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Research Results for SMEs – V



Introduction

Small and medium-sized enterprises (SMEs) are recognised as playing a crucial role for European competitiveness. They are very dynamic, and also very varied. This allows them to respond rapidly to the opportunities of changing markets, but they do not have an easy time.

The European single market has opened up new markets for all firms, which means that competition is becoming increasingly stiff. In a globalising world, innovation has become the fastest way to conquer new markets, and to maintain existing ones. Also, the knowledge base required for any single business is increasing rapidly: marble producers require expertise in new cutting techniques, whilst bicycle manufacturers need specialist knowledge in material science and solder technologies. As a result, SMEs increasingly need to acquire new knowledge, to innovate and to internationalise their network of business partners.

Yet in today's world, these activities are becoming increasingly specialised and costly.

That is why the European Union is encouraging SMEs to participate in its Framework Programme for Research and Technological Development (RTD), which is an excellent instrument to realise all these objectives at the same time.

To encourage more SMEs to take part in the EU's RTD Programmes, special instruments have been developed for SMEs (see <http://www.cordis.lu/sme>). Under the current Sixth Framework Programme (2002-2006) there are three specific instruments:

- Co-operative Research
- Collective Research
- Economic and Technological Intelligence

Co-operative Research (formally CRAFT) projects enable a limited number of SMEs from different countries with a common challenge or problem, but with limited or no in-house RTD capability, to assign a significant part of the research and technological development to RTD performers (e.g. research centres or universities). In all cases, the SMEs retain the ownership of the results. In addition, this instrument gives the SMEs the opportunity to set up international partnerships.

In Collective Research projects, RTD performers conduct research on behalf of industrial associations or groupings, for the most part made up of SMEs and representing their interests, in order to expand the knowledge base of large communities of SMEs and thus to improve their general standard of competitiveness.

The Economic and Technological Intelligence (ETI) scheme aims to stimulate SME participation in European research by promoting innovation in SMEs.

Besides the SME specific instruments, SMEs with their own research capacity can benefit from the other instruments under the Sixth Framework Programme, such as Integrated Projects, STREPS (Specific Targeted Research Projects), and Networks of Excellence.

This publication presents the achievements of 20 CRAFT projects completed under the Fifth Framework Programme (1998-2002). In total, these projects involve some 93 SMEs. They illustrate the richness and diversity of the results that SMEs can obtain from EU research projects and show how SMEs with little or no RTD capacity can benefit from the CRAFT (now the Co-operative Research) scheme.

Further information on the Sixth Framework Programme can be found on the CORDIS server:
<http://www.cordis.lu>



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- Environment
- Information Society
- Medicine and Health

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Software you can depend on

CRAFT

IST-2001-55042

Space applications are mission-critical.

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While hardware systems may be considered mature, software and systems with embedded software are still in their infancy. The difference is nowhere more marked than in validation and verification, when reliability comes to be analysed. For hardware systems, the analysis tools available present the analyst with an embarrassment of choice; for software, especially safety- or mission-critical software, those available are far fewer and much less powerful. When four European software-development SMEs working in assorted industrial sectors teamed up to commission a software dependability tool, they got more than they bargained for.

On 28 June 1999, two Boeing 747s all but collided head-on, 10,000 metres up in the sky. Had the collision not been averted at the last moment, everyone on board the two aircraft – more than 420 people – would almost certainly have been killed. Subsequent investigations implicated software failure as a primary causative factor. Far from preventing a collision, the software installed on both aircraft to control the collision-avoidance system brought them on to a collision course.

The incident highlights the degree to which we rely on software and the respect we owe to one particular requirement of safety- and mission-critical software – dependability. We need to be confident that the computer programs to which we entrust our lives do what they have been designed to do and do not fail. Software is qualitatively different from its hardware. As is often said, it is pure design. If it fails, a design error is to blame, not wear and tear or fatigue or any of the other well-understood mechanisms that cause hardware to fail. Refined over decades of engineering experience, methods for analysing the reliability of hardware are of little use in the validation and verification of software.

Methods for analysing software reliability are much less mature and far less powerful. “Basically, dependability analysis for mission- and safety-critical real-time software is currently done by teams of experts with very limited support tools at best,” says David Escorial of Spacebel. With the Atasdas project, the partners set their sights on a software tool dedicated to dependability analysis that would surpass this basic level of support.

Levels of analysis

The strength of the resulting application, developed for the consortium by Surlog, is rooted in the way it divides up the task of analysing dependability. “It offers different levels of analysis and provides different kinds of output at each level,” Escorial says. “It can provide a quick profile of the overall quality of the program under analysis in just a few minutes.” In addition to the bird’s-eye view of the program’s structure, and of its data and control flows, provided at this level, it also provides users – who need not be experts in the field – with the means to identify critical software modules, unsafe program structures and risks that may be present in the code. Another important output is an estimate of the software integrity level, a measure defined by the widely recognized IEC 61508 standard (for ‘electrical/electronic/programmable electronic safety-related systems’) indicating the probability of failure on demand of the program under analysis.

Escorial says, “Further down the line, you can do a more detailed quality analysis in terms of functions and architectural design.” To work at these levels, the user requires greater expertise in dependability analysis. For the most comprehensive analysis of which the tool is capable, additional work has to be invested during software development in the parallel creation of formal descriptions of the program.

Spacebel and Critical Software are software houses with a strong interest in space applications. TAM Télésanté specialises in telemedicine. XLAB, founded only in 2001,



CRAFT

IST-2001-55042



develops software for a broad range of applications including networking. For all four industrial partners, the process of collectively drawing up their requirements and, in particular, validating the Atasdastool once it was ready, were more fruitful than usual.

Expectations exceeded

"The problem that materialised," Escorial says, "was that we didn't know precisely how we would put the tool to use in our dependability-related tasks, which relied mainly on the tacit knowledge and skill of experts. In defining the functionalities to be provided and then validating the resulting Atasdastool, the specific process requirements of each company crystallised for them as they never had before. In the end, two of the main benefits for all of us were a clearer understanding of our respective dependability-analysis processes and an important gain in productivity when executing them."

Escorial believes the tool itself exceeded the partners' expectations. "One of the major surprises came when we realised that the tool was going to be commercialised. It was not just going to be a prototype to throw away. It's a tool that's going to be widely used and not exclusively by the Atasdastool companies."

The tool also has the potential to be applied outside the domains originally envisaged – to analyse software used in transport, energy (especially nuclear power) and defence.

The tool is now being commercialised under the name 'imPROVE-C Analyzer' by TNI-Software, which has been brought in by Surlog specifically for this task. "None of the partners have the kind of infrastructure to commercialise the tool," Escorial says. Their first targets are the big players with safety concerns, particularly aerospace companies. The partners also see the potential for new business creation on the back of imPROVE-C Analyzer. The idea is for a certification tool kit including the tool that could be used by independent companies to analyse clients' software and help them bring it to an appropriate software integrity level.

The Atasdastool could win recognition from another quarter, according to Escorial. "It could be used as an important instrument for teaching software dependability analysis at universities. The tool implements best practices that would help future engineers to be familiar with the problems and solutions. So, on top of everything else, it is making a contribution to the advancement of knowledge."

Full Title:

Automating target analysis to speed up the dependability analysis of complex real time software modules

Industrial Sector

NACE 35.3 Manufacture of aircraft and spacecraft

Supporting technologies

0579 Software Engineering, Middleware, Groupware; 0100 Certification; 0129 Computer Science/Engineering, Numerical Analysis, Systems, Control; 0243 Formal Safety and Environmental Assessment; 0550 Safety Technology

Information

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SME proposers

- Prime: Spacebel (Belgium)
- Critical Software (Portugal)
- TAM TéléSanté (France)
- XLAB (Slovenia)

RTD performers

- Surlog S.A. (France)

Duration

06/02-05/04

References

IST-2001-55042

Programme

FP5: IST

Project Cost

€1,633,000

Range of SME contribution

€35,000-€312,000

EC funding

€820,000



Tool and die industry – improving communication to streamline production

CRAFT

IST-2001-55021

Part of a stamping tool in development.

The tool and die industry provides parts to other industries, and companies in the sector are obliged to keep abreast of their clients' fast-evolving design needs. Several companies may supply a single client, such as a carmaker, and a longstanding problem has been to synchronise the development of new tools and dies between them. As clients demand faster and faster delivery times, the problem has got worse. The goal of cDie, which it achieved in less than two years, was to develop a technological platform that would improve communication between companies, streamline production and ultimately reduce delivery times.

Take a car. A company has a concept for a new model, and the design process is set in train. When it comes to the production line, each of the car's parts may require a different mould or stamping part. These are provided by the tool and die industry. But the job of the company that produces them is far from straightforward. It has its own design process to manage, in collaboration with both the designers of the car and the company that will eventually produce the parts. It may find itself having to compete with others in the same sector. And it is more than likely to be facing a shortage of skilled workers.

Of course, all these problems are felt most acutely by small and medium-sized enterprises (SMEs). To make matters worse, their original brief is rarely the one they end up following. Along the road from concept to product the car's designers may alter their original plans many times, and the tool and die company must be able to accommodate those changes. "Ten years ago it might have taken four years to bring a new car model to market," says Aitor Alzaga of Tekniker, one of the research companies involved in the cDie project, "but now the market demands innovation every year." Whereas a tool and die producer might once have had a year to develop a part, now it has three months. And in that time, it will probably have to accommodate a dozen changes in the client's specifications.

Inflexible and unwieldy

Traditionally, tool and die companies have responded to these challenges by beefing up their project management structures. But that

is expensive and, moreover, the systems they rely on for sharing information and co-operating with other companies tend to be inflexible – incapable of responding quickly and efficiently to the client's changing needs. With cDie, seven European SMEs mainly serving the automotive industry, including tool manufacturers, stamping die manufacturers and engineering services, collaborated with research partners Tekniker, Agiltec and IPK – companies accustomed to finding solutions for the tool and die industry – to tackle some of these issues.

The challenge that cDie coordinator Goitek System and partners set out to address was how to improve the technology by which companies communicate. They wanted a means of synchronising their development processes and of sharing engineering information through a network, so that production could be tuned to maximum efficiency. Specifically, they set themselves the goal of reducing both project management costs and delivery times by 15%, and reducing the cost of communication and information exchange by 20%. But those were not the only requirements. Bearing the needs of SMEs in mind, the solution they came up with had to be easy to install and sufficiently flexible to allow for new companies joining the network created around a given tool and die project. It also had to be made available on a public internet site which offered good customer support.

Internet solution

The cDie research companies quickly realised that the best way to meet these objectives was to exploit the internet. Their final solution,



Die or stamping part for a car door.



CRAFT

IST-2001-55021

which they arrived at in February 2004, 21 months after the project was launched, was a technological platform that was compatible with internet technology. Using Java and other internet languages, the software was tailored to the particular needs of the industry. For instance, it supports the rapid dissemination of clients' updates on their changing designs.

The software package consists of three main prototypes. The first, MOOGO (methodology and tool for the modelling of business processes within companies), is a tool which helps define organisational models and collaboration strategies. The second, TDW (cDie Tool and Die Workspace), can be used to manage internal company information such as engineering change orders, as well as to integrate information with other companies in the network. The last, SWS (cDie Shared WorkSpace), provides mechanisms for sharing information about work orders with external companies.

The cost of buying a licence for the platform depends on the size of the user company, but

varies from €20,000 to €50,000. Including the cost of installation, the total price works out at between €40,000 and €100,000. According to Iosu Bastida of Goitek System, "the software package is selling well. It has already been sold and implemented in Italy, Spain and Germany."

Those companies that have installed the package report that their management costs are down, though it is too early to say if delivery times will also be cut. And satisfied customers point to another, perhaps unforeseen benefit. Managers say that, thanks to the new technology, they feel more in control of the tool and die development process. If a client asks them to predict the delivery date of a part, for instance, they can do so with greater accuracy now that they have all the relevant information at their fingertips.

All in all, say Bastida and Alzaga, the European tool and die industry is set to become more competitive in a global market, thanks to this solution.

Full title

Collaborative development of tools and dies in SMEs networks

Industrial Sector

NACE 29 Manufacture of machinery and equipment n.e.c.

Supporting technologies

0320 Information Management;
0609 Telecommunication
Engineering/Technology

Information

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SME proposers

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- Troquenor (Spain)
- Dismodel (Spain)
- 16-D (Spain)
- Schambach (Germany)
- IFP (Germany)
- Abrantes (Portugal)

RTD performers

- Tekniker (Spain)
- Agiltec (Portugal)
- IPK (Germany)

Duration

06/02-02/04

References

IST-2001-55021

Programme

FP5: IST

Project Cost

€1,250,000

Range of SME contribution

€47,000-€120,000

EC funding

€600,000



Solid fuels – clean air

CRAFT EVK4-CT-2001-30005



The CleanAir unit.

© APP

The burning of solid fuel contributes to the high incidence of respiratory disease in many European cities. The CleanAir project addressed this problem by developing a compact device to remove particulate matter from domestic chimney emissions. The CleanAir unit, which works using electrostatic precipitation, reduces particulate emissions by around 95%. It was shown to be more effective than alternative pollution-reducing options. The uptake of this technology could significantly improve air quality in urban areas. However, further political initiatives are needed to make it commercially viable.

Smoke from solid fuels like coal and wood reduces air quality and contributes to respiratory disease, especially in towns. The problem is due to particles of soot lodging in the lungs. An 'end of pipe' solution was developed by the CleanAir project, a consortium of SMEs and research partners, funded through the CRAFT initiative. The project succeeded in its aim of producing a cost-effective air-cleaning unit, for fixing on domestic chimney tops, which efficiently removes particulate matter arising from the burning of solid fuels. "We had been working along these lines for several years," says Arne Thomas Haaland of Applied Plasma Physics (Norway), the company which initiated the project. They originally developed the project with Norway's National Institute of Technology which conducted research and took on much of the administrative load. The first big challenge was to assemble the consortium. The other RTD partner, Pera International (UK), conducted electronics research. Three SMEs contributed components for the unit. Sereps (France) made high-voltage electrical components, Schroeder-Plast (Denmark) produced plastics, and B&K Keramik und Tonwaren (Germany) produced quality ceramics and offered expertise on chimney installation. Vukov Extra (Slovakia) worked on production-line manufacturing of the unit, while CSO Technik (UK) conducted practical work on air-pollution control with a view to taking the technology to market.

The CleanAir unit

The CleanAir unit is a compact device (52 cm tall and 42 cm in diameter) which can be fitted to chimneys of different designs using an adjustable base-plate. The main body of the unit consists of six reaction chambers and a power supply. "This required two major innovations," explains Haaland. "One was a dust removal system with a specified efficiency of over 90%, and the other was a miniaturised high-voltage power supply inside the unit."

The reaction chambers surround a central core containing the power supply. The unit works through the electrostatic precipitation of particles. Each reaction chamber has a central electrode connected to the power supply. In operation, ions are produced that confer an electrical charge on any particles passing through the chambers. The particles are attracted to and deposited on charged collection plates. The particulate matter accumulates in removable compartments which require cleaning after one or two years of normal operation.

