



EUROPEAN
COMMISSION

Community research

Co-operative Research projects for SMEs Volume 2



HORIZONTAL ACTIVITIES INVOLVING SMEs

Co-operative Research projects are one of two distinct types of project supported by the 'Horizontal research activities involving SMEs' of the EU's Sixth Research Framework Programme (FP6, 2002-2006), which together have an overall budget of €473 million.

Co-operative Research projects enable transnational consortia of SMEs with shared research needs that they are unable to fulfil themselves to outsource the required work to 'research performers' – normally, universities or research centres. Larger enterprises, including end-users, may also participate, but their participation should be in the interest of SMEs. Projects may address any relevant scientific or technological research topic, and the RTD performers' receive 100% of their project costs for research- and innovation-related activities.

Tightly focused on short-term industrial requirements, the projects last no more than two years, with overall budgets of between €0.5 million and €2 million. Intellectual property rights resulting from the research belong exclusively to the SME participants

This folder contains profiles of 30 of the first FP6 Co-operative Research projects, prepared in the months immediately following their official launch. Similar folders, presenting selections of FP6's first Collective Research and Economic and Technological Intelligence (ETI) projects, are also available.

The Co-operative Research scheme is managed by the Research and SMEs unit of the European Commission's Directorate-General for Research.

Further information

- **SME Update** is a free quarterly newsletter containing news, opinion, statistics and advice on how SMEs can take part in European research projects, as well as examples of successful projects. Subscribe, and download previous editions, at <http://sme.cordis.lu/about/downloadable.cfm>
- **SME TechWeb**, a dedicated web service for SME participants in the EU Research Framework Programmes, is at <http://sme.cordis.lu/>
- Specific enquiries may be sent to the **SME helpdesk** at research-sme@cec.eu.int or posted at http://sme.cordis.lu/assistance/sme_helpline.cfm
- **SME National Contact Points (SME-NCPs)** in each EU Member State and Associated State offer a tailored support service for SMEs. Contact details for each SME-NCP can be found at <http://sme.cordis.lu/assistance/NCPs.cfm>

Contract number	Project Acronym	
CT-2004-512622	BACTOFRUCT	A biological pesticide to extinguish fire blight
CT-2004-512510	BUILD-DSSC	Solar cells give buildings power
CT-2004-508134	E-BREADMAKING	Easier equipment choices for the bakers' dozen
CT-2004-513106	EFROST	Energy-efficient refrigeration in store
CT-2004-508221	EXPLORE	A highly personal museum experience
CT-2004-507729	FASTCAST	Less pattern makes faster cast
CT-2004-512951	FISHTANKRECIRC	Cleaner water on European fish farms
CT-2004-513003	FOOT WOUND HEALING	Support for the diabetic foot
CT-2004-508220	ICACOST	Cutting-edge business tool
CT-2004-508726	ICEMAKER	Liquid ice from seawater preserves on-board catch
CT-2004-512683	INTERPROM	Outsourcing made easy
CT-2004-513190	ION	Unblock the channels for new drug discoveries
CT-2004-507825	IPC-OCT	Optical scanner probes beneath the surface
CT-2004-508097	ISSEA	A modular approach for car components
CT-2004-512855	LCVAC	Vaccine therapy for lung cancer
CT-2004-512670	LIQUIDSOLE	Smart shoes for happy healthy feet
CT-2004-508465	MICRODIS	A cleaner future for European horticulture
CT-2004-508439	MULTISOLAR	Constructing a future for solar cells
CT-2004-508344	NEWTRESI	New coats for implants
CT-2004-513023	PROCOMO	Novel boiler coating for improved combustion
CT-2004-512986	SAFE-RAY	Digital X-rays boost safety
CT-2004-512540	SEWERINSPECT	More light on old pipes
CT-2004-508462	SOCOLD	The cool side of the sun
CT-2004-512667	3D-NANOPRINT	Stamping out 3D nanostructures
CT-2004-005876	TRUESOUND	A blast from the past - the true sound of organ music
CT-2004-508070	TURPRO	Improving productivity on turbot farms
CT-2004-507622	U-RAIL	Laser system focuses on rail defects
CT-2004-507259	WATERTOOL	Real-time monitoring of Europe's liquid assets
CT-2004-512862	WEATHER	Safety in the wind
CT-2004-6026	WS-TALK	Asking simple questions on the web

“If we are successful, Bactofruct will give participating SMEs a way to improve their competitiveness, because there are few, if any, successful products available to fight this disease.”

Fire blight is a very contagious plant disease affecting mainly pear, quince and apple trees, and annually causing damage in the European Union of approximately € 3 million. To date, there is no completely reliable way to control fire blight, which is caused by a bacterium. Streptomycin – mainly known as an antibiotic against lung tuberculosis and other bacterial infections in humans – is currently the strongest pesticide available. However, the Union is expected to ban its use as a pesticide because of the risk that it can lead to antibiotic resistance in fire blight and in human disease-causing microbes. With ten partners from five countries, the Co-operative Research Bactofruct project aims to develop a sustainable biological pesticide against fire blight.

Fire blight, caused by the bacterium *Erwinia amylovora*, is a highly contagious disease affecting primarily pear, quince and apple trees, and sometimes rose bushes, almond, apricot, cherry, plum, raspberry, and related trees and shrubs in the rose family. Its name evokes a scorched appearance among infected trees, with dead, blackened leaves and fruit clinging to branches. Infections can destroy limbs, even entire shrubs or trees. In warm, humid weather, where hail may open vulnerable wounds on branches, the disease can be unstoppable, destroying entire orchards, as it did in 2000 in eastern Switzerland. Each year in the EU it causes damage estimated at € 3 million, while it has also destroyed orchards in North America, New Zealand, and Japan.

No single treatment can stamp out a major fire-blight infection. Sprays containing streptomycin – mainly known as an effective antibiotic for treating human lung tuberculosis and other bacterial infections – can help, but these have limited effectiveness and may lead to development of streptomycin-resistant forms of fire blight, and perhaps of human diseases, too, due to antibiotic residues in fruit and honey consumed by humans. The EU is committed to reducing such residues in the human food chain and is soon expected to ban the use of streptomycin as a pesticide.

Coordinated by the Dutch biotechnology firm ECOstyle B.V., the Co-operative Research Bactofruct project team thinks they may have found a cure for fire blight – using another bacteria to kill the disease. The project is teaming up two other biotechnology SMEs (small and medium-sized enterprises), Dr Schætte, of Germany and Newbiotechnic, of Spain, and seven other partners, with the aim of developing a sustainable biological pesticide against fire blight.

Familiar affliction

The first plant disease shown to be caused by a bacterium rather than the much more abundant fungus diseases, fire blight's path can be mapped from the United States to England and eventually to continental Europe. Usually appearing during rapid growth in spring, the disease typically infects blossoms, stems and succulent shoots first, spreading via splashing rain, insects (especially bees), contaminated pruning blades and wind. Caught early, infections can be stopped in blossoms, but often travel into twigs and

branches, causing shoot ends to wither into the form of a crook and blacken. Bacteria can survive the winter in dark-brown to purplish areas of killed bark, called cankers, and recommence the infection process in spring, when a watery, tan bacterial ooze appears on branches, twigs, and cankers. Exposed to air, the ooze darkens and streaks branches or trunks. Fruits and blossoms are water-soaked. In trees, the pathogen most often moves from the infection site rootward.

According to some experts, a weak mixture of a copper fungicide applied several times per week can reduce new infections, but this will not eliminate all of them and can cause browning or scarring of fruit. Infections in wood must be pruned as much as a foot below the infected area. Pruned limbs must be burned and pruning tools cleansed in a bleach solution.

Growing awareness

Bactofruct has already started looking for a new cure. Initial research by the University of Konstanz, a project research and technology developer (RTD) partner, has identified three strains of *Bacillus* species as potent suppressors of *Erwinia amylovora*. The research team has collected many *Bacillus* and related, natural non-pathogenic species.

The project team will perform laboratory research to screen and characterise additional *Bacillus* strains. Researchers will analyse growth of the selected strains, using



"This project will help improve science in Eastern Europe, and later, production throughout Europe, including more jobs."

microbiological techniques, and later devise appropriate 'recipes' to reproduce them for fermentation and evaluation. They will produce Bacillus spores from various isolates and extensively test them for activity and efficacy on fire-blight-inoculated blossoms, as well as in field tests.

The Co-operative Research project will help raise the level of European research, as Hungarian scientific partners will gain valuable access to the advanced scientific knowledge, processes and tools of their colleagues from Western Europe. Because there are currently no safe, effective products to combat fire blight, a successful biological pesticide would be a significant boost for European agriculture. It might also be useful against other plant diseases. Production would begin in Eastern Europe, later expanding throughout Europe, and bringing with it the potential to create new jobs among EU SMEs.

Project title

Development of biological pesticide against fire blight (BACTOFRUCT)

Contract Number

CT-2004-512622

Duration

24 months

Global project cost

€ 638 022

EC Contribution

€ 392 306.60

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“BUILD-DSSC gives the partner SMEs an opportunity to develop Europe’s first commercial dye-sensitised solar cell product.”

The walls and roofs of our homes and offices are perfect places for solar cells, generating clean electricity during daylight hours. Dye-sensitised solar cells (DSSCs) are well suited to this application. They are relatively simple to make and work well in diffuse light, although they are often unreliable. The BUILD-DSSC Co-operative Research project aims to develop new DSSC materials plus an industrial process for the production of robust, large-area photovoltaic tiles for use on roofs or façades. Mass production should keep costs down, while the tiles’ pleasing aesthetics and possible integration with thermal solar systems should give them a good foothold in the growing market for building-based renewable energy systems.

Buildings are big consumers of energy. In winter they need heating, in summer they need cooling. And inside they usually house a host of appliances – lights, computers, machinery – all needing electricity to function.

Yet buildings also have the potential to actually produce energy. Their large, flat exterior walls and roofs are ideal places for mounting solar cells. In fact, a building can become a sun trap, capturing the energy in light to meet its energy demands.

Making light work

More than 20 years of research in the field of photoelectrochemical cells have led to the development of efficient and low-cost dye-sensitised solar cells (DSSCs) at the laboratory scale. These devices generate electricity when light excites electrons in a photoreactive substrate. The phenomenon is similar to the way in which plants use chlorophyll to capture the sun’s energy for photosynthesis.

As DSSCs can work in diffuse and dull light, they have been shown to produce 10-20% more electricity than conventional crystalline-Si modules, of the same rated power, even though they need a larger area to attain the same rated power because of lower energy conversion efficiency. However, they still suffer from problems related to reliability and durability. Indeed, Europe has yet to achieve its first commercial DSSC-based product.

Recent discoveries by the University of Ferrara, a world leader in DSSC research, have the potential to solve some of the typical limitations of DSSC technology. The BUILD-DSSC Co-operative Research project is looking to exploit these findings. By bringing together the know-how of several European SMEs and the capabilities of four research organisations, the project is working to develop a robust and reliable, large-area DSSC integrated into a ceramic tile for use on roofs and walls.

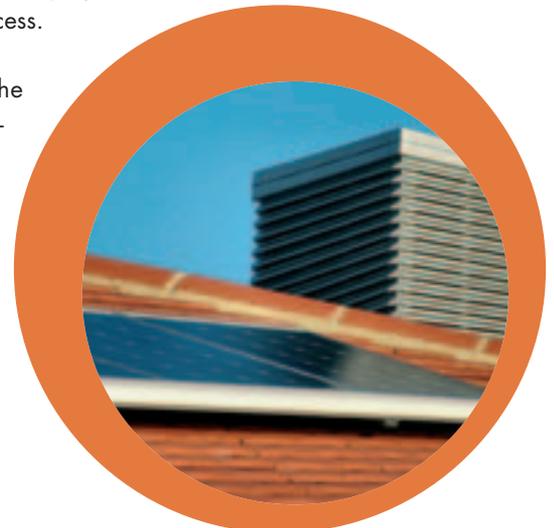
Building blocks

The team’s first task is to build on the results of Sparkglass, a project funded under the Fifth Framework Programme. This earlier project led to a pre-industrial production line for “high conductivity” glass for DSSCs, run by the Spanish company IBE in Segovia, main proposer of the BUILD-DSSC project. The glass is sprayed with a fine layer of metal oxide and nanoscale metal ‘fingers’ that greatly improve the generation of an electric current within a solar cell. Unfortunately, this metal layer is easily damaged by the electron transfer medium that is sandwiched under the glass within a DSSC.

In the current project, the two small and medium-sized enterprises (SMEs IBE and SGG) which developed the glass will work together with the University of Ferrara to develop new classes of non-corrosive and non-volatile electron transfer materials (based on cobalt instead of the usual iodine) that are compatible with the high-conductivity glass. The improved combination should lead to a new generation of DSSCs with better stability and durability in the field.

SGG will also work with the Italian firm MMT to integrate the DSSC into a building product. The idea is to use a ceramic tile for the back of the solar cell. The tile is made conductive using a thin layer of graphite. The UK project partner GEM, a specialist in conductor deposition, and the University of Nantes will work on the graphite deposition process.

Throughout the project, prototypes will be thoroughly tested and characterised



"This project is the culmination of years of R&D and the last step towards the mass production of efficient, cheap and reliable dye-sensitised solar cells."

by the Centre for Renewable Energy Sources in Greece. The Italian research organisation Labor will focus on testing products outdoors. The Slovenian company Limetz is a potential end-user of the BUILD-DSSC product. It will help to formulate specifications for end products and provide the project with important insights into the renewable energy market.

Powerful product

The BUILD-DSSC partners hope that their photovoltaic tile will have at least 5% efficiency and an outdoor stability lasting over ten years. However, the product's competitiveness in the market will greatly depend on its cost. The project will also look at how to adapt the existing pilot plant for the high-conductivity glass into a line for the industrial mass production of the complete photovoltaic tile. The target production cost for the DSSCs is about half that of crystalline-Si cells: € 2 per Wp instead of € 4 per Wp; the target cost for the tile is € 5 per Wp compared to about € 8 for BIPV solutions such as photovoltaic tiles.

The partners hope that these cost savings, plus the tile's easy-to-use 'plug and play' connections, will make the tile a serious contender in the market for photovoltaic products. As Europe strives to meet its renewable energy targets, the availability of the BUILD-DSSC tile will be timely and sales could quickly grow – helping to turn Europe's energy-hungry buildings into generators of clean, renewable power.

Project title

Large area DSSC for building integrated PV tiles

Contract number

CT-2004-512510

Project cost

€ 1 027 504

EC Contribution

€ 629 902

Duration

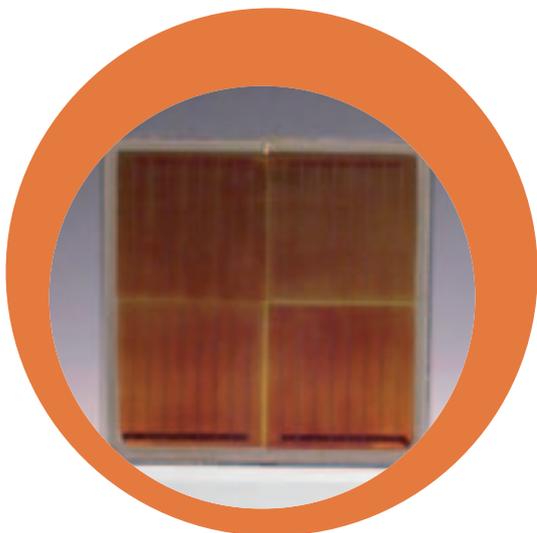
24 months

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Easier equipment choices for the bakers' dozen

"The crucial feature of this project is bringing advanced techniques and agent-based information technologies to a traditional field – bread-making – that hasn't had access these technologies before."

European bakers compete in a rapidly diversifying market in which consumers demand an ever-expanding range of specialty bread products. To bake these products, small and medium-sized breadmaking enterprises need specialised equipment configurations, which are difficult and expensive to design.

On the other hand, SME (small and medium-sized enterprises) manufacturing industrial breadmaking equipment face language, financial and technical obstacles in their efforts to acquire customers in an expanding European market. The 11 partners from five countries in the Co-operative Research E-Breadmaking project plan to develop an advanced web-based tool that helps SME bakers design equipment configurations that meet their specific needs and matches them with the best SME manufacturers to provide the equipment.

As recently as a decade ago, a European breadmaking SME (Small and medium-sized enterprise) could thrive on baking as few as two or three products for a local market. However, today's consumers can choose from bread products from throughout Europe, and they have become more demanding as a result. SME bakers which want to compete in this market must offer an increasingly diverse product range. To be able to produce these products, bakers require specialised configurations of such equipment as kneaders, dividers, moulders, proving rooms and ovens. On the other hand, SMEs that manufacture this equipment face a larger, more complex European market, with inherent communication, financial and distribution problems.

Bakers on-line

The Co-operative Research E-Breadmaking project (E-commerce of breadmaking equipment based on an expert system, distributed agents and virtual reality) aims to develop a web-based tool that will match SME bakers with the manufacturers best able to provide the equipment they need. Coordinated by CRIC, a Spanish multidisciplinary research centre, the project draws on the industrial experience of Industrias Torrents, a Spanish manufacturer of baking and confectionery equipment. Its overall goal is to help modernise the baking industry, using advanced information technologies.

Europe's burgeoning bread basket

A comprehensive classification of Europe's bread varieties would be vast, considering today's possible permutations of shape, flour or grain content, and other variables. For example, a baguette can be made with any of several types of flour, with three different levels of water content, and sold fresh, fresh-packaged, pre-baked frozen, pre-fermented, and in several other ways. Sourdough bread can be made with one-step or three-step methods, with low, medium, or high degrees of sourness. Production of each of these bread types requires a specific equipment configuration.

Many other variables go into determining optimal configuration – for example, the shape and size of the baker's plant, as well as production volume. Environmental factors also have to be considered. A baker in Spain works in very different temperature and humidity conditions than a baker in Poland.

For SME manufacturers, the larger European market creates communication and distribution problems that can pose barriers for manufacturers which want to expand their businesses in the European market. For example, an Italian equipment-maker may have trouble communicating with a potential customer in Lithuania. As equipment configurations become increasingly complex – and many alternative configurations can be proposed for a single bread product – an SME manufacturer able to offer one component of a larger system needs a way to make its bid available to the baker seeking a system, as well as a way to manage distribution.

Employing a highly distributed software architecture, the flexible E-Breadmaking tool will help with all these problems, providing a bridge between bakers and equipment manufacturers. Using the tool, a baker will go on-line to enter product details, requirements and conditions into an easy-to-use interface. The automated tool will present an optimal equipment configuration, including a graphic display, using the least number of machines, and requiring minimal space and labour. From source databases, it will provide technical and contact information for the best possible equipment manufacturers for each component of a particular set-up. The tool will ease customer communication and product distribution for manufacturers, enabling them to tailor configurations for distant customers, expanding their markets, without the need for large numbers of design staff.

European industrial bakers compete in a rapidly diversifying market, in which consumers demand a wide range of speciality bread products.



"This tool is like a bridge between breadmakers and the manufacturers of breadmaking equipment."

E-commerce prototype

Drawing on the experience of food technicians, SME equipment manufacturers and research and technology designers, E-Breadmaking will identify breadmakers' technological needs, building a database of equipment specifications, production tasks and processes and raw materials. Based on its study of the foreseeable benefits of new technologies, the project will enable SME breadmakers and equipment manufacturers to use this knowledge to make strategic business decisions. Project SME partners will test and validate a prototype system.

E-Breadmaking will produce an e-commerce industry standard for breadmaking equipment manufacturers that can be easily transferred to other food sectors. It will improve the competitiveness of equipment-makers, helping them to sell their equipment to a wider market. Breadmakers will get better, more efficient equipment, and bread buyers will have a wider range of products at better prices.

Project title

E-commerce of breadmaking equipment based on an expert system, distributed agents and virtual reality (E-BREADMAKING)

Contract number

CT-2004-508134

Duration

24 months

Global project cost

€ 1 457 058

EC contribution

€ 754 529

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- 6 Bäckerei Brüser GmbH (DE)
- 7 IZR Solutions Ltd (UK)
- 8 Golden Harvest MG. Co Ltd (MT)
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- 10 Pera Innovation Ltd (UK)
- 11 Verein zur Förderung des Technologietransfers an der Hochschule Bremerhaven e.V (TTZ) (DE)



E-Breadmaking will design an on-line tool allowing breadmakers to enter product details, and, using computer-aided design, the tool will generate an optimal equipment configuration.

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“Our main objective is to apply advanced simulation tools and experimental facilities to come up with more energy-efficient refrigeration that does a better job of maintaining the quality and safety of stored food.”

