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Research Results for SMEs – IV



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>). In particular under the current Sixth Framework Programme (2002-2006) there are three specific instruments:

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

For example, **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.

There are also **Economic and Technological Intelligence** (ETI) measures, which aim to stimulate SME participation in European research by promoting innovation in SMEs; gathering, analysing and disseminating information on science and technology developments, applications and markets as well as identifying and disseminating "best practice".

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, Networks of Excellence and STREPS (Specific Targeted Research Projects).

This publication presents the achievements of 17 projects completed under the Fourth and Fifth Framework Programmes (1994-2002). Taken together, these projects involve some 90 SMEs. They illustrate the richness and diversity of the results that SMEs can obtain from EU research projects. Most of them are CRAFT projects, and this shows how SMEs with little or no RTD capacity can benefit from the CRAFT scheme. Some other types of project are also presented to demonstrate the potential they have in allowing SMEs to develop innovative technologies. Further information on the Sixth Framework Programme can be found on the CORDIS server (<http://www.cordis.lu>).



Research Results for SMEs – IV

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New angles on keyhole surgery

CRAFT

BRST-CT98-5464

Minimally invasive surgery means working through small incisions. The technique makes for shorter operations, faster recovery and less scarring

Minimally-invasive surgery benefits patients and doctors alike, but it is currently limited by the tools available. In particular, probes that are flexible enough to reach awkward areas are generally not strong enough to carry out forceful procedures such as drilling. This project, which involved five SMEs, set out to develop new instruments based on nickel-titanium shape memory alloys, and most of the time was spent learning to characterise and handle these extraordinary materials. The European market is worth up to €10m, and a commercial product should be available soon. The partners also developed new techniques for designing with nickel-titanium alloys, and for extruding, cutting and polishing these materials. As a result, at least one partner has already been able to move into a new market area.

If you have visited hospital for an operation recently, it's increasingly likely that you will have been treated using keyhole surgery. "Minimally invasive surgery" or MIS, to give the technique its official name, is growing in popularity because it is less traumatic than conventional surgery. Working through small incisions, surgeons find that operations take less time, yet their patients recover more quickly and with fewer scars.

MIS is still novel, and the current generation of MIS instruments has many limitations, according to Stuart Moran of Surgical Innovations, the lead partner in a CRAFT project to create new MIS instruments that are highly flexible, yet can lock into rigid positions when necessary. Current instruments cannot combine these two properties. The project will result in new MIS instruments reaching the marketplace soon, Mr Moran says. The manufacturing knowledge gained during the project also has applications in many other areas of engineering.

A gap in the market

Many existing MIS instruments are rigid, explains Mr Moran, so that they can resist the forces involved in cutting, drilling and stitching. Not surprisingly, surgeons using rigid instruments cannot always reach the places they need to. Flexible instruments provide better access, but their very lack of rigidity limits their usefulness. The project to develop something better began when Surgical Innovations, an SME

from Leeds in northern England, found itself short of new products. The company already had a successful range of rigid MIS tools, but had licensed out their manufacture to generate cashflow. "So we needed something new, but we didn't have a big enough research budget or even the necessary skills within the company," says Mr Moran. Surgical Innovations knew there was a market for a manipulator that was flexible, to allow access to awkward areas, yet that could become rigid when necessary. It also needed to be hollow, to carry optical fibres or tubes to dispense drugs and adhesives. Mr Moran had a hunch that the answer lay in nickel-titanium alloys or shape memory alloys (SMAs). These materials have a range of special properties, including the ability to recover elastically from extreme bending or stretching, to an extent that would permanently deform ordinary metals. "We believed that a tube of nickel-titanium alloy with a series of transverse slits would be flexible yet springy enough for our purposes," says Mr Moran. "The only snag was that such a tube wasn't available."

Collecting expertise

Nickel-titanium alloys are difficult to work with, not least because many of their properties are not well known. Accordingly, Surgical Innovations set about assembling a team of partners with expertise in special materials.

Professor John Wood of Nottingham University outlined the necessary areas of knowledge. These included materials data, mathematical modelling, the use of lasers to cut the alloy, and actuators to steer the



This CRAFT project is using nickel-titanium shape memory alloys to create surgical probes which can be positioned while flexible and then locked into position.



CRAFT

BRST-CT98-5464

probe and lock it into the desired shape.

"It was an ideal collaborative project because we needed a lot of new skills," says Mr Moran. "Some of these, such as the laser cutting, were not available in the UK. And our partners didn't need much persuasion, because they could all see ways to use nickel-titanium alloys in their existing businesses."

The universities of Nottingham and Huddersfield contributed expertise in materials science and mathematical modelling, which helped to reduce the number of prototypes needed. Among the SMEs, Euroflex Shussler handled the laser machining of the nickel-titanium alloys, while AFT Micromécanique made other components. Diavac, a micro-enterprise, contributed its innovative diamond-like coating which cuts friction and provides electrical insulation. Poligrat, a specialist in electropolishing, developed a new way to polish nickel-titanium alloys, avoiding the use of the hazardous chemicals previously required. This has subsequently become a new business area for Poligrat.

Two large companies joined the project as invited partners and provided valuable help, says Mr Moran. Arrk Europe is a specialist in rapid prototyping, while Smith & Nephew is a large manufacturer and distributor of medical devices.

Approaching the market

Surgical Innovations estimates that the European market for devices based on the technology developed during the project is worth €5–10m. "With a product at the right price, we could capture a significant percentage of that market," says Mr Moran. The original plan to bring the new device to market within the life of the project proved over-optimistic. Prototypes are now being tested, however, including trials with Smith & Nephew in the USA. "All the indications are that we'll achieve a successful product," says Mr Moran, "though it's hard to say when that will be, because we still have some technical hurdles to clear."

"And if we haven't yet developed a product, we have certainly developed a technology," he continues. "We have a robust materials model for nickel-titanium alloys, with design software that's extremely powerful and yet easy to use. There's no way we could have achieved that on our own." "We also gained a number of spin-off benefits. Working in a project like this is a management challenge in itself, and we gained valuable experience in working with companies ranging in size from two people to a multi-million-pound organisation. It gave us the confidence to invest in technology, and to tackle other big projects under our own steam. Many of the other partners made similar gains, and we've made a network of colleagues and friends throughout Europe."

Full Title:

Development of a novel range of instruments for minimal invasive surgery applications

Industrial Sector:

NACE 33 Manufacture of medical, precision and optical instruments, watches and clocks

Supporting Technologies:

0382 Medical Technology;
0388 Metal Technology and Metal Products

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- Poligrat GmbH (D)
- Euroflex Shussler GmbH (D)
- AFT Micromécanique (F)
- Diavac ACM Ltd (UK)

RTD Performers:

- University of Nottingham (UK)
- University of Huddersfield (UK)
- Arrk Europe Ltd (UK)
- Smith & Nephew plc (UK)

Duration:

01/99-12/00

References:

BRST-CT98-5464

Programme:

BRITE-EURAM III

Project Cost:

€710,000

Range of SME Contributions:

€48,000 – €51,000

EC Funding:

€355,000



No escape for petrol vapour

CRAFT

ENV4-CT98-0805

A petrol station can pump as much as two tons of petrol vapour into the atmosphere each year. Project manager Lars-Inge Andersson shows how Malte's new catalytic vapour recovery system cleans up 99.5% of this

A typical petrol filling station releases up to two tonnes of petrol vapour to the environment each year. Vapour recovery systems can prevent much of this waste, but even the best of these can recapture no more than 80% of the escaping vapours. A new process devised by Swedish, Danish and Dutch partners raises that figure to more than 99% and is much cheaper and simpler than competing US systems. The catch is that oil companies are unwilling to invest in improved vapour recovery systems until emission regulations are tightened, and so far only California has taken that step. Will Europe follow?

Fill up your car on a hot day, and you can see as well as smell the escaping petrol vapour. It's very logical – if you put 50 litres of petrol into the tank, 50 litres of petrol vapour will be pushed out to make room for it. If nothing is done to contain it, that vapour will escape into the atmosphere. Over the course of a year a typical filling station may lose between one and two tons of petrol into the environment – polluting the air and losing revenue. Emissions can be cut by up to 80% if the garage installs a vapour recovery system. One Swedish company, Malte Persson, has been supplying such systems since the mid-1980s. "We and Malte had the first certification for vapour recovery systems in Europe," says Krister Janver of the Innovation Team product development consultancy. "They are still on the market and for the time being are still state of the art, but we also know the problems with them."

The present systems suck vapour from around the nozzle back into the storage tank. But only 75-80% of the hydrocarbons are recovered, and leakage from the tank's breather pipes offsets much of the gain. Convinced that better solutions were possible, Malte and Innovation Team assembled a group of SMEs to seek funding from the EU Environment programme to develop a more efficient system. These included Hamer Installatietechniek, a Dutch SME with a long-standing association with Malte, and two local Swedish companies,

GSM Industrier and Halmstads Gummifabrik (HGF). Together with research partners in Sweden and Denmark they studied two basic problems: how to reduce vapour escapes at the nozzle and how to treat the recovered vapour.