High internal voltages are required to produce ions in the reaction chambers. "In technical terms, the biggest challenge of the project was to develop the power supply system – to get it small enough and cost-efficient enough for this task," says Haaland. Problems with insufficient voltage at start-up and current spikes, for example, had to be



CleanAir unit mounted on a chimney top.
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EVK4-CT-2001-30005

overcome. Parts of the unit, particularly innovations in the high-voltage supply, have been protected by patent.

A superior option

The CleanAir unit was laboratory tested with emissions from an old wood-burning stove. Particles were collected upstream and downstream of the unit. The results showed that the unit removed particles from the air with 95% efficiency. This was compared to emissions from modern clean-burning fireplaces and pellet ovens, and these alternatives were found to emit much greater quantities of particles. "A conventional fireplace with the CleanAir unit will release approximately one-tenth of what you would release from a clean-burning stove," explains Haaland. "That is astonishing. I would not have believed that when we started." The CleanAir unit also works out significantly cheaper than other air cleaning options.

The CleanAir unit has been successfully tested on the chimney of a house in Norway, where heavy use is made of a wood-burning stove. Particulate emissions were dramatically reduced, and complaints from neighbours about smoke stopped when the unit was in operation. "The main achievement has been to produce a unit which is actually able to remove particles and dust from the burning of solid fuels to an efficiency of approximately 95%, and to do that in a cost-efficient manner," Haaland summarises.

Commercial development

The participating SMEs have benefited from knowledge transfer and the establishment of business networks that can be used in the future. However, the main commercial benefits will depend on how the market for this type of technology develops. The potential market is huge and there are indications that such technology will soon be in demand throughout Europe. In addition to improving air quality and reducing disease, the CleanAir unit also helps to make wood and other bio-fuels more sustainable, and positions them as more attractive alternatives to non-renewable fossil fuels.

To achieve the goal of the project, however, the right political decisions need to be taken. "Even though we have solved the problem that the political authorities prioritised, and have a product ready for market, the market is not yet ready for the product," explains Haaland. For the widespread installation of devices like the CleanAir unit, enforceable regulations or attractive government grants need to be forthcoming. Haaland is optimistic: "I believe political authorities will wake up and do something about the problem of respirable dusts in urban areas," he says. "If this product is made commercially viable by political initiatives, I really think it could contribute to a significant reduction in disease and deaths caused by respirable dust."

Full title

Increased quality of life for 76 million EU citizens by enhancing air quality in urban areas through development of a residential cleaning technology for burning solid fuel for domestic use

Industrial Sector

NACE 31 Manufacture of electrical machinery and apparatus n.e.c.

Supporting technologies

0213 Environmental Technology/Engineering, Pollution Control

Information

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SME proposers

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- Sereps (France)
- CSO Technik Ltd (UK)
- Schroeder-Plast A/S (Denmark)
- B&K Keramik und Tonwaren GmbH (Germany)
- Vukov Extra AS (Slovakia)

RTD performers

- National Institute of Technology (Norway)
- Pera International (UK)

Duration

05/01-04/04

References

EVK4-CT-2001-30005

Programme

FP5: EESD

Project Cost

€1,250,810

Range of SME contribution

€0-€220,000

EC funding

€625,403



Spine simulation at your service

CRAFT

IST-1999-57446

The Devaspim portal will be invaluable to spine surgeons.

In recent years, research into the biomechanics of spine implants has helped to improve the prognosis for implant patients. Simulation models developed in the course of some of the research embody the know-how of European research centres with outstanding reputations. In principle, the models could serve orthopaedic surgeons and implant manufacturers, who gain from any improvement in their understanding of implant behaviour *in vivo*. A group of small- and medium-sized implant manufacturers, information technology companies and a technology-transfer business have now developed an internet portal that turns the principle into practice.

Thanks to advances in spine surgery, several spinal disorders can now be corrected by surgical operations. The damaged vertebra or disc is removed and bone – typically harvested from the patient’s pelvis – is grafted into place. A few months later, the vertebrae at the injured joint fuse together, the joint is immobilised and the patient’s back pain is gone.

During those post-operative months, the spine has to be supported by a so-called ‘instrumentation system’ consisting of special screws, rods, cross-links and connectors implanted in the spine. This is now common in the treatment of age-related spinal disorders, such as spondylosis (caused by the degeneration of spinal discs) and spondylolisthesis (in which a vertebra slides forward above its lower neighbour). It is also used to treat spinal fractures.

Motivations

Implant manufacturers are continually improving instrumentation systems, but the rate at which they can innovate is limited and the cost is high. The coordinator of the Devaspim project, Luis Blasco of Spanish internet solutions provider Adapting, points to this fact as one of the motivations behind the project. “Implant manufacturing companies face a long laboratory-based product development process governed largely by trial and error before they can launch a product on the market,” he says.

He points to another motivating factor. The spine is a more complex part of the body than

it seems to the layperson and spinal surgery, like implant design, is as much an art as a science. Blasco says, “Of course, in these operations, selecting the correct implant is extremely important but at present it has to be based on the experience and know-how of the individual surgeon.” Approximately one in four operations on the lumbar (i.e. lower) spine are in fact repeat operations necessitated by suboptimal implant choice as well as failure of the implants themselves.

Meanwhile, in publicly funded research laboratories, a lot of research is in progress on the biomechanical behaviour of the instrumented spine. In much of this work, the researchers model the spine using the finite element method (FEM) – a technique that translates intractably complex physical problems into approximations that can be analysed by computer in a realistic time. They do so to compare different implant systems, verify implant designs and learn how implant failures might be prevented.

What if these FEM models, closed until now to all but a few initiates, could be exploited by people with no FEM expertise? This is essentially the idea of Devaspim. “An internet portal, we realised, could make the know-how bound up in these FEM models accessible to orthopaedic surgeons and implant manufacturers, in fact to the whole medical community worldwide,” Blasco says.

Simulation service provider

The system is based on a huge database created over the course of the last few years



Homepage of the web portal.



CRAFT

IST-1999-57446

from the know-how of one of the most important biomechanics laboratories in Europe – the ENSAM Laboratoire de Biomécanique, which is administered by SERAM. With Devaspim, a surgeon or implant engineer can effectively call on the expertise of the best people in the field of spinal surgery. The portal has been designed for the industrial partners by Devaspim's two research centres – SERAM and the Instituto de Biomecánica de Valencia (IBV) – as a simulation service provider or 'SSP'. A user – a surgeon planning an operation, say, or an engineer working for an implant manufacturer – calls up the portal website and orders a simulation service from among those available. He or she enters the appropriate input data when prompted by the user interface. The data will include information about a patient, the spinal injury in question, the implant system to be used and the surgical technique proposed. The SSP connects to a simulation-model server and initiates the simulation computation using a customised and validated model. Once the job is complete, the SSP uploads the resulting report to the portal and notifies the user who can then retrieve it over the internet. For the surgeon, the output indicates whether the proposed technique and instrumentation are likely to be effective and suggests improvements if not. For the implant designer, the

simulation replaces what would otherwise be a much more time-consuming laboratory experiment requiring workshop preparation and testing of real, solid – as opposed to virtual – implant models.

Economic case

The portal is owned jointly by the main industrial partners, the two IT companies Adapting and Surgiview. As clinical users will have to pay for simulation runs and implant suppliers will have to pay to have their products represented among those available for the simulation runs, Devaspim will provide partners with a new income stream. "There will be other services, too," Blasco says, "like advertising on the portal and opportunities for users to participate in networks of experts." He explains the economic good sense underpinning Devaspim's potential. "Europe is the oldest region in the world and one out of every eight EU citizens over the age of 50 will have a spine injury. There are already about 30,000 spine operations performed in the EU every year at an average cost of €15,000 per procedure, and soon each one of them will be able to benefit from using the Devaspim portal. The impact on patients' quality of life will be enormous, but we also expect to see a big impact on the competitiveness of implant manufacturers through cost reduction in the product development process."

Full title

Development of a tool based on new technologies for the design and evaluation of spine implants

Industrial Sector

NACE 85 Health and social work

Supporting technologies

0342 Internet Technologies; 0072 Biomechanics, Biomedical Engineering; 0610 Teleservices, Tele-Working, Tele-Payment, Tele-Medicine; 0188 Electronic Commerce, Electronic Payment, Electronic Signature

Information

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SME proposers

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- Surgiview (France)
- Lafitt (Spain)
- Salgado (Portugal)
- Praxim (France)

RTD performers

- IBV (Spain)
- SERAM (ENSAM LBM) (France)

Duration

09/02-08/04

References

IST-1999-57446

Programme

FP5: IST

Project Cost

€1,002,000

Range of SME contribution

€36,000-€187,000

EC funding

€500,000



Waste pre-treatment to yield more gas

CRAFT CRAFT-1999-71485

Organic matter after processing and homogenisation.

Household and agricultural waste is mainly disposed of either at landfill sites or in incinerators, where energy may be recovered. But new European regulations permit only a small amount of biodegradable matter to be sent to landfill. This means that better methods are needed to break down some types of organic matter in order to improve the efficiency of disposal and recovery methods such as anaerobic digestion. In the Diprowaste project, a German-led consortium is developing pretreatment processes that render organic matter more digestible while also lowering waste treatment costs.

The anaerobic reactors used to digest organic waste produce methane-rich biogas which, after purification, may either be sold as a commercial fuel or used in gas engines for combined heat and power generation. The biodegradation of certain organic materials in waste, such as straw, is very slow and this lowers the efficiency of biogas plants. However, suitable pretreatment of this type of waste can enhance the output of methane, accelerate waste throughput and reduce the requirement for de-watering in the final sludge.

The Diprowaste project aims primarily at making biogas waste treatment plants more economical. "We have worked out how to pretreat many 'difficult' waste materials and speed up degradation," explains Jan Kai Dobelmann of Sesolutions, the project's coordinator. "These include waste mixed with grass, tree twigs, and chicken feathers, which take a long time to digest. One example is spoilt orange juice, which causes problems because it is so hard to predict its reactions in the fermenter. Usually it overreacts because the acidification bacteria in the fermenter drive down the pH so far that the degradation process comes to a standstill. Biogas plants have, to date, kept away from these types of materials, preferring relatively homogeneous waste, like grease or manure. With the results from Diprowaste, biogas plants will be able to take in many more kinds of waste – and operate at a profit."

Having looked at several pretreatment methods, the project team found steam hydrolysis using ohmic heating to give the best

results. This works by producing steam from water already present in the waste. Other methods examined were direct steam injection, ultrasound and various forms of chemical treatment.

Specialist assembly

There are four small and medium-sized enterprises (SMEs) and two research partners in the project team, several of which had collaborated before. Two of the SMEs are German engineering firms, one specialising in anaerobic digestion processes, the other in wastewater management. A landfill operator from Wales joined because it had limited landfill capacity and wanted to try pretreating the waste it receives. Another SME from the UK owns a unique dry digestion process that removes a lot of organic matter from waste. One German research partner has a lot of experience in waste management, while the other from the UK was instrumental in adapting the ohmic heater for this application. These heaters have been widely used in the food industry but never before for waste treatment. An ohmic heater is currently being installed at a project team member's landfill site. It should provide long-term performance data that will lead to improvements in implementation of the process. "Until now, no one has identified the best, most economical pretreatment method, and then gone on to build it. But now we have a full-scale operational plant making use of the results from Diprowaste," Dobelmann points out. "We have accumulated specialised knowledge of the



30 kW ohmic heater for steam hydrolysis of organic waste.



CRAFT

CRAFT-1999-71485

degradability of various types of waste mixtures in the pretreatment phase. That is the innovation underlying this project's success."

Standard waste

How the different types of waste degrade on pretreatment can vary greatly. The temperature, pressure, and retention time required in the reactor is still down to operator skill and experience. A major part of Diprowaste has been to determine degradability parameters for certain standard waste mixtures. "We carried out a lot of standardisation at the beginning of the project," Dobelmann explains. "For instance, we took varying proportions of cow dung and straw – a common type of waste – and made tables of measurements in the lab. In the future, we hope to add an electronic nose that could detect specific aromatic compounds formed when the treated waste is ready."

Ohmic heating for pretreated organic waste is likely to remain a niche market for some years, but the long-term outlook is very promising. Two plants are planned to become operational during the course of the project – due for completion in January 2005 – and more should follow soon after. Dobelmann outlines his hope for the future. "After about five years there should be enough experience with the

system to attract high-volume processors, for instance handling waste generated by fruit picking. It could become much more mainstream, especially if we can fit an electronic nose to make it easier to operate."

The SMEs have gained expertise through Diprowaste. "The fact that they are on the cutting edge of this technology should make them more competitive," says Dobelmann. "The collaboration has also allowed them to see the waste-treatment market from a different angle, because the approach taken in the UK is not the same as it is in Germany. I am sure that the new pre-treatment system installed in the UK will find its way to Germany."

Diprowaste addresses pressing issues of both waste treatment and energy savings. It may have a huge impact on rural society if farms decide to function in part as producers of energy and fertiliser from waste. As Dobelmann sums up, "CRAFT funding gave us the opportunity to adopt this longer-term approach to a highly innovative application with a very demanding learning curve. It clearly demonstrates that certain waste materials that had caused apparently insurmountable problems are in fact treatable. Hopefully, we will have encouraged others to come up with similar solutions."

Full title

Enhanced production of methane from anaerobic digestion with pre-processed solid waste for renewable energy

Industrial Sector

NACE 90 Sewage and refuse disposal, sanitation and similar activities

Supporting technologies

0063 Biodegradation; 0066 Biogas Production; 0664 Waste Biotreatment

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- Bioplex Ltd (UK)
- Evans Logistics (UK)

RTD performers

- TTZ-Bremerhaven (Germany)
- C-Tech Innovsation Ltd (UK)

Duration

01/03-01/05

References

CRAFT-1999-71485

Programme

FP5: EESD

Project Cost

€1,087,000

Range of SME contribution

€120,000-€158,000

EC funding

€544,000



Explosives help to fight wildfires

CRAFT EVG1-CT-2000-30002

The lightweight explosive hose can be unrolled quickly, yet is tough enough to cope with difficult terrain.

© CEREN

Each summer, fire takes a terrible toll on the forest and wilderness areas of southern Europe. Fighting wildfires by dropping water from aircraft is expensive and wasteful, while hoses are slow and labour-intensive. The FIMEX project brought together SMEs in Germany and France, and RTD performers in France and Greece, to develop a dramatic new firefighting technology. Large-bore hose fitted with explosive charges is laid in front of the fire and filled with water. Detonation creates a fog of water droplets that rapidly puts out the fire. The system is proven and endorsed by firefighters, though the need to use licensed explosives technicians is currently limiting its take-up.

All over the world, dry summers bring wildfires that endanger life, destroy property and devastate huge areas of forest and wilderness. Summer 2003, for example, saw disastrous fires in Portugal, France and Italy. The USA, Indonesia, Australia and many other countries have also suffered badly in recent years.