Small and medium-size enterprises (SMEs) in the European food industry need to find new refrigeration methods that are more energy efficient and safer for the environment than those currently in use. With ten partners from six countries, the Co-operative Research E Frost project aims to design and develop innovative cold storage systems relying on the natural refrigerant ammonia.

These new systems will enhance efficiency, helping to cut costs while improving the environmental sustainability of cold food systems as well as food safety and quality. The new technology should have other cooling applications, too, giving European SMEs new ways to make money and boost employment.

As part of a comprehensive effort to secure Europe’s food chain, the European Union has targeted poor-quality cold storage as a source of bacteria growth and unwanted chemical reactions that can damage food flavour and safety. Inefficient refrigeration also burns more energy, a costly source of waste for SMEs, contributing to higher food prices, and contributing to global warming through excess CO₂ production. Certain refrigerants are a major cause of ozone depletion.

Coordinated by the Barcelona-based Universitat Politècnica de Catalunya, the E Frost (Efficient Refrigerated Food Storage) project lines up seven SMEs and three research and technology developers (RTDs), from six European Union countries, which will collaborate to develop energy-efficient, environmentally sustainable, food cold storage that will prove cost-effective for SMEs, and contribute to lower food prices while helping to preserve food quality and safety.

Old solution to a modern problem

Early refrigeration systems developed in the late 1800s were based on vapour compression, and since then the basic technology has changed little for most models. The chief varying factor is the chemical refrigerant that circulates through a system’s metallic tubes in a closed loop. Refrigerants remove heat from a chamber by evaporation, and then are compressed, condensed and expanded in a continuous cycle. Halocarbons – until recently the favoured refrigerant for most non-industrial use such as home and commercial refrigerators and air-conditioning – are a major cause of global warming. With life cycles stretching over 200-300 years, halocarbons can eventually end up in the stratosphere, releasing chlorine ions that damage the ozone layer’s ability to filter ultraviolet radiation. This creates health risks for humans, as well as other biological problems. The 1987 Montreal Protocol, a landmark international agreement on substances depleting the ozone layer, banned certain halocarbons and stipulated that others be phased out by 2030.

Since halocarbons are odourless, system leaks often go undetected, releasing huge quantities into the atmosphere. Therefore, one of E Frost’s chief goals is to increase the use of ammonia as a sustainable refrigerant. Ammonia (NH₃) naturally breaks down into hydrogen and nitrogen molecules (the atmosphere of the earth is about 80%

nitrogen) and does not deplete the ozone layer. Ammonia’s powerful odour is an inbuilt alarm for even tiny leaks.

Ammonia refrigeration is significantly more efficient than most other systems. In use since the 19th century, it is widely used in the food processing and preservation and, to a lesser extent, in chemical industries. Its limited use for home and small-scale commercial food businesses is partly due to its toxic and flammable nature under certain conditions.

The highly efficient refrigeration systems the E Frost Co-operative Research project aims to develop for industrial and commercial food firms will minimise the ammonia charge in systems, improving safety and saving energy. Based on advanced computational tools and experimental facilities, the project will work to enhance system heat-transfer performance and determine optimal operating conditions. It will improve system temperature control and management, refining chamber lay-out and air velocity, optimising fan numbers, size and control to reduce electrical consumption and improve preservation of food quality. It will introduce use of efficient indirect refrigeration systems using advanced secondary coolants (ice slurries), in cases where direct use of ammonia is prohibited. Its research into secondary coolants will give SMEs working in the field an updated catalogue of heat exchangers.



"We will apply the knowledge of SMEs to the problem of developing new tools. This project is especially dedicated to finding ways to use ammonia in industrial and commercial refrigeration."

Temperature control

Efrost will determine the best thickness of thermal insulation panels, to reduce heat and humidity seepage through openings from outside. It will optimise the frost-defrost cycle to cut the refrigeration load, enabling use of a smaller compressor and thus saving energy. The project will increase basic knowledge about frost formation and melting on fin-and-tube surfaces. Finally, Efrost will develop and test a rating-design code and guidelines for the whole cold-storage unit, creating test cases based on typical layouts used by SMEs. It will disseminate its findings via a dedicated website.

Innovations from the project should eventually find additional applications in home refrigeration and air-conditioning systems, and possibly other industrial uses, such as cooling telecommunication circuits. The project should help generate European employment as new refrigeration systems are manufactured and sold and European SMEs become more competitive abroad. But most important is the fact that highly efficient refrigeration means safer, better quality food at lower prices for EU consumers.

Project title

Efficient refrigerated food storage (EFROST)

Project Number

CT-2004-513106

Duration

24 months

Project cost

€ 1 176 047

EC Contribution

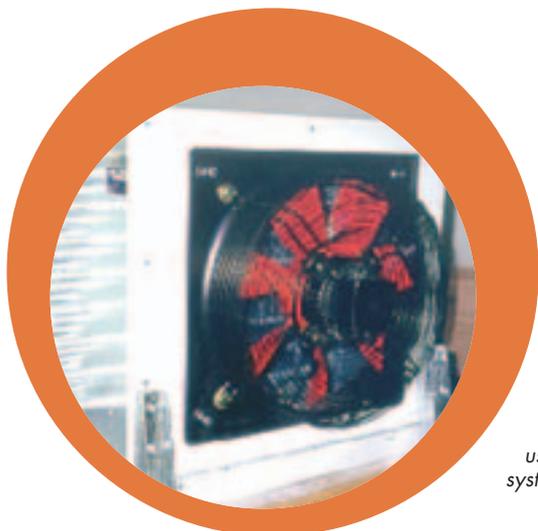
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- 8 Clauger, S.A. (FR)
- 9 Josef Friedl, GmbH. (AT)
- 10 Star Refrigeration Ltd. (UK)



Reducing fan size and number can cut energy use in refrigeration systems.



"Explore offers a very personal service. We can get a lot of information on request into the mobile phone."

For the first time, location-dependent information about exhibits in museums is being made available on visitors' own mobile phones. Co-operative

Research's Explore project aims to provide this information according to the age, language and special interests of each visitor. Prerecorded guides to the exhibits plus interactive games also come as part of this personalised service.

The museums expect to attract many more young people, while the SME (small and medium-sized enterprise) partners hope to have a highly marketable digital communications product that can be further enhanced and developed. By boosting museum visits, it is hoped to make a significant impact on the cultural and educational life of Europe.

A visit to a museum can easily become a confusing search through a bewildering maze of exhibits. How often do visitors leave with aching feet after walking many kilometres from one end of the museum to the other, but having not found an exhibit that they might have really enjoyed? All this could be about to change with the technology pioneered in Explore, a European project with partners from Finland, Germany, Italy, and Denmark. This allows a visitor's own mobile phone to function as a personalised guide to a museum or exhibition. Once their age, language, and special interests are keyed into their mobile phone, a visitor is offered various personalised choices. In addition to location-dependent information about exhibits, there are guided tours and interactive games on offer. Guided tours are prepackaged to meet visitors' different preferences and spoken languages. The information about nearby exhibits takes the personal profiles into account, so what a young child sees and hears would be different to that of an adult.

Museum information services already exist. Some are based on wireless LAN, while others come in the form of mobile devices with prerecorded guides that visitors borrow. However, none as yet make location-dependent information accessible via mobile phones. Explore allows mobile phones to access various on-line databases via the system to obtain a lot of additional relevant information. The positioning software in Explore is based on Bluetooth wireless technology, and is scalable to various sizes of exhibition layout. The project aims to raise attendance at museums and cultural exhibitions, especially among young people and foreign visitors. Explore began in February 2004 and is due to run until October 2005.

Design and content

The eight project partners in the Co-operative Research project Explore consist of four SMEs, two museums and two research institutes. As the project aims to develop highly innovative software, it is no surprise that three of the SMEs are software specialists. NitroFx, an SME in Finland, works in graphic design for mobile phone applications. Profium, also Finnish, brings expertise to the project in terms of content management and database systems, while the German company ProcessWare is a specialist in software design and internet portal technology. The fourth SME, Experimentarium, is Denmark's largest science park. It is participating in the project from the perspective of an end-user.

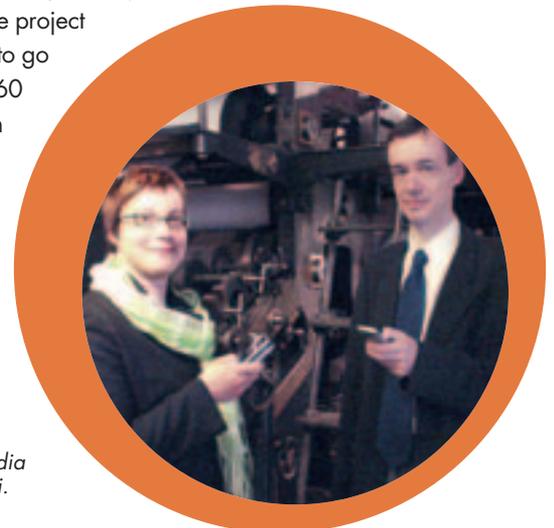
The system is now being piloted in two partner museums. The Media Museum Rupriikki in Finland is located in a historic factory building. The Explore pilot system focuses on the history of the building and the history of mass media communications. The second is a museum in Italy run by the Tito Balestra Foundation that houses a major collection of 20th-century Italian art.

The research partner VTT is a large Finnish contract research organisation. One of its groups deals with local and cellular wireless data transmission, positioning and identification technologies, mobile user interfaces and mobile terminal technologies. The other research partner, the Fraunhofer Institute for Software and Systems Engineering in Germany, brings to the project wide-ranging expertise in innovative IT infrastructures.

Further enhancement

The museums will have a tool which they can use to generate the input for the mobile device for their different – also temporary – exhibitions. The SME partners should be able to expand their range of digital communications products with Explore. NitroFx, in particular, intends to market the new technology throughout the Nordic region.

Microsoft Windows is the operating system found on the majority of personal computers, but mobile phones use many different operating systems. Explore project partners opted to go with the Series 60 platform, built on the Symbian operating



The Explore system at the Media Museum Rupriikki.

"This is a completely new technology."

system, the most widespread operating system for smartphones. This is targeted at advanced mobile phones that possess photographic and video capabilities. After the project has ended, the SMEs intend to enhance and further develop the tool's content and functionality, including access via other operating systems. It is envisaged that museums in the same town or city will be able to collaborate over the internet through a more developed system, sharing databases to provide a very powerful information tool. Ultimately, it is hoped that through this new technology museum visits will become much more an integral part of cultural and educational life in Europe.

Project title

Gaming and guiding system for museum and exhibition environments (EXPLORE)

Contract number

CT-2004-508221

Duration

21 months

Global project cost

€ 1 164 411

EC contribution

€ 601 309

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“Results from the project have already been adopted by some collaborators and are increasing their competitiveness today.”

The European foundry industry needs to reduce manufacturing and delivery lead times in the face of mounting low-cost international competition. The sector is highly skilled with a large number of SME businesses, especially in the market for complex but low-volume metal castings. The Fastcast Co-operative Research project will develop a high-technology patternless process for rapid and accurate casting of complex, intricate metal components that will bring a world-beating knowledge-based, but affordable, technology to the European industry. This will boost productivity, increase competitiveness and secure jobs in a vital supplier sector for European manufacturing.

The European foundry industry is an essential provider of complex metal cast components to many strategically important engineering sectors, including transportation, energy generation and the oil and gas industries. Within the sector many, often family-owned, SMEs (small and medium-sized enterprises) are involved in the supply of intricate and expertly made ‘one-off’ or low-order volume castings. However, there is increasing competition from low cost producers outside Europe.

Reducing manufacturing and delivery lead times is essential in this ‘fast manufacturing’ environment, and the rapid production of castings is critical for the continued survival and success of these SME foundries. Complex, intricate castings can only be produced using a lengthy trial-and-error method which can take weeks or even months. This impacts not only on the competitiveness of SME foundries, but also on the thousands of businesses in strategically important engineering sectors whose performance is adversely affected by this low-technology casting process.

No pattern

The Fastcast Co-operative Research project will develop a high-technology process for rapid and accurate casting of complex, intricate components, such as automotive cylinder heads and heat exchangers. Its objectives are to make significant advances to the ‘patternless’ technique of casting. This technique has been proved industrially for large castings up to 3m in size, but at present cannot be applied to delicate components. Fastcast will unlock the potential of the process for small, delicate, intricate or complex castings.

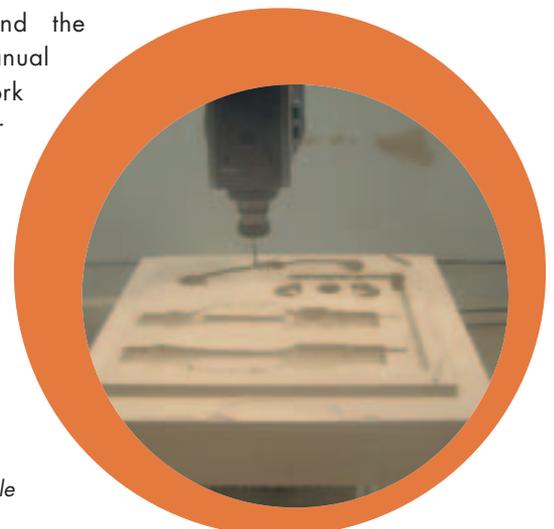
The conventional route to developing a metal casting is to take the engineer’s drawing and produce a (usually) wooden ‘pattern’ which is then used to make the sand mould into which molten metal is placed to make the cast part. Producing a pattern is a very skilled job as the shape of the pattern (and therefore the mould) has to incorporate features that will allow the molten metal to enter, fully filling the mould and providing a reserve of metal (feeds) that can flow within the cast as it cools and shrinks to the required ‘room temperature’ shape. Typically, the pattern needs to be 5-8% larger to accommodate this shrinkage effect.

Once again, the patternless technique starts with the engineering drawing to produce a ‘virtual’ pattern in a computer-aided design (CAD) system. This virtual pattern can then be directly produced out of a block of casting sand using a CNC (Computer Numeric Control) machine. This new technique removes one iterative process step and should accelerate the time from the initial design to the product being in the customer’s hand.

Accuracy is key

Two significant tasks face the Fastcast team as they push the limits of the patternless technique, both of which relate to the accuracy of the mould production and therefore the part. The CNC machine needs to be able to mill the mould media accurately at a much greater tolerance than the engineering drawings require. The machine needs to be stable and able to mill with very low vibration even at extended distances. The CNC device chosen by project co-ordinators, Castings Technology International of the UK, is a five-axis machine which has a very fine tolerance, but is competitively priced – a very important factor for small companies.

The project will also look at the moulding media. Conventional casting sand is made up of particles of 0.25mm diameter – this puts a natural limit on the tolerance and surface finish of the cast part. Fastcast will investigate other media that will enable an improved finish “straight out of the mould”. This will have advantages for both cast production and the amount of manual finishing work required after casting: a part of the process



High-speed machining of a mould for a nozzle casting.

"The patternless casting technique should vastly reduce production cycles."

that can add significant costs. In addition, software will be developed to integrate the process and store a number of basic shape coordinates to assist manufacturers in using the CNC device. Slovak University Alexandra Dubceka will be leading in this area.

Six SME companies are taking part in the project. F. Bamford of the UK and Norwegian company Oshaug Metall are both involved in the marine propeller and thrusters business. Two Slovak companies, Four Trade SRO and ALACO, make numerous aluminium and zinc castings: Four Trade for cable cars and ALACO selling to the automotive and food-processing sectors. Another UK company, Walter Frank & Sons, are aluminium die-casters but are looking to use the technology. Finally, Maus Modell-und Formenbau GmbH of Germany actually make aluminium rotational moulds used to form plastic mouldings for a wide range of applications. The mould is cast metal and requires a high-quality "as cast" finish, meaning that 'right first time' is essential.

All the SME partners, and ultimately the rest of the foundry sector in Europe, will gain a significant competitive advantage via the knowledge-based technology developed in this project. This will protect and extend market share and secure employment.

Project title

Fast Manufacturing Process for Complex Cast Metal Components (FASTCAST)

Contract number

CT-2004-507729

Duration

24 months

Global project cost

€ 1 115 824

EC contribution

€ 669 883

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“The primary technological innovation is to refigure electro-coagulation to deal with low particle concentrations and high water volumes.”

Land-based aquaculture is a major economic growth area. However, innovation within the European industry is required in the face of strong competition from non-EU countries. Water recirculation systems are used in intensive land-based aquaculture, for better temperature control and to preserve water resources. Maintaining water quality is vital in these systems for optimal fish growth. The Fishtankrecirc project from Co-operative Research aims to improve water quality in recirculating systems using electro-coagulation techniques. Novel electro-coagulation and filtration configurations need to be established to produce a state-of-the-art water control technology for European aquaculture.

Fish production in land-based aquaculture has increased rapidly in recent years. However, European producers have faced increasing competition from non-EU countries, especially in Asia and South America. Innovation is required to ensure that the European aquaculture industry remains competitive. In particular, research is needed to develop sustainable yet intensive land-based aquaculture systems for marine and freshwater fish species. To this end, the Fishtankrecirc project aims to develop technology to maintain water quality in intensive land-based aquaculture, using a novel water treatment method.

Water quality and electro-coagulation

A key factor in intensive land-based aquaculture is water quality. Good water quality is vital for optimal fish growth, and to produce safe high-quality produce for the consumer. Water is recirculated in land-based systems to facilitate better temperature control, to preserve scarce water resources, and to reduce environmental pollution. Filtration is essential to maintain the quality of recirculated water. The Fishtankrecirc consortium from Co-operative Research is using electro-coagulation techniques to improve the filtration process and therefore enhance water quality.

Electro-coagulation works by altering the electrical charge on suspended particles, resulting in small particles binding together to form larger particles. These larger particles are more easily removed from water by sedimentation or filtration units. Electro-coagulation technology is used in a number of industries, especially in the treatment of sewage and liquid industrial waste. However, these applications typically deal with high concentrations of suspended particles. “The major technological innovation is to refigure electro-coagulation to deal with low particle concentrations and high water volumes,” says Dr Morten Berntsen of the National Institute of Technology in Norway. “This is the first time electro-coagulation has been applied in an aquaculture setting.”

The Fishtankrecirc partners are developing a novel electro-coagulation reactor configuration to be used as a pretreatment within a filtration unit. “The new filtration unit will use a three-step procedure,” explains Dr Berntsen, “firstly a coarse filter, secondly an electro-coagulation reactor, and finally a vacuum filter.” The unit will be able to remove organic particles, phosphates, nitrates, ammonia and soluble organic compounds from recirculating water, at a rate sufficient to improve water quality and to enhance the growth rate of fish.

The consortium

The Fishtankrecirc project started in November 2004 and runs for two years. The consortium consists of seven small and medium-sized enterprises (SMEs) and a primary research and technical development (RTD) partner: the Norwegian National Institute of Technology. The latter is managing the project and defining the requirements of the new technology through experimental study. Salsnes Filter is supplying the coarse filter technology for the unit, Killybegs Electrical Refrigeration (KER) the electro-coagulation and vacuum filtration components, Aswega the water-flow meters, and Pollution Control Systems the equipment for monitoring organic compounds and other water-borne materials. The Pera Innovation consultancy is helping these SMEs come together to develop this new technology. The two commercial fish-farming operations in the consortium are testing the technology in pilot schemes. Artec Aqua is conducting a freshwater pilot study in Norway, while Selonda Aquaculture is responsible for a seawater study in Greece.

Healthier environment, healthier fish

The new technology has a number of important environmental benefits. There is a pressing need to conserve water resources with the aid of recirculating systems, and improved filtration will enable a more efficient recycling of cleaned water. “The new recirculation unit will remove more effluents and allow a high degree of control of emissions,” says Dr Berntsen, “which include fish waste and food spills, nitrogen compounds and other pollutants that can cause eutrophication in water bodies.” The impact of aquaculture on the environment will therefore be reduced.



“The new recirculation unit will remove more effluents and allow a high degree of control of emissions.”

The market demand for recirculation systems in aquaculture is set to increase further. They enable a high degree of temperature control to be achieved, which is critical for optimal fish growth. The improved filtration unit will enhance the maintenance of water quality in intensive aquaculture with recirculation systems. This is essential for high yields of safe and high-quality fish. The Fishtankrecirc project is therefore developing a cost-effective and reliable technology that addresses the needs of the European aquaculture sector, and that will help the industry remain competitive.