Boots and catalysts

The first problem was relatively straightforward. Researchers at Chalmers University in Gothenburg worked with HGF to design a flexible PVC "boot" attached to the pump nozzle to make a seal around the inlet pipe of the car's fuel tank. "Just putting this little boot on the nozzle, in an existing system, would raise the efficiency dramatically," says Mr Janver.

In parallel with the boot, Chalmers and the Swedish Ceramic Institute looked at ways of removing hydrocarbons from the captured vapour so they would not escape to the air. Ceramic and membrane filters proved impractical, as did attempts to absorb or condense the vapours. Finally, they hit upon the idea of using a catalyst, similar to those fitted on cars, to break down the petrol vapour to carbon dioxide and water. The catalytic unit can be fitted to the breather pipe of the underground storage tank and destroys 98-99% of hydrocarbons escaping by that route.

The combined system of boot and catalyst, already evaluated by regulatory agencies in Sweden and Denmark, can suppress 99.5% of petrol vapour emissions and is expected to be cheap and simple to install – a typical filling station could be upgraded for only €4,000-6,000. Maintenance costs are low and the lifetime cost is expected to be only 20-30% of that of existing systems.

A prototype constructed by GSM Industrier



In Malte's new vapour recovery system, a plastic boot catches petrol vapour escaping from the filler pipe and returns it to the underground storage tank. Excess vapour from the tank is expelled to a catalyst, which turns it into harmless carbon dioxide and water.



CRAFT

ENV4-CT98-0805

has been installed at Malte's premises. "But it's still a prototype," says Mr Janver, "and it needs to be taken further to make it a marketable product." The problem now is to find buyers. Oil companies have had a difficult time in recent years and have not been investing in their filling stations. "Vapour recovery systems on the market today are good enough to fulfil current legal requirements in the EU," Mr Janver adds.

All eyes on California

California has introduced stricter emission regulations, but the cost of obtaining the necessary certification is so high that a European SME could not even think of entering the US market. The latest US vapour recovery systems are more complicated and more expensive than the Malte proposal, but have the advantage of recovering all the escaping vapour rather than

destroying it, so the installation could pay for itself over time. That suggests a natural market niche for the Malte product. "Our system could be a good solution for a small or middle-sized filling station, but for really large stations the American system could be a better way," says Mr Janver. "Such a system on a small site would never pay for itself, but our system would be a fairly low-cost investment."

The partners estimate that the market for improved vapour recovery systems in the EU alone could be €250 million, and they plan to supply 10% of that market over a period of 10 years, creating 10 to 15 new jobs in each partner company.

"All this depends on European countries tightening up on forecourt emissions," says Mr Janver. "But I remain optimistic that the deficiencies of existing regulations will lead to action."

Full Title:

Vapour Recovery Stage II

Industrial Sector:

NACE 60 Land transport;
transport via pipelines

Supporting Technologies:

0213 Environmental
Technology/Engineering,
Pollution Control; 0498 Polymer
Technology; Biopolymers

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Proposers:

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- Halmstads Gummifabrik AB (S)
- GSM Industrier AB (S)

RTD Performers:

- Innovation Team AB [formerly Utvecklingsbyrån] (S)
- Svenska Keraminstitutet (S)
- Sveriges Provnings & Forskningsinstitut AB (S)
- FORCE Institutet (DK)
- Chalmers Industriteknik (S)

Duration:

02/99-06/01

References:

ENV4-CT98-0805

Programme:

Environment

Project Cost:

€840,000

Range of SME Contributions:

€78,000 – €134,000

EC Funding:

€420,000



Stand up and walk

CRAFT

BMH4-CT96-1501

As many as 300,000 Europeans might be able to walk again using a new device which stimulates the nerves in their legs.

About 300,000 Europeans suffer from paralysis caused by spinal injuries, largely from road and sports accidents. In the EU-supported collaborative research project "Stand up and Walk", researchers have developed an implantable device that can restore a degree of mobility to many paralysed patients by artificially stimulating their leg muscles. Two patients have received the computer-controlled implant so far and a further 15 will pilot an improved version in clinical trials expected in 2003. The implant, the result of more than two decades of European research into spinal injury and so-called "functional electrical stimulation", could be made available to specialist hospitals from 2004.

In France alone there are 30,000 paraplegic patients, who have lost the use of their legs through spinal injury, and 6,500 quadriplegics who are paralysed in all four limbs. About 65% of them were injured in road accidents and another 15% in sports accidents. Numbers throughout Europe are about ten times greater. Each patient has sustained damage to the spinal cord, the thick bundle of nerves that carries signals between the brain and the rest of the body. The patient loses all control and sensation in the part of the body below the injury. Damage to the spinal cord is irreversible, explains Professor Pierre Rabischong of the Faculty of Medicine at the University of Montpellier, but that does not mean there is no hope for these patients. "Muscles below the lesion are still alive," he points out. "If we can re-use those muscles in an artificial programme of co-ordination we can allow the patient to walk again." Muscles can be stimulated artificially by using electrical signals. The principle is not new, but conventionally the electrodes have been placed on the skin, which is cumbersome for the patient. Professor Rabischong's innovation – known as functional electrical stimulation – is to implant the electrodes directly on the surface of the muscles, or (a method which uses much less electrical power) around the muscular nerves. He has been working on the idea since 1989, first as part of a EUREKA collaboration (called CALIES) and since 1996 under the BIOMED 2 programme in a

demonstration project known as *Stand up and Walk* (SUAW). BIOMED aims to improve the health of Europe's people and its medical research firms.

Sophisticated control system

It is, of course, easier said than done.

"People always underestimate the complexity of the system," observes Professor Rabischong. "You have 50 muscles in the lower limbs. When you decide to walk you don't think about which muscles to activate. You decide to walk and you do walk." This complexity means that a sophisticated control system is required to translate a simple command to walk into a sequence of signals to many different muscles at the right time. "We designed a portable programmer, a computer system which does what the brain normally does," he says. "It chooses the right muscle at the right time, taking account of all the knowledge we have about the co-ordination of the different muscles in walking."

In the complete SUAW system, wires connected to the nerves in the leg muscles run to a small ceramic box located under the skin of the abdomen, just above the navel. The implant needs no batteries and will last the lifetime of the patient. It is powered and controlled by radio signals transmitted from an external antenna placed against the skin. The antenna, in turn, is fed from a programmer the size of a portable cassette player. A computer in the programmer sends signals to the muscles in the correct sequence for standing up, walking and sitting down.

So far it has proved difficult to achieve the complex co-ordination necessary to balance the body when standing. Users have to use



Stand up and Walk has shown how direct electrical stimulus to the leg muscles can enable paraplegics to walk again.



CRAFT

BMH4-CT96-1501

a walking frame to support themselves, and it carries the controls for the programmer. "The patient pushes a button and the programmer activates the contraction of the main muscles allowing the patient to stand up," says Professor Rabischong. "It's important to adjust the vertical line of the body in order to avoid pressure on the hands. The patient then has buttons on each side of the frame to activate the walking sequence." The walking gait is close to natural but Professor Rabischong expects to refine it further to make walking faster and more comfortable.

15 patients awaiting surgery

Under the BIOMED 2 demonstration project two patients, one in France and one in Italy, received experimental versions of the implant in 1999 and 2000, and both are doing well. As a result, trials of the complete system on at least 15 patients will take place in eight European countries in 2003. "One of the strengths of our approach is that in each of seven European countries we have built up a clinical network made up of spinal rehabilitation centres, medical doctors, physiotherapists and surgeons," Professor Rabischong says. "This means we can train surgeons, patients can be treated near home, and SMEs marketing the procedure have a local reference centre to support them. It is interesting to note

that America has never succeeded in developing a network like this – each state has its own."

The Professor stresses that the implant will not restore complete mobility and will only be suitable for certain types of spinal injury. Prospective patients will be carefully screened and, to avoid raising false hopes, suitable candidates will be fitted with skin electrodes which will enable them to try out the control system before they decide to have the operation. "The patient then knows exactly what to expect from the technology and is under no illusion about what he or she can get from the implant." While similar research is going on in the United States and Japan, the European project is the only one close to allowing paralysed patients to walk. The electronics were developed by IBM France and the SME MXM in Antibes, while the Fraunhofer Institute for Biomedical Engineering supplied the electrodes. A new company has been set up to market the implant, capital is being raised, and by early 2004 Professor Rabischong hopes to have secured the CE mark, which will allow better dissemination. For Europe's 300,000 paraplegics the benefits cannot come too soon. After that he intends to turn his attention to the control of smooth rather than striated muscle, to help paralysed persons with bladder dysfunctions.