Fires in typical Mediterranean vegetation can move at up to six metres per second, with flames six to eight metres high. In remote terrain, fighting such fires with hand-held hoses is difficult and dangerous. Instead, firefighters often turn to water dropped from planes or helicopters.

“But most of the water dropped from aircraft never reaches its target, and the updraught is so fierce that much of the rest evaporates before it can quench the fire,” explains Florence Daniault of German fire protection company Wagner Alarm- und Sicherungssysteme, the coordinator of the FIMEX project. The origins of a better way to fight wildfires lie with two Germans, one a firefighter and the other an explosives expert. Fine droplets of water are very effective at putting out fires, while the use of explosives to create firebreaks goes back hundreds of years. Putting these two ideas together, the two inventors reasoned that they could create droplets using an explosive hose filled with water. They patented their idea, and licensed it to Wagner.

Assembling a project

The suggestion for an EU-supported research

project came from staff at CEREN, the test and research centre of the Entente Inter-départementale, the French government organisation responsible for preventing and fighting forest fires. CEREN already had a good working relationship with Wagner, and agreed to organise field trials for the technology if Wagner became the lead SME partner. Algosystems, a Greek IT company with which CEREN had previously worked, became the project's second research partner. Algosystems' role was to develop software to predict the spread of the fire and thus help firefighters position the hoses where they will be most effective.

The other SME partners were Itratech, a French manufacturer of fire-retardant additives, Seybold, a German company whose job was to design the special hose, and Wagner ZRS, another company in the Wagner group which was responsible for distributing the finished product.

“The collaboration between the partners worked very well,” says Daniault. “The French and Greek partners had already worked together, and we were familiar with the other German partner and with CEREN, so that helped to make our teamwork effective.”

Unroll, fill and detonate

The project team refined their idea until they had a system that was effective, yet simple enough to be deployed quickly under real fire conditions. The hose is made from lightweight PVC-coated fabric with a drawstring



Detonating the hose, which is filled with water and a fire-retardant chemical, quickly extinguishes even fierce fires.

© Wagner Alarm- und Sicherungssysteme



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EVG1-CT-2000-30002

down the centre. It is available in diameters of 14, 18 and 25 cm, in lengths of 100 m. Having decided where to place the barrier, the fire crew unroll the hose and lay it in position. Next, they tie the drawstring to a length of blasting cord, typically used for demolition jobs such as cutting steel girders, and use the string to pull the blasting cord into position inside the hose. Then they add a dose of fire retardant, fill the hose with water from a fire truck and seal the ends. Adaptors developed as part of the project allow lengths of explosive hose to be connected together and filled from the many different types of hose fittings used by firefighters across Europe.

A few seconds before the fire reaches the hose, the blasting cord is detonated. This creates a dense cloud of droplets that saturate the vegetation and quench the fire. Plain water works well, but the fire-retardant additive improves the system to the point where it can completely extinguish an entire flame front. At this point, the firefighters can move in to deal with the smaller blazes behind.

The FIMEX team tested their explosive hose under realistic fire conditions at three test sites in France and one in Portugal, as well as on a NATO exercise in Croatia. "At the start of the field trials it took three people up to 20 minutes to deploy," says Daniault. "Now we have practised and refined the system, two people can set it up in five or ten minutes."

The result is a product that will not be suitable for every fire, but has a valuable niche in

fighting intense fires in difficult terrain. It is also ideal for protecting specific areas such as isolated houses, motorway service areas or even entire villages.

Battling bureaucracy

With the new system tested, analysed and documented on video, the project team saw a very positive response from firefighters – up to a point. It was then that they realised that the storage and use of explosives is a serious problem for civilian firefighters.

"There is a logistical problem, because the explosives have to be stored somewhere, and you need a blasting expert on hand at all times," says Daniault. "The fire brigades are enthusiastic about the technical performance of the product, but at the moment they are not allowed to store or handle explosives, and paying someone else to do this is expensive." As a result, Wagner currently has a product without a market. "We are still confident that we will be able to sell it," says Daniault. "We have developed a lot of good contacts among firefighters in Europe, the USA and Australia, and we may persuade the fire brigades to change their attitudes to explosives. We are also talking to military and civil defence firefighters, who are often called in to help with big fires and who may be more familiar with explosives. Meanwhile, we have a world lead in this technology, a safe patent position and an excellent product."

Full title

Forest fire fighting method with explosive hoses filled with an extinguishing agent

Industrial Sector

NACE 93 Other service activities

Supporting technologies

0241 Forest Protection; 0550 Safety Technology; 0092 Carbochemistry, Petrochemistry, Fuels and Explosives Technology

Information

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RTD performers

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- Algosystems SA (Greece)

Duration

04/01-03/03

References

EVG1-CT-2000-30002

Programme

FP5: EESD

Project Cost

€746,945

Range of SME contribution

€116,000-€294,000

EC funding

€370,368



Surveying sediments in waterways

CRAFT

EVK1-CT-2001-30009



Surveying a Dutch canal from a 3.5-metre inflatable boat. The seismic system is to the right, the GPR antenna on the end of the wooden pole to the left.

Sediment is a problem in many of Europe's waterways, trapping pollution and hindering navigation. Unfortunately, mapping the location and thickness of sediments is a tricky job, and until now no single method has been really satisfactory. The Geowaters project combined two existing geophysical methods, ground-penetrating radar and seismic surveying, to create a surveying technology that is more effective than either method used on its own. The new system, which has proved its worth at sites all over Europe, is now commercially available and represents a world lead for European SMEs. According to its coordinator, the project was a model for wide-ranging collaboration.

At the bottom of many European lakes, rivers and canals is a layer of sediment, and in the sediment can lurk pollutants such as heavy metals and polychlorinated biphenyls (PCBs). The EU is committed to cleaning up our waterways, but that depends on knowing where the sediments are. Once we have good maps of sediment distribution, the mammoth task of prioritising, analysing, dredging and remediation can begin. Even where sediments are not polluted, they may need to be removed if they obstruct shipping. Sediment thickness can vary greatly over a short distance, so the traditional technique of taking soundings with a pole is often inaccurate as well as slow. Two modern geophysical techniques, ground-penetrating radar (GPR) and high-resolution seismic surveying, can help, but each has serious drawbacks when used alone.

The Geowaters project successfully combined GPR and seismic techniques to develop a surveying system that is fast and accurate. "We faced big technical challenges, but the result was even more positive than we had expected," says coordinator Tamás Tóth of Hungarian SME Geomega, the lead partner in Geowaters. "Even at the test stage we were able to solve real problems that had defeated previous researchers, and now Europe has a world lead in this technology."

The best of both worlds

High-resolution seismic surveys are a speciality of Geomega, and Tóth explains that under the right conditions this technique works well

for mapping sediments. Short impulses from a metal plate rather like an underwater loud-speaker are transmitted through the water, reflected by the layers of sediment, and picked up by underwater microphones.

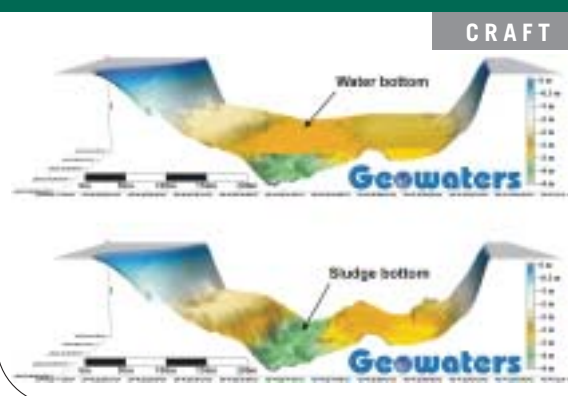
Measuring the timing and intensity of the reflections yields sediment profiles with a resolution of 10 centimetres. Unfortunately, seismic surveying does not work well when the sediment contains bubbles of gas from rotting vegetation – a frequent problem, especially in shallow water.

GPR provides similar accuracy under the right conditions, and is not affected by gas bubbles. Unfortunately, it does not work well in deep or brackish water. "The obvious solution was to combine GPR and seismic surveys, to give us the best of both worlds," says Tóth. "To do that, we needed to design a new submersible GPR antenna and develop software to combine the results of the two survey methods." Geomega teamed up with two Dutch SMEs specialising in GPR, SCANLINK and MAP Environmental Research. Latvian GPR equipment company RadSys built the new GPR antenna, while other SMEs in Greece, the Netherlands and Slovakia contributed expertise in geochemistry and database management. The research providers were the University of Thessaloniki in Greece, which was responsible for the software, and Hungarian company FRACTAL, whose job was to research sediment density.

Despite its wide geographical spread and many partners, the project came together well, says Tóth. "We had a strict programme



3-D maps of sediment in a backwater of the Danube, south of Budapest, Hungary, showing a metre-thick layer of sludge (top) and the original profile of the river bed (bottom).



CRAFT

EVK1-CT-2001-30009

of meetings at six-monthly intervals, hosted by a different partner each time," he explains. "The need to make regular progress reports helped keep everyone on track. All the partners said it was the most successful project they had been in."

Unexpected synergy

The team was able to develop a new GPR antenna that can be submerged to depths of several metres. They created a combined GPR and seismic system that can be operated from a small boat by just two people, and tested it at sites across Europe, from the Netherlands to Greece.

The new system was so successful that it was able to map sediments that had baffled researchers for years. One example was sewage pollution affecting a flooded gravel pit in Slovakia. It turned out that the gravel extraction had left a series of small but deep holes across the floor of the pit. These holes, whose existence had not previously been suspected, were trapping the contaminated sludge. The site will be difficult to clean up, Tóth notes, but at least the researchers now know the cause of the pollution problem.

Collecting GPR and seismic data at the same time hugely improved the quality of the sediment mapping, and also brought unexpected benefits. "It turned out that the combination of data tells us a lot about the density and other properties of the sediment," says Tóth. "That's really useful to the people who have to remove the sludge, and who want to know more than just its thickness. This is a real advance in applied science."

The new system so impressed Geomega that the company bought the equipment for its own use, and now offers GPR surveys alongside its original speciality of seismic surveying. The two Dutch survey companies, which originally used only GPR, have likewise moved into seismic surveying as well. The technology is still quite specialised, so it will be used mainly by professional survey companies, Tóth explains. As a result, the world market may be limited to a few hundred units, but this is an important technology in which European SMEs now have a huge lead. "I'm not aware of anything like it anywhere in the world," claims Tóth.

Full title

Integrated geophysical techniques for surveying and quantifying potentially polluted sediments in European waterways

Industrial Sector

NACE 93 Other service activities

Supporting technologies

0269 Geophysics, Physical Oceanography, Meteorology, Geochemistry, Tectonics; 0596 Surveying; 0580 Soil Science, Agricultural Hydrology, Water Processes; 0669 Water: Hydrology; 0213 Environmental Technology/Engineering, Pollution Control

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- Terramentor EEIG (Greece)

RTD performers

- Aristotle University of Thessaloniki (Greece)
- Fractal (Hungary)
- Hydeko KV (Slovakia)
- MAP Environmental Research BV (Netherlands)
- Radar Systems Inc. (Latvia)

Duration

01/02-12/03

References

EVK1-CT-2001-30009

Programme

FP5: EESD

Project Cost

€1,170,000

Range of SME contribution

€120,000-€188,000

EC funding

€585,000



Helping gas turbines beat the heat

CRAFT

CRAFT-1999-70021

The ice storage system is based round a large tank, in which are placed thousands of water-filled plastic balls.

Gas turbines are compact and efficient sources of power, but their performance suffers as the temperature of the surrounding air rises. Conventional methods of cooling the intake air to increase output power are either of limited effectiveness or very expensive. The Ice Turbo project adapted an energy storage technology already used for air conditioning systems – plastic balls filled with ice – to create a low-cost way of boosting gas turbine power by as much as 25%. The new system relies on intermittent operation, which is perfect for gas turbines used to generate peak-load electricity. The new cooling system is now fully commercial and has great sales potential.

Listen to the roar of a gas turbine – essentially a jet engine in a box – and the last thing you would expect of such a beast is that it would wilt in hot weather. Yet gas turbines are sensitive to the temperature of their air supply, and an increase from 10°C to 35°C can reduce output power by a quarter.

That is bad news in hot climates, especially where gas turbines are used to generate electricity. Power demand peaks in the hottest weather, when air-conditioning is running at full stretch and the gas turbines are performing at their worst.

Cooling the intake air has been used for many years to increase gas turbine power, but all the existing methods have drawbacks. The partners in the Ice Turbo project developed a novel air-cooling system based on a proven technology: plastic balls filled with ice. For gas turbines used to generate peak-hour electricity, the Ice Turbo system is a simple and cost-effective route to more power when it is needed most.

Make ice when power is cheap

Because gas turbines can be started up in just a few minutes, generating companies switch them on during periods of peak electricity demand, explains Martine Fauré of SCITE, the French power company that coordinated the project. The fact that many gas turbines operate intermittently had already sparked an idea at CRYOGEL, a French SME that specialises in using ice to store energy.

CRYOGEL's business is based on the fact that large air-conditioning systems typically run at

full load only during the day. At night they have spare cooling capacity which can be used in conjunction with cheap off-peak electricity to make ice. The ice acts as a reservoir of 'cool' which can be released back to the air-conditioning system during the day, boosting performance and cutting power bills.

CRYOGEL realised that the technology could also be used to cool the intake air for a gas turbine. "Obviously, this won't work for gas turbines that run continuously," says Jean Patry of CRYOGEL, "but it's ideal for machines that are used only a few hours a day, to meet peak loads."

Gas turbines that run continuously can use conventional refrigeration systems to cool their intake air directly, explains Patry, but the cooling system consumes nearly a third of the extra electricity produced. A cheaper method is to spray water into the intake air, but this only works in dry climates and cannot boost performance by more than 10%. Ice storage systems for gas turbines have been tried before, but have tended to be costly and unreliable. The CRYOGEL technology, in contrast, had the potential to increase power by 25% while remaining simple, reliable and cheap.

Team and technology

To launch the project, CRYOGEL teamed up with SCITE and two other SMEs: Belgian plastics company INCOPLAS, and CEEETA, a Portuguese consultancy specialising in environmental policy and energy markets. The RTD performers were CRIF, a Belgian research and technology transfer centre; SIIF, which



At the heart of the Ice Turbo system is the ice container, a plastic ball full of water.

© CRYOGEL



CRAFT

CRAFT-1999-70021

specialises in building and operating renewable energy plants; and Dalkia, a multinational energy company based in France. "This project was simply too expensive for our company to carry out alone," explains Patry. CRYOGEL's ice storage system is based on water-filled plastic balls the size of large grapefruit. Dimples on the surface of each ball improve heat transfer, while inside are a nucleating agent to promote the formation of ice crystals and a flexible plastic insert to absorb the resulting expansion. Thousands of these balls are stacked randomly in a large tank.

During off-peak hours, electricity is used to power a conventional refrigeration system. Because it runs for up to 18 hours a day, the refrigeration system can be much smaller, and therefore cheaper, than if it had to provide the same total amount of cooling during the peak demand period. The refrigeration system cools a solution of ethylene glycol, better known as antifreeze, which is sprayed over the balls to freeze the water inside. When the gas turbine is running, the glycol spray stops and the intake air is simply blown through the tank of balls. As the ice melts, the air temperature falls to around 5°C.