Project title

Development of electro-coagulation technique for optimal cleaning efficiency and maximum reuse of water in land-based fish farming (FISHTANKRECIRC)

Duration

24 months

Project Number

CT-2004-512951

Project cost

€ 1 324 479

EC Contribution

€ 683 616

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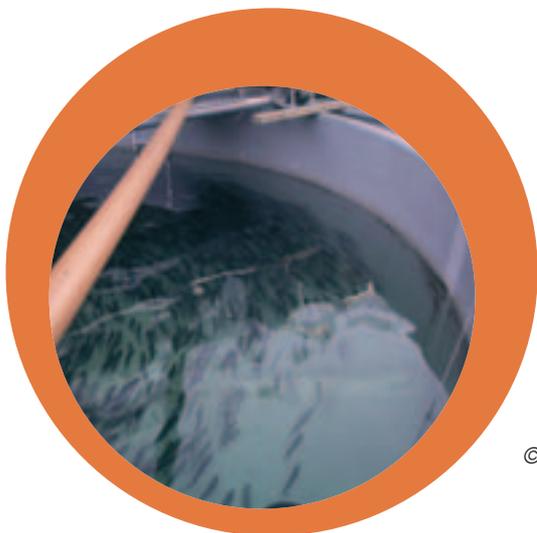
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“There are huge healthcare costs associated with this problem and we hope to be able to reduce them.”

Open wounds of the foot, caused by poor circulation, are a huge problem for diabetic patients and a considerable burden on the resources of healthcare providers. The wounds can be very difficult to heal, and cause problems ranging from inconvenience to amputation. The Foot Wound Healing Co-operative Research project is attempting to improve the situation for diabetic patients with foot wounds by developing new footwear to promote healing. The potential for improvement was identified by a small group of SMEs (Small and medium-sized enterprises) working with experienced research partners to explore new solutions. The firms hope to capture a significant share of a large market, while improving the efficiency of healthcare provision.

Diabetes is a major healthcare problem, affecting millions of people across Europe, and at least 150 million worldwide. Approximately 15% of these people either currently have or will eventually develop open ulcer wounds on their feet, due to poor circulation and decreased resistance to infection associated with diabetes. This is a particular problem for the elderly. In the most severe cases, the inability of the wounds to heal will lead to amputation of at least one foot, and even in the less severe cases the diabetic foot wounds can be severely debilitating, greatly affecting quality of life. They are also a major drain on the resources of national healthcare programmes. The Foot Wound Healing project is tackling the problem by developing new healing footwear to prevent and treat foot ulcers in diabetic patients.

Relieving pressure

The key to successful therapy is to take pressure off the wounds while keeping the patient mobile. It is also important that the footwear should be low cost and that it should be practical for patients to wear it 24 hours a day. One of the problems with current treatment is that several weeks of improvement can be reversed if a patient simply walks for a short while unprotected, as many tend to do at night, or when attending a brief social occasion, etc. An incident as simple as catching a foot on a stone or even a few grains of sand can be sufficient to cause a major setback in the healing process.

The footwear must be designed in a way that both relieves pressure but also maintains an environment that discourages microbial growth and encourages effective healing. The design options are complex, with many different factors to be taken into account. Possibilities include different combinations of cells filled with gels and with air. The eventual end product is likely to be something in-between a sock and a shoe, although it is possible that a range of different options may emerge.

SME insight

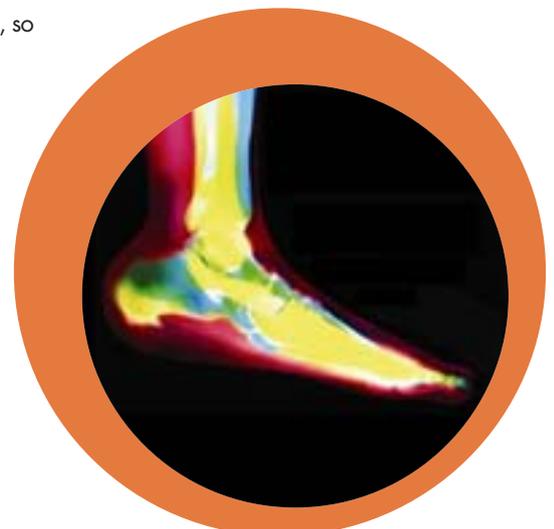
The idea for this Co-operative Research project originated among three European SMEs (Camp Scandinavia of Sweden, Basko of the Netherlands, and Gilbert and Mellish of the UK) with combined expertise in producing, supplying and fitting orthotic products for patients with a range of medical conditions. Together with Sahva of Denmark, a larger company that works with patients to supply

and fit orthotic products, these small and medium-sized enterprises identified a clear need for a much better way to promote the healing of diabetic foot wounds. They recognised, however, that they would require specialist research and development help to explore all the options and develop a new product.

The necessary research and technological development assistance is being provided by the academic and clinical research partners based in Denmark, the UK and Sweden. IFP Research of Sweden, Innovation Team Sweden and Institutet for Produktudvikling of Denmark are specialists in materials composition and performance, with experience in a wide range of sectors including medical applications. They are being assisted by the University of Wales in Cardiff, UK, which has a unit with specialised competence in the medical aspects of the care and prevention of diabetic foot wounds.

The SME partners intend to jointly exploit the project's results commercially, by producing and selling the new product from 2007 onwards. There will be a very large market, both within Europe and worldwide, for any product that can be shown to be a clear improvement on existing solutions. There is therefore significant potential for this project to have a considerable commercial impact on the SMEs involved in it.

The number of people suffering from diabetes is predicted to double by 2025, so there are huge medical and economic



“Working with people from different countries brings together a wide range of experience and knowledge, which should help with successful commercialisation of the end product.”

incentives to develop improved prevention and care of the problems associated with diabetes. The St Vincent Declaration, an internationally adopted initiative from the World Health Organisation and the International Diabetic Federation, has set out a specific objective of reducing the number of diabetic patients who need an amputation by 50%. This reflects the great importance that healthcare authorities attach to the problem of diabetic foot wounds.

A successful Foot Wound Healing project would promote the aims of the St Vincent Declaration and could cause a significant decrease in suffering and increase in quality of life for large numbers of diabetic patients. It would also bring considerable savings for healthcare providers, reducing the need for expensive surgery, aftercare, rehabilitation and prosthetics.

Project title

New healing footwear reducing problems with foot wounds among diabetic patients (FOOT WOUND HEALING)

Contract number

CT-2004-513003

Duration

24 months

Global project cost

€ 1 379 900

EC contribution

€ 689 700

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Foot wounds are a major health problem for diabetics.



“The Icacost software will reduce costs for laser cutting firms.”

The phrase ‘time is money’ is never truer than in the metal-cutting business. Estimating prices for customer offers is a skilled business-critical art, but Icacost aims to develop a software tool that will accelerate the process and make it more accurate through the application of science. This Co-operative Research project will be able to generate a geometric dataset from customers’ engineering drawings that can be related to specific laser tools and company parameters to deliver accurate and competitive pricing. The result will be less skilled time spent on customer offer preparation, more reliable estimates, and a reduction in corporate risk for the SMEs involved.

Preparing costing estimates in response to customer enquiries can be a complex and time-consuming business for any enterprise. For small and medium-sized enterprises (SMEs) in the sheet metal industry – in particular those involved in laser cutting of intricate 2-D and 3-D patterns – accurate estimates need to be made by very experienced personnel as the balance between competitive, but profitable, pricing and losing money is very tight. Unfortunately, with perhaps only one in eight customer enquiries becoming real business, job estimation ties up valuable personnel in relatively unprofitable efforts. In addition, the concentration of corporate experience and knowledge in just one or two people represents a considerable risk for very small companies.

The Icacost project aims to automate the cost-estimation process. The software to be produced will allow customer quotes to be generated quickly and more accurately while freeing skilled personnel to attend to the work in hand. The initiative, led by Laser Zentrum Hannover (LZH) in Germany, will remove the potential for significant loss of knowledge and experience of the cost calculation process when key workers retire, suffer ill health, move on to other companies or are merely on leave.

Characteristic numbers

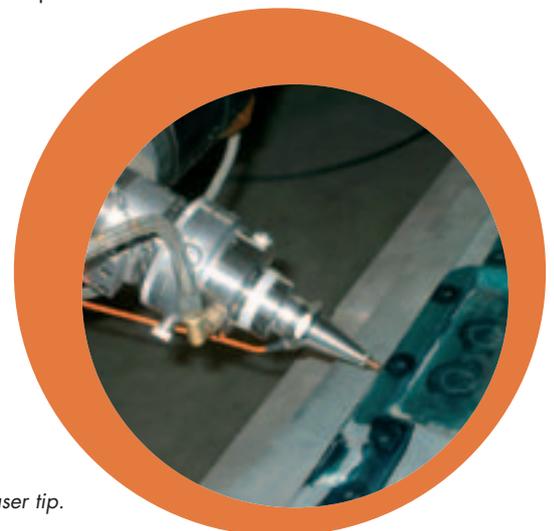
For most metal-cutting companies, bid calculations are still based on manual estimation, supported in many cases by a variety of computer systems, and relying on the skill and experience of senior staff. Only long practical experience and familiarity with the characteristics of a company’s tools allows an accurate estimation of the time needed to cut the contours from the engineering CAD drawings that are supplied as part of the typical customer’s enquiry documentation. The estimated production time for the work piece needs to address problem areas such as sharp angles and narrow radii when the cutting speed of the laser must slow down. Often, the true machining time is only calculated after time-consuming off-line programming has been completed using a post-processor simulation. The accuracy of the estimated time to produce an individual piece is critical if the production run is hundreds and thousands: a small error can result in a large loss to the company.

The Icacost solution will look to automatically generate a set of characteristic numbers that are based on the geometry of the work piece. These characteristic numbers contain all the geometrical influences relating to the laser cut. They are then linked to specific laser tool parameters, such as laser output, axis speed, etc. to calculate the cutting time.

Other factors that affect the production time need to be factored into the programme as well as the geometry. These include the size and weight of the individual piece – not all workshops can handle very large pieces – and the material to be used. Different metals have varying reflective properties depending on the laser wavelength that changes cutting effectiveness. The work piece may also need to be held in more than one orientation to achieve the desired result. For each orientation a specific fixture will be required.

Business integration

LZH is leading the research efforts and will produce the technical software for the machining time calculation. Its fellow research organisation, Fundación Robotiker from Spain, will embed the technical modules within business applications to link with typical company accounting and administration systems allowing easy integration. Robotiker work will link machining time to company-specific fixed and variable costs to deliver a price per unit. This price can then be cross-referenced to a database of past orders to help validate the number.



Close-up of the laser tip.

"Estimating job cost can be performed by less experienced people and will be consistently more accurate and profitable."

Seven SMEs working in the metal-cutting sector from four countries are involved with Icacost. The companies represent a range of company sizes and a number of aspects of metal cutting including 2-D and 3-D processes, sheet and tube cutting. CLW Clausthaler from Germany specialise in particularly complex pieces requiring multiple fixtures, while fellow German company Tubecut feels it needs Icacost in order to enter the 3-D sector. The German SMEs, MARS Lasertechnik and Wilco Wilken have good experience of cost estimation for 3-D cutting but are looking to further refine and streamline their processes. Italian firm Gualini Lamiere is also hoping to bring more consistency to their job-estimation process and Laser-Tech of the Czech Republic mainly work in 2-D cutting but want Icacost to capture the experience and knowledge inherent in their company. Finally, Spanish company Dismodel is looking to Icacost to keep them informed about the state of the art in business software for the sector. Whatever their individual motivation, Icacost has real potential to significantly boost competitiveness for the SMEs involved in the project.

Project title

Individually configurable automatic cost calculation system for 3-d laser cutting (ICACOST)

Contract number

CT-2004-508220

Duration

24 months

Global project cost

€ 874 419

EC contribution

€ 606 700

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A laser cutter in action.



Liquid ice from seawater preserves on-board catch

ICEMAKER

“There are around 97 000 fishing vessels in the EU fleet, 20% of which are of small and medium sized – the target market for the new icemaker.”

A supply of ice on-board fishing vessels is essential to preserve the fish catch. Larger fishing vessels have on-board ice generators, but these are unsuitable for small and medium-sized vessels. The Icemaker project from Co-operative Research aims to develop a low-cost icemaker for smaller boats, using an innovative heat-absorption process to convert seawater into fluid ice. Thermal energy will be reclaimed from the engine exhaust. Seawater will be ionised to create germ-free ice. This technology will enable European fishing fleets, operating smaller boats, to reduce costs by optimising fuel and ice usage, and increase profits through less fish wastage.

The fishing industry relies on ice for the preservation of fresh fish. Larger fishing vessels have on-board facilities for making ice, which make use of mechanical compression systems. However, the commercial ice-generating units currently available are unsuitable for small and medium-sized vessels because they are too bulky and expensive to operate. Small and medium-sized fishing vessels, which tend to operate closer to shore, therefore take ice on-board at port to preserve the day's catch. This increases costs, due to the purchase and handling of ice, and makes fishing vessels dependent on ports having ice-making equipment. In addition, ice melts during transport and handling, thereby losing its energy, and it may run out during a day's fishing leading to spoilage and economic losses. There is consequently a need for a compact low-cost ice manufacturing system for use on smaller fishing vessels.

From design to prototype

The Co-operative Research Icemaker consortium has the necessary scientific and technical expertise to develop and commercialise an innovative ice-making system. The coordinating partner, CRIC (Centre de Recerca i Investigació de Catalunya) is a research institute with the facilities to design and assemble the icemaker. A group of SME (small and medium-sized enterprise) partners are manufacturing the various components, two are advising on environmental issues, while two others operate fishing fleets on which the prototype system will be tested.

The innovative design of the icemaker requires that the SMEs design and manufacture four main components: a heat absorption unit, a heat pipe system, an ozone generator, and a fluid ice generator. These will be assembled into a small low-cost and energy-efficient unit ideally suited for the needs of small to medium-sized fishing vessels.

Energy conservation

The new icemaker is designed to have lower energy consumption, be smaller, and to produce less waste than existing ice-generating systems. It should also have lower production and installation costs. Energy efficiency is achieved by exploiting the heat given off by the fishing boat's engine. A heat absorption process is used to trap thermal energy that would otherwise be emitted into the atmosphere.

A heat pipe system harnesses the recovered thermal energy. Heat pipes use the cooling power of vaporisation to move thermal energy from one place to another, using the principles of phase-change recirculation. This drives the conversion of seawater to ice. Therefore, no additional fuel consumption costs are incurred – an advance on existing compression systems used on larger fishing vessels.

Liquid ice

Ozonised seawater is used to make ice. This is advantageous because ozone disinfects seawater – an efficient way of killing pathogens and creating germ-free ice that better preserves fresh fish. The ozone is produced using an innovative electrochemical process. The hydrogen and oxygen liberated by this process can potentially be reused in combustion cells to generate electrical energy, further enhancing the energy efficiency of the process.

The icemaker generates fluid ice. This is ice that consists of microscopic spherical crystals suspended in an 'antifreeze' solution. This type of ice has a faster freezing rate and a greater thermal transfer than other types. It is good for the preservation of fish because it does less damage to their skins. The fluid ice is transportable via pipes and can be stored in tanks.

Major benefits

An on-board icemaker will enable small and medium-sized fishing vessels to be independent of shore-based ice-making facilities. They can make optimal use of a continuous



supply of clean ice throughout a fishing trip. The icemaker will reduce costs and have environmental benefits. Renewable energy is used and pollution and waste will be reduced, for example, with fewer spoiled fish being dumped.

"There are around 97 000 fishing vessels in the EU fleet, 20% of which are of small and medium sized – the target market for the new icemaker," says Estela Pacheco of CRIC. The technology will enable these vessels to land fish of enhanced quality which will generate higher profits at the market. In addition, renewable energy is used which reduces overall fuel costs. "It is estimated that the new icemaker could save the fishing industry around € 58 million over five years, due to improvements in fish preservation." The compact, low-cost icemaker therefore answers a clear need within the fishing sector, and will help to increase the competitiveness of the European fishing industry.

Project title

Development of a low-cost, low-power consumption system for manufacturing ozonised fluid ice for fishing, via an absorption system (ICEMAKER)

Proposal Number

CT-2004-508726

Duration

24 months

Project cost

€ 1 701 802

EC Contribution

€ 865 901

"It is estimated that the new icemaker could save the fishing industry around € 58 million over five years, due to improvements in fish preservation."

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- 4 E.C.T. TBN Offshore Service AB (SE)
- 5 Industria Técnica Valenciana S.A. (ES)
- 6 Marine Conservation Centre Deniz Koruma Merkezi (TR)
- 7 Aquabio Tech Limited Group (MT)
- 8 Doulopoulos Shipyards LTD (EL)
- 9 Oremar S.A. (ES)
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Heat exchanger

“InterPROM will be especially attractive to very small SMEs because it is so easy to install and use. This is important.”

Small and medium-sized enterprises (SMEs) need expensive, elaborate software to be able to communicate effectively with systems in large companies. Most SMEs are either unable or unwilling to make the investment required, and so miss out on long-ranging outsourcing projects from major companies.

Innovative new software technology in Co-operative Research project InterPROM enables a high level of integration between the systems in place in SMEs and those in large company project partners. This greatly improves communications and decision-making, reduces costs and project times, and opens up a huge potential global market for European SMEs.

At present, large corporations often ignore SMEs when it comes to outsourcing development projects. Available solutions are generally too complex and expensive for most SMEs. Low-priced software is generally incompatible in terms of required workflow and project management. Now, a German-led consortium of nine partners is developing software technology that enables SMEs to carry out these projects efficiently and meet the given quality standards at the same time. InterPROM aims to achieve a mutual exchange of all kinds of business processes between a large company and an SME subcontractor. The idea is to make use of existing, freely available, operating systems and servers, to include Linux and the Java 2 Platform, Enterprise Edition (J2EE). The InterPROM software itself is inexpensive and easy to install and use. It delivers the basic functionality of the system, and is the only software the end-user needs to licence. As security issues are a primary concern, InterPROM can be configured to allow only project-relevant information within an organisation to be accessed by an external partner.

Co-operative Research's InterPROM is unique because, for the first time, it integrates both project management and workflow systems. This enables SMEs to function as virtual departments of a large company. Because their respective systems become highly integrated, a contractor can monitor and supervise project activities in the SME as they are taking place.

The software permits a high level of transparency, since project information is accessible by all project participants at any time. Since communications between the partners are much improved, they can rapidly determine when secondary project decisions need to be made. This becomes even more important if additional partners join in the same project.

Deeply involved

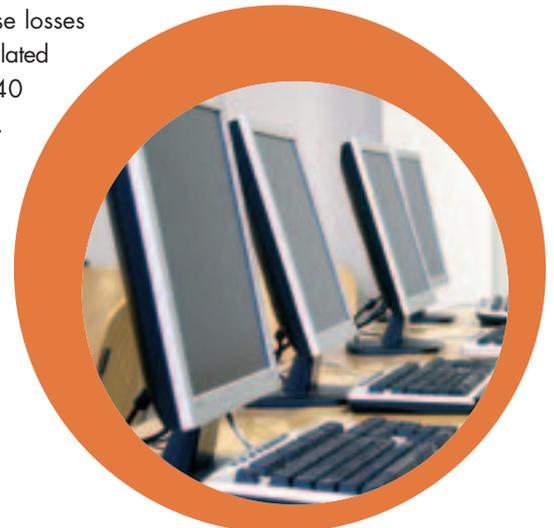
The five SME partners in the consortium bring highly complementary skills to the project. Four work in the fields of consulting, project management and software solutions for industry. Another is a marketing specialist with a strong distribution network in Europe, which is ready to promote and widely commercialise the InterPROM product once the project is completed. The SME Pavone, in particular, has considerable experience in projects outsourced by major companies. With their combined experience, the SMEs

were able to identify the numerous weak points in existing collaborative systems used by SMEs and large contracting companies. The SMEs hope to substantially expand their own product portfolio through InterPROM and also become important facilitators for other companies wishing to enter the outsourcing market.

The three university departments involved specialise in research including workflow, database design and web-based architecture, and enterprise resource planning. They hope to advance their knowledge base through this project and disseminate the findings of their research in the scientific community. The European Aeronautic Defence and Space Company (EADS), maker of the Airbus and Eurofighter, is the pilot end-user of InterPROM. EADS, as the first 'customer', is giving extremely useful feedback about the implementation of the system. It already does business with many SMEs, so this novel platform could offer immediate benefits for the company. If they run into any snags in a project, communication with their SME partners ought to be more to the point, faster, and less costly. From a personal standpoint, participants are likely to feel much more deeply involved in projects.

Great potential

Currently, only a small proportion of long-range outsourced projects are completed on time and, in fact, the majority of them are cancelled. These losses have been calculated at around €40 billion per year.



“As a result of InterPROM, there should be many more SMEs working as virtual departments of big companies. And it saves time and money for everyone involved.”

A simple, adaptable solution is obviously badly needed. A big advantage of InterPROM is that it is unnecessary to involve either senior management or the IT department in the decision to install it. This can be done by a project engineer. The consortium hopes InterPROM will become the standard platform for the future. According to research instigated by the consortium, the market for software solutions like InterPROM is approximately €1.6 billion.