Full Title:

Stand up and walk

Industrial Sector:

NACE 85 – Health and social work

Supporting Technologies:

0382 Medical Technology;
0426 Neurobiology,
Neurochemistry, Neurology,
Neuropsychology,
Neurophysiology; 0567
Skeleton, Muscle system,
Rheumatology, Locomotion

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Proposers:

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- Thomson CSF, F
- Roessingh Research and Development BV, NL
- European CALIES Association, UK

RTD Performers:

- Fraunhofer-Institut für Biomedizinische Technik, D
- Université de Montpellier, F

Duration:

07/96-06/00

References:

BMH4-CT96-1501

Programme:

BIOMED 2

Project Cost:

€2,500,000

Range of SME Contributions:

€300,000

EC Funding:

€1,500,000



Virtually, anything is possible

CRAFT

ESP4-22647

Two companies in Europe and two companies in Brazil have formed a "virtual enterprise" (VE) to make bicycles

Now that the internet has become a household name, we are prepared to accept some pretty strange ideas. Once upon a time 'virtual' meant a conceptually incomplete place or thing, but now it can mean much more. Take the 'virtual enterprise' for starters. Can a physically separated group of enterprises sharing skills and resources over a computer network really deliver the goods? A consortium of 11 partners from academia and industry across Europe – as well as from Brazil – set out to prove that it could. What's more, the technology could also work in SMEs. With support from the EU's ESPRIT programme, the team developed a range of virtual enterprise support tools which could find applications for SMEs in numerous sectors.

The use of the term 'virtual' in connection with all things computer-related is unfortunate, as it has 'unreal' connotations. For there cannot be such a thing as an unreal real thing. But virtual products and virtual enterprises are very real, just not in a physical sense. Their reality comes from society's acceptance that, through electronic interaction with such entities or enterprises, there is a tangible, manifest result. Order some goods via a network, internet or extranet, and two weeks, days – even hours – later it arrives. In some cases it may even not appear physically, but as a transfer in the supply chain of a virtual enterprise. Professor Luis M Camarinha-Matos, who was instrumental in the EU-funded project Prodnet II, has his own take on how 'virtual' fits into the enterprise paradigm. "The concept of virtual enterprises (VE) challenges the way industrial production systems are planned and managed," he notes. "[VEs are] ... a temporary alliance of enterprises that come together to share skills and resources in order to better respond to business opportunities, and whose co-operation is supported by computer networks." His department, the Faculty of Sciences and Technology at the New University of Lisbon, provided academic leadership during the Prodnet II project – standing for "Production planning and management in an extended enterprise". Alongside universities in Portugal, the Netherlands and as far away as Brazil, several SMEs also participated in the project, including the project's

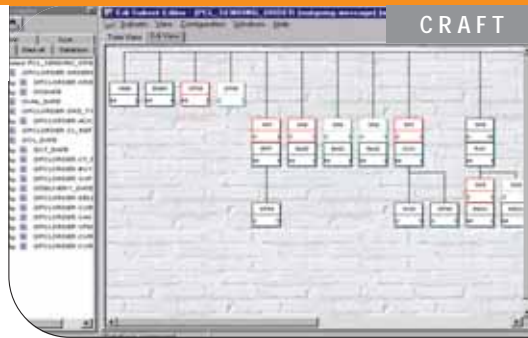
lead partner, Construção de Software e Automação na Indústria from Portugal, as well as companies from the UK, France, Germany and Brazil.

Deep impact

Developments in the internet and in technologies associated with both knowledge and work management have led to new and potentially fruitful ways of doing business. Groups of companies can – using virtual enterprise concepts – pool their strengths to offer a specific service which, traditionally, has been provided by a single enterprise. This has a deep and lasting impact on the economy as a whole, but is especially promising for SMEs. Launching a new product or service on the market is a complex and expensive process for any organisation, and such a huge capital outlay can make or break an SME. Applying virtual enterprise technology and techniques, SMEs can compete on a level playing field with their larger counterparts. Using VE technology, smaller firms can speed up their product development and improve their trans-national co-operation. Partners can streamline everything from supply chains and logistics to information and data sharing, workflow management and, potentially, overall decision-making. One of the most important aspects of VEs, according to Professor Camarinha-Matos, is to have timely, secure supplier information up and down the supply chain. He explains that a so-called mobile-agent-based approach allows the VE to function as a network of "agentified" enterprises, which means each one has some autonomy, privacy and capacity to interact with other nodes in the VE. But the technology to



Graphical configuration of EDIFACT messages in PRODNET II.



ESP4-22647

implement this and other aspects of a properly running VE can be costly and difficult to introduce for SMEs.

SMEs can do it too

Prodnet II set out to overcome this hurdle. Its plan was to design an open platform (accessible system) and IT tools to support many possible functions and challenges associated with VEs. These include: designing easy to use – non-proprietary – software, understanding the nature and structure of business data, acknowledging international standards (e.g. ISO 9000) to help SMEs compete Europe-wide, and involving IT vendors in the process. But the main goal was to prove that it was possible for SMEs to manage internal and external business relationships.

Today, almost three years after the project ended, several partners have capitalised on their involvement. For example, thanks to knowledge gained from taking part in Prodnet II, Illicom – a French consulting company specialised in electronic data interchange (EDI) – was able to put on the market a piece of software called Visual Commerce, which is a business-related message exchange system designed specifically for SME partners in a supply chain environment. "This is very close to the VE concept advocated in Prodnet II," notes Pierre Gibon, founder and manager of Illicom. "One of the innovative aspects of the Visual Commerce software is that users don't have to make dramatic changes in their own IT environment (production or legacy systems) to fit their business partners' requirements," explains Mr Gibon. "Actually, Prodnet was a good stimulation exercise for

Illicom. Thanks to our involvement in the project, our company turnover has grown by an average of 30% a year since the beginning of the project in 1996."

Rolling out EU research

Illicom followed its launch of Visual Commerce, which coincided with the conclusion of the Prodnet II project in 1999, with a product called TradeXpress Designer in 2002. The two products were later merged to create Illicom's TradeXpress Enterprise software. "These software packages were made possible in part by the work done in the Prodnet project," confirms Mr Gibon. "We are also about to put on the market new business process management systems which are very close to what was developed within the project." Working with organisations and academic research partners in the context of an EU project has other spin-offs. A major one, says Mr Gibon, is that he is able to distribute his products via the partners in Europe and in South America, through a Brazilian university and SME involved in Prodnet II. "We'd like to think that these sales contribute to the external balance of the European economy in two ways," says Mr Gibon. "We are able to both compete with non-European companies and make direct sales outside Europe. Maintaining this network of contacts through the Prodnet partnership is also the key factor behind our company's continued research and development efforts."

Note: for detailed technical information on PRODNET II, please see *Infrastructures for Virtual Enterprises – Networking Industrial Enterprises*, L.M. Camarinha-Matos, H. Afsarmanesh (editors), Kluwer Academic Publishers, ISBN 0-7923-8639-6, October 1999.

Full Title:

Prodnet II – Production planning and management in an extended enterprise

Industrial Sector:

NACE 72 Computers and related activities

Supporting Technologies:

0579 Software Engineering, Middleware, Groupware; 0660 Virtual organisations

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- CIMIO, UK
- Illicom (former Lichen Informatique), F
- Empresa Ciclista Miralago, SA, P
- ESTEC – Estudos e Tecnologias da Informação, P
- Proststep, D
- Herten, BR

RTD Performers:

- Faculdade de Ciencias e Tecnologias da Universidade Nova de Lisboa, P (technical co-ordination)
- Universidade Federal de Santa Catarina, BR
- Universiteit van Amsterdam, NL
- Instituto de Desenvolvimento de Novas Tecnologias, P

Duration:

10/96-10/99

References:

ESP4-22647

Programme:

ESPRIT 4

Project Cost:

€4,132,000

Range of SME Contributions:

€100,000 – 484,000

EC Funding:

€2,139,000



CRAFT

ESP4-29365

Engineering a level playing field for SMEs

Aircraft manufacturers are using the techniques of concurrent engineering to streamline their production processes

The aeronautics industry has hit turbulence. The large consortia in the sector – mainly in Europe and the USA – are consolidating and re-engineering their supply chains to boost their efficiency and competitiveness. This means SMEs have to be ever more responsive to customer needs. To compete with their larger brethren, they have to improve the build quality and reliability of aircraft parts, but also cut production costs and time to market. A difficult task even for the big players. Rising to the challenge, SMEs and research centres in Italy, Germany and the UK joined forces in an ESPRIT project to investigate the use of concurrent engineering (CE) in SME product development. The partners pulled together to develop a proven method for SMEs to get the most out of CE.

