations. **Easy to understand and use, the system takes account of the specifics of the EU directive, is compliant with all international standards and best practices and makes it simple for national regulatory authorities to compare and analyse results thanks to data-mining, statistical tools and report management features.** As well as saving users time in assessing risks, it also allows them to more quickly implement critical risk-protection measures, with results that can be benchmarked. By enabling more widespread implementation of risk-assessment and security measures across the sector, TISRIM Telco will have positive benefits for both citizens and the economy.

## Spreading the message

Following testing by three national TSPs, TISRIM Telco is now available under free licence to all Luxembourg's TSPs. Currently, 26 companies are licenced, and 50 people trained, to use it. As more of the EU's 28 member states seek to introduce national legislation in accordance with the new regulation, some have shown interest in

providing TISRIM Telco to their TSPs. The proposal is that the software will be commercialised in countries beyond Luxembourg through national regulators and/or directly to the thousands of companies operating in the European market. Four software licences have already been sold in Europe and several other paid-for licences are in the pipeline. The success of this project and the demands of the market have encouraged CRP Henri Tudor to use its experience to take a similar approach to risk-assessment solutions for other sectors, such as health and IT services.

**Research shows that just over half of telecommunication service providers in Luxembourg had no knowledge of information security and only 19% had ever performed security-risk analysis.**

**Widespread use of the risk-assessment tool in Luxembourg is the first step towards extremely challenging work on national governance of systemic risks with all the main regulators.**

**The team at CRP Henri Tudor is now working with the Luxembourg Regulation Institute to prepare a three-year agenda for maintaining and improving the solution.**



**tudor**  
PUBLIC RESEARCH CENTRE HENRI TUDOR

CRP Henri Tudor is the leading Research and Technology Organisation in Luxembourg. It 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 400 employees, will merge with CRP-Gabriel-Lippmann on 1 January 2015 to form a new RTO, the Luxembourg Institute of Science and Technology (LIST), which will focus on IT for innovative services, material science, environment and agro-biotechnology. Today, the two centres have a combined budget of €70m, 700 employees and 100 PhD researchers, produce nearly 400 scientific publications and conduct 300 research projects a year, with contract research valued at €12m and competitive research at €14m.

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



**Impact**  
Delivered

# SECURITY CAMERA SETS THE STANDARD FOR PERSONAL SAFETY AND LOSS PREVENTION



The camera's multi-band imaging is a globally new offering capable of driving up detection of concealed items. With corporate theft in retail running at about €75 billion a year, there's an urgent need for effective screening of employees at large commercial operations like logistics hubs employing many thousands of people.

A revolutionary passive imaging system that can remotely, accurately and speedily screen large numbers of moving people for concealed objects such as stolen goods, weapons and bombs is set to transform security operations at crowded places and critical infrastructures around the world. Developed by EARTO member VTT, the multiband camera technology is the first of its kind to detect the electromagnetic radiation emitted naturally by subjects without the need for any additional irradiation, enabling safe and also privacy-preserving screening anywhere from airports and shopping centres to government buildings and sporting venues.

There is considerable pressure to increase personnel screening, not only as a consequence of terrorist activity but also of corporate theft, which costs around €225 billion a year. Today's most common screening procedures - physical 'pat downs', walk-through metal detectors and body scanners - are all intrusive, time consuming and have high false alarm rates. Submillimetre-wave screening systems were in the frame as their successors but had yet to be developed to perform adequately in all the relevant imaging metrics - frame rate, field of view, contrast and spatial resolution - and so enable the whole person to be viewed in motion and the smallest of objects to be identified.

## Colourful solution

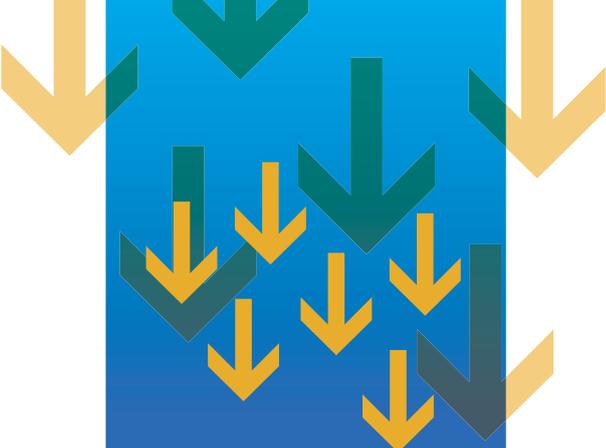
VTT's objective was to improve all of these metrics by at least a factor of three, which would in turn improve detection capability by a factor of 240 and have a huge impact on screening throughput. The high-performance submillimetre-wave thermal camera it developed exceeds this goal and is further augmented by the introduction of spectroscopic imaging capability. This allows for the streaming of false-colour video clearly highlighting concealed objects and, when applied with the machine vision automated anomaly detection, serves to improve detection of non-metallic objects. The camera is also the first commercially available cryogenic imaging system based on superconductive electronics, an achievement requiring a number of innovations to construct a cryogenic camera that is transparent to the user and easy to use, reliable and field-serviceable.

## Efficient operation

VTT's camera provides customers with an absolutely safe capability for detecting concealed items on moving subjects - more than 15 a minute - at a stand-off range of between five and 15 metres. **Its colour imagery serves to significantly improve detection statistics too, helping to save commerce millions and save lives around the world.** Yet such high performance doesn't come at a high cost, in fact as well as its low production costs the camera costs far less to operate, with lower manpower requirements to deal with false alarms.