The cross-organisational collaboration enabled by InterPROM is expected to increase business co-operation in general in Europe, and its multilingual possibilities should facilitate transnational co-operation. SMEs will be able to comply with the requirements and standards of larger companies – both at a European and a global level. Therefore, the ultimate objective of this project must surely be no less than an assurance of survival for SMEs.

Project title

Interoperable collaborative process management (InterPROM)

Contract number

CT-2004-512683

Duration

24 months

Global project cost

€ 1 776 614

EC contribution

€ 1 374 351

Contact person

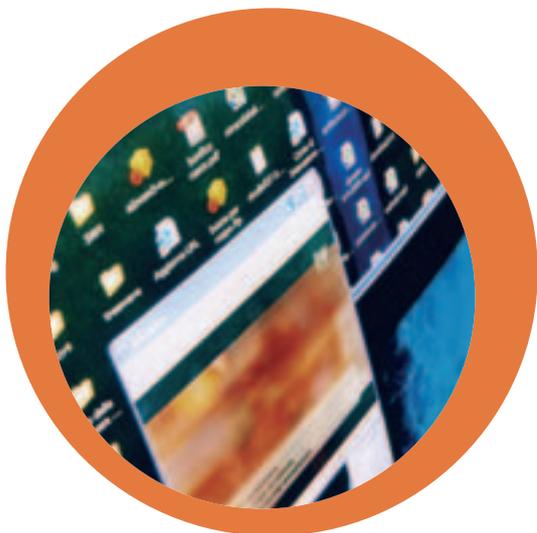
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- 5 Kachel GmbH (DE)
- 6 Inter Enterprise Information Exchange Ltd (UK)
- 7 Technical University of Varna (BG)
- 8 University of Essex (UK)
- 9 University of Paderborn (DE)



“The idea is to develop a new drug-screening process – the discovery of better drugs will hopefully come later, when people use that process.”

Ion channels are complex molecular systems that control the movement of the charged particles called ions through biological membranes. Dysfunctions of ion channels underlie many common medical conditions, especially within the central nervous system. The ION project is developing an integrated system to increase the speed and efficiency of testing compounds for the ability to block ion channels, which might be exploited therapeutically. The Co-operative Research partners in the project believe they can produce a system which could find a large market in Europe, the USA and worldwide. Patients and healthcare providers will also benefit, if new drugs can be developed and commercialised more quickly.

New medicines emerge from a long and tortuous research and development process that often begins with huge numbers of candidate chemicals being tested, or ‘screened’ for useful biological effects. The basic objective of the ION project is to develop an innovative system to screen candidate drugs for their ability to affect, at bio-molecular level, ion-channels which control the flow of the charged particles called ions across biological membranes. Problems with the behaviour of ion channels are found in a wide range of diseases, including very common neurological and psychiatric disorders such as depression, Parkinson’s disease, epilepsy, migraine and pain.

This Co-operative Research project has been set up around four specialised SMEs (small and medium-sized enterprises) based in Italy, Germany and Romania. The necessary research and technological development (RTD) assistance is provided by five academic research institutes, in Italy, Poland and Hungary.

Integration for high throughput

The SME partners conducted an on-line questionnaire-based survey of end-users of the current screening technologies, and identified a clear need for an improved and integrated process. Overall, the major benefits of the project will be to provide the necessary single integrated system to screen candidate compounds more quickly and analyse the results more efficiently than existing alternatives.

The partners are producing what the end-users asked for by developing technical modifications to existing machinery, and new software solutions for handling and analysing the data that are produced.

The existing technology uses two separate electrodes to maintain and measure changes in current through ion channels in the membranes of ‘oocytes’ (female reproductive egg cells). A major innovation of the project is to simplify the existing procedure into a one-electrode system. This is being incorporated into an improved version of the Roboocyte machinery produced by the SME partner Multi Channel Systems of Germany.

New software to cope with the data generated by the machinery is being developed by SC IT Romania ITR, an SME specialising in

scientific software. In addition to analysing the data from initial screening, this software will help in the design of subsequent steps in the drug discovery process.

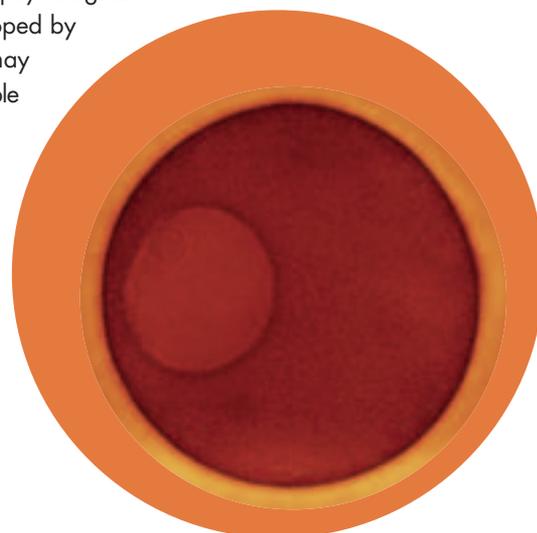
Newron Pharmaceuticals of Italy is an SME partner that uses screening technology in its drug development work. It is performing the screening trials and acting as the project coordinator. Newron specialises in drugs affecting the central nervous system, in which the role of ion channels controlling ion flow across cell membranes is especially significant. The fourth SME partner, Nikem Research of Italy, supplies new chemical entities, expertise in computational chemistry and additional chemical knowledge to assist in the project.

The key role of the RTD partners is to provide the necessary academic research expertise, and to assist in selecting which specific ion channels and candidate and reference drug compounds should be used. Their expertise is also required to validate the outcomes of the new system, ensuring it can be used with confidence by end-users who may be SMEs with limited RTD facilities of their own.

European benefits

The SME partners will gain clear commercial benefits from a successful project. Multi Channel Systems should gain a much-improved commercial product to sell.

The new electrophysiological platform developed by this company may also be applicable more widely within other products which they



"It is very nice to have an international team working together, and we are learning a lot from that."

manufacture. SC IT Romania ITR will have the rights to the new software solutions they develop, which may also be adaptable to serve other related needs. Newron and Nikem will have the use of the much-improved process to assist in the search for new drugs, which can ultimately be put through clinical trials and brought to market.

The RTD partners gain commercial insights and practical experience by working with SMEs on a technical problem of direct commercial significance. European society, in the long term, will clearly benefit if the project increases the rate and efficiency of drug discovery. A major bottleneck in the search for new drugs is the initial screening of the enormous variety of compounds which might, in principle, yield the 'blockbuster' medicines of the future.

Other companies and consortia throughout the world are also trying to transform the inherently low-throughput existing techniques into high throughput ones. But the ION project is developing a coherent European solution that will maintain European competitiveness in this important but highly specialised field. A successful system could find a large market, not only in Europe, but also in external markets such as the USA and Japan.

Project title

A sequential high-throughput ion channel screening system for drug discovery in neurological and psychiatric disorders (ION)

Contract number

CT-2004-513190

Duration

24 months

Global project cost

€ 1 833 760

EC contribution

€ 1 275 340

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- 4 Multi Channel Systems MCS GmbH (DE)
- 5 Nikem Research SRL (IT)
- 6 Politecnico di Milano (IT)
- 7 SC IT Romania ITR SRL (RO)
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- 9 University of Debrecen (HU)



Ion channels incorporated into oocyte cell membranes are being tested to identify new drug candidates

©Courtesy of Multi Channel Systems GmbH



“What is good in medicine might be also very helpful for non-destructive evaluation in industry.”

Optical coherence tomography (OCT) is a non-invasive imaging technique that uses light to create cross-sectional images of solid surfaces to a depth of typically 1-2 mm, without touching or damaging the sample. Until now its main uses have been in medicine but a new Co-operative Research project, IPC-OCT, is developing an OCT scanner that could be used in industry for quality control of small components, coatings and multilayer structures. The consortium includes three SMEs (small and medium-sized enterprises) which are developing the technology, three research centres and three potential end-users of the scanner. Possible applications range from lacquered wood panels to helicopter rotor blades.

With manufacturing technology reaching ever smaller scales, the problem of quality control arises. How does one know that a coating has the correct thickness? How can you assure customers that the dimensions of a tiny moulded component are what you say they are? The answer, according to a new Co-operative Research project, could be a technique known as optical coherence tomography (OCT).

In OCT, light is shone on to a surface. Most of it is reflected back but some will penetrate into the material and be scattered out again. By analysing the scattered light with an interferometer it is possible to construct a cross-sectional image of the surface and the region beneath it. A material does not have to be transparent for OCT to work. Most polymers, glasses and ceramics are translucent to some extent, and OCT can probe to depths of typically 1-2 millimetres. Completely opaque materials, such as metals, cannot be probed but it is still possible to map their surface structure.

Until now the main application of OCT has been in medicine, where specialised scanners can measure the thickness of the retina and so help to diagnose diseases of the eye. Other applications, such as in skin cancer and dentistry, are being developed. But there has been little research into using OCT in industry.

New light source

The idea for this Co-operative Research project took shape when Isis Optronics, a German SME (small and medium-sized enterprise), looked for industrial applications of an OCT scanner they had developed for medical diagnosis. One problem was the diverse range of materials used in industry. Another was the resolution. Current medical applications of OCT can resolve structures as small as ten micrometres, but that needs to be pushed below five micrometres if it is to be useful in industry. The key is the quality of the light source, which is usually derived from an infrared laser but spread over a broad band of wavelengths. A lot of research was needed, far beyond what SMEs can normally contemplate.

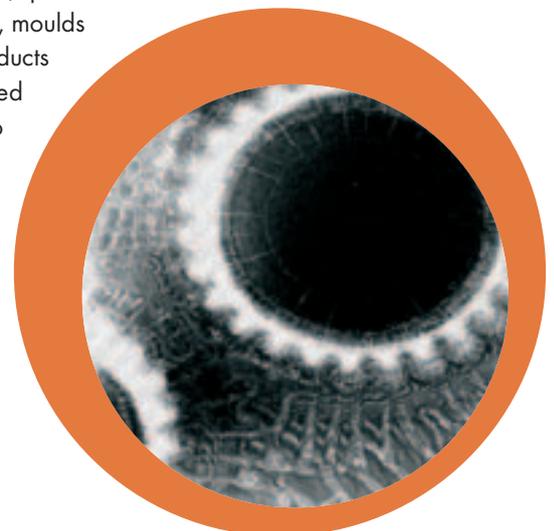
Isis teamed up with an Austrian SME, High Q Laser Production, which had a new kind of laser light source especially suited to OCT work and wanted to find new uses for it. Together they had the basis for a project known as IPC-OCT, the aim of which was to develop a commercial OCT scanner for use in industry.

The project is coordinated by Upper Austrian Research, which has many years' experience in OCT and its applications. The University of Bath is bringing its experience of novel optical fibres to work with High Q on a new broadband light source. The University of Applied Sciences, Upper Austria, is making available its X-ray tomography scanner as a benchmark against which the performance of the OCT scanner can be evaluated. They in turn are working with a Romanian SME, Accent Pro 2000, which has experience in software for analysing such X-ray data and will be contributing its expertise to the analysis of OCT images.

Industrial applications

Three other partners are potential end-users of the new technology. PKT, in Austria, make tiny polymer components where surface quality and lack of flaws is critical. Micro Resist, in Germany, make deep, but narrow moulds for small metal components. Boehringer Ingelheim microParts, a large German company, make thin foil laminates. All three would like to use OCT in their production to check the quality of their products.

Beyond the immediate circle of the partners is an industry support group which will eventually number around 20 companies from a wide range of sectors. The idea is to demonstrate future uses of OCT by applying it to real industrial problems. Already potential applications are emerging in packaging materials, micro-injection polymers, fibre-reinforced composites, multilayer foils, protective coatings, filters, moulds and many products from lacquered wood panels to helicopter rotor blades.



"If you want to look at materials microscopically, OCT will be the diagnostic tool of choice."

Apart from ultrasound, whose resolution is too low, the only other competing technique is X-ray tomography which involves shining X-rays through a sample from different directions, using the same principle as medical body scanners. It is expensive and cumbersome, and not suited to routine production monitoring. An OCT scanner, on the other hand, is compact and can be focused on a small region of interest and so can be incorporated into a production line, scanning products as they pass by without touching them. It should be an order of magnitude cheaper and simpler than X-ray tomography and give sharper images than ultrasound.

While commercialisation of the full scanning system is still some years away, High Q have already marketed a new laser developed for the project and there is much interest in their broadband light source.

Project title

In-line process control with optical coherence tomography (IPC-OCT)

Contract number

CT-2004-507825

Duration

24 months

Global project cost

€ 1 477 439

EC contribution

€ 955 831

Contact person

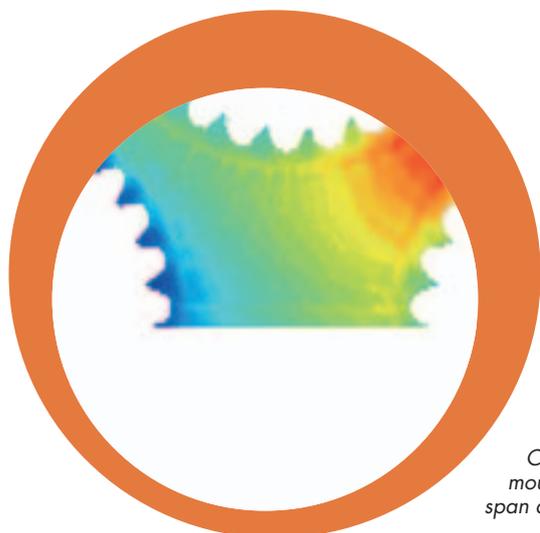
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- 5 Isis Optronics GmbH (DE)
- 6 Micro Resist Technology GmbH (DE)
- 7 Präzisionskunststofftechnik Bürtlmair GmbH (PKT) (AT)
- 8 University of Applied Sciences, Upper Austria (AT)
- 9 University of Bath (UK)



Colour-coded OCT depth scan of a mould for gear wheels. The colours span a depth range of 18 micrometres.



“The new process will be faster, cheaper and provide higher quality.”

In the automotive field, integrated security sub-modules are the sub-assemblies that have a significant role in vehicle safety: examples include the suspension and steering modules in cars. The quality of manufacturing required for these sub-modules is high and the European vehicle component and assembly industry has a long history of quality excellence. However, it is facing rising competition from international manufacturers, in particular from south Asia and China. To increase European competitiveness, new ways of working are required incorporating new technologies and pushing quality standards higher. The ISSEA Co-operative Research project aims to do just that.

Currently, automotive sub-modules are made in multi-step processes. The sub-modules are made up of stamped steel structures with other composite elements (rubber-metal or plastic-metal). The components undergo separate surface treatments to prevent corrosion during use before being assembled using traditional methods such as adhesives and screws. The whole process has a large number of stages, gives the opportunity for quality issues where components are joined, and can also allow the generation of corrosion ‘hot spots’.

Doing more with less

ISSEA will drastically reduce the number of steps involved in producing sub-modules and use modern materials, such as high-strength low-alloy steel (HSLA), to give improved strength and safety with lower weight and cost. Laser welding techniques will be developed as the main assembly method as this gives very high quality and has been demonstrated to be extremely accurate in a number of manufacturing situations. The result will be fully integrated, lighter and more reliable security sub-modules.

The final step will be to use a specially developed surface treatment for anti-corrosion that can be applied to the whole, fully assembled sub-module. This will ensure full protection with no ‘chinks in the armour’. It will give a superior corrosion protection for the module and increase its potential useful lifetime. The chosen treatment method is autophoretic coating that is environmentally friendly as it does not involve use of volatile organic chemicals or heavy metals (such as chromium, zinc and nickel), but is compatible with the different materials found in the assembled sub-module, i.e., steel, rubber and thermoplastics. The treatment will need to work effectively at a relatively low application temperature (100°C maximum).

Using knowledge for quality

Co-operative Research’s success in ISSEA will provide automotive SME (small and medium-sized enterprise) suppliers an additional added value and cost reduction as well as a boost to competitiveness. Suppliers now work much more closely with vehicle manufacturers, providing an integrated business service from design activities to delivery of the assembled modules for final assembly. The industry has a continuing need to move with technology developments and acquire new knowledge and expertise to remain competitive. The project partners brought together by ISSEA are likely to become much closer and initiate other collaborative business initiatives.

The SMEs participating in ISSEA represent a cross-section of the value chain in this sector. Plásticos Dúrex is the Spanish company coordinating ISSEA and is engaged in the moulding of elastomers and thermoplastics, and specialises in the development and production of pieces and assemblies for shock-absorbers, suspensions and isolating elements of motor vehicle chassis. Micrometric Techniques is a subcontracting operation specialising in laser manufacturing solutions and providing a service to a wide range of industries and customers. This UK company is a European leader in the use of lasers for the manufacture of precision components. Autoforese is a Portuguese company involved in the surface corrosion protection treatment of component parts for industries such as automotive, household goods and furniture. Tecnisata, also from Portugal, designs, develops and manufactures cutting, embossing and progressive press tools, moulds, and prototypes for industries such as automotive components, electric and electronics. The Teknia Manufacturing Group is a dynamic Spanish industrial group that aims to be a leading manufacturer for the automotive sector. Finally, PyroGenesis S.A. of Greece is a specialised coatings company based in Athens.

A complementary set of research institutions have also been assembled for ISSEA. The Centro Sviluppo Materiali is a private research company based in Rome with experience in metals, ceramics and coated products. The Spanish Automotive Research and Development Centre within the University of Valladolid was specially formed



Modern cars contain many complex sub-assemblies.

"The SMEs involved in ISSEA aim to collaborate more closely in other initiatives as well."

to contribute to the automotive sector, whilst the Instituto Superior Tecnico is the largest engineering school in Portugal, as well as one of its largest R&D institutes, with expertise in areas as diverse as microelectronics, advanced materials, combustion and chemistry. Luleå University of Technology in Sweden has more than 20 years experience in developing materials-processing applications using lasers, particularly in laser welding.

Project title

Integration of the security sub-modules elements in the automotive industry (ISSEA)

Contract number

CT-2004-508097

Duration

18 months

Global project cost

€ 1 493 189

EC contribution

€ 746 494

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- 4 Fundación para la Investigación y Desarrollo en Automoción (ES)
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- 6 Luleå University Of Technology (SE)
- 7 Micrometric Ltd (UK)
- 8 PyroGenesis S.A. (EL)
- 9 Tecnisata Industria Metalomecanica LDA (PT)
- 10 Teknia Dej (ES)



Security sub-modules include suspension and steering units.

“The lung cancer vaccine is MUBio’s second big job: ultimately we hope it will be a clinical as well as a commercial success.”

The LCVAC project is seeking to develop a vaccine to treat lung cancer, which is the leading cause of cancer deaths in Europe. The project is tackling the daunting challenges of finding antigens able to stimulate an effective immune response against lung cancer, and of combating the variety of types of lung cancer with one general vaccine. The Co-operative Research project team consists of three young biotechnology SMEs (small and medium-sized enterprises) and two academic research units attached to large universities. A successful project would bring significant commercial success to the SME partners, and would contribute greatly to the management of one of Europe’s greatest healthcare problems.

Lung cancer is the number one killer of cancer patients, and there is no adequate treatment for this very common condition. The aim of the LCVAC project is to develop new ways to treat lung cancer using the process of vaccination, in which the body’s own immune system fights the disease. The personal, social and economic costs of lung cancer are immense, as it accounts for about one-fifth of all cancer deaths in Europe. Any improvement in the situation that might result from the LCVAC project could have a substantial impact on European healthcare costs, in addition to saving lives and improving quality of life.

The partners do not expect to create a single dramatic cure for lung cancer. Even if their best hopes are realised, their vaccine will probably need to be used in combination with chemotherapy, radiotherapy or surgery.

Multiple challenges

Trying to lessen the terrible toll of lung cancer is a huge challenge. It tends to be diagnosed when already far advanced. The cancer cells can be highly ‘metastatic’, meaning they multiply and spread very aggressively. The cells can also be resistant to chemotherapy and it is difficult to remove all of the cancerous tissue by surgery. Using vaccines to stimulate the immune system into attacking the cancer is, in principle, a very promising approach, but there are many obstacles that the LCVAC partners must strive to overcome.

The immune system is stimulated to attack disease by its ability to recognise chemical features of an invading micro-organism or diseased cell as being abnormal or ‘foreign’. The molecular triggers for the immune response are called ‘antigens’. A vaccine is essentially a form of purified antigen or mixture of antigens, together with immune-stimulating agents called adjuvants, administered to induce an effective immune response. Unfortunately, effective antigens specific to lung cancer cells are not currently known. Also, lung cancers are characterised by some variations in cancer cell type which increases the difficulty of finding effective vaccines.