Europe's aeronautics manufacturing industry is facing a stiff headwind. In recent years, the sector has been under mounting pressure from consumers and authorities to raise standards across the board, especially in component safety, quality and price. This ill wind has been fanned by growing competition, mainly from the USA. For small and medium-sized enterprises (SMEs) looking to take on the bigger players, the stakes are even higher. In this industrial era of 'faster, cheaper and better', improvements in the product development process are of paramount importance. Some of the opportunities for improvement are obvious, but others may be less so. Larger manufacturers in many industries have been making good use of 'concurrent engineering' (CE) to reduce costs and increase general product reliability. But SMEs, which clearly have much to gain from this approach, have been slower to take it up. Implementing concurrent engineering means studying the whole product life cycle – from concept to disposal, via quality control, costing, scheduling and user requirements – to find ways to speed up and improve product development. The chief benefits come through the synergies and integration that can be brought about. For example, an aircraft hydraulics manufacturer trying to compete against low-cost foreign imports needs to lower costs but increase output at the same time. CE techniques and accompanying software tools

help the firm identify ways to streamline the development process, such as optimising its design to meet faster production schedules.

Getting the word out

Unfortunately, few SMEs are aware of the benefits of CE, according to Bruno Lisanti, who co-ordinated the EU-supported project *Cepra – Concurrent Engineering in Practice*. Those that are aware of it lack the resources to implement it. Others simply balk at the idea of re-engineering their production processes without the right in-house skills for the job. SMEs are then forced to adopt ad-hoc tools and techniques, often imposed on them by their customers. Concurrent engineering has been in fairly widespread use since the early 1990s. The main aim of Cepra was to set up pilot projects in the UK, Italy and Germany to show how SMEs, in particular, could use it for developing aircraft components. Supported by the EU's ESPRIT 4 programme, the project set out to adapt a set of interactive tools which could first provide a picture of a company's present situation, then identify potential improvements to be made, as well as the right CE tools to do it. Nine partners – three from academia and six from the aeronautics and engineering industries – carried out the project between 1998 and 2000.

Change manager

Resolving the issue of low take-up of CE principles in SMEs is not easy because changing the way a product is developed and produced is in itself a very difficult task. Experts say that companies are often sur-



Concurrent engineering is delivering shorter lead times, better punctuality and higher profits, enabling SMEs to stay aloft in the global market place.



CRAFT

ESP4-29365

prised by the resistance to change.

Mr Lisanti, from the Milan-based SME Concurrent Engineering Consulting (CEC), notes the importance of business culture as a potential hurdle to SMEs effectively applying CE: "Despite being smaller, SMEs still need to address resistance to change," he says. Another important element in the success of the Cepra project was learning how to handle cultural differences between the academic and the industrial partners. "From the start, our university partners focused more on the method and CE's 'potential' benefits for SMEs. Whereas our industrial SMEs kept asking 'how can we get this to market?' It was a question of 'potentials' versus 'actuals'," he explains. But, as co-ordinator of the project, Mr Lisanti believes these are things that have to be dealt with. It is also a working rationale for this type of Community research, bridging academia and industry.

Smart SMEs

In the end, Cepra came up with the results. All five of the industrial end users in the project consortium, Aerodata and Sigma of Germany, Cardinal Broach and Northern Technologies of England and Sofiter of Italy, were able to apply various principles of CE to improve their bottom line in one way or another.

Aerodata, an SME from the north German town of Braunschweig that specialises in real-time airborne data processing, used CE software components developed under Cepra to achieve significant savings. Sofiter, a 400-strong systems integrator based in Turin, has seen opportunities to build upon the ICT tools and concepts

introduced in Cepra to upgrade its procedures and its communication, both internally and with customers. This is helping it to compete more effectively for contracts around the world and to deploy its knowledge more effectively. "We looked into how to increase international custom and found we were losing time not in design or construction but in distribution and internal communication," says Angelo Comino of Sofiter. Being a 'smart SME' means Sofiter is able to improve its contribution to European projects such as the Eurofighter. Sigma, a Hamburg aeronautical engineering practice that tested Cepra's tools, discovered through the project that there is much more to concurrent engineering than it previously thought. In recognition of the shift in emphasis to a broader 'CE culture', the company even changed its name to Sigma Concurrent Engineering.

"We learned through the project that CE was more than just using different databases at the same time," says Ulf Karnath from Sigma CE. "We're living CE every day – everything we do, from talking and meeting with customers to finding solutions to problems, can be seen through the prism of CE principles," he adds. Simply by thinking about CE's broader usefulness, Mr Karnath confirms that aeronautics businesses like his own can save 10-20%. Cepra also established its transnational credentials. "It is one of the first times that CE has been used simultaneously by SMEs across several EU countries," notes Mr Lisanti. "A major return on this project for me has been the evidence that SMEs are ready to use CE potentially for any type of product development."

Full Title:

Concurrent engineering in practice – demonstrating the innovative development of aircraft components

Industrial Sector:

NACE 35.3 Manufacture of aircraft and spacecraft

Supporting Technologies:

0007 Aeronautics;
0123 Company Re-Engineering/
Organisational Development;
0204 Engineering, Concurrent Engineering

Information:

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Proposers:

- Prime: CEC – Concurrent Engineering Consulting Srl, I
- TEAM – Tecnologia Energia Ambiente Materiali Srl, I
- Sofiter Spa, I
- Cardinal Broach plc, UK
- Northern Technologies (Europe) Ltd, UK
- BIBA - Bremer Institut für Betriebstechnik und Angewandte, D
- SIGMA Concurrent Engineering GmbH, D
- Aerodata Flugmesstechnik GmbH, D

RTD Performers:

University of Nottingham, UK

Duration:

11/98-10/00

References:

ESP4-29365

Programme:

ESPRIT 4

Project Cost:

€1,455,000

Range of SME Contributions:

€40,000 – €100,000

EC Funding:

€800,000



Textile firms take to the net

CRAFT

ESP4-29817

Textiles and clothing, Europe's oldest manufacturing industry, is made up of a patchwork of SMEs

Europe's oldest manufacturing industry, textiles and clothing, is made up largely of clusters of SMEs working together. But how can such a diverse and fragmented industry, which depends on interlinked chains of independent suppliers, respond speedily to the rapidly changing demands of customers? The EU-supported VISIT project, involving SMEs in Germany, Belgium and Italy, has devised an on-line system, eChain, which co-ordinates activities along the supply chain, improving manufacturing efficiency and cutting delivery times. More than 20 enterprises are using the system so far. Products like eChain help SMEs raise their efficiency, and thus strengthen the competitiveness of the industry.

"If you look in the big clothing stores you'll see that the range of garments on sale changes every few weeks," says Dieter Stellmach of ITV Denkendorf, a leading German textiles research institute, located near Stuttgart. "Five or ten years ago clothing manufacturers would launch two collections each year, for the winter and summer seasons, and between these two seasons they had to change their production programmes completely. Now they have to change them every two or three weeks." That, in a nutshell, is the competitive challenge facing the textile and clothing industry. Fashions change quickly (as does the weather) and producers have to keep pace with fluctuating demands to stay in business.

"The main problem of the textile and clothing industry – especially in the finishing industry for printed fabrics – is speed," says Mr Stellmach. "It's a problem of production management and also of the supply chain." EU-wide, only about 5% of employees in the industry work for big-name companies; the rest are in about 110,000 SMEs grouped in networks and clusters. The 'supply chain' consists of all the companies who contribute towards the manufacture of a product – typically a spinner, a weaver, a finisher and a garment maker – and also suppliers and subcontractors within and further down the chain as well as wholesalers and retailers.

Supply chain management

The idea of using the internet to improve co-ordination amongst SMEs came from KBC, a German textile finishing company. They approached ITV, who put together an ESPRIT project called VISIT. Two more enterprises – Santi, an Italian weaving SME, and Gerry Weber, a German clothing manufacturer – joined KBC in a consortium representing three links in the supply chain. Two main products have come out of VISIT. First is a supply chain management system called eChain, developed by MSO Concept, a German software SME. Firms installing eChain use the internet to exchange information, allowing them to co-ordinate production better. The result is more reliable delivery dates, lower stockholding, and fewer deliveries between firms in the supply chain. It is almost as if a multitude of SMEs are working as parts of a single, dispersed enterprise.

Gerry Weber started installing eChain two years ago, and now the supply network using the system consists of almost 20 companies. This generates a licence income of up to €100,000 per year, and at the same time a significant cost reduction in the supply chain. "MSO is now in discussion with more than 50 companies," says Mr Stellmach. "But so far sales have been more or less concentrated in Germany, so the next step will be to spread out to other European countries." An urgent need now is to agree standards for on-line communication between numerous small companies.



Fashions change rapidly nowadays, so SMEs in the clothing industry need the tools to work together efficiently.