The prototype was developed around a 5 MW gas turbine operated by Dalkia at Nogent-sur-Oise, France. Once a number of minor technical problems had been solved, the system worked exactly as planned.

Proven performance

By increasing the power available from existing gas turbines, the Ice Turbo technology can delay the need for investment in new generating plant and so help keep electricity costs down. In cases where existing plant is operating near its limits, the new system can also increase the reliability of the electricity supply. "At peak periods we can increase the capacity of a gas turbine by more than 20%, for a typical investment cost of €250 for each additional kilowatt of output power. That's less than half the cost of increasing capacity by installing a new gas turbine," says Patry. The technology is aimed at gas turbine manufacturers, suppliers of packaged generating systems, power companies and operators of large plants who generate their own electricity. CRYOGEL has had inquiries from France, Spain, Switzerland, Tunisia and the Caribbean for systems to suit gas turbines from 5 MW to 40 MW, and hopes soon to provide the first commercial installation.

"SCITE has been involved in operating and maintaining power plants for many years," says project coordinator Martine Fauré. "This project could bring us new opportunities in cogeneration or power production, as well as retrofits to improve the performance of our existing plants."

Full title

Study, optimisation and experimentation of a thermal storage made of ice containers for combustion turbine inlet air cooling allowing a better efficiency of the electric production

Industrial Sector

NACE 40 Electricity, gas, steam and hot water supply

Supporting technologies

0251 Gas Turbines for Energy Conversion; 0614 Thermal Engineering, Applied Thermodynamics; 0116 Combined Heat and Power Systems

Information

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- Centro de Estudos em Economia da Energia, dos Transportes e do Ambiente (CEEETA) (Portugal)

RTD performers

- CRIF (Belgium)
- SIIF Energies (France)
- Dalkia (France)

Duration

01/01-01/03

References

CRAFT-1999-70021

Programme

FP5: EESD

Project Cost

€1,241,000

Range of SME contribution

€31,000-€205,000

EC funding

€618,000



Learning from Roman mortar

CRAFT EVK4-CT-2001-30004

Roman mortar at Xanten (Thermen) in Germany.

© Peter Kienzle, ITER Consortium

The goal of the ITER consortium was to discover why Roman mortar is so resilient. A combination of innovative isotope technology and traditional methods helped to identify a unique property of Roman mortar that accounts for its durability. Isotopic and mineralogical data collected from three archaeological sites was used to construct a database of mortar characteristics, which is being used to reproduce mortars for the authentic conservation of ancient buildings and artefacts. The knowledge gained from this CRAFT project is being used to develop new construction techniques and to produce improved mortars.

Roman buildings were made to last. One of the key reasons for their longevity is the quality of the mortar used in their construction. The best Roman mortars are durable, strong and resistant to water. “The goal of the ITER project,” explains Dr Caterina Rehm-Berbenni of FUTUREtec, “was to understand how the Romans prepared their mortars to enable them to remain durable.” Roman mortars can remain effective for up to at least 2,000 years, while modern mortars are often in need of restoration after 50 years. In addition to helping reproduce ancient mortars, a better understanding of Roman mortars could therefore also aid in developing better modern mortars.

The ITER consortium consisted of four SMEs and two RTD performers. In addition, three antiquities authorities were subcontracted to the project. Rehm-Berbenni stresses the importance of this multidisciplinary approach. Fostering effective co-operation, for instance, between experts conducting mineralogical and isotopic analysis of ancient building techniques and knowledgeable specialists working in the protection of cultural heritage, was key to the success of this CRAFT project.

Isotopes and archaeology

The analysis of isotopes in mortar had not been done prior to the ITER project. This innovative isotope technology was conducted alongside traditional analytical techniques, to examine samples of Roman mortar from three major archaeological sites, with the help of the relevant antiquities authorities. The sites,

representing different climatic and environmental conditions, were in Germany (Colonia Ulpia Traiana, Xanten), Italy (Villa Traiana, Rome), and Israel (Caesarea Maritima).

The SMEs Hydroisotop (Germany) and Servin (Italy) conducted light isotope analysis, along with providing expertise on sampling procedures and data interpretation, while the mortar producer Krusemark (Germany) prepared mortar prototypes. The RTD performers provided dedicated research facilities, which were beyond the means of the individual SMEs. The Institute for Energy Technology (Norway) analysed heavy isotopes and light isotopes, while CNR (Italy) conducted the mineralogical analysis. The results, together with historical and bibliographical information, were stored in an internet database. FUTUREtec (Germany) constructed the database with Servin, developed an ITER co-operative working tool, and oversaw intellectual property rights issues relating to the project.

Many elements in nature consist of different isotopes, which are atoms of an element with different numbers of neutrons in their nucleus. Isotope technologies analyse differences in the ratios of isotopes in selected elements. In the mortar samples, isotopes of carbon (C), strontium (Sr), oxygen (O) and lead (Pb) were measured, along with sulphur (S) and nitrogen (N). This yielded important new information on the origin and composition of building materials, mortar preparation methods, building techniques, and how environmental factors affect mortars over time.



Villa Traiana, Rome.

© Klaus Seyfried, ITER Consortium

Self-healing mortars

The Romans knew what they were doing when it came to preparing mortar. "Roman building technology is based on a variety of mortar assemblages depending on the function of the building materials," explains Rehm-Berbenni. Although mortar from around the former Roman empire varies in composition due to differences in local materials (e.g. sand and limestone), distinct similarities in the ratios of components and preparation technique were observed at the three sites.

The most important finding of the ITER project was to show that part of the lime component in Roman mortar can remain reactive for hundreds and, in some cases, thousands of years. This is due to its encapsulation within lime nodules. While the outer surface becomes calcified, sealing off the mortar inside, the core retains small nodules of reactive lime. If the mortar becomes cracked and carbon dioxide enters the core, the reactive lime crystallises to form calcite. This acts to rebind the mortar. "The encapsulation of part of the binder in nodules is therefore an important part of the preparation technique," she says. "This property can explain the durability of Roman mortars." Conserving the past, building for the future The ITER consortium established models of Roman mortar composition and preparation technique. From this, Krusemark produced mortar prototypes at the laboratory level. Krusemark supplies mortar to archaeological and conservation bodies for use in heritage



projects, as well as to the building trade generally. Mortar prototypes, together with the mortar database, will form the basis of authentic mortars for the accurate conservation of ancient buildings and artefacts. They will also lead to the production of new mortars with improved durability for use in modern buildings. The knowledge gained from the study of bedding mortars in Roman cisterns, for example, may lead to new mortars with enhanced hydraulic performance. The methods of mortar analysis and preparation developed during the ITER project are being protected by the participating SMEs. This will enhance their prestige and increase their potential markets. Other spin-offs arising from ITER methodologies include the monitoring of materials in buildings and the assessment of air pollution that better distinguishes its impacts from that of intrinsic deterioration due to construction and materials. Rehm-Berbenni suggests that the project may have a widespread impact: "In the future, the methodologies could help to monitor the state of cultural heritage on a European level and provide, among others, dedicated IT tools for decision-makers."

CRAFT

EVK4-CT-2001-30004

Full title

Isotopic Technologies applied to the analysis of ancient Roman Mortars (ITER)

Industrial Sector

NACE 45 Construction

Supporting technologies

0143 Cultural Heritage: Preservation and Restoration/Cultural Studies; 0373 Materials Technology/Engineering; 0089 Building Construction, Shell Sustainability

Information

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- FUTUREtec GmbH (Germany)

RTD performers

- Istituto per la Conservazione e la Valorizzazione dei Beni Culturali (ICVBC) 'Gino Bozza' – CNR (Italy)
- IFE, Institute for Energy Technology (Norway)

Duration

04/02-07/04

References

EVK4-CT-2001-30004

Programme

FP5: EESD

Project Cost

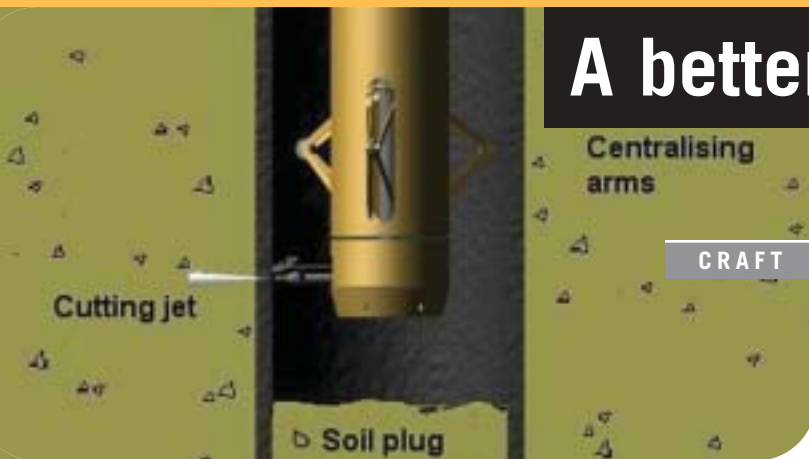
€957,251

Range of SME contribution

€96,000-€192,000

EC funding

€478,179



A better way to remove old oil wells

CRAFT CRAFT-1999-70845

Jetcut's system can be lowered into a well or a tubular steel pile (as in this diagram) to produce a quick, clean cut without disturbing oil-contaminated sediments on the seabed.

The Jetcut project has developed an advanced abrasive water-jet cutting system for removing offshore oil and gas wells. The new-generation Jetcut system is powerful enough to cut through thick steel pipes and water-filled gaps that are beyond the scope of existing water-jet cutting systems. Such jobs normally require explosives, which can kill marine life and release oil into the water, so in environmental terms the new cutting system is a big improvement. The new system also has potential applications in decommissioning nuclear power stations and other process plants, while a novel hydrocarbon sensor developed as part of the project could find a wide market in pollution monitoring.

When a sub-sea oil or gas well reaches the end of its productive life, environmental concerns dictate that as much of it as possible should be removed. Each well is lined with a series of concentric steel tubes known collectively as the well casing. To avoid future damage to fishing nets, this casing needs to be cut off several metres below the sea bed. With an estimated 30,000 offshore wells in the world – more than 4,000 of them in Europe – there is a big market for decommissioning services. Until now, however, no method of cutting the well casing has been completely satisfactory, explains David Dent, managing director of Circle Technical Services, the lead partner in the Jetcut project.

Accordingly, the company set up a collaborative project to develop an existing technology, abrasive water-jet cutting, to the point where it could be used for the challenging task of severing well casings. "It has been extremely successful," says Dent. "We now have a commercial lead in Europe and the USA, and possibly in the world."

Drawbacks of existing methods

Explosives are often used to cut well casings, but this has two big environmental drawbacks. The explosion can kill nearby fish, turtles and marine mammals, and it also disturbs the mound of cuttings that surrounds the well from the original drilling operations. Older wells used oil-based drilling fluids, which are likely to release oil into the water. "Oil companies are not forbidden to use explosives," says Dent. "But in sensitive areas

such as the Gulf of Mexico they are fined heavily for any environmental damage that results."

Another cutting method involves a milling machine that can be lowered down the well. This is less damaging to the environment, but it is slow and often unreliable. "With a mechanical cutter there is always the chance that it will get stuck," Dent explains. "Since the operation costs tens of thousands of euros a day, that can be very expensive."

Circle Technical Services is based in Aberdeen, the hub of the UK's oil industry. The company already had a strong background in abrasive water-jet cutting, a technique in which a narrow jet of water containing hard mineral particles is blasted out of a nozzle at very high pressures. Existing jet cutting systems operating at pressures of 350 or even 700 bar could cut through several centimetres of concrete or steel, but were defeated by the special construction of well casings.

"The problem," explains David Dent, "is that in old wells the cement-based grout between the steel tubes often breaks up, leaving water-filled gaps that dissipate the energy of the cutting jet. The company decided that a specially-designed jet cutting system operating at 1,000 bar was needed, and put together a project to develop one."

Upping the pressure

The Jetcut project had three other SME partners. CM Ingegneria, an Italian engineering firm, made some of the specialised parts needed for the new cutting system. Lateral, a



The water jet from the yellow Jetcut cutting head slices through a well casing from the inside.



CRAFT

CRAFT-1999-70845

Norwegian company based in Stavanger, defined the decommissioning requirements for the Norwegian sector of the North Sea, and German company Capsum developed a specialist hydrocarbon sensor to monitor pollution. Research was carried out by the National Hyperbaric Centre in Aberdeen and by GKSS Forschungszentrum in Germany. Together, the project partners developed a new generation of water-jet cutting systems that combines very high pressures with high flow rates. The bulk of the equipment, including the water pump and the system that mixes in a controlled quantity of abrasive garnet particles, is skid-mounted on a barge or drilling platform at the surface. A hose connects this equipment to the actual cutting jet, which can be up to 1000 metres below the sea surface.

"We had to develop every part of the system, from the pump to the cutting nozzle," says David Dent. Key to the system's success, he explains, is a 'manipulator' which ensures accurate cuts by controlling the jet's position and cutting speed precisely. A specially-developed acoustic sensor helps the operator on the surface monitor the progress of the cut, while the hydrocarbon sensor checks that no oil is being released.

Tapping the market

The prototype cutting unit is now undergoing trials in the North Sea with a leading

European sub-sea contractor. Once the system is fully proven, Dent foresees an excellent commercial future. Circle Technical Services owns the intellectual property rights, and will provide services based on the new cutting system from its offices in Aberdeen, Louisiana and Singapore. "Our best prospects are in the Gulf of Mexico, because of the combination of the age and number of the wells there – more than 4,500 structures altogether," he says.

The new cutting system is not limited to oil and gas wells. It can also be used to remove piles and other sub-sea structures, while outside the oil industry it may have applications in decommissioning chemical plants and nuclear power stations. The submersible hydrocarbon sensor developed as part of the project is a compact and robust instrument with many other applications, such as monitoring oil discharges from ships, shipwrecks and industrial plant.

With just 30 people, Circle Technical Services could never have afforded to develop a project on this scale without outside help, says Dent. "I have been very pleased with the cooperation between the partners, and with the overall progress," he says. "Together, we have developed a cutting technology that is quick, cost-effective, reliable and environment-friendly, and that has to be a winning combination."

Full title

Remotely operated abrasive water-jet cutting for offshore oil and gas well removal

Industrial Sector

NACE 11 Extraction of crude petroleum and natural gas + service activities, excl..