The compact partnership of the LCVAC Co-operative Research project brings together a blend of academic, medical and commercial expertise chosen to match the difficult challenges facing the project.

MUBio Products BV of the Netherlands is a biotechnology SME (small and medium-sized enterprise) that has branched out of the University of Maastricht. MUBio focuses on the development of new diagnostic and therapeutic reagents for lung cancer patients and cancer patients suffering from cytomegalovirus (CMV) infections. MUBio is coordinating the LCVAC project and much of the work will take place on its premises.

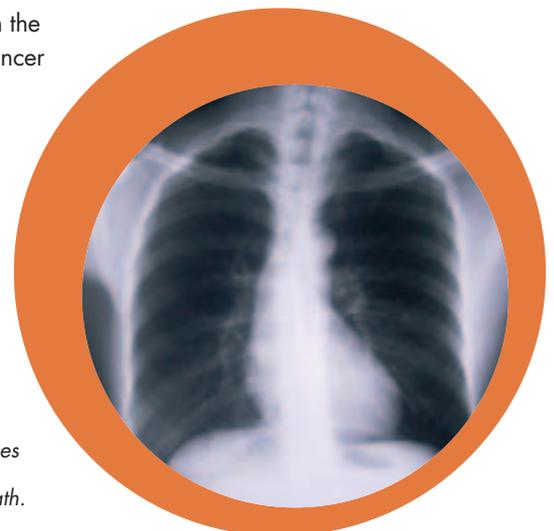
CIRES GmbH is a German biotechnology company with extensive knowledge of tumour immunology and models for testing anticancer vaccines. It provides access to vaccine delivery methods that could prove very important in eliciting immune responses leading to the destruction of the cancer cells.

Onyvax Ltd of the UK has already developed a vaccine for prostate cancer, which is currently being tested in clinical phase studies. They bring expertise in cancer vaccine development, regulatory issues and clinical trials.

The two large research and technological development partners are the Medical Proteome Centre at Ruhr University in Germany and the University of Maastricht in the Netherlands. These partners supply the detailed academic expertise needed to identify suitable antigens and help put them together into a vaccine.

Steps to success

The first step on the road to lung cancer vaccines is to search for suitable protein molecules specific for lung cancer



Lung cancer causes a huge toll of suffering and death.

“Lung cancer is very aggressive. It would be an achievement if we could increase the patient’s quality of life during the treatment of the disease.”

cells that might be used as effective antigens within a vaccine. The problem is to find proteins that are made only by the cancerous cells, and not by normal cells, to ensure that the vaccine will stimulate the immune system to attack cancer cells while leaving healthy cells alone.

The team will probably need to use a variety of protein antigens, to allow them to create a general vaccine that will be effective against the different types of lung cancer. Even within a single individual, lung cancer can often involve a mixture of cell types, so the vaccine will have to target all of them.

Having identified suitable antigens, the next stage will be to test possible vaccine mixtures on cultured cells and animals. Clinical trials on humans would follow only after good results had been demonstrated with these laboratory tests.

This project is a good example of large-scale academic units working to nurture the SMEs that they have given rise to. For example, having originated as a spin-off from the University of Maastricht, MUBio can exploit its extensive links with that large academic partner while pioneering its own commercial development.

Project title

New vaccination therapies for lung cancer (LCVAC)

Project Number

CT-2004-512855

Duration

24 months

Project cost

€ 1 763 350

EC Contribution

€ 1 231 269

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Vaccine therapy for lung cancer could be a big step forward.



“Foot problems are a real danger for diabetes sufferers. The results of this project will improve their health.”

Many people with diabetes wear special shoes to reduce the pressure on their feet and minimise the risk of ulcers. The Liquidsole Co-operative Research partners plan to create a shoe sole that adapts to the shape and movement of the foot in real time, using a magneto-rheological ‘smart fluid’ controlled by magnets and electronics embedded in the shoe. Conventional orthopaedic shoes are often unfashionable, so another aim of the project is to create shoes that are good looking as well as effective – and eventually to extend the principle to sports shoes. The vertically integrated project team includes experts in orthopaedics, smart fluids, shoe manufacturing and fashion.

People who suffer from diabetes face a real risk of foot ulcers – in the worst cases leading to amputation – because of poor circulation and nerve damage. According to Giorgio Pezzuto of Italian engineering company D’Appolonia, foot problems affect one in four diabetics, and rates of the disease are rising rapidly in Europe.

Diabetics can protect their feet by wearing special shoes designed to avoid pressure points and abrasions. “But most ordinary diabetic shoes are not very attractive,” says Pezzuto. “We set up the Liquidsole project with the aim of producing a shoe that looks better as well as performing better.”

Key to the project, he explains, is the use of special ‘magneto-rheological’ (MR) fluids to produce a sole that changes its shape and stiffness on demand. Controlled by a miniature computer embedded in the shoe, the sole could adapt itself not only to the shape of the wearer’s feet but also to their gait or the type of terrain. “Imagine a shoe that changes its shock-absorbing properties according to whether you are walking or running,” says Pezzuto. “There is a big market for this technology in sports shoes, too.”

Smart fluids

The idea of self-adapting shoes has not been lost on other manufacturers. Adidas, for instance, has launched the adidas_1, a \$250 trainer that uses a force sensor, microprocessor and electric motor to control a spring-like damping mechanism in the heel. Another company, VectraSense, has developed a smart shoe with adjustable air bladders in the sole.

An MR fluid held in channels within the sole is a more elegant way to provide adjustable cushioning, Pezzuto believes, because apart from the fluid itself there are no moving parts. The fluid is made from microscopic magnetic particles suspended in oil, and its flowability is controlled by varying an external magnetic field. “The fluid can change from a free-flowing liquid to a solid in an instant,” says Pezzuto.

Although MR fluids have been known for many years, only recently has the technology become mature enough for them to be used in applications such as tuneable shock absorbers for cars. Technical challenges for the project team include developing a suitable MR fluid for use in shoes, creating accurate mathematical models of its

performance, designing a magneto-electronic control system, and mass producing everything in the form of a thin, lightweight sole.

“We hope to power the system from piezoelectric foils embedded in the sole, so we may be able to eliminate the need for batteries,” Pezzuto adds. The new sole should also be cheaper to make than designs with complex air valves or motors, though price is not the most important factor in diabetic shoes or high-end trainers.

Smart team

The Co-operative Research project team has a high degree of vertical integration. The idea of using MR fluids as the basis for smart soles was patented by Karada Italia. This high-profile SME (small and medium-sized enterprise) designs fashionable clothes with a technological twist, and is now one of the Liquidsole partners. D’Appolonia is the project coordinator.

The MR fluids are being developed by Liquids Research Limited, a British SME that is a world leader in this area. Another UK SME, Goudsmit Magnetics, is supplying the magnetic systems needed to control the fluid properties precisely. Evvent, an Italian SME, will develop the electronic control system which senses pressure on the sole and adjusts the cushioning accordingly – one of the most difficult parts of the project, according to Pezzuto.

Although the smart sole is the most important part of the shoe, it cannot be developed in isolation, Pezzuto points out.



"This is a shoe that thinks for itself. It will give your feet just the right amount of cushioning at all times."

Two Spanish SMEs, Artesano and Analco, are contributing specialised manufacturing knowledge in orthopaedic and diabetic shoes, while the Institute of Biomechanics in Valencia will specify performance requirements and test the products. Haswell Moulding Technologies and Pera International in the UK will help to develop the plastics moulding technology needed to produce a complex sole in large quantities. The remaining partner, Alpina, is a Slovenian manufacturer of shoes for sports and outdoor use. Alpina is a large company whose marketing expertise will help in commercialising the results, says Pezzuto.

"Technically this is a difficult project, but we have an excellent team and the commercial rewards should make it worthwhile," he says. "We estimate that the European market for diabetic shoes is € 28 million, and our secondary market for functional and outdoor shoes is worth € 60 million. The project finishes in January 2007, by which time we will have prototypes to show that the idea will work, and I think we should have a commercial product two years after that."

Project title

Development of a cost-effective adjustable damping sole based on magneto-rheological (MR) fluids (LIQUIDSOLE)

Project Number

CT-2004-512670

Duration

24 months

Project cost

€ 1 418 839

EC Contribution

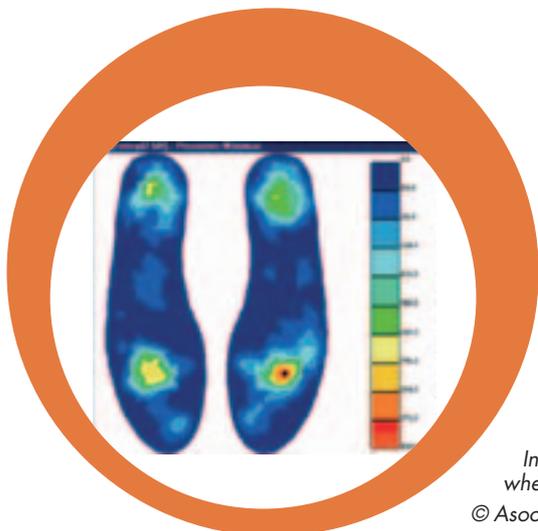
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Excessive pressure can cause foot injury in athletes and serious ulcers in people with diabetes. The Biofoot system at the Institute of Biomechanics of Valencia shows where stresses are highest.

© Asociación Instituto de Biomecánica de Valencia



“Being approached directly by someone in the strawberry-growing business has helped the research team to identify more closely with the needs of growers.”

Effective weed control is vital in horticulture, especially with crops grown under glass. To give crops the best chance of yielding top-quality production, the soil must be free of weed seed, pests and diseases before sowing. For many years, methyl bromide has been the most effective and widely-used chemical for fumigation but, since an agreement in 2001 to end its use in Europe, the challenge has been to find a replacement that outperforms it commercially and delivers environmental benefits. The Microdis Co-operative Research project brings together engineers with horticultural scientists, equipment manufacturers and growers in eight European countries to develop a new fumigation system that meets the tough new environmental and economic criteria.

In 1991, the Montreal Agreement identified methyl bromide as being harmful to the ozone layer and, by 2001, agreement had been reached in Europe to end its use by the end of 2005. It has been a highly effective fumigant for over 100 crops, but, in practice, its use has been heavily concentrated on soil for strawberries, tomatoes, peppers, ornamentals and nursery crops. The growers of these crops are therefore particularly vulnerable to new commercial pressures, especially as methyl bromide will continue to be used by competitor producers in third world countries and the United States after its European phase-out.

Taking methyl bromide out of the equation

Alternative systems trialled so far have generally been effective fumigants, but are not energy-efficient and are not commercially viable in horticulture where price pressure is intense. The Microdis project will develop, test and validate an industrial prototype for fumigating soils by electromagnetic radiation, focusing on soils for strawberries and perennial crops grown under a diverse range of European growing conditions. The prototype must be judged by exacting commercial and environmental criteria, covering its cost effectiveness, ease of use, availability and proven safety to the ozone layer.

The project is being coordinated by the Centre de Recerca i Investigació de Catalunya, Spain, and brings together experts in microwave technology with companies specialising in machinery for soil removal, equipment manufacturers, experts in pest and pathogen control, analysts, farmers and crop growers. These partners cover each aspect of the fumigation problem, from technical experts through to the end-user. The best technology can therefore be applied in conjunction with the growers' expertise in maintaining soil nutrients and organic matter.

The research must closely mirror real crop-producing conditions and the starting point for the trials is based on detailed soil specifications. After this, microwaves will be tested to see how well they destroy unwanted pathogens while preserving nutrients. Some innovations are particularly aimed at boosting energy efficiency, including trials with low-temperature plasma and hydrogen peroxide, ways to preheat the system prior to fumigation and the incorporation of a fuel cell to generate power. The prototype must be developed within a high-capacity machine to maximise labour productivity, and

some conventional agricultural machinery will also be adapted to deal with soil removal and replacement in sufficient volumes.

The programme has been carefully subdivided so that the partners can exploit their technological expertise to the full while still being involved in the majority of the tasks. This makes the project easier to control and the objectives can be clearly validated as the work progresses.

Securing the market for European growers

The CRIC first became aware of the need for an alternative fumigation system through a direct approach from a strawberry producer in Spain who had a prototype system needing further development. This very real gap in the market provided the impetus for the research partners to be drawn up, each with an ability to integrate their technological expertise with the specific needs of the horticultural sector.

With the use of methyl bromide in Europe set to end in 2005, this project could deliver an urgently needed solution to soil fumigation. In doing so, it must also tackle the problems of energy efficiency and cost effectiveness for producers, allowing them to embrace new environmental standards without compromising the viability of their businesses.

At the end of their research lies the prize of developing the successor to methyl bromide that gives European growers a competitive edge while delivering



"This project could go all the way to achieving a market launch for a new fumigation system and establishing intellectual property rights for the SME project partners."

new environmental benefits. The Co-operative Research project partners are striving to achieve the market launch of a viable fumigation system, giving each of the SME (small and medium-sized enterprise) partners intellectual property rights to a valuable commercial asset. As the market place for strawberries and other crops becomes more competitive, European growers need the confidence of knowing that their production systems are effective, efficient and safe.

While consumers are swayed by price, they also need solid reassurances about the safety of production methods and their impact on the world they live in. Today, new technology must address issues of efficiency and safety and the Microdis project illustrates this well in its broad range of goals and its diverse partners. This practical combination could secure the future of European growers well beyond the methyl bromide era and ensure that European consumers can enjoy competitively priced products supplied by sound environmental systems.

Project title

Soil disinfestation microwave system as an alternative to methyl bromide (MICRODIS)

Contract number

CT-2004-508465

Duration

24 months

Global project cost

€ 1 569 814

EC contribution

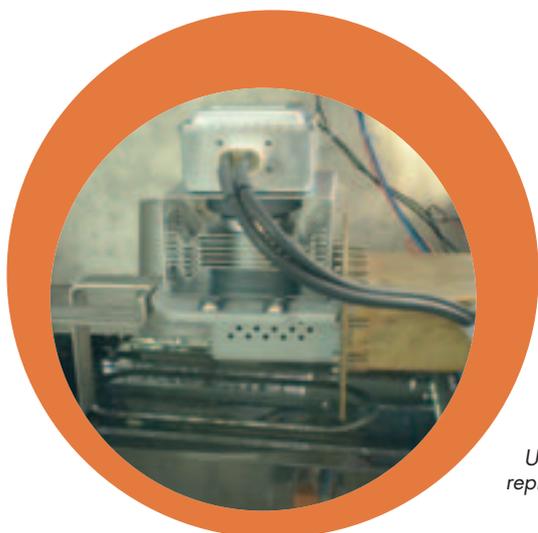
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Using microwaves to replace methyl bromide.

“A integrated multisolar system is the ultimate brickstone of the 21st century.”

Photovoltaic cells (PV) are an increasingly popular power source for buildings. But they suffer from one major drawback: as they heat up in the sun their efficiency drops. A design patented by an Israeli SME uses water and air to cool the PV panels and maintain their yield, whilst simultaneously producing hot water and enough thermal energy to run air-conditioning or for heating, depending on the season.

The Multisolar Co-operative Research project is bringing together the expertise of other European SMEs and research organisations to integrate this technology into building structures. The integrated products will save on construction materials and provide a complete solar system that is up to 85% efficient.

Just like most people, photovoltaic (PV) cells struggle in the heat. The hotter they get, the less efficient they become. In southern Europe, for example, an outdoor PV may only reach half of its maximum efficiency during the hottest part of the day in summer.

Millennium Electric, a small Israeli firm, has patented an elegant system that keeps PVs working hard whatever the weather. Cold water and air pass through pipes behind the PV panels and take away the heat. The cooled panels maintain their electrical output, but the extracted heat does not go to waste – it is used to supply the building with hot water and hot air. Overall, this “triple energy” system can be up to 85% efficient.

There are over 100 of these multisolar systems installed as standalone products across the globe, but Millennium Electric wanted to develop the product further. Specifically, the company wanted to integrate its technology into building structures, even replacing roofs or façades with functional yet structurally and aesthetically acceptable solar systems.

Sunny prospect

This adaptation of the multisolar technology is the primary aim of Multisolar, a Co-operative Research project that combines expertise from a range of SMEs (small and medium-sized enterprises) and research institutions from across Europe. Millennium Electric is leading the consortium which also includes an Italian electronics firm, a Spanish ceramic roof tile producer, and two manufacturers and installers of renewable energy systems from Germany and Bulgaria. Together, these firms will investigate how to integrate a modular multisolar system and its controls into the very fabric of a building.

These SMEs are working closely with three research institutes. The Department of Building Constructions at the University of Seville is providing architectural support to the partners, working on designs and material specifications. The Technical University of Denmark, meanwhile, is investigating different ways to incorporate and use the hot water, hot air and electrical outputs of the system within the building. Umwelt, the project’s third RTD performer, is largely responsible for monitoring and analysing the performance of the prototype technologies within the building over a 12-month trial operational period.

As the existing standalone multisolar system is already tried and tested, this project is largely based ‘in the field’. The consortium has selected a building near Bremerhaven, Germany, in which to try out their novel products. The building is in an area where numerous PV systems are currently being showcased, so the project should benefit from a high profile and good publicity.

Markets warming up

If the integrated PV panels approach the 85% efficiency of the standalone multisolar devices, the partners expect to capture a significant proportion of the market for renewable energy systems. They say that the triple energy approach means that buildings can generate electricity (which could be sold back to the grid) and deliver heat and hot water free of charge. Moreover, the combination system would cost only three-quarters of the sum of separate solar thermal and PV module costs. Finally, a system integrated into roof and façade tiles will allow customers to save on resources and the cost of construction materials.

In Europe, Germany, Italy and Spain are probably the markets with the most potential. Elsewhere, Japan and the US both have large, clean energy initiatives and strong incentives for people to purchase renewable energy systems, thereby offering a large export market for the Multisolar system. Thus, by working together the five SMEs in the project all have an opportunity to expand their businesses



"The Multisolar project is a great way for the SMEs to expand their business financially and geographically."

financially and geographically. Millennium Electric, Cerámica Vereá and Maniero Elettronica will all manufacture components of the integrated system. Having gained valuable experience in the product's production, installation and servicing, Ad Fontes and Apex will be well placed to sell the system to clients in their respective markets.

But it is not just the SMEs and their direct customers who stand to gain. Europe is committed to reducing emissions of greenhouse gases, lowering energy consumption in buildings and making renewable energy account for 12% of consumption by 2010. By making it easier for buildings to harness the power of the sun efficiently, the integrated Multisolar system will play its part in reducing Europe's reliance on energy from fossil fuels.

Project title

Development of an Integrated Solar System for Buildings (MULTISOLAR)

Contract number

CT-2004-508439

Duration

24 months

Global project cost

€ 950 029

EC contribution

€ 599 000

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"It is very innovative to apply the technology in this way, and the initial results are very promising."

Surgical implants are a growing part of routine medical care. The Newtresi partners are working to improve the efficiency and lifespan of specific types of implants by developing innovative thin-film coatings. The specialised coatings protect the implants from biological fluids and promote their integration into the body's tissues. The five Co-operative Research SME (small and medium-sized enterprise) partners hope to gain a significant commercial advantage in a global market, assisted by research partners who provide the academic insight and sophisticated equipment required. Patients will gain improved quality of life, and healthcare providers should benefit from the savings achieved by increased implant lifespan and reduced complications.

Increasing numbers of European citizens are benefiting from specialised surgical implants, designed to correct many medical conditions including hearing problems, dental decay and joint degeneration. Placing non-biological components into the body poses many challenges, however, including the need to avoid rejection and corrosion and to promote successful integration into the living tissue. The Newtresi project is working towards improved coatings for a specialised range of implants, which will improve European healthcare while providing a good commercial opportunity for the SME partners involved.

Building a barrier

One focus for the partners' efforts are the intracochlear implants that can restore partial hearing to profoundly deaf people. These microelectronic devices are implanted deep in the inner ear. A tiny microphone detects incoming sounds, which are converted by the device into electronic signals delivered directly to surrounding nerve fibres. The ceramic casing currently used for these implants is too thick for optimum performance. The project partners are replacing the ceramic case with a thinner multi-layer coating that has the necessary electrical properties and also forms a barrier against the penetration of water and body fluids.

Another target for the project is the range of dental and orthopaedic prosthesis based on titanium. Improvements on existing coatings would promote faster integration into the bone tissue, allow rejection to be avoided during an implant lifetime of more than 20 years, while also providing a barrier to fluid penetration.