CRAFT

ESP4-29817

Monitoring system

The other product is a series of specialised hardware and software modules developed by Barco, a Belgian company specialising in automation for the textile industry. They are used for the monitoring system within an SME and are directly linked to the machines on the shop floor. Data from the monitoring system are then used for production management, production programme planning and scheduling and are closely linked with the eChain supply chain management system. "Barco is one of the world's biggest providers of monitoring systems to the textile industry," says Mr Stellmach. "There are only three or four others, which are also acting worldwide. So the theoretical potential for sales is very high."

With fierce competition from overseas manufacturers, mainly in Asia, the European textile and clothing industry needs to innovate to survive. The results of VISIT will give a boost to SMEs which are traditionally wary of investing in new ways of working. But Mr Stellmach cautions that new technology alone will not immediately improve the industry's competitiveness. "Introducing a new system is difficult from both the organisational and the human point of view," he says. "Technically it's very easy but it is much more difficult to get good quality data. You need a good in-house database and you need to maintain it."

Time for change

That requires a long period of training and familiarisation to help the workforce gain confidence in new ways of working. "You might compare it with driving a car. For the first few weeks it's almost impossible, and then after a while you don't have to think about it. But it takes a long time. There is a great potential in introducing such systems but it will take a long time to introduce them in a sustainable way."

Mr Stellmach is pleased that the innovations of the VISIT project will help bring the industry firmly into the information age. "Not many people know how the textile industry works and what it produces. There are many small, creative companies making many products which feature in our daily lives. You have ropes, seat belts, oil filters, curtains and so on, and most people don't recognise these as textiles. The textile industry is the oldest mechanised manufacturing industry. There's a wealth of knowledge and experience that other industries could learn from. I think it's important that the European Commission has recognised this and given us the opportunity to demonstrate to the European citizen how this work can help give us a competitive and successful industry."

Full Title:

Virtual integration and simulation-based PPC in the textile clothing industry

Industrial Sector:

NACE 18 Manufacture of wearing apparel; dressing and dyeing of fur

Supporting Technologies:

0509 Production Technology;
0579 Software Engineering,
Middleware, Groupware;
0612 Textiles Technology

Information:

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Proposers:

- Prime: Institut für Textil und Verfahrenstechnik Denkendorf (ITV), D
- Barco NV, B
- Gerry Weber International AG, D
- KBC Manufaktur Koechlin, Baumgartner und Cie. GmbH, D
- MSO Concept GmbH, D
- Tessitura Luigi Santi Spa, I

Duration:

03/99-06/01

References:

ESP4-29817

Programme:

ESPRIT 4

Project Cost:

€2,100,000

Range of SME Contributions:

€11,000 – €247,000

EC Funding:

€1,260,000



Bacteria sniff out oil pollution

CRAFT

EVK3-CT-2001-30002

Oil spills are not always catastrophic, but even small ones cause damage. The Polbiosensor is a cheap, simple way of getting early warning of oil pollution.

Oil pollution is one of the most common and most insidious threats to the ecology and economy of Europe's coastal waters. A consortium of SMEs with an interest in the marine environment has commissioned research to design a new type of biological sensor to detect hydrocarbons in seawater. Based on a common type of marine bacterium, the Polbiosensor could guard coastal fisheries, ports, beaches, recreational facilities and other places vulnerable to oil pollution. It could also be used to monitor escapes from oil production platforms, and even provide a fast and convenient way to test water samples in the field. The technology opens up new opportunities for SMEs to operate coastal environmental protection services.

Major oil spills, like that from the Prestige tanker which devastated the beaches and fisheries of France and Spain in 2002, always make the headlines. But every day numerous minor escapes of oil contaminate beaches and harbours around Europe's coasts. What is needed is a cheap, simple system to give early warning of such spills while there is still time to do something about it.

Like many innovations, the principle behind the "Polbiosensor" was discovered by accident. A research team at the St Jerome Faculty of Science in Marseille were investigating bacteria that could clean up oil spills. "They were studying micro-organisms that were good at "eating" different petroleum compounds," recalls Guillaume Pérocheau of Idee.com, a French company specialising in marine and environmental engineering. "They discovered that one of these micro-organisms produced a yellow compound when it was in contact with hydrocarbons." The scientists discussed their findings with colleagues at Eramer, a marine technology firm, who realised that they had the making of a new kind of oil pollution sensor.

Seeing yellow

"There is a market for a low-cost sensor based on biological material," says Mr Pérocheau. "If you have this micro-organism in a detection chamber in contact with even a very small quantity of hydrocarbons

it will produce this yellow compound. And if you can detect the yellow with an electronic device you know that there are hydrocarbons there."

Idee.com leads a project consortium of eight SMEs which are all possible end-users for the Polbiosensor technology. "We discovered that there are many SMEs working in coastal and environmental protection. They were all interested in having in their portfolio a biosensor for monitoring the coastal zone."

The development work was carried out by four research partners: St Jerome produced the bacteria, Irish company Stocker Yale made the electronics and Redcai, from Spain, supplied floats. One of the SMEs, Valeport, also contributed some of the hardware. The whole product is being conceived and assembled by Eramer.

"It's not very difficult to detect the yellow colour," says Mr Pérocheau, "What was innovative was to maintain the bacteria in the natural environment while ensuring they would produce a detectable amount of the yellow compound."

Floating sensor

The sensor is suspended from floats about one metre below the surface of the sea. It can be powered either by an undersea cable or by solar batteries. Water is drawn into the detection chamber where it passes over the bacteria, which are enclosed in a permeable capsule. An optical monitoring system detects any yellow colour and sounds the alarm, which is radioed to a control centre. So sensitive is the device that it can detect tiny quantities of hydrocarbons that are invisible to the eye. The



The Polbiosensor floats just below the water surface. The sensor chamber (left) contains a bacterium that produces a yellow compound when in contact with hydrocarbons. An electronic sensor then detects the yellow colour and sends an alarm by radio or by cable.



CRAFT

EVK3-CT-2001-30002

capsule containing the bacteria needs to be replaced every two months.

"We are testing a final version of the biosensor in real conditions in different oceans," explains Mr Pérocheau. "We have two or three clients who are ready to test the prototype to make sure it works in the long term. I think that within six months to one year from the end of the project it will be on the market."

There are many possible markets for such a sensor. Protection of coastal fisheries and shellfisheries is an obvious one, especially oyster beds which are highly vulnerable to oil pollution: owners will be able to certify that their produce has not been contaminated. Port authorities could use biosensors to monitor fuel spillages from ships, while tourist resorts would welcome early warning of pollution that might affect their beaches and other recreational facilities. Oil companies could put strings of sensors around their production platforms to detect escaping oil.

Coastal protection

In fact, Mr Pérocheau foresees a whole new service sector, run by SMEs, for coastal

environmental protection services. "We are going to create a new kind of job in coastal monitoring. It's a job that's emerging already, but this tool could help create specialised environmental services for coastal zones."

The Polbiosensor technology could have still more applications, such as field monitoring of water samples. Rather than send suspect water samples to a laboratory for expensive analysis, a simple biosensor kit could be used to screen samples in the field. "You can just take water from a place where there may be pollution, add dried cells and see if a yellow colour appears." Only where the sensor indicated the presence of hydrocarbons would a full analysis be required.

Mr Pérocheau expects about 100 sensors to be sold in the first year, rising to 1,000 in the second year. "It could be sold all around the world. We know of no equivalent product. Sometimes biological sensors for oil pollution appear on the market, but they use enzymes rather than fresh living cells. Our is the first sensor to use whole cells for hydrocarbon detection."

Full Title:

Research and development of an economical biologic sensor for detection of marine pollution by hydrocarbons

Industrial Sector:

NACE 11 Extraction of crude petroleum and natural gas; service activities incidental to oil and gas

Supporting Technologies:

0080 Biosensors;
0213 Environmental Technology/Engineering, Pollution Control;
0368 Marine: Instrumentation and Underwater Technology

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Proposers:

- Prime: Idee.com (F)
- Marilim Aquatic Research (D)
- Hispano Marine Cantabria (E)
- Nereides SA (F)
- Novurania SPA (I)
- Trondheim Maritime Instrumentering (NO)
- Edge Enviro Services Ltd (UK)
- Valeport Ltd (UK)

RTD Performers:

- Eramer SA (F)
- Faculté de St Jerome, UDESA (F)
- Redcai SA (E)
- Stocker Yale (IRL)

Duration:

01/02 – 12/03

References:

EVK3-CT-2001-30002

Programme:

EESD

Project Cost:

€1.72m

Range of SME Contributions:

€65,000 – €163,500

EC FUNDING:

€0.86m



Seaside cure for thyroid disorders

CRAFT

BRST-CT98-9230

The coasts of northern Europe are rich in an underused natural resource – iodine-bearing oarweed or kombu, which can be used to combat thyroid disorders

Worldwide, iodine deficiency is the chief cause of potentially preventable mental retardation and brain damage. Even in parts of Europe it still causes health problems. Most iodine comes from seafood, but even eating it every week does not guarantee an adequate intake. In a CRAFT project under the EU's FAIR programme, a group of SMEs and research institutes found that freshwater fish could also be turned into a useful source of iodine, if iodine-rich seaweed was added to their feed. On a commercial scale, this would provide a dietary alternative that is sustainable and economically viable, and also create new jobs on the coast and inland.