## Confident commercialisation

**The new technology is being commercialised by a spin-off company from VTT, Asqella, which will be releasing its first products this year. Its initial focus will be capturing security screening markets beyond airports such as large sporting venues.** Other potential purchasers include data centres, the military, industrial facilities such as power plants and mines, prisons, embassies, courthouses, hospitals, schools, transit hubs and border controls. Government agencies responsible for internal security have already expressed interest in testing the system. Sales potential is considerable, with the current market estimated to be worth €100m and growing fast, particularly in previously untapped segments such as retail and logistics.



**'Asqella can now provide customers with highly effective yet acceptable screening capability, well beyond any available today. Asqella is also using spectroscopic camera technology. You could compare that to switching from black-and-white to colour TV'**

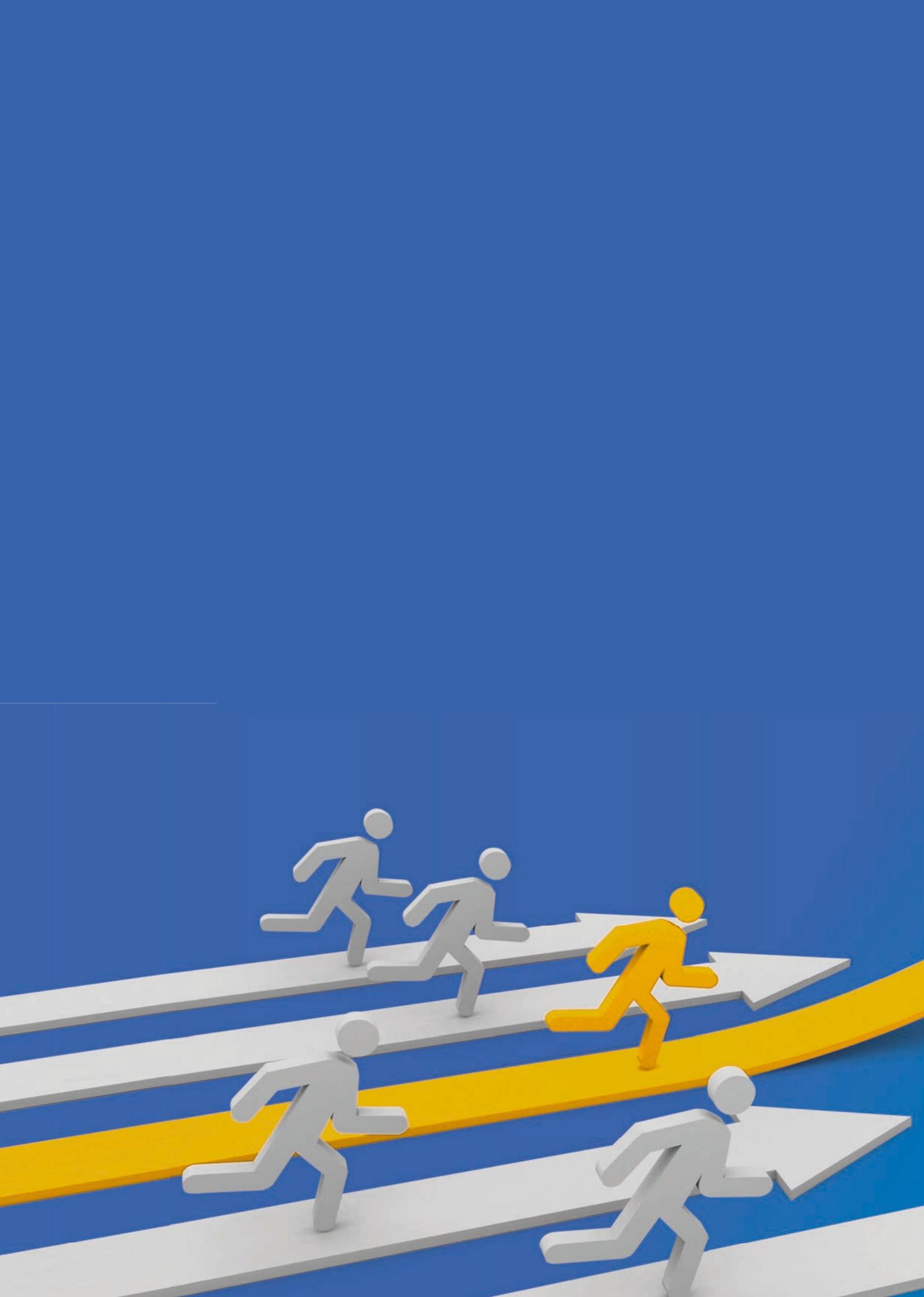
Arttu Luukanen,  
Managing Director, Asqella

**Existing body scanners take at least 30 seconds to screen one person: with the new thermal imaging camera the throughput is improved tenfold, enabling a significant reduction in operating expenses.**



VTT Technical Research Centre of Finland is the biggest multi-technological Research and Technology Organisation in northern Europe. With its staff of 2900, its unique research facilities and extensive global co-operation networks, it provides leading-edge technology solutions and innovation services for clients in the public and private sectors. VTT works to enhance its customers' competitiveness and competence, creating the prerequisites for society's sustainable development, employment and wellbeing.

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