Supporting technologies

0447 Offshore Technology, Soil Mechanics, Hydraulic Engineering; 0305 Hydrocarbons Exploration and Production; 0105 Civil Engineering (Incl Pavements and Structures); 0213 Environmental Technology/Engineering, Pollution Control

Information

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SME proposers

- Prime: Circle Technical Services Ltd. (UK)
- CM Ingegneria srl (Italy)
- Lateral AS (Norway)
- Capsum GmbH (Germany)

RTD performers

- National Hyperbaric Centre (UK)
- GKSS Forschungszentrum (Germany)

Duration

10/02-09/04

References

CRAFT-1999-70845

Programme

FP5: EESD

Project Cost

€1,852,000

Range of SME contribution

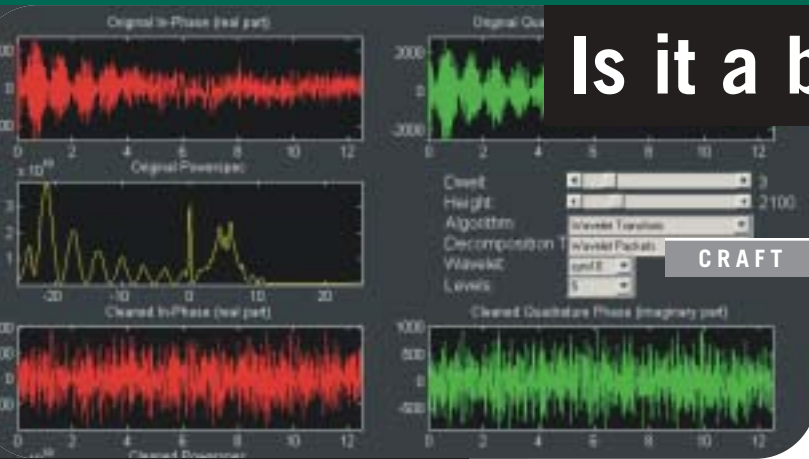
€144,000-€349,000

EC funding

€925,000



Is it a bird, a plane – or just the wind?



The Mepros algorithm in action removing background noise from signals.

Worldwide, the market for radar and acoustic wind profiling systems is dominated by one company. This situation has so far hindered innovation in the area of specialist software for particular sectors of the market. Mepros, a CRAFT project, is an example of how small and medium-sized enterprises (SMEs) and academic research partners can successfully capture a niche market by pooling their resources. Six SMEs and three universities have developed a system that improves the profiling of atmospheric wind layers. It means that airports can better distinguish between air turbulence and 'noise' due to bird flight or backscatter from aircraft, resulting in both increased safety and cost-savings.

Airports rely on the continuous monitoring of atmospheric conditions using radar and acoustic wind profiling systems to get a detailed picture of the local weather. They can then advise on flight conditions and in particular warn aircraft of air turbulence. However, air traffic controllers can be misled when wind profilers interpret ground 'clutter' and disruptive signals from birds or aircraft as air turbulence. For the first time, a consortium led by a German SME has developed a statistical programme based on wavelet technology that can identify and eliminate underlying 'noise' peaks in the electronic signals of wind profiles.

Jürgen Spiess of SHE Informationstechnologie AG in Germany, the joint project coordinator, stresses the importance of the multi-disciplinary approach to the success of the project. "We wanted both manufacturers and end-users in our consortium, as well as mathematicians, software developers and applications specialists. The producers helped the researchers understand how wind-profiling devices need to work in practice, while the end-user made sure everyone understood what the market wanted. Software objectives were divided among the three research partners. One worked mainly on the theoretical aspects, another incorporated the new algorithm for testing purposes into software it had already prepared, while the third completed the final algorithm."

Decontamination

The innovation behind Mepros can be compared to the digital re-mastering of old music

records on to compact discs. Many of the hisses and scratches heard on the original recordings can be removed, while the music itself is left unaltered. In a similar way, electronic noise can be filtered out of electronic measurements of wind profiles.

For example, the consortium has simulated bird flight and produced an electronic waveform for it. If a wind profile signal happens to be contaminated by the noise of bird flight, an inverse representation of this waveform superimposed on it should remove a lot of the noise. Of course, each bird flight will sound a little different. In fact, the consortium has built up a library of high-quality test data of background noise in real situations – one of the project's key achievements.

"The main challenge we faced was to get good data from real time measurements," observes Spiess. "This meant that somebody had to go to the radar wind profiler at a large international airport and take recordings for a few days. We had to make sure the data we collected was fully compatible with the software being developed. There is a multitude of different noises in the environment and all of them have to be identified and statistical models for each constructed in order to remove them."

Potential market

Before the Mepros project finished at the end of October 2004, a competitive prototype was available together with a library of statistical models which could be built into existing wind profilers. Relatively few of the world's



Radar wind profilers provide continuous wind measurements.



CRAFT

EVK2-CT-2002-30002

airports use radar wind profilers, which would qualify them for the Mepros software package. However, test fields employing wind turbines would also be interested. "I think it will take less than a year after the end of the project to make the product fully marketable," says Spiess. "Although we expect to sell some tens of units in the first year, the market potential may be as high as 1,000 a year. Naturally, this will depend very much on the price, which looks likely to be around €10,000."

All the participants in the project should benefit from its success. Because this is a niche market, there are relatively few suppliers worldwide and the ones participating in this project have collaborated for the first time. The enhanced pan-European network of business contacts gained from this collaboration should give each of them a competitive edge. "The SME manufacturers will be able to offer devices incorporating Mepros that generate better data than their competitors," Spiess points out. "The end-user SME had the opportunity of advancing its own ideas, and will benefit from making use of the results of the project at a low cost. The SME software developer will be able to offer Mepros as a package by itself or incorporate it into one of its existing software tools, and so extend its product portfolio."

Cheaper, safer flights

Mepros could greatly improve detection of the 'shear winds' which can destabilise planes at take-off and landing, by providing accurate alerts in real time. "This should reduce the number of false reports of air turbulence which currently cause the temporary grounding of aircraft," explains Spiess. "These are costly to the airlines and discourage passengers from flying. The more operators can rely on the accuracy of weather forecasts, the more they can reduce costs. Wind profiles in particular directly influence the calculations of the amount of fuel that has to be carried on a plane, which must include a large safety buffer. There is little doubt that Mepros is a significant step towards cheaper and safer flights."

The consortium has tentative plans to continue the development of the Mepros software after the end of the project. One ambitious prospect for the future is that, with suitable modifications to the algorithm, the software could be used to remove background clutter in all kinds of electronic data streams.

Full title

A new and innovative meteorological profiling system based on wavelet technology for radar and acoustic devices

Industrial Sector

NACE 93 Other service activities

Supporting technologies

0129 Computer Science/ Engineering, Numerical Analysis, Systems, Control; 0269 Geophysics, Physical Oceanography, Meteorology, Geochemistry, Tectonics; 0290 High Frequency Technology, Microwaves; 0563 Signal Processing

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SME proposers

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- Bristol Industrial & Research Associates LDT (United Kingdom)
- Scintec AG (Germany)
- Eurelectronica ICAS SRL (Italy)
- Espace Eolien Développement (France)
- Metek GmbH (Germany)

RTD performers

- Fachhochschule Worms (Germany)
- Universität Bremen (Germany)
- University of Aveiro (Spain)

Duration

11/02-10/04

References

EVK2-CT-2002-30002

Programme

FP5 key action Global Change, Climate and Biodiversity

Project Cost

€1,049,400

Range of SME contribution

€4,000-€45,000

EC funding

€511,700



Subsea robot makes the connection

CRAFT

CRAFT-1999-70441



The 16-metre HTCU (Hot-Tap Cutting Unit) ready for deployment.

With North Sea oil and gas reserves starting to run down, attention is shifting to the smaller fields. But how can a small field be connected to the main subsea pipelines? Traditional methods are expensive and require a diver to weld a junction into the pipe on the seabed. In the Pipetap project, a remotely controlled machine is lowered on to the pipe and makes the connection independently. As well as improving the prospects for operators of small fields, the system could be used to supply coastal gas-fired power stations and even to seal leaks in sunken oil tankers. Norwegian oil giant Statoil has already bought one system and is conducting field trials in the North Sea.

When the North Sea gas and oil fields started producing in the 1960s, it seemed that Europe could look forward to a long period of bountiful energy from its own sources. That period is now coming to an end. The larger fields are starting to run down and oil companies are turning their attention to the smaller fields that are more difficult and costly to exploit.

Clear Well Subsea, an SME based in Aberdeen, offers design and consultancy services to oil companies trying to bring small fields into production. One problem such companies face is the expensive necessity of running an undersea pipeline from their field to one of the major trunk lines carrying oil or gas to the shore. By working with clients on various such projects, Clear Well discovered that one key element of the cost was exporting gas from the field. "Small oil fields very often have a burden of gas in the reservoir and there is no easy method of transporting it away," says Keith Evans who is managing the Pipetap project. "And it's the export pipeline for the gas that is very often the stumbling block in the costing of a small field development. So we wanted an alternative strategy for providing that export route."

What was needed was a simple way of connecting the small gas pipe from the field to a larger trunk line without interrupting the flow, an operation known as 'hot tapping'. Traditionally, such connections have been made by a diver working in a pressurised chamber surrounding the pipe and welding the junction into place – a very expensive

option. The aim of the CRAFT project was to do the whole operation remotely. "We hoped to develop two distinct technologies," says Evans. "The first is a different method of making the branch connection to the pipeline, and the second is to use friction stitch welding between the host pipe and the branch nozzle."

No divers needed

Three other SMEs – Circle Technical Services, Norwegian Universal Technology and NEOS Robotics – joined the CRAFT consortium to offer their experience and know-how in different aspects of bringing the new product to market. They were assisted by two research partners, GKSS in Germany (which specialises in undersea welding) and the UK's National Hyperbaric Centre, which had expertise in hot tapping.

In the Pipetap system the remotely controlled hot-tapping machine is lowered to the seabed from a ship stationed above the main pipeline. It clamps on to the pipe and then performs a series of operations to create a T-junction and valve to which the branch pipe is connected. The whole process is controlled from the ship and no divers are needed.

Statoil, the Norwegian oil company, has already bought a Pipetap machine and is conducting field trials. They plan to demonstrate it to other companies with the intention of having it available for all the Norwegian pipeline operators.

"We generate our revenue from sales of the system and also from supporting it through a licensing scheme," Evans explains. "Statoil is



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CRAFT-1999-70441



negotiating with us for a worldwide licence to exploit the technology. We have also had interest from a couple of subsea contractors in Aberdeen. They are waiting to see how the system sold to Statoil performs during the proving trials this winter."

Specialised market

The potential market for such a specialised technology is not large – Clear Well expects to sell another three Pipetap systems over the next two years – but Evans is already looking at other products that could emerge from the work. "We have a couple of other associated technologies we should like to go on to develop. But we're not exactly trumpeting them at the moment because we want to keep the commercial side of it fairly tight until we feel we've got a product we can protect." The project is set to transform the prospects of operators of small oil fields. Until now, only two companies offer hot-tapping services – using conventional methods – and Pipetap's new technology provides a cheaper alternative for connecting small fields to the pipeline system.

Meanwhile, other applications come to mind. Pipetap could be used to drain oil from sunken

tankers, especially those in deep water, and to seal leaks. Statoil are interested in using it to create direct feeds from subsea gas pipelines to customers such as gas-fired power stations, offering the possibility of new employment in coastal communities hit by the decline in fishing or shipbuilding.

There are other benefits too. "All the SME partners have been able to tap into the larger research institutions and benefit from their experience," notes Evans. "Those are areas of expertise a small company would not have been able to access otherwise. NEOS has been able to develop its robotics expertise and NUT has been exposed to new markets and new customers. It has certainly helped us expand our client base and given us confidence that we can take forward a European project and reach a successful outcome – you don't have to be a large company to be involved in one of these projects.

"We'd like to thank the EU for the active support we have received," he adds. "It's enabled us to fight well above our weight band in the arena. It's been a good project for all the partners."

Full title

Remotely operated hot tapping of deep water subsea pipelines

Industrial Sector

NACE 11 Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction, excluding surveying

Supporting technologies

0368 Marine: Instrumentation and Underwater Technology; 0418 Natural Gas; 0488 Pipeline Technology; 0633 Transport of Gas and Liquid Fuels

Information

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SME proposers

- Prime: Clear Well Subsea Ltd (United Kingdom)
- Circle Technical Services Ltd (United Kingdom)
- NEOS Robotics AB (Sweden)
- Norwegian Universal Technology AS (Norway)

RTD performers

- GKSS Forschungszentrum Geesthacht GmbH (Germany)
- National Hyperbaric Centre Ltd (United Kingdom)

Duration

10/01-03/03

References

CRAFT-1999-70441

Programme

FP5: EESD

Project Cost

€1,331,000

Range of SME contribution

€0-€246,000

EC funding

€684,000



New tests to fight lung diseases

CRAFT QLK2-CT-2002-70963

The project logo uses two of the last paintings by an artist who suffered from lung disease.

© By courtesy of HJ Houthoff

Faster and more accurate ways of diagnosing tuberculosis and other lung diseases would help doctors to counter a worrying trend. A team of biotechnology SMEs supported by research centres in the Netherlands, Belgium and Spain has devised a new set of tests for five important lung infections, that promise much faster and more accurate identification of the diseases. In the long run the work could lead to a single test for all five pathogens that could be used by doctors at the point of care to produce reliable diagnoses. This will allow quicker and more targeted treatment of diseases and reduce the over-prescription of drugs.

According to the World Health Organization, the number of new cases of tuberculosis (TB) in the world rose by 2.4% to 8.8 million in 2002. The fastest growing areas are Africa and the countries of the former Soviet Union but, with greater mobility of populations, more and more cases are appearing throughout Europe.

The early symptoms of TB can be similar to many other lung infections and it can be difficult for a general practitioner to make a reliable diagnosis. A patient with a cough and a fever may have a virus or any of a number of bacterial infections of which TB is the most feared. Several tests for TB and for other pathogens are available, but they all require samples to be sent to a clinical laboratory and diagnosis may still be uncertain. The most reliable is the culture test but this can take six to eight weeks – simply too long for adequate disease management.

“If you could have a test that could be conducted in one or two days, with a very high sensitivity and specificity, that would be a major breakthrough in the diagnosis and treatment of TB,” says Dr Jack Veuskens of Kreatech, a Dutch biotechnology company which has worked for several years on the diagnosis of TB. “But then we thought, why not incorporate other pathogens that cause diseases with similar symptoms?”

A so-called ‘differential’ test would look simultaneously for TB and other important pathogens. A positive result for TB would then carry more weight if the other bacteria could be ruled out at the same time. And, whatever the result, the doctor could then prescribe a more specific drug treatment with greater confidence.

Five pathogens

Kreatech already had experience in designing diagnostic tests for TB based on proprietary technologies to isolate and identify molecules specific to the bacterium causing TB. They had also led an earlier EU-funded project on TB and had learned the art of managing international collaborations.

“So we had the idea and then we gathered collaborators who already had a major track record in the areas we were interested in,” says Veuskens. “They are all specialists in their own fields of expertise. And it became clear from talking to hospitals in the Netherlands and elsewhere that there really was a need for a differential test.”

Apart from Kreatech, which coordinated the project, the SMEs in PulmInfect include Belgian firm Diamed Benelux (former Eurogenetics), which had long experience of the diagnostic testing of pneumonia pathogens, and Vitro, a Spanish company with expertise in biosensors. Each company brought in research institutes they had previously worked with.