It is a simple problem, but a widespread one. In today's Europe, the populations of 30 countries – a sixth of the continent's population – suffer from iodine deficiency, which causes thyroid disorders such as goitre, leading to mental retardation and in extreme cases cretinism. Surgery to correct struma (an autoimmune disease of the thyroid) costs around €1 billion/year. The body does not store this element, so it has to be taken little and often, and the World Health Organisation recommends consuming 200 micrograms per day. Yet the average daily intake in a largely inland country like Germany is only 119 micrograms. Despite the widespread iodisation of salt, the principal sources of iodine in human food are fish and shellfish from the sea. As sea fish like mackerel or halibut contain only about 500 micrograms of iodine per kilogram, this means eating it at least once per week.

However various seaweeds that are common in northern European waters are rich not only in iodine, but also in trace elements and omega-3 fatty acids, which are essential for neural development. Although these algae are harvested to produce alginates, agar and other ingredients for the food, agriculture and cosmetics industries, they are not normally eaten themselves.

Organic source of iodine

An imaginative CRAFT project, co-ordinated by the Brittany-based Centre d'Etude et de Valorisation des Algues (CEVA), has demon-

strated that it is feasible to incorporate seaweed into the feed of farmed freshwater fish – which, under natural conditions, do not take up significant quantities of iodine. The consortium that carried out this 30-month initiative includes fish farms in France and Germany, a specialist biotechnology SME, a feed manufacturing co-operative and several research institutes. The idea has a lot going for it. From an environmental viewpoint, it is evidently preferable to use a sustainable natural source of nutrients rather than add inorganic iodides or iodates. Economically, the possibility of promoting 'enhanced' freshwater fish as an organically produced health food would create new market opportunities, as well as new jobs in collecting and processing seaweed. As the basis for its experiments, CEVA opted for the seaweed *Laminaria digitata*, a brown variety of kelp known as oarweed – or in Japanese *kombu* – which is readily available along the coasts of northern Europe. Studies on samples collected over a six-month period showed this to be suitable in composition, as it contains over four grams of iodine per kilo of dry weight, while also meeting the regulations for hazardous compound content, particularly with regard to heavy metals. German partner Raiffeisen-Kraftfutterwerk Kehl produced the special fishfood, in the form of extruded pellets containing varying proportions of pre-dried and ground seaweed. Key questions for research were whether the iodine and other nutritionally beneficial components of the weed would be fixed in the flesh of fish fed on such a diet – and, if so, what the optimal dose would be. It would then be necessary to



A CRAFT project has developed an iodine-enriched feed for freshwater fish.



CRAFT

BRST-CT98-9230

establish whether it could be transferred with beneficial effect to human consumers. An essential requirement was therefore to develop a method of measuring the low concentrations of iodine in the feed, in the fish, and in humans. This was achieved using high temperature extraction, followed by gas chromatographic separation of the fractions and analysis by mass spectrometry. CEVA monitored the feed over a four-month period to verify that iodine was not lost through sublimation (evaporation). Three institutes in Germany – the Bayerische Landesanstalt für Ernährung, the Bayerische Landesanstalt für Fischerei and the Institut für Physiologie of the Technische Universität München – then carried out laboratory feeding tests which showed that rainbow trout could metabolise the iodine. Further studies involving checks for fucoxanthin, a distinctive identifier compound present in *Laminaria digitata*, showed that the iodine from seaweed is incorporated in the body just as it is when food is dosed with chemical additives.

Practical and tasty

The farming partners conducted pilot trials to evaluate whether the new food would work on a commercial scale. Here, too, the focus

was on trout – although it would be equally applicable to other species such as salmon trout, salmon, arctic char, carp and perch. These trials verified that the stock could be reared satisfactorily, and that the results were reproducible. At the same time human volunteers confirmed that the end-product tasted fine – while also providing samples which showed that their bodies had fixed appreciable amounts of iodine. What is more, added at the rate of about 1%, the iodine has a very small affect on the cost of the feed.

“In fact, we reached all of our objectives,” observes Hervé Le Deit of CEVA. “The feed is ready to go into production as soon as sufficient market interest can be generated to make it economically feasible. We have not patented our method, so it is freely available for exploitation.

“For regions where fish is not a regular dietary component, it could also be interesting to explore the addition of seaweed to the feed of meat-giving animals – especially as it also provides other trace elements, fatty acids and fibres. This would extend the potential for health improvement, create yet more jobs and make an even greater contribution to sustainable development.”

Full Title:

Algae, a new source of iodine for freshwater fishfeeding

Industrial Sector:

NACE 05 Fishing, operation of fish hatcheries and fish farms; service activities incidental to fishing

Supporting Technologies:

0044 Aquaculture, aquaculture technology; 0229 Fish/fisheries; 0517 Public health

Information:

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Proposers:

- Forellenzucht Aumühle (D)
- Peter Hofer Forellenzucht (D)
- Raiffeisen-Kraftfutterwerk Kehl (D)
- Ferme du Jaudy (F)
- Javenech (F)
- Pisciculture du Moulin (GAEC) (F)

RTD Performers:

- Centre d'Etude et de Valorisation des Algues (F)
- Université de la Méditerranée (F)
- Bayerische Landesanstalt für Ernährung (D)
- Bayerische Landesanstalt für Fischerei (D)
- Institut für Physiologie, Physiologische Chemie und Tierernährung, Ludwig-Maximilians-Universität München (D)

Duration:

1/99 – 6/01

References:

BRST-CT98-9230

Programme:

FAIR

Project Cost: €545,500

Range of SME Contributions:

€15,000 – €70,000

EC Funding:

€227,750



Thought for food



CRAFT

FAIR-CT96-9508

The public loves the convenience of packaged foods – but demands high quality as well as moderate prices

Supermarkets never stop pushing their suppliers to keep improving quality while cutting costs. So in the food processing industry, the quest for the perfect recipe is never-ending. One way of ensuring that experiments on food formulations are as effective as possible is to use a goal oriented methodology based on statistical experimental design (SED), which is a way of getting the maximum amount of information from the minimum number of tests. SMEs, however, generally have little or no experience of SED, and their business can suffer as a result. French and Norwegian food research institutes have joined forces with food manufacturing SMEs from both countries in this FAIR project, to develop a simplified way of doing SED, which will make it much more accessible to SMEs. The French institute, ADRIA, is running regular courses to disseminate the technique.

The world's great chefs use their skills and talents to create culinary masterpieces. Just the right seasoning, a touch of a spice or two, and exactly the correct amounts of cream and wine in the sauce. They have their Michelin stars, and they have earned them. Processed food manufacturers are not running in the same race, and the constraints they work under are much more stringent, but they too are still searching for that spark of excellence. They face a number of separate challenges, and they have to meet them all if their products are to be commercially acceptable. The price may be right, but does it taste good? Will it stand being frozen, canned or packed in plastic? What is its shelf life? Is it safe when the consumers wield their forks? All these questions – and more – are in the minds of the technicians who devise the recipes for the foods we buy on an industrial scale. Everything we find on the supermarket shelves, from biscuits to biryanis, must undergo rigorous tests. Getting the recipe exactly right is vital, and quality is crucial.

The customer is always right

It is, perhaps, supermarkets that are the major driving force in quality improvement. Mass purchasing power allows their buyers to impose ever more stringent specifications on their suppliers. Food producers are subject to constrictions that no single chef

could tolerate. The emphasis is, then, to get the product exactly right. But how?

Part of the answer lies in statistical experimental design (SED). Not a phrase that trips easily off the lips, to be sure, but it is a powerful tool to ensure that the effect of varying the ingredients and processing of a food product can be predicted. It thus means that new product development times can be slashed. The problem is that SME food producers, in general, have little or no experience of SED. In the past, this has led small manufacturers to give up lucrative contracts with large retail chains, or submit to being absorbed by a larger group with deeper pockets.

"Our goal in this FAIR project was to bring a rational and goal oriented methodology, based on the use of the techniques of statistical experimental design, within the grasp of SMEs," says Isabelle Dulau. As a project manager at France's ADRIA (Association pour le Développement et la Recherche Appliquée aux Industries Alimentaires – Association for applied research and development for the food industry), she co-ordinated this FAIR project which has, at last, brought SED to SMEs.

"It was, if you like, very much a customer-driven project," says Ms Dulau. "The SME food producers in the project pushed ADRIA to ensure that the end results were user-friendly, and accessible to other small companies."