Two highly specialised technologies are being used to apply the innovative coatings, known as Ion Plating Plasma Assisted (IPPA) and High Density Plasma Enhanced Chemical Vapour Deposition Plasma Assisted (HDPECVD). Essentially, these techniques involve particles in the gas phase being deposited on to the materials being coated, building up the coating layer by layer with great consistency and control. Some of the coatings are composed of a mixture of titanium carbide and titanium oxide. Others use silicon carbide, aluminium oxide and silicon oxycarbide. The procedures provide fine control over the precise roughness of the substrate and texture of the coating, which is critical in achieving the best performance. They also allow a very adherent, dense and compact coating to be produced.

A partnership of specialists

The project consortium is composed of five SMEs and five research and technological development (RTD) partners. The RTD partners consist of two university research laboratories (the universities of Innsbruck, Austria, and Uppsala, Sweden) and three specialised research organisations (Biophy of France, Ionbond of the UK and Romani Film Sottili of Italy). The university partners can offer some of the best expertise in Europe in the field of deposition technology. Biophy specialises in characterising the types of thin-film coatings being developed by the project. Romana Film Sottili and Ionbond have critical expertise in coating technologies. Working together, the RTD partners have all the necessary research skills and technological expertise required to produce and test the innovative coatings for medical applications.

The SMEs are a range of specialist producers and technical service providers. Assing of Italy produces a range of high-tech scientific instruments. Campus Micro Technologies of Germany make medical sensor equipment. Or-Vit of Italy produces dental and orthopaedic implants. Hipot of Slovenia are experts in the development of micro pressure sensors, and Coating Plasma Industrie in France provides plasma coating services. These SMEs all have much to gain by participating in a project developing new coatings for medical appliances and prosthesis. They expect to draw commercial advantage by applying specific aspects of the new technology to their highly specialised markets.



"The SMEs can see the commercial potential, but they are not equipped with the necessary deposition technology so they must work with the larger partners."

Promising indications

Initial results obtained by the partners are very promising. A crucial part of the work is to comprehensively test such features as the impermeability, durability and biocompatibility of the new coatings. As the partners hoped, the deposition techniques do appear to be creating high-quality impermeable coatings more compatible with the body's internal environment than existing materials. Analysis clearly shows, for example, improved integration into surrounding bone with the bone growing faster on the new treated surfaces.

The market for improved medical implants is a global one. A successful Newtresi project can be expected to increase European competitiveness in this market, in addition to the medical benefits for recipients of the implants and increase in efficiency for healthcare providers.

Project title

New treatments for surgical implants (NEWTRESI)

Contract number

CT-2004-508344

Duration

24 months

Global project cost

€ 1 874 000

EC contribution

€ 962 000

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"This is the first time that these two technologies have been combined in a high-temperature and high-corrosion environment."

As more waste and biomass is incinerated, new technologies are desirable to improve the combustion process. The Procomo project from Co-operative Research is developing new and more resilient boiler coatings that incorporate temperature-monitoring optical fibres. The project consortium consists of two research institutes and five companies that specialise in thermal spray coating and distributed temperature sensing. The technological innovation will enable boilers to better withstand the complex combustion processes arising from waste and biomass fuels. Boiler life will be extended, while combustion will proceed more efficiently and with the emission of fewer pollutants.

Incineration is becoming an increasingly important method of waste disposal and a means of generating energy. Waste incineration eases the pressure on landfills, while the combustion of biomass will make Europe less dependent on imported and non-renewable fossil fuels. New applications, however, make new demands on the boilers used for incineration. The burning of mixed fuels, including waste and biomass, produces more complex combustion processes than the burning of traditional fuels. These processes are harder to control and require more accurate temperature monitoring. In addition, they result in greater wear and corrosion, resulting in shorter boiler component lifespan. There is therefore a need for advances in combustion technology, especially in the areas of resilient coatings and the accurate control of the burning process.

Combining technologies

The Procomo project, which started in September 2004 and runs until August 2006, addresses this need. The main innovation is to combine two technological areas: innovative coating materials and temperature monitoring using optical fibres. "As far as we know, this is the first time that these two technologies have been combined in a high-temperature and high-corrosion environment," says Maria Oksa of VTT Technical Research Centre of Finland. The Co-operative Research project consortium aims to develop novel protective coatings that incorporate state-of-the-art temperature sensors.

The Procomo consortium consists of five small and medium-sized enterprises (SMEs) and two research and technological development (RTD) partners. The coordinating partner, VTT Technical Research Centre of Finland, is conducting tests on coatings and optical fibres. The Netherlands Organisation for Applied Scientific Research is working on analysis software and connecting systems for boilers with the new coating technology. The SMEs offer complementary expertise in thermal spray coatings and optical fibre technology.

Thermal spray coatings

Thermal spraying is a process by which a coating is deposited on to a surface to protect it against wear and corrosion. Fine particles of coating material are injected into a heated gas stream and deposited at high velocity on to a surface in a dense homogeneous

layer. The Procomo project is developing new and highly resilient thermal spray coatings for boilers.

Durum (Germany) manufactures powders and other raw materials for coatings. Within the project, Durum is experimenting with new material combinations that resist corrosion. PikoBlade (Finland) and Flame Spray (Italy) are thermal spraying specialists. They work with many industrial applications of thermal spraying, and will develop and test a range of new coatings for boilers.

Fibre optics

Optical fibres offer unique advantages for spatially distributed temperature measurement. A network of very small optical fibres can be embedded within a coating material to enable temperatures to be accurately recorded. ART Photonics (Germany) produces optical fibres and offers a wealth of information and experience in this field. Hitele Systems (UK) makes distributed temperature sensing (DTS) equipment. They are manufacturing a device, to be used in conjunction with optical fibres, to measure temperature within boilers.

"The fibre optics are very small, about 100-125 μm in diameter," explains Dr Oksa. "Around a couple of hundred metres of optical fibre will be present in a boiler coating." Although distributed throughout the internal coating, the technology will enable temperature readings to be focused on particular areas of the boiler, where temperature is most critical for the combustion process.



"The innovation in design will enable boilers to be used more safely and more efficiently, with fewer emissions due to cleaner combustion, and a longer lifetime for components."

Market potential

The market for the new boiler coatings will be large. "The coatings can be used when repairing old boilers, as well as on new boilers," says Dr Oksa. Meanwhile, new EU legislation requires that more waste is incinerated, and more biomass is burnt to generate energy, creating demand for new boilers. The new temperature-monitoring coatings will help to lessen the effects of the harsh conditions inherent in waste and biomass combustion. Furthermore, the greater control over combustion through temperature monitoring will lower levels of polluting emissions being released into the environment.

The new coatings will therefore have wide application in incineration systems and will provide a number of important benefits. Dr Oksa concludes: "The innovation in design will enable boilers to be used more safely and more efficiently, with fewer emissions due to cleaner combustion, and a longer lifetime for components."

Project title

Protective coatings with combined monitoring system to control process conditions in boilers (PROCOMO)

Contract number

CT-2004-513023

Duration

24 months

Global project cost

€ 1 127 775

EC contribution

€ 584 338

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“The digital radiographic technique will be safer, easier and quicker.”

The safe and effective inspection of refineries, chemical plants and transmission pipelines is a vital service for modern society. The Safe-Ray project from Co-operative Research aims to bring the advantages of digital technology to X-ray inspection of pipework, joints and welds that will speed up the inspection process, and make it safer at the same time, by reducing costs and production downtime. The technique will also be applicable to the ‘in-line’ inspection of welds and castings in sectors such as the aerospace and automotive industries, enabling significant savings that will mark a step change in manufacturing. The potential market for the services of this new European technology is considerable.

The complex economic infrastructure of the European Community includes over 110 hydrocarbon refineries, 400 chemical plants and an estimated 10 million kilometres of interconnecting transmission pipelines carrying vital fuels and other fluids. There are also an estimated 200 offshore oil and gas production installations operating within European waters with thousands of kilometres of critical ‘topside’ pipework. To ensure the continuous and safe operation of these vital arteries of modern society, rigorous testing is necessary that minimises downtime and does not compromise the integrity of the pipes or other structures involved.

Almost half of the pipework is directly accessible for non-destructive testing (NDT) and inspection. Currently, X-ray imaging (radiography) of welds and joints is a common technique to assess the safety status of an installation and is also used to assess the integrity of castings and welds in many other industries. Here, inspection using film radiography is ‘off-line’ of the casting production process. Digital direct radiography would significantly reduce the inspection cycle inspection time by allowing the ‘in-line’ radiography.

Conventional radiography requires a fine-grain X-ray sensitive film to be brought into contact with pipework together with a high-power X-ray source. This film approach has high resolution and good contrast, which make it ideal for revealing very small defects such as cracks. However, it suffers from a number of drawbacks. In particular, large amounts of radiation and long exposure times are needed to fully expose the film. This has implications for production time and cost as well as for the health and safety of operators.

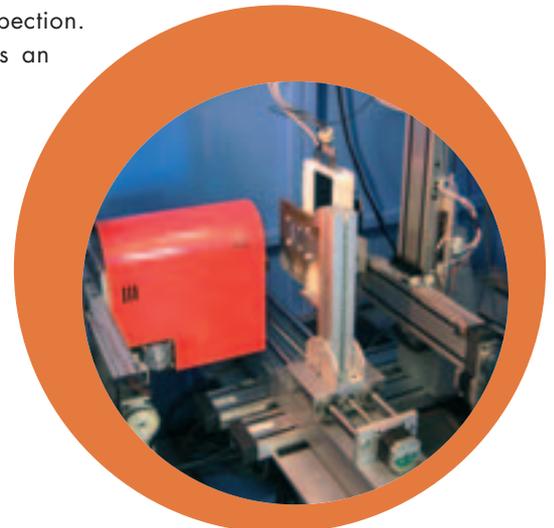
Digital challenge

The Safe-Ray project from Co-operative Research aims to develop a new radiographic technique based on digital technology for inspections that will be safer, faster and more economical for *in situ* operation. Digital images have the inherent advantages of being easily shared, processed and communicated. In addition, the amount of radiation needed to obtain an image using digital radiography is less than 4% of that needed for films and, typically, the exposure time required is less than 10%, significantly reducing operator exposure.

There are a number of challenges facing Safe-Ray in its quest to boost the performance of digital systems to match the resolution and contrast offered by current film technology. In particular, the new system needs to be able to easily image defects of the order of tens of microns (10-6m). To bring the digital technology up to speed, Safe-Ray will be developing digital radiographic hardware with improved performance, in particular direct-direct digital detectors to enhance contrast and sharpness, and using a radiographic technique called projection magnification to increase the resolution of the final image. The project will also develop automated defect recognition (ADR) for use with castings and welds – a task that is considerably easier using a digital technique.

Experts, users and service providers

The Safe-ray consortium includes experts in radiography, critical equipment suppliers, NDT service providers and a selection of end-user companies. TWI is joined by the UK’s NDT Consultants and Germany’s Forschungszentrum Juelich as the main R&D resources with Computerised Information Technology Ltd of the UK, Balteau NDT of Belgium and Oy Ajat of Finland providing integration software, a compact X-ray generator and the critical X-ray detectors, respectively. Trueflaw Ltd of Finland will provide metal artefacts with extremely well-characterised cracks in order to help assess the new technology. ATG SRO of the Czech Republic and Tecnitest Ingenieros of Spain are SME specialists which are involved in pipework inspection. Airbus UK has an obvious need



The Safe-ray development rig.

"The European market for the services of this inspection technology is around € 500 million a year."

for fast and effective inspection of welded joints, as does ZF Lemforder which is a major player in the metal vehicle components sector. Advantica, also of the UK, has a significant interest in global pipeline inspection technology. Mach-Ten Limited, the final project partner, is one of the UK's leading offshore installation inspection companies working with oil and gas facilities in the North Sea.

The consortium intends to produce a cabinet-based digital radiographic system that will meet the stringent defect detectability requirements of the petrochemical, aerospace and automotive industries. Success will bring a step change in the use of in-line and on-site radiography bringing safety, environmental and economics benefits that will be compelling for end-users. The European market for in-service inspection for pipeline/pipework in the oil and gas and petrochemical industries, together with the precision casting inspection market place for the aerospace and automotive industry, is at least € 500 million per annum.

Project title

Development of digital radiography techniques, sensors and systems to replace film radiography for defect detection in safety critical welds and castings (SAFE-RAY)

Contract number

CT-2004-512986

Duration

24 months

Global project cost

€ 1 909 500

EC contribution

€ 1 026 548

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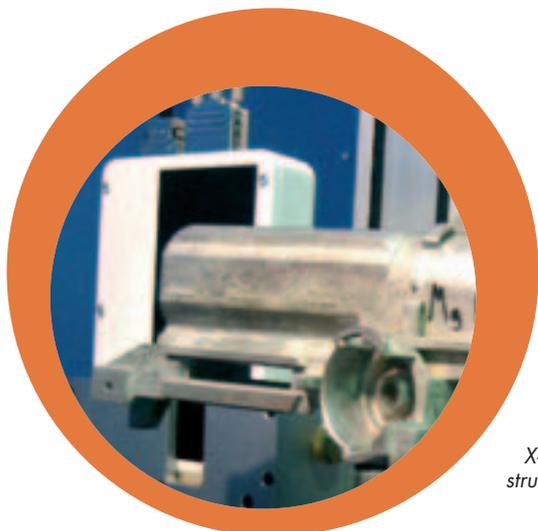
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X-rays reveal the internal structure of a casting.



“This project will produce a unique, marketable, software that will increase the competitiveness of the participating SMEs.”

Leaks from Europe’s sewer systems can pollute urban groundwater. At the same time, infiltrating groundwater can wreak havoc in these sewer networks, which are among the world’s oldest. As wastewater utilities work to comply with European Union standards aimed at ensuring the water-tightness of sewage systems, engineers at these companies, as well as the small and medium-sized enterprises (SMEs) that work with them, are hampered by inadequate software tools for assessing data supplied by closed circuit television (CCTV) inspections of sewers. The seven partners from five countries of the Co-operative Research Sewerinspect project plan to develop an advanced, computer-based tool that enables water-utility engineers to better plan sewer rehabilitation projects, based on the results of CCTV inspections.

Europe’s sewer networks are crucial to the health and economy of its cities. Among the world’s oldest, many of these European systems have components aged over 100 years old. They require constant attention to keep them effectively and efficiently transporting and treating residential, business and storm-water waste. Until the mid-1990s, European Union regulation of these systems mostly focused on major structural defects. However, it does not take a big pipe break to cause serious problems. As sewer networks age, groundwater can seep in, eventually overloading collection systems and treatment plants. Wastewater seeping out from sewers can contribute to urban groundwater pollution.

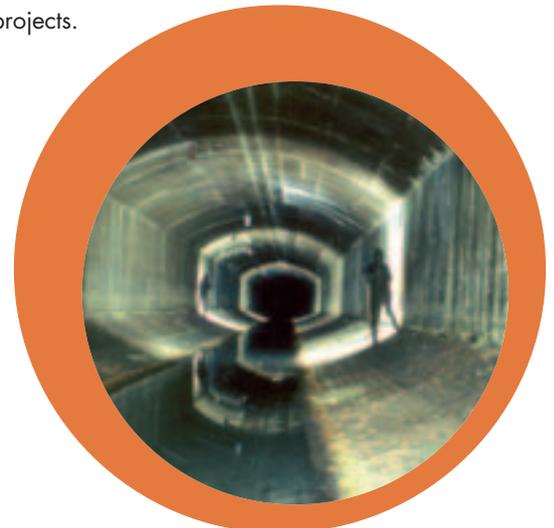
The EU Standard EN 752-2 of 1995 and the EU Wastewater Directive stressed the structural integrity and water-tightness of Europe’s urban sewer systems, in particular for protecting groundwater. Wastewater utilities are still working to meet these standards. To monitor sewer networks for problems, most of these companies rely on CCTV inspections, the neural network of which was refined in the RESEW Growth project. The problem is that currently available software applications for interpreting CCTV images provide little more than crudely filtered data, so engineers often have to make important decisions about renovating sewers without having all the facts. This can lead to errors, costing money and time. Coordinated by the Italian engineering company TECNIC Consulting Engineers S.p.A., the Co-operative Research Sewerinspect project is aimed at developing a computer-based system that evaluates CCTV inspection data to give engineers much useful information on which to base their decisions on rehabilitating or renovating sewers.

Sewerinspect’s seven partners from five countries include the Civil Engineering Department of Istanbul Technical University, and the Sewerage Board of Limassol Amathus in Cyprus. SME partners include Optimes GmbH, a German CCTV equipment manufacturer and developer and distributor of sewer-evaluation software. The British company General Underground Services provides CCTV sewer inspection and “NO-DIG” pipeline rehabilitation skills. The Cypriot company A Tsouloftas & Sons specialises in CCTV sewer inspection, drain cleaning and repairs.

From images to action

Sewerinspect will develop an integrated decision-support-system (DSS) that resolves the key problem of how to translate findings from CCTV sewer surveys into an action programme for maintenance. The computer system will archive digital CCTV inspection tapes and related findings into a searchable database. A water-utility engineer will be able to access the system’s easy-to-use graphical interface to call up findings about a particular section of the sewer network. With help from the German software house RISA GmbH, which specialises in probabilistic safety analyses and Bayesian techniques, Sewerinspect will develop probabilistic models that assess structural factors such as pipe material and estimated wall thickness and loading factors, for example, seismic forces both vertical and parallel to the sewer’s axis. They will examine deterioration caused by such mechanisms as voiding of the soil bedding and backfill that supports pipes, effects of corrosive soils, industrial wastes and groundwater, and sulphide formation in wastewater flow. Based on these models, the DSS will present onscreen reports and graphical representations that help engineers predict a sewer section’s structural reliability and life expectancy.

When a problem such as blockage is found, or in case of failure, the DSS will provide objective information to help engineers choose the best remedial measures and prioritise rehabilitation projects, based on how critical a particular section of sewer is. Finally, the DSS will schedule re-inspection by CCTV, to gauge the success of previous decisions and projects.



"Sewerinspect will provide a new product for sewer inspection that will permit a detailed structural assessment of the damaged sewers, helping achieve compliance with EU Standard EN 752-2 and protecting the groundwater."

More cost-effective use of engineers' time

Through automation and reproducibility, Sewerinspect will enable detailed structural assessments of damaged sewers. It will help cities protect their groundwater and save engineering time, as it improves efficient use of capital expenditures, bringing down labour expenses, and promoting pipeline longevity and reliability. The project's SME partners will get at least two new ways to improve their revenues, using the system to offer new, more effective and higher quality sewer-assessment services to water-utility companies, and selling the DSS in Europe and worldwide.

Project title

Integrated system for structural assessment and upgrading of sewers based on input from CCTV inspection (SEWERINSPECT)

Contract Number

CT-2004-512540

Duration

24 months

Global Project cost

€ 1 494 656

EC Contribution

€ 829 866

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“The Socold project perfectly fits in with Europe’s strategy to boost renewable energy.”

The heat of the sun can be put to many uses – and can even keep things cool. A number of solar air-conditioning and refrigeration systems are commercially available, but the equipment is large, sophisticated and expensive. The Socold project aims to make solar cooling available for households and small businesses. By using highly efficient solar collectors with a relatively simple solid adsorption system, the Co-operative Research project partners expect to develop an affordable device with around one-tenth of the power of current solar cooling systems. The participants also hope to open up the large market for environmentally friendlier cooling and refrigeration in Europe’s homes and offices.

When you turn your head to the sun and feel its heat on your face it is hard to believe that the same heat can be used to cool things down. But that is exactly how solar air-conditioning and refrigeration work.

First, the warm air from a building or the interior of a refrigeration unit evaporates a coolant liquid, transferring the heat energy out of the air to the coolant vapour. The vapour then attaches itself to a solid, porous material (adsorption) or is taken up by a liquid (absorption), releasing heat in the process. Eventually, the sorbent material becomes saturated and has to be dried out, or desorbed, using the heat collected from the sun. The coolant vapour is released, condensed and fed back to the evaporator where the cycle begins again.

Whilst solar cooling is based on simple thermodynamics, the systems currently on the market are large and expensive, with sophisticated controls. They are only suitable for large buildings like office blocks and factories.

Warming up

The Socold project has been established to develop solar cooling technologies that can be adapted to the needs and budgets of smaller businesses and households. The idea is to produce a scaled-down solid adsorption device that is just one-tenth of the power of existing systems. The Co-operative Research consortium combines the knowledge and experience of SMEs (small and medium-sized enterprises) which manufacture solar collectors, gas equipment, and thermal chillers along with installers and potential end-users of solar cooling technologies. These firms are joined by scientists and engineers from research institutions in Austria, France and Germany.

The Socold partners are willing to attempt their pioneering research because they have access to a novel, high-temperature solar collector. Solarfocus, a small Austrian manufacturer of renewable energy systems, is making available its compound parabolic collector (CPC). This technology, developed in a previous EU CRAFT project, is capable of efficiently capturing solar energy and delivering temperatures of around 120°C for the dehumidification of the sorbent material.