The consortium started by devising improved tests for five bacterial pathogens: tuberculosis, legionnaires’ disease and three bacteria implicated in pneumonia, with the ultimate aim of devising a combined differential test for all five. Each test identifies the pathogen by looking for three different signals: its DNA (the genetic material unique to that organism), its antigens (characteristic molecules on the surface of the cell), and the antibodies produced by the human body as part of its response to infection. The three factors together improve accuracy and give some indication of the development of the infection.



CRAFT

QLK2-CT-2002-70963



They also studied the form of the test. The classical laboratory test – the ELISA – is too slow and cumbersome for widespread clinical use, so PulmInfect created prototypes of more convenient and simpler test formats known as micro-arrays (suitable for relatively cheap screening tests) and biosensors (suitable for point-of-care tests).

Quick results

Depending on the chosen format, the differential test could deliver results in two days or even less. "It is most likely that a micro-array will be first and then the biosensor, unless somebody with a really good biosensor technology comes along," says Veuskens. "And the advantage of a biosensor is that it is really useful in a point-of-care set-up where the doctor does the test him- or herself." It could be a further three to five years before such a multi-pathogen test is on the market, but the benefits to society are not hard to see. "The benefits are increased sensitivity and specificity – it is that simple," Veuskens stresses. "To be on the safe side, a doctor will often prefer to treat patients who are not infected with TB rather than take the risk that they are infected and leave them untreated. If we can reduce this misdiagnosis, it will definitely improve the welfare of patients and those who live near them."

Even where TB is not implicated, the multi-pathogen test will help doctors diagnose common lung infections more quickly and so prescribe more specific treatments, especially where more than one pathogen is involved. It should be possible to reduce the unnecessary use of broad-spectrum antibiotics and so slow the rise of resistant strains. In principle viruses, as well as markers for other disorders (such as lung cancer) could also be added to the test. And the technologies developed in PulmInfect could be used to develop quick and simple tests for other infectious diseases. In the meantime the SME partners are busy commercialising early results from the project. Kreatech, for example, has already farmed out products for TB diagnosis that are expected to come on the market in 2005, and products based on the other individual tests may follow. "As the coordinator of PulmInfect, I have not seen a basic research project that has been so successful in terms of scientific output," Veuskens comments. "This is definitely the most rewarding project I have been involved in."

Full title

Differential diagnosis of infectious lung diseases

Industrial Sector

NACE 85 Health and social work

Supporting technologies

0074 Biomedical Sciences; 0159 Diagnostics, Diagnosis; 0311 Immunology, Immunotherapy, Immunoassays; 0317 Infections; 0381 Medical Sciences/Research

Information

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SME proposers

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- Diamed Benelux NV (Belgium)
- Vitro SA (Spain)

RTD performers

- Erasmus University Medical Centre (Netherlands)
- Koninklijk Instituut voor de Tropen (Netherlands)
- Leiden University Medical Centre (Netherlands)
- Limburgs Universitair Centrum (Belgium)
- Rega Institute, Katholieke Universiteit Leuven (Belgium)
- Universidad de Oviedo (Spain)

Duration

06/02-05/04

References

QLK2-CT-2002-70963

Programme

FP5: Quality of life

Project Cost

€1,773,000

Range of SME contribution

€208,000-€408,000

EC funding

€886,000



Fast test for antibiotic resistance

CRAFT

QLK2-CT-2001-70561

Miniaturised electrode.

One of the main reasons for the rise in antibiotic-resistant bacteria is the inappropriate use of antibiotics – clinicians prescribe treatments with no knowledge of the susceptibility of the infecting bugs. A group of four European universities and three SMEs formed the Rastud project to develop a rapid testing system based on the phenomenon of dielectrophoresis. Bacterial samples can be treated with a range of antibiotics and their susceptibility measured within an hour by measuring their behaviour in a non-uniform electric field. The technology has good market prospects in Europe's hospitals and should result in reduced mortality, lower hospital costs and improved treatment outcomes.

Ever since the discovery of penicillin in 1928, bacteria have resisted attempts to keep them at bay. Despite powerful antibiotics, resistant strains are now common – superbugs are on the loose!

Hospitals are especially prone to resistant bacteria like methicillin resistant *Staphylococcus aureus* (MRSA). The WHO estimates that, each year, resistant bacteria cause around 60% of hospital infections and are responsible for over 14,000 deaths.

To diagnose the antibiotic susceptibility of infections, most hospitals use a traditional system of agar diffusion assays or broth dilution tests. However, these tests require an incubation stage of 24 hours or longer, so treatment is often prescribed before a clinician really knows which antibiotic would work best.

Rapid response

"To overcome inappropriate treatments – which only compound the problem of bacterial resistance – we need rapid assays," says Peter Salmon, the coordinator of the Rastud project. "Even the current rapid methods of assessing the antibiotic susceptibility of an organism are limited, as the majority of systems require the pre-processing of organisms and still rely on the growth of bacteria."

Peter Salmon is CEO of Cell Analysis, a small firm in the United Kingdom that develops technologies based on a phenomenon called dielectrophoresis (DEP). "When cells are placed in a non-uniform electric field they can be induced to collect upon microelectrodes," explains Salmon. "The extent of collection

varies as a function of the electric field frequency and is determined by cell characteristics. Changes in the surface chemistry or structure of a cell – caused for example by antibiotic treatment – lead to a corresponding change in the dielectrophoretic frequency response. DEP can be performed directly on a sample, without the need for incubation. Instead of waiting days for results on antibiotic resistance, clinicians should in future have the results they need within an hour."

Adept adaptation

Cell Analysis formed the Rastud project to adapt its patented DEP platform technology for testing antibiotic susceptibility in bacteria. The group combines the interests of two further European SMEs and four universities. The Institute for Microsensors, Actuators and Systems at the University of Bremen performed the research into microelectrodes. It investigated the best materials to collect the bacteria during DEP analysis and assessed the designed electrode arrays to produce the best resolution of bacteria. It found that multi-channel, dual electrode arrays permitted the simultaneous analysis of sensitivity to eight different antibiotics. The electrode arrays were coated in a thin polymer film to inhibit bacterial adhesion.

Meanwhile, researchers at Madrid's Universidad Complutense and the University of York in the United Kingdom focused on the microbiology. They looked at a range of bacterial strains and antibiotic treatments to test whether DEP was appropriate in a clinical



CRAFT

QLK2-CT-2001-70561

context. Computational models were developed to explain and predict changes in the dielectrophoretic characteristics of bacterial cells following exposure to an antibiotic.

Sheffield Hallam University developed the mathematical algorithms and pattern recognition software (based on a mathematical technique called eigenvector decomposition) to distinguish between susceptible and resistant cells in the dielectrophoresis data. The university assessed the statistical reproducibility of the technique, and found it to be reliable and accurate. In addition, the team developed a graphical interface for the bacterial classification program, which could also be used to quickly identify bacteria (as well as their antibiotic susceptibility) by electronic analysis.

Cell Analysis integrated the results from the four different RTD performers into a prototype system. The company worked closely with the German project partner Protron Mikrotechnik, a specialist in biological and medical microfluidic devices, to scale down the technology from laboratory dimension to a miniaturised device. The final prototype measured 40cm³, opening up the potential for this technology to be used at the point of care, circumventing the extra bureaucracy and costs of clinicians having to use laboratories to assess samples.

SME partner IDC, based in the UK, looked at possible designs for a commercial product.

Beating the superbugs

"Our prototype system can detect bacteria that are susceptible or resistant to a wide range of antibiotics. We are pleased with the success of the Rastud project, and benefited from a team of researchers and SMEs that worked well together. We were clear on our objectives and all worked to achieve them," says Salmon.

He adds that the market prospects for this technology are good for all the SMEs that share in the IPR stemming from the project. "All three of the SMEs participating in Rastud should expect a keen interest in any products they develop. Health authorities are desperate for technologies that permit faster and more informed prescribing of appropriate antibiotics, reducing hospital costs and improving public health."

More work is required before the technology can be commercialised, however. "We achieved all the project milestones and a prototype system," Salmon explains. "Now we have to turn it into a user-friendly, commercial product."

Whilst the commercial benefits have yet to be realised, Salmon is keen to point out eventual benefits that European citizens can expect to see from Rastud. "The potential returns on investment are high in terms of reduced patient mortality, lower hospital costs and more effective treatment. Antibiotic resistance problems will be greatly reduced by avoiding current broad-spectrum prescription practices."

Full title

Rapid antibiotic susceptibility testing using dielectrophoresis

Industrial Sector

NACE 85 Health and social work

Supporting technologies

0039 Antibiotics; 0382 Medical Technology; 0391 Microbial Biotechnology, Microbial Modelling; 0393 Microbiology; 0395 Micro-electronics; 0396 Microengineering, Micromachining; 0397 Micro-systems; 0474 Pharmaceuticals and Related Technologies

Information

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SME proposers

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RTD performers

- Sheffield Hallam University (United Kingdom)
- Universidad Complutense de Madrid (Spain)
- Universität Bremen (Germany)
- University of York (United Kingdom)

Duration

01/02-12/03

References

QLK2-CT-2001-70561

Programme

FP5: Quality of Life

Project Cost

€1,402,000

Range of SME contribution

€55,000-€412,000

EC funding


€773,000



Oxidation cleans up contaminated effluents

CRAFT

EVK1-CT-2001-30014



Electrochemical oxidation unit.

The manufacture of printed circuit boards (PCBs) and metal finishing processes both use a number of harmful organic chemicals that are difficult to treat. A group of European SMEs formed a research project to develop a new process that efficiently degrades these compounds. ROCWAT combined advanced oxidation and electrochemical oxidation processes to develop a prototype batch treatment system that can break down highly concentrated organic-bearing effluents to a level acceptable for discharge. Full in-line integration of the novel system should enable SMEs using recalcitrant organic compounds to meet their environmental obligations whilst remaining competitive.

Despite fierce competition from the USA and Asia, Europe continues to be an important producer of printed circuit boards (PCBs). Both large corporations and small businesses contribute to an overall market worth around €4 billion a year.

Over the past few years, however, production has declined. At the same time, new EU environmental legislation is forcing manufacturers to invest heavily in new technologies to clean up their processes.

"Small companies especially are faced with a heavy burden," remarks Cecil O'Connor, Managing Director at P W Circuits, a high technology PCB manufacturer in the United Kingdom. "Many of the compounds used in the PCB industry are hazardous to human health and all can be harmful to the environment. Given the financial constraints of the PCB market, companies are increasingly looking for innovative technologies that will deal with these substances more effectively and cheaply."

Recalcitrant compounds

Some of the most noxious chemicals used in PCB production do not respond well to current clean-up technologies. They include wetting agents and chelating agents, especially a compound known as EDTA (ethylenediaminetetraacetic acid). EDTA is a complexing agent with low biodegradability that tightly binds heavy metals, including copper and nickel.

"There are a number of methods that treat organic pollutants in effluent streams at the moment, but they are not always effective and they also produce secondary waste," says

O'Connor. "You end up with a sludge or a concentrated organic waste that has to be disposed of at further cost to the company. Also, these are end-of-pipe solutions, whereas it would be better to deal with these chemicals at source. What we really want is to decompose the organics into carbon dioxide and water. Then we can safely discharge the water."

Realising that this issue faced a large number of PCB manufacturers and metal-finishing firms across Europe, O'Connor teamed up with fellow SMEs in PCB manufacturing, metal-finishing and waste water treatment to form the ROCWAT project under the Fifth Framework Programme. "The overall objective was to develop new techniques which will efficiently and cost-effectively allow *in situ* destruction of these toxic organic compounds as an integral part of treating the effluent stream from the PCB manufacturing or metal-finishing processes."

Synergy

Through industry contacts the consortium of SMEs found two firms that agreed to act as the research and development contractors. C-Tech Innovation from Chester in the UK was already investigating electrochemical oxidation, while the speciality chemicals company Shipley Europe Ltd (now part of Rohm and Haas Electronic Materials) had looked at the possibility of an advanced oxidation technology in its own plants. ROCWAT decided to see whether these two complementary techniques could be combined into a single, highly efficient treatment technology.



Advanced oxidation unit.



CRAFT

EVK1-CT-2001-30014

Narinder Bains of Shipley Europe notes that advanced oxidation is not new, but has never been used much by SMEs, or applied in this particular industrial context. "Advanced oxidation uses ultraviolet radiation to form highly reactive hydroxyl radicals from ozone that destroy the organic compounds. These techniques have been around for more than 25 years, but their cost was initially too high for small manufacturers," he explains. "Now the prices have come down: ozone generators and UV reactors are much cheaper, and are readily and commercially available today. C-Tech's innovative electrochemical oxidation breaks down the organic compounds using specialised diamond-coated anode cells. By combining these two methods we hoped to develop a highly effective solution for the SMEs."

The two research contractors took a step-by-step approach. First they tested the two methods on laboratory samples of specific organic chemicals. They then went on to prove the feasibility of the methods on end-of-pipe effluent samples and concentrated wastes.

Treatment trials

Having demonstrated that both approaches worked well, the two RTD providers combined their technologies into a single prototype technology. The electrochemical process would first treat bulk organics, which would then be pumped into the UV-ozone unit for final polishing. Each SME tested the system for around a month.

The pilot successfully reduced organic contaminants in the waste stream from a chemical oxygen demand as high as 6,000 ppm to below 150 ppm, which is within the acceptable range for discharge to sewers.

"All the SME partners are pleased with the results of the batch processing," says O'Connor. "We are now looking to take this work further. We want to develop a system that can be integrated into the production line, and also assess the economic viability of the process."

O'Connor is confident that the innovative treatment will help to keep Europe's PCB and metal-finishing industries competitive. "The technology in this project will help many European SMEs to achieve their environmental targets and release them from the cost burdens of compliance. It will enable them to adapt to European regulations on environment protection by reducing the disposal of harmful wastes by at least 50%, by saving energy in processing, by avoiding the transport of hazardous materials, and by recycling water. It will also contribute to and encourage the environmental equipment industry across Europe, with consequent benefits to the community.

"We believe that ROCWAT and its successors will play an important part in protecting our environment and preserving the jobs of more than 50,000 people employed in PCB manufacturing in Europe today."

Full title

Removal of organic contaminants and recycling of waste water from electroless plating process streams

Industrial Sector

NACE 31 Manufacture of electrical machinery and apparatus, n.e.c.

Supporting technologies

0102 Chemical Technology and Engineering; 0213 Environmental Technology/Engineering, Pollution Control; 0670 Water: Monitoring/Quality/Treatment

Information

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- Water Treatment Cooperation AB (Sweden)
- Metakem Gesellschaft für Schichtchemie der Metalle GmbH (Germany)
- Graphic plc (United Kingdom)
- Alchemia Ltd (United Kingdom)

RTD performers

- C-Tech Innovation Ltd (United Kingdom)
- Shipley Europe Ltd (United Kingdom)

Duration

01/02-12/03

References

EVK1-CT-2001-30014

Programme

FP5: EESD

Project Cost

€1,118,000

Range of SME contribution

€41,000-€168,000

EC funding

€559,000



Inkjet printing marks new route for mobile device antenna

CRAFT

IST-2001-55034

Printed gold seed layer on ceramic puck.