But what exactly is SED? "It is just a technique that can be applied to any number of areas of experimentation," explains Ms Dulau. "It allows formulators to grade the effect of varying such factors as ingredients and processing conditions. This, in turn,



Supermarkets, with their massive buying power, are making ever more stringent demands on packaged meal producers



CRAFT

FAIR-CT96-9508

means that the scientists can concentrate on those factors which have the greatest effect on the end product, rather than making 'shot in the dark' changes to a formulation or process. Sound SED will lead to the lowest cost, highest quality and most reliable product, because it is a way of gaining the maximum amount of information from the minimum number of tests."

Four steps to heaven

Fine. In theory. But how does it work in practice, and how, in particular, can it help food manufacturers? "It's effectively a four-step process," says Ms Dulau. The principle is to link practical knowledge with statistical techniques. "First comes the **problem definition** stage, during which all the members of the team brainstorm the variables to be studied and the methods for evaluating results. The choice of factors is based on the skill of the technicians and the knowledge of the specialists. This step is the most important because it is the most critical to success. Next comes the **screening** phase, when the experimental design is initiated, and the results are interpreted. Then comes **optimisation**, in which the experimental

designs are fine-tuned and the results are analysed." Last comes the **validation** step which ensures that the goals have been reached.

"SED can be applied to any processed food," Ms Dulau continues, "and our task now is to educate SME food producers in its benefits. We have distributed 700 copies of a methodological guide to food formulation – 500 to food manufacturers and 200 to students. We held a workshop in Rennes in 1998 which attracted 100 people, and since then have held seminars for some 80 people. The content of the guide has been greatly enriched by our SME partners' contributions, and both the book and courses take a 'hands on' approach."

But does it all, in the end, make a major difference? "Yes," says Ms Dulau. "Very definitely, yes. It's difficult to put a cash value on the benefits to SMEs, but we know of cases where SED has helped companies create new products, or reduce costs, when otherwise they could have been facing the wall. Jobs have been safeguarded, and futures secured."

And who could put a price on that?

Full Title:

Rapid product development in food SMEs by the use of systematic and goal oriented formulation procedures

Industrial Sector:

NACE 15 Manufacture of food products and beverages

Supporting Technologies:

0231 Food and Drink Technology; 0232 Food Chemistry, Food Ingredients; 0590 Statistics

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Proposers:

- Prime: Caugant (F)
- Christian Faure Entreprise (F)
- Storms Chemical Laboratory (NO)
- Trondhjem Preserving (NO)

RTD Performers:

ADRIA (F), Norwegian Food Research Institute (NO)

Duration:

01/97 – 12/98

References:

FAIR-CT96-9508

Programme:

FAIR

Project Cost:

€1,000,000

Range of SME Contributions:

(cash and kind): €120,000 – €130,000

EC Funding:

€489,000



Bioliqids make greener cleaners

CRAFT

FAIR-CT98-9588

Cleaning products made from plants instead of mineral oil are easier to recycle and healthier for users

In recent years, environmental concerns, rising safety and health at work standards, and the drive for sustainable development have combined to stimulate the search for cleaning agents and solvents that are not only renewable but are also safer than many of today's products. The challenge is to find replacements that perform just as well and are no more expensive. A CRAFT project under the FAIR programme assembled SMEs from the detergents, inks and paints industries that – with help from specialist research providers – joined forces to explore the possibilities in their particular sectors. Present and future eco-taxes are likely to tip the balance in favour of biologically-derived alternatives.

The search is on for new detergents and solvents that are safer for their producers, users and the environment.

Currently, materials of this type are derived from mineral oil. But as fossil fuel reserves dwindle, researchers are looking more intently at renewable replacements such as plant oils. As well benefiting from the eco-taxes which are progressively being introduced, these are better for our health. Yet the market will only accept alternatives if they perform well and are competitively priced. Options that have been investigated to date include water-based systems, less use of solvents, reactive diluents and extremely acid or alkaline water-based cleaners. Not all of these are viable for every application, and not all are really less hazardous than the chemicals they replaced.

A two-year CRAFT project funded under the FAIR programme therefore brought four industrial SMEs together with materials suppliers and research organisations to develop ecologically sound cleaners for the industrial cleaning, paints and inks sectors. Comprising partners from Belgium, Denmark, France, the Netherlands and UK – and co-ordinated by Holland's Instituut voor Agrotechnologisch Onderzoek (ATO) – this consortium was assembled with help from various local chambers of commerce.

Multiple objectives

The project's overall aim, one which was attained in December 2000, was to replace organic solvents and synthetic surfactants

by bioliqids and biosurfactants originating from agricultural raw materials. This reduces the impact on health and the environment. The specific objectives were:

- To formulate a water-soluble and/or water-emulsifiable biode detergent for floor cleaning;
- To substitute organic solvents in speciality paint formulations, without compromising their high performance;
- To develop a fast ink-cleaning agent for the offset printing industry;
- To explore the possibilities of recycling emulsions based on bioliqids, by breaking and distillation.

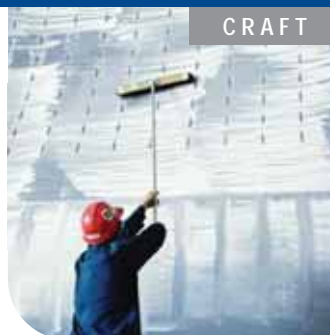
The researchers learnt valuable lessons in all these areas – and the findings have already led to the introduction of a user-friendly commercial product with broad industrial application.

Cleaning up

Patrick Leclerc of Procédés de Nettoyage Rationnel (PNR), an industrial cleaning products manufacturer located in the Paris region, explains that French business facilities such as factories and supermarkets are subject to a 'pollution quota' based on the chemical oxygen demand (COD) of the liquid they discharge into the sewage system (the amount of oxygen they use up as they degrade). If they could switch to readily biodegradable detergents, they would find it easier to stay within the prescribed limits. In the CRAFT project, a first step was to work out a test to measure the cleaning power of any new formulations and get reproducible results. A method devised by ATO, based on coating tiles with coloured crude palm oil, was eventually adopted. With help from the University of



*Bioliqids make cleaning up
less of a dirty chore.*



CRAFT

FAIR-CT98-9588

Amsterdam, PNR then began to explore a range of candidate formulations. A blend containing an alkyl sulphonate, an alkyl polyglucoside and an alkyl polyethoxylate showed the best performance, close to that of PNR's existing SMB-50 detergent, which was used as the benchmark. It also provided the required low-foam and non-slip characteristics.

The bioliqid has a COD value down to almost half that of the conventional product, and is also substantially less acidic, so is kinder to users' hands. After slight modification, the new cleaning agent could be brought into full compliance with the EU eco-label and the Swann standard used in Scandinavia.

It is now being marketed under the name *PNR Clean*, and, as it works especially well with mineral oils, is positioned as an industrial cleaner suitable for all surfaces except wood. It accounts for around 10% of PNR's overall output, and plans are in hand to extend the technology to two or three further products.

More work needed

The results of the paint solvent studies, conducted on behalf of Lippens, Belgium,

were less conclusive. For some finishes, it proved possible to achieve acceptable drying times and viable costs, combined with reduced aquatic toxicity and neurotoxicity. But the researchers could not eliminate the unhealthy ingredients within the funded period.

The project also investigated replacements for aromatised hydrocarbons for use in cleaning inks from offset printing machines. Here, the best candidates look like being fatty acid esters and micro-emulsions based on rapeseed oils and ester derivatives, with appropriate surfactants. As regards recyclability, ATO was able to demonstrate that emulsion-based cleaners could successfully be recycled by vacuum distillation, with minimal changes in composition. But some problems remain regarding low evaporation rates and a tendency to swell the rubber print rollers.

"Taking part in projects such as this is of great value to SMEs like ours, which operate in lower volume niche markets and lack the resources to carry out basic research without external assistance," says Patrick Leclerc.

Full Title:

Bioliqid mixtures for detergent and/or solvent applications

Industrial Sector:

NACE 24 Manufacture of chemicals and chemical products

Supporting Technologies:

0060 Biochemical technology,
0496 Plant products

Information:

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Proposers:

- Prime: Procédés de Nettoyage Rationnel (F)
- W Lippens (B)
- Aarhus Oliefabrik (DK)
- ATF Recycling (NL)
- Erwen Th. Koomen (NL)
- Graphic Printing Chemicals (UK)

RTD Performers:

- EnPro (DK)
- Chemiewinkel, University of Amsterdam (NL)

Duration:

1/99 – 12/00

References:

FAIR-CT98-9588

Programme:

FAIR

Project Cost:

€328,000

Range of SME Contributions:

€24,000 – €48,000

EC Funding:

€164,000



Robot wars

CRAFT

G1ST-CT-2000-50054

Robots are perfect for manufacturing a standardised product. Now standardisation is being applied to them too

Automated production lines have to date required separate control units for each of their robots and handling systems. The software has to be configured individually, which usually entails long set-up times and high engineering costs. What's more, changing the product means reprogramming the software or installing new controllers. Now, a German-led CRAFT consortium has developed a unique PC-based controller that can manage several handling systems at the same time. In partnership with two other SMEs, Manz Automation is currently testing the final product in the field. There are already several customers working with the new product, and many more are expected once the trials are complete.