The project is split into two elements. An air-conditioning (AC) strand, led by the German research organisation Fraunhofer Gesellschaft, is assessing and characterising the adsorption process using water as the coolant fluid and silica gel as the adsorbent material. The aim is to cool air down to 18°C.

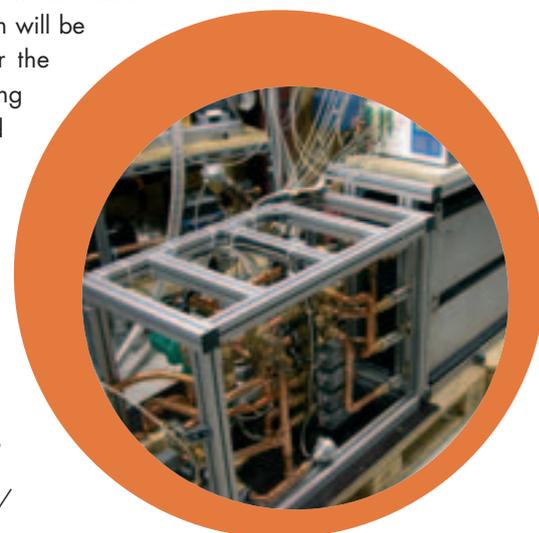
Meanwhile, the FROST strand of the project is investigating the feasibility of solar refrigeration, using pure methanol as the coolant and activated carbon as the adsorbent. The French Conservatoire National des Arts et Métiers is conducting experiments to see whether it is possible to use this combination to bring temperatures down to -20°C, cold enough for food preservation. This part of the project marks the first attempt to use solar thermal energy for sub-zero cooling applications using adsorption technology.

Hot technology

The results of these laboratory analyses will be considered alongside end-user requirements collected by Solarfocus and the firm’s distributor in Spain, Altersun. Product specifications will be agreed and Sortech AG and Indutherm S.L. will build two prototype systems. The prototype AC system will be installed at Intiam Ruai’s premises. This SME provides training for solar energy engineers in Spain and will benefit from its early involvement with the Socold system. The FROST system will be installed at the facilities of the Asturian Research Association for the meat industry and to help the association show its support for renewable energy. Altersun will be responsible for the long-term testing of the adapted solar collectors and the integrated cooling systems.

Adsorption chiller/heat pump prototype developed by the SorTech AG.

© Fraunhofer ISE/SorTech AG



"We have built an efficient team from a heterogeneous consortium, and the participants show a good measure of élan and motivation."

One of the most important measures of performance will be the systems' energy management profiles. Regardless of the economics, solar cooling systems are only worthwhile if they can demonstrate their favourable use of energy (during their manufacture, installation and operation) compared to more traditional refrigeration technologies. Profactor will offer its experience of alternative refrigeration systems gained through its participation in other research projects, and use a developmental energy management tool to assess how Socold compares with other cooling devices.

If the Socold system proves economically and environmentally competitive, the participating SMEs anticipate a significant demand for the technology, especially among homeowners and small businesses in southern Europe. Climate change coupled with mounting pressure to use renewable energy wherever possible could make solar cooling and the Socold system a really hot technology.

Project title

Development and implementation of a cost effective adsorption refrigeration system utilising high temperature (120°C) solar Compound Parabolic Collectors (SOCOLD)

Contract number

CT-2004-508462

Duration

24 months

Global project cost

€ 1 753 625

EC contribution

€ 1 013 510

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"This is the first practical mass-production technique for nanoscale structures."

3D Nanoprint is developing the tools and techniques needed to create three-dimensional layered nanoscale structures, based on the technique known as nanoimprint lithography. The Co-operative Research project partners will demonstrate their new process by using it to make 3D photonic crystals for use in optical-fibre communications, although the technology has many other applications in electronic components, circuits and devices. Even though the technique can be used for mass production, European SMEs which want to produce prototypes and small production runs of innovative electronic devices will also benefit from this exciting new technology.

Nanoimprint lithography (NIL) is a fast, flexible and low-cost way of making nanostructures – patterns with features down to 10 nm in size – by stamping or printing special liquid polymers on to a solid substrate. NIL combines two characteristics of importance to the semiconductor industry: high speed and high resolution.

Optical lithography, the process currently used to make semiconductor chips, is quick because it produces a complete pattern in a single step, although current systems struggle to create features smaller than 70 nm. Another process, electron beam (EB) lithography, works down to 10 nm, but is slow because it draws patterns one line at a time.

NIL combines the speed of optical lithography with the resolution of EB lithography, making it possible to mass produce nanoscale structures. It also has low capital costs which make it particularly interesting to SMEs (small and medium-sized enterprises). Compared to the € 25 million or so needed for an optical lithography plant, the cost of UV-NIL equipment is lower by a factor of 25 to 100, depending on the degree of automation required.

Although it is possible to make useful products based on single-layer patterns, most electronic and other devices contain multiple layers. "NIL is a very promising technique, but so far it has been used to create single layers," says Dr Michael Mühlberger, of Austrian research organisation Profactor Produktionsforschungs. "In 3D Nanoprint, we plan to make structures of up to five layers."

Polished performance

As a demonstration product, the project team chose to make photonic crystals, nanostructured optical devices used to control laser light in modern communication systems. "Photonic crystals are not the focus of the project, but they are a good choice because they are very sensitive to the quality of the manufacturing process," says Dr Mühlberger. Other applications may include microprocessors, organic thin-film transistors, and micro-electromechanical (MEMS) devices.

Like other nano-fabrication processes, NIL involves several steps. The first is to use EB lithography to manufacture a stamp from silica, which is transparent to ultraviolet (UV) light. Next, the stamp is used to print a pattern of a special liquid polymer on to a substrate material, typically silicon. UV light is then used to harden the polymer, and the stamp is removed.

In the next step – reactive ion etching – the surface of the substrate that is not protected by the hardened polymer is attacked by a plasma, creating recessed areas. Once the polymer has been removed, the protected areas form the raised parts of the pattern. A final step may be to deposit a coating material over the surface, followed by polishing to remove the coating from everywhere except the recessed areas.

To make a multi-layer structure, the process is then repeated using a different pattern or a different orientation. For photonic crystals, for instance, the structure resembles a wood pile: layers of rods, each 200 nm wide, arranged alternately at right angles. The rods in the third layer are positioned above the inter-rod spaces in the first layer, and correspondingly for the other layers.

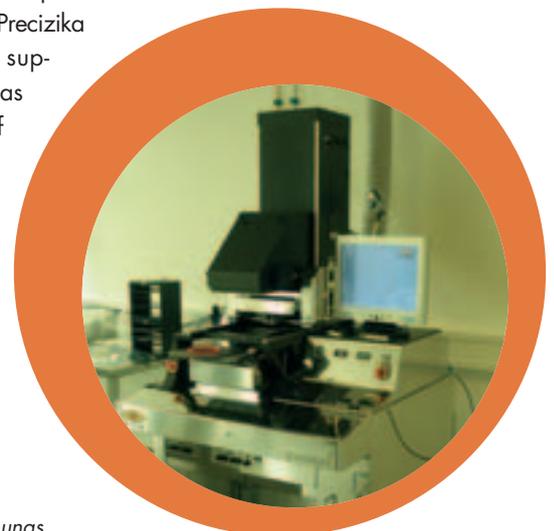
Partners, progress and prospects

Profactor, the Co-operative Research project coordinator, has assembled a well-balanced team of SMEs and researchers. Another Austrian firm, EVG, manufactures nanoimprinting equipment. German company Sentech Instruments makes the reactive ion etching equipment, with research support from Friedrich Schiller University of Jena. Microresist Technology, also from Germany, specialises in etch-resist coatings.

In addition, there are several end-user firms and academic partners. Brown&Sharpe Precizika of Lithuania, supported by Kaunas University of Technology, makes optical

The EVG nanoimprinting equipment installed in the cleanroom at Profactor.

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"This is a very challenging project, so we need the best people from all over Europe."

encoders and alignment systems that could be used in the project, as well as being potential end-users in their own right. Finnish company Heptagon manufactures photonics devices, while Johannes Kepler University of Linz specialises in photonics research.

"This is a very challenging project, so we need the best people from all over Europe," says Dr Mühlberger. "We have to solve the problems of stamping, alignment, reactive ion etching and etch resists, to create a reliable 3D NIL process. We will also define the requirements for NIL as a practical production tool."

"I'm not sure that the semiconductor industry will adopt NIL," says Dr Mühlberger. "There's no technical reason why they shouldn't, but they are very conservative. Everyone else, however – and especially SMEs – will have access to a cost-effective, high-throughput, ultra-precise tool for 3D nanostructures. I expect to see a commercial process in six to 12 months after the end of the project. We need to keep up with the USA and Japan."

Project title

Nanoimprint Lithography for Novel 2- and 3- dimensional Nanostructures (3D NANOPRINT)

Project Number

CT-2004-512667

Duration

24 months

Project cost

€ 1 393 229

EC Contribution

€ 967 980

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- 7 Sentech Instruments GmbH (DE)
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- 9 Kaunas University of Technology Institute of Physical Electronics (LT)



*3D nanoprint coordinator
Dr Michael Mühlberger
shows off the EVG nanoimprinting
equipment installed in the cleanroom
at Profactor.*

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A blast from the past – the true sound of organ music

TRUESOUND

“Organs less than 100 years old have a completely different sound from older organs.”

Organs dating from the mediaeval or Baroque periods rarely produce authentic sound if they have been repaired or restored with modern materials. In the Truesound Co-operative Research Project, four research centres are analysing the brass reed tongues from historical organs all over Europe. Working with organ builders from five countries, they intend to formulate a range of alloys that will allow craftsmen to recreate the original sound of the organ. Church organs in Latvia and Lithuania will be the first to benefit from the new alloys and there is expected to be a healthy market for the repair and construction of organs both in Europe and overseas.

The organ music of Bach is regarded as being among the most inspirational ever written. But can we be sure that we are hearing it as Johann Sebastian intended? Many organs from the mediaeval and Baroque periods survive all over Europe but they have been repaired over the centuries. Organ-makers know that an organ repaired with modern materials, no matter how carefully, just does not sound the same. Is it possible to recreate the authentic sound of historical organs?

That was the question the Truesound Co-operative Research project was designed to answer. The initiative came from the Göteborg Organ Art Center (GOArt) an international centre at Göteborg University, Sweden, for research into all aspects of the organ. They had just completed an ambitious 11-year project to construct a new, 4 000-pipe Baroque organ of the type built in North Germany around 1700. Part of the work involved reproducing the alloys of lead and tin that would have been used to make the pipes in an organ of that era. That was so successful that they wanted to take the work further.

Flue pipes and reed pipes

Organs have two kinds of pipe. Most of them are so-called flue pipes, which have no moving parts and produce the note in the same way as a whistle. The remaining 10-20% of the pipes in an organ use reeds to generate the sound. These consist of a brass ‘tongue’ which vibrates when air is passed over it, producing a broad spectrum of vibrations which are then shaped by the pipe to generate a distinct note and overtones. Over the years, the reed tongues in many historical organs have been replaced with modern substitutes, but somehow the sound is not the same. The composition and manufacturing processes for the tongues are crucial, it seems, to the sound of the organ.

Truesound began by investigating the composition, microstructure and mechanical properties of surviving brass tongues with all the techniques available to modern analytical science. The work is being coordinated by the Max Planck Institute for Metals Research (MPI) in Stuttgart with the research being shared between the MPI, Chalmers University, Sweden, which has worked with GOArt on the North German organ, and the Università Politecnica delle Marche in Ancona, Italy. At the same time, the partners are

researching the historical methods used to make the tongues and how they influence the material properties and sound quality.

Organ-makers in the Netherlands, Sweden, Italy, Lithuania and Latvia – the SME partners – have been collecting examples of reed tongues for analysis. Other SMEs in Belgium, France, Germany, Spain and the UK have also been helping informally even though they are not members of the project.

Two historical organs

Mediaeval and Baroque reed tongues were made with whatever materials were available locally, with none of the consistency of modern industrial brasses. About 12 different alloys have been identified so far. Early results reveal that the brass used in the tongues is made from copper, zinc and lead, but with less zinc than is usual in modern brasses. It is not yet clear whether the presence of lead affects the sound or is just an impurity that was unavoidable at the time. The aim is to produce four to six different alloys that should be adequate substitutes for the 200-400-year-old materials used in organ pipes all over Europe.

In the first instance, materials and techniques developed in the Truesound project will contribute to the restoration of two historical organs. The first is likely to be the organ in Ugale, Latvia, where the local SME (small and medium-sized enterprise) partner, the Ugale Organbuilding Workshop, is already achieving good results with one of the alloys produced by



Reconstructed organs in Oergrite Nya kirka in Gothenburg, Sweden.

“Organ-builders have wanted this technology for many years.”

the project. That could be complete by the end of 2005. A bigger venture is the ongoing restoration of the Casparini organ in the Dominican church in Vilnius, dating from 1776, which is coordinated by GOArt and expected to be finished in 2006.

One outcome of the Truesound project is likely to be new business for the many European organ builders, some of which employ just one or two people. They have been asking for a long time for help with reproducing historical materials and will soon be able to assure customers that new or repaired Baroque organs will match the authentic sound of the period. The new alloy parts will be produced and supplied by the SME partners. Amounts will be small – a typical organ would need only a few kilograms of brass – but the market in Europe and around the world is large. The number of historically important organs in Europe has been estimated at 10 000 and all need to be maintained and sometimes repaired. There is a strong export market for new but historically authentic organs in countries like the USA, Korea and Japan with a new organ costing around € 1 million or more.

Project title

A challenge for materials science: Bringing true Baroque and medieval sound (Truesound)

Project Number

CT-2004-005876

Duration

24 months

Project cost

€ 1 038 764

EC Contribution

€ 618 764

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- 9 Ugale Organbuilding Workshop (LV)



*Collaborators of GOArt workshop
working with the sand-casted Sn-Pb
strips for organ pipes.*



“The primary objective is to maximise the production potential of turbot. By doing this, we will be able to increase production by up to 25-35%.”

Turbot is a high-value marine fish that has great potential as a land-based aquaculture species. Innovation is necessary, however, if European producers are to fully exploit this potential. The Turpro project from Co-operative Research aims to provide new information on optimal rearing conditions, especially in relation to temperature, photo-period and water quality. An understanding of the requirements of turbot under intensive rearing conditions will help raise yields and flesh quality. Improved processing methods are also being developed. The findings are being used to devise a strategy for the cost-effective production of turbot in European land-based aquaculture.

Land-based aquaculture is an increasingly important sector within the fisheries industry. There has been a move towards farming a greater diversity of marine fish species, including cod, halibut and sea bass. New species promote growth in the aquaculture sector, and address an increasing consumer demand for farmed fish. Turbot is a large marine flatfish that has great potential in land-based aquaculture. It is native to Europe, difficult to catch at sea, is esteemed for its flesh, and has a high market value. However, technological improvements are needed to exploit turbot's potential. Lower costs and higher yields will enable small and medium-sized enterprises (SMEs) to expand production and ensure that Europe remains a world leader in turbot farming.

The consortium

The Turpro project from Co-operative Enterprises is aiming to enhance productivity throughout the turbot production chain, from juvenile fish to the market. The key to successful turbot farming is a reliable year-round supply of intensively reared juveniles. To help achieve this, new knowledge is being obtained on the impact of environmental factors on growth rate, food conversion efficiency, and time to maturity. The project partners are also improving processing methods (e.g. slaughtering and storage). The information is being used to formulate an overall strategy for reducing production costs, while improving flesh quality and yields of turbot. “The primary objective is to maximise the production potential of turbot,” says Professor Albert Imsland of coordinating partner Akvaplan-niva. “By doing this, we will be able to increase production by up to 25-35%.”

Five SMEs and three RTD partners make up the Turpro consortium. Akvaplan-niva is the aquaculture research and consultancy firm managing the project. The Netherlands Institute for Fisheries Research (RIVO) and the Department of Fisheries and Marine Biology, University of Bergen, are the other two RTD partners. Llyn Aquaculture is a fish hatchery that designs water recirculation systems. Zeeland, A. Coelho e Castro (ACC), Sæbyli and Ecomares operate commercial turbot farms in the Netherlands, Portugal, Iceland and Germany, respectively. Collectively, the partners have the ideal research and development facilities to study the environmental manipulation of growth, and the processing of turbot for the market.

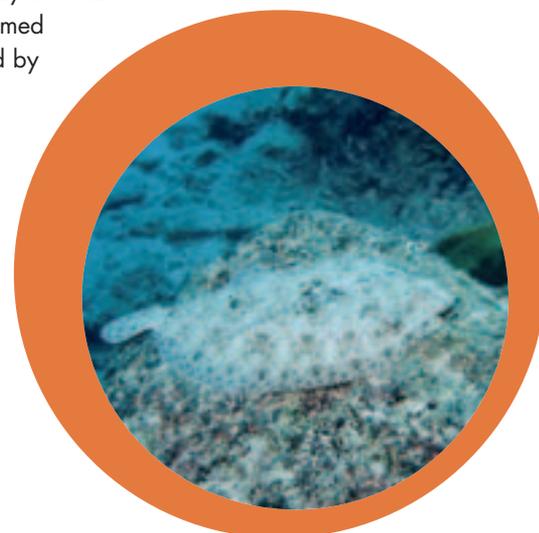
Photo-period, temperature and water quality

It is desirable to delay sexual maturity in turbot to maximise growth. Extending photo-period is a means of achieving this, and experiments are revealing appropriate photo-period regimes for controlling maturation. Temperature is an important factor determining turbot growth rates. Optimal temperatures for growth are being defined, while the benefits of using stepped temperature regimes instead of constant temperature regimes are being quantified. A new rearing regime that uses the temperature-step principle and delayed maturation could increase yields of turbot by around 20-30%. In addition, food conversion efficiency also increases, saving on food costs.

The benefits of environmental manipulation of fish growth, however, are reduced in systems with poor water quality. Maintaining water quality is essential in recirculation systems with high stocking densities. The project partners are identifying factors, such as levels of dissolved oxygen, which constrain optimal performance in turbot farms. The efficient recirculation of water conserves resources and reduces the discharge of organic waste from fish farms. “For turbot, water can be reused up to 20 times,” explains Professor Imsland. “The more water is reused, the better it is for the environmental impact.”

A growing market

Spain is currently the main producer of farmed turbot, followed by France and Portugal, but production is expanding



"The market potential for turbot is tremendous."

throughout Europe. New farms in Norway, for example, use heated industrial cooling water to save on energy costs. Nevertheless, the current production, nearing 7 000 tonnes annually, is still modest compared to consumer demand for high-quality farmed fish.

"The market potential for turbot is tremendous," says Professor Imsland. Although popular as a table fish in Spain and France, turbot is only just being discovered in Northern Europe. It attracts high prices and fish farmers can make good profits from it. "However, production costs are high for smaller European enterprises, and production in China is increasing very fast." Turpro is delivering a protocol, in the form of a practical manual, to reduce costs and increase productivity on turbot farms, in a sustainable and environmentally friendly manner. This will enable European SMEs to remain competitive, and will ensure that consumer demand for safe, healthy and high-quality turbot is satisfied.

Project title

Biological optimisation and development of processing methods for turbot farming (TURPRO)

Proposal Number

CT-2004-508070

Duration

24 months

Project cost

€ 1 500 000

EC Contribution

€ 750 000

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Close up picture of a turbot at one of the Turpro farms.

©Lars Olav Sparboe Akvaplan-niva, Norway



"We were attracted by this new technology because it used lasers and required no contact with the surface."

The growth of high-speed rail transport means that it is more important than ever to maintain tracks in good condition. Conventional rail-inspection systems rely on ultrasound technology to probe the rails for signs of cracking and other defects. While effective, they require physical contact with the rail and are slow and expensive to run. The U-RAIL Co-operative Research project brings together four SMEs (small and medium-sized enterprises), four research centres and four railway companies to develop a new laser-based technology that can detect defects faster and more reliably than conventional systems – and without touching the track.

Broken rails are a common cause of train derailments and can be disastrous on fast passenger routes. As high-speed rail networks spread across Europe, train operators have become more concerned about keeping the tracks in first-class condition.

Railway operators use ultrasound systems to detect defects in rails before they grow large enough to become dangerous. Ultrasound pulses are transmitted into the rail and the echoes received can reveal cracks or other defects within the metal. Though ultrasound systems are used worldwide and are the standard method for inspecting tracks, they suffer from several limitations.

Most importantly, there must be physical contact between the transducer – which transmits and receives the pulses – and the rail. Usually this is achieved by placing the transducer inside a rubber wheel filled with water. This need for contact slows down the speed at which the track can be inspected. Typical mainline routes in Europe can be covered at 50-60 kilometres per hour.