A UK manufacturer of a highly efficient antenna for the latest mobile devices needed to find a new process to meet a rapid rise in demand. It assembled a consortium of European SMEs and technology research consultancies to develop a new method based on inkjet technology. Guide tracks are printed onto a ceramic core to form an adhesion surface for gold plating. The novel process will save time, reduce waste and help to maintain Europe's position in mobile device manufacturing. It will also boost uptake of the innovative antenna and lead to mobile devices that emit much less electromagnetic radiation.

You almost certainly own a mobile phone, and possibly a personal digital assistant (PDA) too. You may well be reading this on a laptop over a wireless network. Over the past few years Europe has taken to radio data transmission in a big way. More often than not, 'getting connected' needs no wires.

At the heart of every mobile telecommunications device is the antenna, which must be small and light yet capable of picking up the weak radio signals sent to the device.

In 2002 Sarantel, a small UK firm, launched a new antenna based on a copper helix wound round a ceramic core. The patented component uses much less power than a monopole antenna and cuts the amount of radiation the body absorbs by over 95%. This not only reduces any health risk associated with the heating of the cells next to the ear, but means the device will last longer between charges. Its accuracy makes it ideal for location-based applications, as it is possible to pinpoint the device to within a few metres. This makes a reliable and predictable automatic location identification (ALI) system for mobile phones easier to implement, which is important for the emergency services and could be used to provide travellers with information without relying on the GPS system.

Limited growth

Unsurprisingly, Sarantel has seen sales for its product soar, as Mark Dowsett, Director of Product Management and Applications, testifies: "We have about a 10-fold year on year increase in demand for the antenna. We

recognised that we would have to find a new way to make it if we were to meet demand in the long term." The existing process covers the ceramic core in a film of copper, which is then etched away to leave copper tracks. "We needed a high volume, precision manufacturing process that was not wasteful like etching. We knew we had to do some research."

With limited research facilities of its own, Sarantel approached Pera, a British technology consultancy, and asked it to help develop a new production process for the antenna. Together, Pera and Sarantel approached several SME partners across Europe and brought them together for the SAFE COMM project, funded under the CRAFT scheme within the Fifth Framework Programme. "The four other SMEs involved in this project all saw the benefits of this combined research for their own businesses and markets," says Dowsett, "and were willing to invest time and money in the project. Working with us would be a stepping stone for them."

Project on track

After 20 months the partners achieved their main aim – a prototype system that allowed the accurate printing of helical seed tracks onto the ceramic core, or 'puck', that could then be plated with a gold-based formulation to reproduce the antenna.

"The new process incorporates innovation in several areas," Dowsett remarks. "Gwent Electronic Materials (GEM) developed the ink formulations, while Citam Assembly



Nokia 7710 widescreen smartphone.

© Nokia 2004



CRAFT

IST-2001-55034

Automatics worked on the automation technologies required for accurate printing. DG Technology developed the dielectric measurement system. Siegfried Schaal Metallveredelung were the experts in plating and came up with the formulation for the final plating step."

SAFE COMM also benefited from the expertise of its two RTD performers, Pera and the Italian engineering consultancy D'Appolonia. The latter worked on the control systems for the printing process as well as the system for measuring the dielectric properties of each ceramic puck and the software that uses this information. Pera, meanwhile, assessed the accuracy of the final product, although it also helped Sarantel with the project management. "This project has made several technological breakthroughs," enthuses Dowsett, "especially in the formulation of the ink and the accuracy of the printing process. We have proof of principle and a demonstrator process and expect to apply this industrially in the near future."

Of course, it took a lot of work to reach this satisfactory result. "The challenge for all of us has been the tremendous amount of time needed to run and manage the project despite the excellent work of the RTD providers," says Dowsett. "Keeping to

timescales and budgets is hard and we had to run right up to the end. For instance, we initially thought that we would have the right ink formulation about three months into the project – in the end we only got it a month before the end!"

Everyone wins

Dowsett acknowledges the commitment of all the partners. "Our meetings were the best attended of any project I have ever worked on – we really gelled together, and everyone understood the benefits."

GEM, for instance, added an innovative ink system for the metallisation of electroceramic substrates to its portfolio, while Siegfried Schaal gained new experience in plating directly on these types of inks. DG Technology used the project to expand its business to the telecommunications sector. All the partner SMEs agreed that their businesses directly benefited from participating in the project. Dowsett argues that the whole of European society could benefit from SAFE COMM too: "The project should make it possible for us to manufacture many more of these antennae in a more environmentally friendly way whilst meeting the growing demand for safer and more efficient wireless devices."

Full title

Flexible printing of seeding layer for 3D twisted loop circuit on ceramic pucks to enable production of high efficiency antenna for cell phone location

Industrial Sector

NACE 64 Post and telecommunications

Supporting technologies

0054 Automation, Robotics Control Systems; 0120 Communication Engineering/Technology; 0192 Electronics, Electronic Engineering; 0228 Fine Chemicals, Dyes and Inks; 0399 Mobile Communications; 0504 Precision Engineering; 0509 Production Technology; 0609 Telecommunication Engineering/Technology

Information

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- Citam Assembly Automatics Oy, Finland
- DG Technology Service Srl, Italy
- Gwent Electronic Materials Ltd, United Kingdom
- Siegfried Schaal Metallveredelung GmbH & Co, Germany

RTD performers

- Pera International, United Kingdom
- D'Appolonia S.p.A., Italy

Duration

05/02-05/04

References

IST-2001-55034

Programme

FP5: IST

Project Cost

€1,157,599

Range of SME contribution

€28,000-€180,000

EC funding

€571,388



An array of 20 T3D quad antennas. Each antenna is around 1.3m wide and 2m high.

Wind radar technology surges forward

CRAFT EVK2-CT-2002-30004

Weather forecasting relies in part on accurate wind measurements, but existing high-frequency radars are not versatile. The T3D project combined the expertise of five European SMEs and a university research institute to produce a prototype radar profiler that overcomes the inadequacies of current equipment. The new system has a compact antenna array yet can profile winds in three dimensions at altitudes ranging from 150m to 15km. The new system should help improve weather forecasts, and may also find a major outlet in the European market of over 2,000 airports.

Whether you are piloting an aeroplane, predicting floods or simply planning a picnic, you will undoubtedly be relying on accurate weather forecasting. We take forecasts for granted, yet even short-term outlooks require supercomputers, complex modelling software and enormous quantities of data.

Wind measurements – not just on the ground but also at higher altitudes – are among the essential data elements necessary for good forecasts. At present meteorologists use high-frequency radar to profile wind movements. Very high-frequency (VHF) radar can detect wind patterns at altitudes from 2-15km whilst ultra-high-frequency (UHF) equipment is used to profile low altitude winds (100m-3km).

However, both of these radar techniques are subject to serious limitations. UHF radar can detect small echoes from rain, birds or insects in the lower atmosphere, but it cannot function in bad weather. VHF, on the other hand, requires a large antenna array, sometimes taking up thousands of square metres. The UHF and VHF radar coverage is also narrow, so it is difficult to profile wind patterns over a large area.

Combined vision

Gérard de Donato, an engineer at Systelia, a small French electronics research consultancy, says that the drawbacks of each radar technique affect the precision of current wind profiles. "Ideally, what you want is to take all the advantages of each technique and try to eliminate the disadvantages. You want a single system that can profile high-altitude

winds in all weathers like VHF, but with a small antenna and at low altitudes like UHF. And if you're redesigning things, it would also be good to increase the coverage of radar profiling to produce a better picture of the winds and turbulence in three dimensions."

This is a vision shared by all the members of T3D, a research and development project funded under the CRAFT mechanism of the Fifth Framework Programme. Five European SMEs and the Institute of Radio Frequency Technology in Stuttgart University combined their expertise and market knowledge to develop what they believe will be the next generation of wind profiling equipment.

United strength

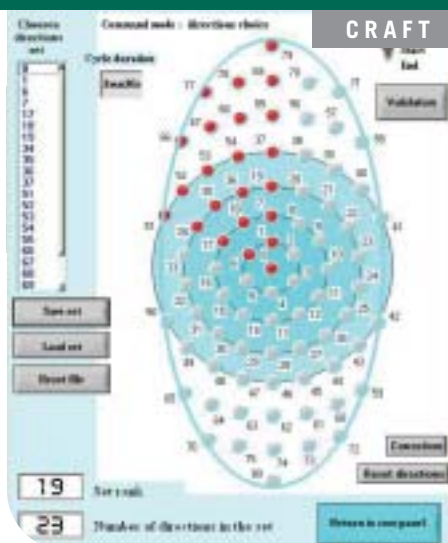
Spanish firm Geonica, which coordinated the project, designs and integrates weather monitoring equipment. "The development of a wind profiling radar like this offers an exciting opportunity for us to expand our market," says Carlos Gómez Carrió, the T3D coordinator. "We would like to integrate a compact wind radar into our weather stations so we can get more information on winds above ground level."

Scintec from Germany and BIRAL from the UK are both manufacturers of atmospheric measurement instrumentation. Like Geonica, they recognised the impact the T3D project could have for expanding their businesses.

As none of these SMEs had R&D facilities related to this specific radar technology, the project benefited from three RTD providers, which conducted the laboratory analyses and testing. La Société Française d'Emetteurs



Direction monitoring – the red LEDs are the selected directions for the current profile in the command mode, among the 81 possible ones.



CRAFT

EVK2-CT-2002-30004

(SFE), a small specialist engineering firm from the South of France, built the high frequency emission and receiving equipment. In particular, it developed an emitter that could vary the power of the radar beams to allow the radar to 'see' over a wide range of altitudes.

Meanwhile, the Institute of Radio Frequency Technology in Stuttgart worked on the antenna array. After testing various designs they decided that 20 quad antennas would provide a sensitive, but compact, antenna array (the whole measuring only 10m x 10m). "The antenna is an important innovation in this project," notes de Donato. "It is used for both sending and receiving the signal, so requires very rapid switching between the two states. At the moment we are using components called circulators for the fast switching, though this is expensive and we are currently looking at cheaper solutions.

"This phased array scanning means that we effectively have radar beams in many directions, compared to the three or five beams you find on existing equipment. We can get a much more accurate and three-dimensional picture of the winds in the atmosphere."

Systelia developed most of the data processing software and algorithms. "The small antenna array would normally mean that you

lose precision in VHF radar because of the large beamwidth, but we produced an algorithm that restores this loss," de Donato continues. "We also developed rapid data processing. Even though the T3D system measures in up to 81 directions, we get the results back in three dimensions in around five minutes. With an old system it could take up to an hour to bring back the same information!"

A prototype T3D system is now being tested by the partners at a small airport near Montélimar in France. "We are very satisfied with the achievements of the project," says Gómez. "The combined knowledge of the partners is impressive and all the participants complemented each other well."

"We expect to see weather services benefit from T3D as it provides an accurate picture of winds and turbulences in altitudes ranging from a few hundred metres to as high as 15km," Gómez remarks. "But airports are probably the biggest market for this new profiler. They will now be able to know in real time what the wind is doing, not just on the ground, and this will be important for people like pilots and parachutists. In the EU alone there are 90 international airports, 250 domestic airports and 2,000 small airports. The T3D profiler has excellent commercial prospects and will help Europe to remain competitive in this field."

Full title

Research and development of a compact wind profiling radar in VHF frequency

Industrial Sector

NACE 93 Other service activities

Supporting technologies

0129 Computer Science/ Engineering, Numerical Analysis, Systems, Control; 0269 Geophysics, Physical Oceanography, Meteorology, Geochemistry, Tectonics; 0290 High Frequency Technology, Microwaves; 0563 Signal Processing

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SME proposers

- Prime: Geonica S.A. (Spain)
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- BIRAL (United Kingdom)

RTD performers

- Systelia Technologies (France)
- Société Française d'Emetteurs (France)
- Institut für Hochfrequenztechnik (Germany)

Duration

11/02-04/05

References

EVK2-CT-2002-30004

Programme

FP5: EESD

Project Cost

€1,955,000

Range of SME contribution

€30,000-€65,000

EC funding

€977,000

*Teleoperation post.*

Remotely operated vehicles (ROVs) are commonly used to work in environments too dangerous or difficult for humans. Although at present they are mainly used in industry, they could be used for recreation too, taking virtual passengers into normally inaccessible areas. The Teledrive project has developed a demonstrator system that recreates the movements, sounds and images from an ROV in a showroom, for the remote driver and passengers to experience. The six participating SMEs will incorporate the project results into a variety of entertainment and tourist experiences.

A driving force for virtual tourism

CRAFT

IST-1999-57451

We've all seen remotely operated vehicles (ROVs) at work in films and on television," says Mario Maza. "They work in environments that are too harsh or dangerous for humans, such as the reactors of nuclear power stations. At present you control the ROV from a distance using some sort of control panel, but wouldn't it be great if you could operate the vehicle as if you were inside driving it? You can install cameras, sensors and a transmitter on the ROV, and reconstruct all the sensations – images, movement, sound – back at base so that the operator feels like they are in the ROV itself. "Then, if you are able to reconstruct all these sensations, how else could you apply the technology? You're not limited to industrial applications, but you can imagine the idea of virtual travellers in your ROV. You could have a kind of showroom where you could drive tourists round an archaeological site, or a cave or a wreck under the sea. They would receive all the stimuli as if they were in a real vehicle."

Unlikely reality?

Dr Maza, a researcher at the University of Zaragoza, likes to dream, but his dream is shared by several small companies across Europe. Indeed, confident that the dream could be made reality, they formed the EU-funded Teledrive project. Each SME had its own plans for developing a tele-traveller experience. Industrias Royo, S.A. (IROS), a manufacturer of fairground equipment, first approached Maza because it wanted to produce a ride where people could drive a virtual

vehicle. Oceanopolis, an aquarium in Brest, France, saw the potential for using ROVs to observe dangerous and delicate specimens – teledriving the vehicle would make it easier for human operators to control it, and could also allow visitors to the aquarium to take a virtual tour through its tanks.

Two other SMEs – Superelectric and OK Games – were ready to try out teletourism: they are developing an integrated system for environmental monitoring and teletourism which combines a submarine ROV and an aerial ROV. The ROVs are equipped with cameras and sensors. They record all the data and images, and then reproduce the experience for tourists on dry land.

The Greek partner, Reflexion, intends to use the tele-operation technology in the ship-building industry, where it has most of its business activities. Another partner SME, SoProMar, produces scientific vessels and ROVs for maritime research, and wanted to use Teledrive technology to improve its products. "There is no doubt that all the companies involved in this project are highly ambitious," remarks José Miguel Royo, the project's coordinator. "At the start of the project we basically had nothing more than the idea. We had to think about the very basics. For example, what kind of image projection and screen, what kind of motion platform, what kind of speakers did we want in the showroom?"

Driven by innovation

One of the major challenges for the project was how to replicate the motion of the ROV



Stereo camera system attached to the submarine ROV.



CRAFT

IST-1999-57451

for the driver and passengers. As the main RTD contractor, the Department of Mechanical Engineering at the University of Zaragoza, working with the Centre de Robotique Intégrée d'Ile de France (CRIIF), adapted some algorithms used to produce movement in simulator cabins. "We had some experience of simulators, and CRIIF has a good knowledge of robotics and control for measuring the movement of the ROV," says Maza. "We decided to measure the linear acceleration and angular velocities, then used the algorithms to reconstruct the movement of the ROV on the movable showroom platform. The computer calculations are done in real time to improve the feeling of a virtual reality."

Another innovation in the project is a system that provides teledrivers or passengers with additional information about what they can see – a process known as augmented reality. Prolexia, a small French software company and the project's third research contractor, used its expertise in virtual reality programming and artificial intelligence to produce powerful image recognition software. The software identifies known objects appearing on the showroom screens, so that additional information can then be flashed up on the screen or a pre-recorded commentary played.

A new type of tourism

From little more than a wild dream, the project partners successfully built a demonstrator system that included an ROV, a control room and a showroom for virtual passengers. Tests included teledriving a submersible ROV in the Isola dell'Asinara harbour in Sardinia.

"The involvement of all the project partners has been key to the success of this project," notes Royo. "It is not about the SMEs handing over the research task to the RTD performers and then coming back in two years to see what has happened. In this project everyone worked hard and committed a lot of time and resources to its success."

The project's only drawback, according to Maza, was its size. "The teledrive concept and the potential of teletourism are tremendous and could have a huge impact on the tourism and entertainment industries, as well as in the more traditional industrial applications of ROVs. But big ideas with small budgets usually lead to small results. This was a very early stage and limited project and it is unlikely that the results will go far beyond the participants, though it will make a big difference to them. To extend the technology further and really make a noticeable impact in society, we now have to expand what we have started here on to a much bigger scale."

Full title

Vehicle tele-operation system for application to entertainment, research and remote interventions

Industrial Sector

NACE 92 Recreational, cultural and sporting activities

Supporting technologies

0053 Audiovisual Communication; 0054 Automation, Robotics Control Systems; 0120 Communication Engineering/Technology; 0129 Computer Science/Engineering, Numerical Analysis, Systems, Control; 0184 Educational Multimedia; 0310 Imaging, Image Processing; 0411 Multimedia; 0412 Multisensory Technology, Multi-Sensing; 0536 Remote Sensing; 0656 Vehicle Technology

Information

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SME proposers

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- OK Games di Alessandro Carta (Italy)
- Sopab Brest (France)
- Superelectric di Carlo Paglialunga & C. Sas (Italy)
- SoProMar (Italy)
- Reflexion (Greece)

RTD performers

- Centre de Robotique Intégrée d'Ile de France – CRIIF (France)
- Prolexia (France)
- Universidad de Zaragoza (Spain)

Duration

09/02-10/04

References

IST-1999-57451

Programme

FP5: IST

Project Cost

€997,619

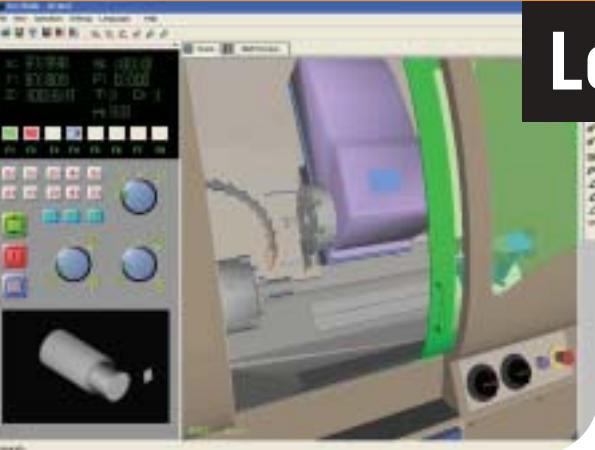
Range of SME contribution

€29,000-€156,000

EC funding

€498,771

SPECIFIC SME ACTIVITIES



Learning a trade on a virtual machine

CRAFT CRAFT-1999-70292

Interface for a CNC lathe – the controls work like those of a real lathe.
© VIRTUOL

Training students and workers to use modern machine tools can be a time-consuming and expensive process. Now a consortium of engineering firms, machine tool manufacturers, software developers and trainers has come up with a software package that promises to give trainees hands-on experience of machine tools before they set foot in the workshop, or even before the tools are installed. VIRTUOL is a virtual reality-based training system that can be programmed to simulate a variety of training tasks on a wide range of machine tools. Trainees will be better prepared to work with real machines when they finally meet them, and will be able – without risks to the machines or themselves – to gain proficiency much more quickly.

One of the weaknesses of the European economy is the shortage of skilled workers trained in the manufacturing technologies that are so important for our future. But training takes a long time and requires many hours of supervised practical work. Engineering companies and training colleges do their best, but modern machine tools are complex and expensive, and there are simply not enough of them available to provide all the hands-on experience trainees need.

It was with this problem in mind that a training organisation in northern Spain (IMH) approached a local industrial research centre (CEIT) to see if the technology of virtual reality could be employed to train students and workers more efficiently. The idea seemed promising, so a partnership was formed to propose a CRAFT project called Virtool.

“The main objective was to train students in the preparation, use and first level maintenance of machine tools,” explains Nieves Alcain of Alecop, the Virtool project coordinator and a local manufacturer of training equipment. “We were not intending to eliminate training on real machines, of course, but with this system the student could learn their skills more easily beforehand. They could learn about the machine in the classroom before going into the workshop.”

Virtool was launched in 2001 as a 30-month project under the EU’s Information Society Technologies programme. The original Spanish proposers teamed up with engineering firms, machine tool manufacturers, software companies, training organisations

and universities in Austria, France, Germany and Italy.

“The project was very successful,” says Alcain. “We are now working to industrialise the Virtool product and launch it on the market in 2005.”

Four applications

The product will consist of four software applications. Virtool Master is used to create a complete model of a machine, while Virtool Generic creates a library of cutting tools, clamps and other accessories to be used with it. The actual training tasks are set up with Virtool Case Generator, which the instructor can use to devise exercises such as making particular work pieces. But the heart of the package is Virtool Machine, which uses virtual reality technology to simulate the operation of the machine. It can run on a normal desktop computer – with keyboard and mouse – and gives a realistic portrayal of a machine which the student can control as if it were real. Virtool Machine can also be used with more sophisticated virtual reality systems employing stereoscopic vision.

Trainees working with Virtool have the opportunity to spend plenty of time learning the basic principles of machine tools in complete safety before venturing on to the shop floor. They can use machines in a wider variety of situations than is practicable in the workshop, and can even use specialised machines that the college or company does not possess in reality. Because of the safe environment, trainees can work with much less supervision



Virtool interface for a conventional milling machine – the user can manipulate the machine just like a real one.

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CRAFT

CRAFT-1999-70292

than would be required in a real workshop without fear of damaging the machine or themselves. When they do meet the real machines, they can gain proficiency much more quickly.

Alcain sees a worldwide market for Virtool. "Alcain are now selling all over the world. We have another collaborator, a distributor, and we are working very hard in France, Portugal and other countries in Europe, South America and Asia. So we have a world market. Some of the project partners – such as Cadware and Tangram – are important in their own countries, so the idea is to work with them to exploit the product."

World-wide market

With the help of the SME partners a marketing drive will get underway next year and the universities of Dresden and Hamburg will demonstrate and present the Virtool package as well.

Likely purchasers of Virtool include training colleges, manufacturers of machine tools and engineering companies. "We have some data about the number of training centres in France, Italy and Spain, but it is difficult to define the size of the market. Alcain is selling another type of simulation software in the

same area and in four years we have sold 4,000 licences." Alcain is aware of similar research going on in North America but does not know of any competing product yet on the market.

For the project partners the experience has been very positive. Training organisations can now offer more attractive and comprehensive courses, and some are even looking at marketing distance learning courses based on Virtool products. Machine tool manufacturers can use Virtool for training and also to demonstrate their products to potential customers. As an added bonus they hope that better customer training will reduce the need for after-sales support. The end users – engineering firms – will benefit from being able to train their staff in a wider range of skills, while reducing the time that production machines are out of service for training sessions. And the research partners have widened their knowledge of virtual reality applications and will continue their research in this area.

"It has been a long project but in the end the result has been very satisfying for all the partners," Alcain remarks. "We think the result of the project will be a good tool for European manufacturing industry."

Full title

Virtual manipulation to simulate machine-tool processes

Industrial Sector

NACE 29 Manufacture of machinery and equipment n.e.c.

Supporting technologies

0131 Computer-Based Training; 0313 Industrial Engineering; 0565 Simulation, Simulation Engineering; 0579 Software Engineering, Middleware, Groupware; 0661 Virtual Reality

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SME proposers

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- Fundación para la Formación en Máquina Herramienta – IMH (Spain)
- Ingenio E-Learning AG (Austria)
- Cadware (France)
- Société de Mécanique et d'Automatisme du Bourbonnais – SOMAB (France)
- Tangram (Italy)

RTD performers

- Académie de Clermont Ferrand – ACM (France)
- Centro de Estudios e Investigaciones Técnicas de Gipuzkoa – CEIT (Spain)
- Technische Universität Dresden – TUD (Germany)
- Universität Hamburg – UHH (Germany)

Duration

04/01-09/03

References

CRAFT-1999-70292

Programme

FP5: IST

Project Cost

€1,350,000

Range of SME contribution

€67,000-€200,000

EC funding

€675,000

SPECIFIC SME ACTIVITIES



Water saving pump

CRAFT EVK1-CT-2001-30013

Lagafors' new high-pressure water pump is more efficient and reliable than conventional pumps.

High-pressure water jets are widely used in industry – especially in food processing – to wash down contaminated surfaces. Now a consortium of Scandinavian SMEs has developed a new kind of high-pressure pump that is driven by hydraulic power instead of an electric motor. The new pump uses 20% less water and 15% less energy than a conventional high-pressure pump, maintains a steady flow and is more reliable and cheaper to maintain. The consortium has applied for patents on the pump and on a new design of water nozzle, and the product should be on the market in 2005. Among potential customers are food processing plants, abattoirs, breweries and fishing fleets.

Every day, vast amounts of cleaning water are used in the food, pharmaceutical and agricultural industries to wash down surfaces and so help meet improved standards of quality and hygiene. But in some parts of the world clean, safe water is in short supply. Water consumption can be reduced by using high-pressure water jets, which can achieve the same cleaning effect with less water, but conventional high-pressure water pumps are expensive to maintain and not as efficient or reliable as they could be.

“For many years we wanted to design a high-pressure pump that had many of the good features that modern low-pressure pumps already have, especially low maintenance costs,” explains Magnus Elmlblad of Lagafors, a Swedish manufacturer of water jet cleaning systems. “It is very important for us to show our customers that we can decrease their water and energy costs. We have a lot of fresh water in Sweden, but elsewhere in Europe and around the world water consumption is a bigger problem.”

The idea seemed ideal for a CRAFT project, especially as some expert research assistance was going to be needed. “We wanted input from firms in different countries, so we brought in some of our colleagues in the business who we knew had a lot of experience in the field, and we tried to put a group together that would give us knowledge of different markets. We also had some research organisations that undertook studies for us.”

Hydraulic power

The SMEs in the consortium, apart from Lagafors itself, included Trönningeverken, a manufacturer of dishwashing machines, Arena Kemi, a manufacturer of cleaning chemicals, and Hygienteknikk and Clean Tech, who both sell cleaning equipment to the food industry. They were supported by research on microbiology carried out by the Technical Research Centre of Finland and work on ergonomics at Stiftelsen Chalmers Industriteknik. The Institute for Product Development in Denmark advised on pump technology and Utvecklingsbyrån assisted with project management.

By all accounts the two-year project has been a success. Unlike traditional water pumps, which use an electric motor, the new pump uses hydraulic power to pressurise the water. The power can be supplied from an existing oil hydraulic system or from a special portable power pack. The pump contains no fast-moving parts so wear and tear is lessened and the need for maintenance is reduced. Water emerges from the nozzle in a steady flow without pulsing, making it more comfortable to hold and to use, and several large water cylinders can be operated from the same power pack, with no noticeable fluctuations in pressure. The water flow rate and the pressure can be adjusted independently of each other, reducing water consumption by about 20%. And because of the higher efficiency, energy consumption is about 15% lower than for a traditional high-pressure pump.



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EVK1-CT-2001-30013

The team also designed a new 'turbo nozzle' for pre-rinsing, to complement the usual 'flat fan' nozzle used for cleaning. It has a more efficient spray pattern, which produces fewer droplets so reduces the possible spread of micro-organisms and consumes less cleaning agent. The consortium has already applied for two patents – one for the pump itself and the other for the nozzle.

Fishing boats

A prototype of the new pump has been shown at trade fairs in Sweden and Norway, and after a series of field trials it is expected to be on the market in the middle of 2005. Prospective purchasers are most likely to be in countries where water supply is less abundant than in northern Europe, but the pump will appeal wherever water and energy conservation are important. Traditionally Lagafors has sold its water pumps to the food industry – especially processing plants, breweries and abattoirs – but new markets are likely to emerge. One such is the fishing industry. "Fishing boats already have oil hydraulics,"

remarks Elmblad, "so you could just sell the water pump part to them. I think our system will be a very big thing on boats in future." He stresses that the new pump will have wide benefits for the customers. "They will get lower water consumption, lower energy costs, lower maintenance costs and a higher quality pump that they can rely on – they won't have so many production stops due to breakdowns and things like that. And that means better hygiene and better quality products." Lagafors estimates that it could sell 100 of the new pumps in the first year, and ultimately 2,000. Elmblad says the SME partners have all gained from the two years they spent working on the project. "Everybody in this group has learned a lot about each other and about our markets. The value of what we have learned is very high and also the technology that we have developed has been good for all the partners." In fact, Lagafors is now starting a new CRAFT collaboration to reduce water consumption even further. "It is called 'aerosol reduction' and we are trying to do a lot of dry cleaning instead of wet cleaning. That's the next project."

Full title

New type of water and energy saving cleaning technique to improve the hygienic result

Industrial Sector

NACE 15 Manufacture of food products and beverages

Supporting technologies

0378 Mechanical Engineering, Hydraulics, Vibration and Acoustic Engineering; 0671 Water: Rational and Efficient Use

Information

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- Arena Kemi AB (Sweden)
- Trönningseverken AB (Sweden)
- Clean Tech A/S (Denmark)
- Hygienteknikk A/S (Norway)

RTD performers

- Institute for Product Development (Denmark)
- Stiftelsen Chalmers Industriteknik (Sweden)
- Technical Research Centre of Finland (Finland)
- Utvecklingsbyrå AB (Sweden)

Duration

01/02-12/03

References

EVK1-CT-2001-30013

Programme

FP5: EESD

Project Cost

€940,000

Range of SME contribution

€45,000-€170,000

EC funding

€470,000

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