Ultrasound systems can probe the head of the rail and the supporting 'web' but cannot detect flaws in the base of the rail where it is attached to the sleepers. Neither are they effective within the top three millimetres of the rail where the echoes arrive too soon after the transmitted pulses. Indeed, defects close to the surface can mask more serious flaws deeper in the rail. Imperfect alignment of the rails can also affect the reliability of the survey as can the condition of the metal surface and the geometry and orientation of a defect.

No physical contact

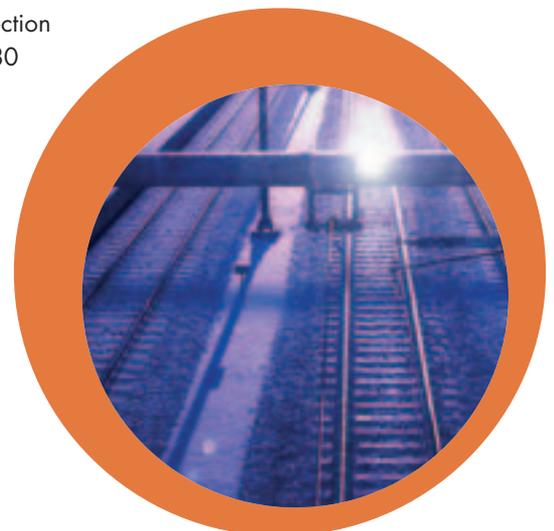
Partners in the U-RAIL Co-operative Research project are developing a new kind of track inspection system that overcomes many of these limitations. A powerful laser on the inspection vehicle directs a pulsed beam down on to the rail. Each pulse rapidly heats a small area of the surface causing a pulse of sound to travel into the rail, much like a blow from a hammer. A microphone behind the laser picks up the sound coming back from the rail. A defect will affect the shape of the pulse or block it altogether. The instrument is mounted at least five centimetres above the rail and requires no physical contact.

The project coordinator, Tecnogamma, is an Italian SME specialising in the industrial application of lasers and with long experience of European research projects. Quantel, a French SME, is developing the laser system, while Jenaer Messtechnik (Germany) and CM4 (Spain) are working on the control system that will ensure that the instrument accurately follows the top of the rail even where the alignment is less than perfect. They are supported by four research partners. Palermo University, Italy, is looking at the optimum configuration of the sensors, Trastec, Italy, is working with Tecnogamma on hardware and software support, the University of Liège, Belgium, is studying the effects of the laser on the rail, and ENEA, Italy, will evaluate the new system in comparison with the conventional ultrasound technology.

Trials with rail companies

A further four partners are potential end-users of the technology. They include Italian Railways, Eurotunnel and the underground railway operators in Paris and Athens. They have been advising on the technical specifications and will take part in field trials of the U-RAIL system.

The project SMEs, led by Tecnogamma, are already planning their marketing strategy and all expect to benefit when the new system is launched on the market towards the end of 2006. The world market for a better track inspection system is huge: in the USA alone one track inspection company has 80 vehicles. With high-speed rail routes being built in many



"This will change the way companies perform railway maintenance."

European countries, the need for frequent and reliable track testing is becoming more urgent. Operators of mineral railways, which often carry very large loads over relatively short lengths of track, are especially interested in the new system. Currently, they inspect tracks as frequently as once a week but this is expensive and they would like a more reliable technology.

Adoption of the U-RAIL system is likely to change the way railways are maintained. At present, due to the high number of false positive readings, potential defects detected by ultrasound surveys must be laboriously checked by maintenance teams to confirm that a defect exists and to decide what work needs to be done. The new system will be much more reliable as, for instance, analysis of the data is fast, automatic and does not require a skilled operator to interpret it. Defects found by the system are much more likely to be genuine, allowing better use of maintenance personnel. The new system will be able to probe the base of the rail as well as the head and is expected to detect defects earlier, reducing the need for emergency engineering work.

Project title

Non-contact ultrasonic system for rail track inspection (U-RAIL)

Project Number

CT-2004-507622

Project cost

€ 1 453 496

EC Contribution

€ 1 044 428

Duration

24 months

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Example of prototype hollow-fibre membranes.
© Eidos SRO



"The combined experience of end-user SMEs and the research groups should produce a device that fulfils the market demand as well as meeting the requirements of European legislation."

Under the Water Framework Directive, EU Member States must monitor regularly the quality of any water intended for human consumption. Real-time, remote sensing would be an advantage, but few products exist on the market.

The WaterTool project aims to develop a robust probe that measures up to 15 different parameters simultaneously in surface- or groundwater and, using wireless technology, sends the data back to the end-user. The five partner SMEs, which all conduct water-quality analyses, expect to gain significant cost savings and better quality data that satisfy the requirements of EU legislation. The Co-operative Research should also help other end-users have more control over water resources to ensure that they remain clean and safe.

When you turn on a tap you presume that the water is clean and safe to use and drink. Water companies and government agencies take many precautions to safeguard Europe's citizens from the dangers of polluted water.

The sampling, analysis and ongoing monitoring of water quality is an essential part of this protection process. After all, it is only by knowing exactly what is in the water that you know it is uncontaminated and that treatment technologies are functioning correctly. Indeed, the EU Water Framework Directive acknowledges that monitoring is at the heart of water-quality management.

A real demand

The degree of monitoring required by the Directive makes continuous, remote monitoring an attractive option. Rather than having scientists work in the field filling sample jars and bottles for analysis back in the laboratory, you simply install a box of electronics and let it run. Data can be sent back to a base station for analysis using modern wireless or mobile telephone technology.

Despite the growing demand for such devices, manufacturers of water-quality measuring instrumentation have been slow to keep pace with the technological advances of the last decade. However, the WaterTool project has this lucrative market in its sights. The aim is to produce a prototype device that simultaneously measures and monitors up to 15 water quality parameters (including nitrate, ammonia, chloride, sodium, calcium) and transmits this data over GSM mobile networks, making it available in real time for the end-users.

The Co-operative Research project is taking a grass-roots approach to the design of the new probe, starting with the experience and requirements of its five SME (small and medium-sized enterprise) partners to establish the technical specifications. These firms are monitoring a range of contaminants (from synthetic chemical pollutants to agricultural nitrates) in different environmental conditions in Greece, Cyprus, the Netherlands, Slovakia and Finland. Each company is providing invaluable insights into the requirements of potential end-users of the probe. They will also extensively test and evaluate prototype models in the field.

Watertight collaboration

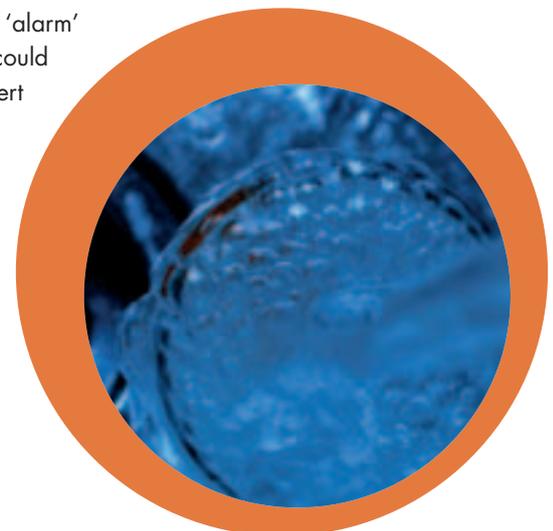
None of the SMEs have any product development facilities, so the bulk of the research activity within the project will be conducted by four RTD performers, assisted by the coordinating SME TerraMentor E.E.I.G.

Two Dutch research organisations, the UNESCO-IHE Institute for Water Education and the environmental group SELOR, are focusing on the probe's sensing capabilities. SELOR is involved in a number of environmental technology projects and will use its expertise to develop this new probe's software, calibration systems and some of the ion-selective electrodes which can detect specific chemical compounds in water. IHE will work closely with SELOR to develop some additional electrodes and also test the range of electrodes in its laboratories.

A German SME, Bohrlochmessungen (DBM), designs and manufactures measurement and monitoring geophysical devices for boreholes. Together with the GTK from Finland, DBM will adapt its data-logging software for the WaterTool probe.

TerraMentor is collaborating extensively with SELOR to integrate all the components of the multichannel probe into a small product, enclosed in a specially designed, titanium housing that will allow it to operate to depths of 200m down narrow borehole shafts.

The device will also incorporate an 'alarm' feature which could immediately alert regulators and decision-makers if the concentration



“WaterTool will provide the water industry with a device that will help to protect the safety of citizens, in real time.”

of chemicals in the water exceeds pre-set levels. Such a feature is useful when monitoring drinking water supplies. It will enable those responsible for the safety of people and livestock, or the protection of the environment, to take well-informed, rapid action to avert disasters.

Probing the market

The WaterTool SMEs are excited by the prospect of a multifunctional monitoring tool. The ability to measure up to 15 physical and chemical parameters (chosen from a range of possibilities), in real time, will give these firms a substantial competitive advantage in the area of water and environmental monitoring services. The device will provide more data than sampling and spot analyses, yet cost less by saving on travel expenses and laboratory testing.

The WaterTool probe is designed to produce analytical data in a range that covers the requirements for water quality laid down by European legislation. It should prove a popular choice among a wide range of end-users, from water suppliers, pisciculture and agriculturalists, local and national authorities and environmental organisations, as well as engineering groups involved in water and sewage treatment works.

In short, wherever water is used as a resource, monitoring must take place. The WaterTool project should make the task easier – and help to ensure that Europe’s water assets are cleaner and safer than ever.

Project title

An Innovative Tool for multi-element analysis of ground and surface water (WaterTool)

Contract number

CT-2004-507259

Duration

24 months

Global project cost

€ 1 769 517

EC contribution

€ 916 848

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"It is very difficult to get statistics on road and rail accidents caused by wind."

High winds are a danger to road traffic, especially on bridges, viaducts, embankments and other exposed routes, and are equally hazardous to high-speed trains. In the Weather Co-operative Research project, a consortium of companies and universities from France, Italy, Spain and the United Kingdom is creating a commercial wind alarm system that can be installed on any vulnerable section of road or railway. Based on sophisticated numerical models supported by wind-tunnel and field measurements, the system will monitor weather conditions and offer real-time predictions of the risk of an accident. Benefits include safer road and rail travel and fewer unnecessary closures.

Almost everyone has had the unnerving experience of travelling in a car in high winds. The car weaves from side to side and can be difficult to control. Winds can be especially dangerous on exposed sections of route such as bridges, viaducts and embankments where conditions can change suddenly. The larger the vehicle the bigger the forces from winds, and vulnerable routes are often closed to high-sided vehicles in stormy weather. Accidents are not unusual.

Trains, too, can be affected by winds and there are examples from Ireland, Austria and Japan of trains being blown off the rails. With many countries now building high-speed rail networks with trains running at 300 km/h or more, the consequences of a derailment can be extremely serious. French railways now require a risk assessment of wind conditions on all their new TGV routes.

But, strangely enough, there is no commercially available warning system that road and rail authorities can install to make objective assessments of the risks to traffic at particular times. While wind speeds may be routinely monitored, the collected data are not used in any systematic way. Too often, routes are closed only after accidents have already happened.

Wind modelling

The Co-operative Research Weather project is trying to do something about this. The project coordinator, Meteodyn, is a French SME (Small to medium-sized enterprise) specialising in modelling wind behaviour and analysing meteorological risks. It has been working with French, Spanish and Korean railways to assess wind risks on new high-speed routes. At a conference in Texas in 2003 it discovered that a research group at Birmingham University was studying the effects of wind on road vehicles, and decided to team up and apply for funding for a Co-operative Research project.

The aim of the Weather project is to develop a practical warning system that can predict wind conditions and the risks for different types of vehicle.

As a first step, five SME partners, led by Atmos, are gathering continuous meteorological data from eight exposed road and rail routes around Europe. They include three in Italy, two in France, two in Spain and one in the UK, representing a range of climatic

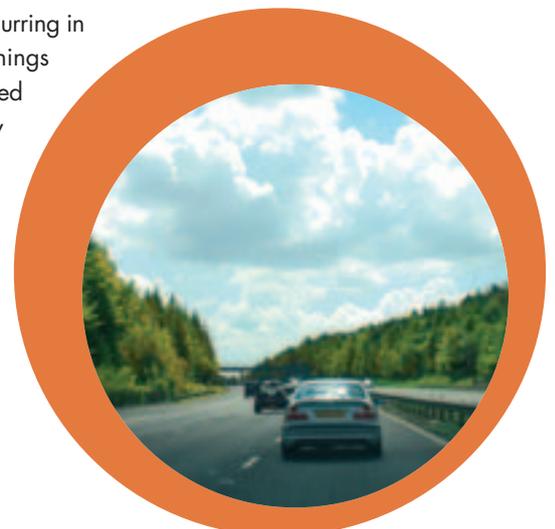
and geographical locations. Meteodyn will use the data to develop and calibrate a model of wind behaviour around bridges and embankments, including the effects of turbulence. The object is to predict wind speed and direction and also road surface conditions.

The next step is to calculate the forces that the winds will exert on vehicles. Milan Polytechnic is doing wind-tunnel tests on models of two types of lorry on an embankment and a viaduct, while Nottingham University is doing numerical fluid dynamic simulations of wind forces on a lorry and a train. Birmingham is carrying out field trials on a large van, measuring how the forces on it depend on local wind speeds. In due course, this work will be extended to a wider range of vehicles.

Alarm system

Meteodyn, working with Atmos, Nubila and Birmingham, will then develop statistical models to estimate the risk of a vehicle overturning or being blown off course in given wind conditions.

Finally, all the work will be brought together in a prototype of a practical wind alarm system requiring input from all the SMEs. The system will consist of sensors for wind, temperature, pressure and humidity as well as the road surface conditions, which can be installed on a bridge, for example. Data from the sensors will be transmitted to a central point where the model will predict the risk of an accident occurring in real time. Warnings will then be issued to the authority responsible for managing



"If you pay to drive on a toll-road and you have an accident on a bridge due to high winds, who is responsible?"

traffic on the bridge which will then decide what to do with that information. It could restrict the bridge to particular classes of vehicles or even close it altogether. The system will be equally suitable for roads and railways.

It will be 2008-09 before a product is on the market, but it could prove attractive to highway authorities and railways all over Europe as well as overseas. A practical warning system could lead to better informed decisions about how to handle weather risks, reducing accidents while avoiding economic losses through unnecessary closures of important routes.

Although much research is being done around the world on wind risks, the partners believe that their project is the only one aiming to produce a comprehensive warning system. The SME partners are all contributing to development and testing of the prototype and are likely to benefit from increased demand for meteorological monitoring equipment as the warning systems are installed.

Project title

Wind early alarm system for terrestrial transport handling evaluation of risks (WEATHER)

Project Number

CT-2004-512862

Duration

24 months

Project cost

€ 1 374 872

EC Contribution

€ 906 045

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"We are helping people who are not experts in XML to get relevant information from web services with the minimum of effort."

Thanks to technologies such as XML, many computer-based documents and information services are now 'intelligent': they have an internal logic that can be queried and understood by external programs. This should make it much easier to track down useful information, but unfortunately most of us are not fluent in XML. The Co-operative Research project WS-Talk aims to overcome this problem by bridging the gap between the everyday language used to describe business processes and the arcane language of web services. Systems developed using WS-Talk will translate a user's request into machine-readable form, locate suitable web services, query them and return the results to the user.

When you need information, the chances are that it is already available on a computer somewhere. You can probably find it on the web, or even within the organisation you work for. Tracking it down in a form that is easy to use, however, is often another matter.

If you are lucky, the data will be available as one of the 'web services' many of us now take for granted. Customised maps, news feeds, currency conversions and translations are just some examples of web services that are easy to use. But if you want to know, say, the growth rate of the French chemical industry in 2003, you are more likely to have to plough through a pile of reports.

Computer languages such as XML and BPEL (Business Process Execution Language) are increasingly used to describe the structure and purpose of documents and web services. But although the 'semantic web' can make it easier to find information, this can still be difficult without specialist computing knowledge.

The goal of the WS-Talk project is to make web services more accessible to non-programmers by taking requests in everyday language, translating them into machine-readable form, locating suitable information sources and extracting specific information.

As well as helping people to mine the web, WS-Talk will improve the flow of data between the information 'islands' that plague many businesses. "Web services provide an open-standards approach to the problem of linking computer systems," explains Kurt Englmeier of German systems house LemonLabs, the coordinator of WS-Talk, "so they are easier and quicker to use than traditional 'middleware'."

From words to concepts

Low-cost integration methods are especially useful for small companies or when flexibility is important, Englmeier points out. Repeated queries may justify paying a programmer to create a customised application, but off-the-cuff requests or prototype systems need methods that are easy for non-specialists to use.

"People understand the terminology and business processes that are relevant to them, but not necessarily the specialist computer language used to describe web services," says Englmeier. "So we want to create a wrapper that can map descriptions in everyday language – 'natural

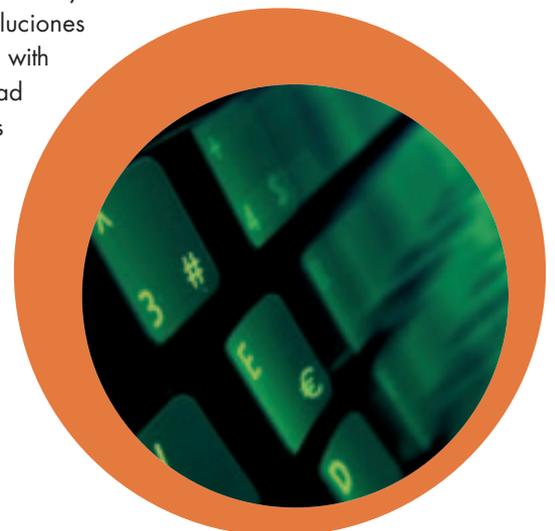
language', in linguists' jargon – on to the representations used for web services, which are written in XML or something similar."

The WS-Talk approach is rather like someone on a customer helpline trying to match a query to a list of frequently-asked questions, says Englmeier. "We use the available documents to build a 'controlled vocabulary' – a bit like an index – from which we extract a hierarchy of concepts. Then the system takes a natural-language query and uses standard text analysis tools to discover its meaning. If the two sets of concepts meet in the middle, the system has understood the query and knows where to find the answer."

The controlled vocabulary is tedious to compile, says Englmeier, and limits the scope of the system to one area of knowledge at a time, but it avoids the ambiguities that often cause problems for general-purpose machine translation systems. "Luckily, the controlled vocabulary and concept hierarchy are very stable over time, so they don't need frequent updates," he says.

Widespread applications

Organisations interested in the potential of WS-Talk include an economic research institute in Germany, a well-known manufacturer of sports goods, and health insurance companies in Chile and Argentina. LemonLabs works closely with the sports goods company. The health insurance companies are handled by another WS-Talk partner, Chilean systems company Soluciones which, together with the Universidad Diego Portales, is working on text-interpreting software.



Turkish company Luckyeye is developing tools for creating the controlled vocabulary and concept hierarchy, while the IRIT Laboratory at the Université Paul Sabatier in Toulouse handles text analysis. AKRA of Germany is developing a system that helps users formulate their service requests in appropriate language; the company also has experience in workflow management that will become important later in the project. The Chilean company Soluciones is developing a search and orchestration engine that enables users to retrieve services and assemble them into more complex systems. Further help comes from Royal Holloway University of London and the Universidad Diego Portales of Santiago de Chile.

The project began in December 2004 and will finish at the end of 2006. "The end-products of WS-Talk will themselves be web services: tools for analysing texts and defining controlled vocabularies, tools to help users formulate their queries, and tools to identify the web services that are likely to provide the answers to these queries," says Englmeier. "Eight months in, we have made good progress. By the time we are finished we should have practical tools that can be adopted straight away by large companies, and then I hope they will begin to be used."

Project title

Web services communicating in the language of their user community (WS-Talk)

Contract number

CT-2004-6026

Duration

24 months

Global project cost

€ 1 711 501

EC contribution

€ 1 046 500

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WS-Talk will help users formulate queries for web services in everyday business language.

Co-operative Research projects are one of two distinct types of project supported by the *Horizontal research activities involving SMEs* of the EU's Sixth Research Framework Programme (FP6, 2002-2006), which together have an overall budget of €473 million. They enable transnational consortia of SMEs with shared research needs which they are unable to fulfil themselves to outsource the required work to 'research performers'. This folder contains profiles of 30 FP6 Co-operative Research projects, prepared in the months immediately following their official launch. Similar folders, presenting selections of FP6's first Collective Research and Economic and Technological Intelligence (ETI) projects, are also available.

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