In a recent Europe-wide TV advertising campaign, a major French carmaker depicted a production line with robots behaving badly. As soon as the overseer's back was turned, the machines would amuse themselves by spray-painting bizarre patterns on the cars, or assembling the standard components into units that more closely resembled abstract sculpture than anything seen on the road. The company obviously had a problem with its kinematics. To a mathematician, kinematics explains how velocities and accelerations of parts of a moving system are related. Meanwhile for the production engineer, it is a question of controlling the motion of a machine containing a myriad of different moving parts. But how, exactly, are robots controlled? Until recently, automated production lines had to rely on separate control units for each type of robot and handling system. In most cases, the control units, robots, motors and peripherals had to be bought from the same supplier, as each manufacturer has its own communication interfaces. Not any more. Partners in this project have developed what is thought to be the world's first single software platform – the Advanced Motion Control System (AMCS) – with a wide range of standard interfaces. Uniquely, the software code of the AMCS needs to be written just once, and can then be adapted to different production requirements. The benefits of this controller should be substantial, as set-up times for new production models are much reduced, as are the engineering costs.

Opening up to others

The AMCS is very versatile and can work with many different approaches, such as dedicated motion control (which has only one application), programmable logic controllers (PLCs, with the flexibility to deal with complex tasks and a variety of functions), or vision systems (for visually inspecting a component for defects and/or measurement criteria). The software utilities in the full system mean that both the production hardware and the robotics programming can be developed on a simulation. This can then be compared to the performance of the actual hardware that will be installed – an important advantage. Additionally, one special interface allows customers to install their own kinematics (motion control software) inside the controller, which means they can retain in-house know-how as production jobs change.

These features make AMCS a powerful tool – enabling easier and more flexible programming of robotics. "In theory, there is no limit to the number of kinematics that can be adapted on the AMCS, since it has very open interfaces," says Eduard Ams, the CRAFT project co-ordinator. "So if you buy this control unit from us you have the option of going to other manufacturers for the other components, even though we or our project partners can supply them to you." The AMCS consists of a PC card containing sophisticated software that runs on a standard PC processor. PC-driven controllers offer many advantages over traditional PLCs as they are non-proprietary, much less expensive, easily upgradeable, and user-friendly.



The AMCS project makes automation cheaper by enabling manufacturers to control robots from different makers with one software system.



CRAFT

G1ST-CT-2000-50054

The 'open system' approach adopted here looks like an invitation to the competition, but Mr Ams is very upbeat about it. "We have the advantage of a flexible system backed up by very good support. This is our big plus. In addition, at a price of €2,000-€10,000, depending on the software content, the AMCS is cheaper than machine controllers offered by competing suppliers. And none of them offers all these comprehensive capabilities together on the same platform – typically, they are restricted to motion control."

The project consortium assembled the whole AMCS package in just 18 months. Manz Automation from Reutlingen, near Stuttgart in Germany, led the project, in partnership with two SMEs working in the same field of production control systems – Servotecnica from Italy, and Shafir Production Systems from Israel. Another Israeli partner, Kollmorgen Servotronics (the AMCS RTD performer) was responsible for all firmware-related developments: kinematic transformations, open kinematic interfaces and typical robot functions. The package was finished at the end of July 2002 and is currently undergoing final testing. A number of potential customers are awaiting the results of the beta tests, or have already produced the first applications. "The use of servo-controlled systems like ours for production handling, especially for high-precision applications, is increasing fast," says Mr Ams. "They are rapidly becoming less expensive and there will be many more of them five years from now."

Half the time and half the cost

Even though the AMCS looks like a sure-fire winner, Manz realises that it will take time

for it to be accepted by the automation industry. The company has been actively marketing the product through advertisements in magazines and promotions at four exhibitions. "Within two years, we hope to have up to 100 customers," says Mr Ams. "We hope that many of the larger automation companies, with over a hundred employees, will be particularly interested. They build big production lines and carry out complex projects requiring perhaps ten automation controllers a year. As a direct result of the success of this project, staffing in our department grew from two to eight during 2002, and we plan to take on another three people in 2003. That number should grow to about 25 over the next 5 years if AMCS is as successful as we believe it will be."

Mr Ams emphasises how user-friendly the new controller is. "If you are installing two or three different kinematics in your line, they can be set up in less than half the time and at half the cost. Maintenance is easier and less demanding and self-check features are built in. It seems complicated to use because it can do so many things, but that is not the case. We put a lot of effort into making it very easy to configure the system. It was one of the main objectives of our project."

The simplification and opening of automation control standards will allow system components from different manufacturers to be used together. This should make production lines of all kinds much more competitive, and ultimately result in lower prices of goods in the shops. Plans are already underway at Manz to submit a proposal in 2003 for a new project of a similar nature, to develop advanced innovative features of adaptive control for robots.

Full Title:

AMCS – Advanced Motion Control System

Industrial Sector:

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

Supporting Technologies:

0137 Control Engineering;
0509 Production Technology;
0579 Software Engineering,
Middleware, Groupware

Information:

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Proposers:

- Prime: Automation Components Systems and Services (D)
- Servotecnica (I)
- Shafir Production Systems (IL)

RTD PERFORMER:

Kollmorgen Servotronics (IL)

Duration:

02/01 – 07/02

References:

G1ST-CT-2000-50054

Programme:

Growth

Project Cost:

€702,171

Range of SME Contributions:

€20,000 – €300,000

EC Funding:

€349,944



Propane – a cool gas for heat pumps

CRAFT

JOE3-CT97-0077

Heat pumps that use propane are an environmentally friendly way of keeping buildings cool in the summer and warm in the winter

With the help of the EU's JOULE programme, a consortium of European SMEs and researchers has designed a new type of reversible heat pump that uses environment-friendly propane gas as its refrigerant. It performs better than conventional heat pumps and is ideal for the climatic conditions of southern Europe where it can keep houses cool in summer and warm in winter. A model for northern Europe can extract heat from a nearby river or lake or even from the Earth itself. If it is successful, the new heat pump will contribute to the use of renewable energy and start to reclaim some of the market dominated by US and Asian manufacturers.

A heat pump, as its name suggests, is a device that moves heat “uphill” from a cooler area to a warmer area. A domestic refrigerator is the most familiar application of the heat pump principle, but the technology has much wider applications.

Central heating systems can use a heat pump to extract heat from the cool outside air and pump it into the house. Electricity is used only to operate the pump, not as a source of heat. A reversible heat pump has an added benefit - it can heat the house in winter but cool it in summer.

Heat pumps are common in North America, but less so in Europe. They are used in northern Europe for heating and in southern Europe, especially Spain, Italy and Greece, for both heating and cooling. Hot summers and mild winters are ideal conditions for cooling and heating houses by heat pump. Units currently installed tend to be small, serving a single room or a small flat. Since the Mediterranean climate is similar to that in parts of the US and Asia, this market is dominated by products from overseas manufacturers.

The heart of a heat pump is its working fluid, or refrigerant, which is alternately evaporated and condensed within the unit. Refrigerants using ozone-damaging CFC gases have been phased out, but modern synthetic refrigerants, such as those used by overseas manufacturers still act as greenhouse gases, contributing to global warming. This is where propane comes in.

“Natural working fluids like propane are

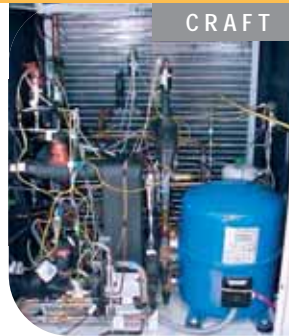
much better for the environment than the others,” says Juan de Blas, research director at Madrid-based energy and environment consultancy BESEL. “Heat pumps in northern Europe use propane, but only for heating. We wanted to develop a propane heat pump for the Mediterranean countries that could be used for both heating and cooling. There was nothing in Europe like the product we proposed.”

Resistance from industry

Another reason for the project was to demonstrate that propane, an inflammable gas, is a safe refrigerant. “Many groups were looking for a new refrigerant and propane was known to perform as well as or even better than conventional refrigerants,” he says. “But even if we could demonstrate that it was a fantastic refrigerant for a heat pump, we had to face opposition from the compressor industry, which did not want to make propane compressors because it thought them unsafe. This was a real barrier to the introduction of propane.” A partnership between manufacturers and research institutions in Spain, Italy and Sweden found support for a research project under the EU's JOULE programme. Mr de Blas co-ordinated the project on behalf of AEDIE, a Spanish industrial association promoting the use of alternative energy. CIATESA, a Spanish manufacturer of heat pumps, supplied a commercial pump to be adapted for propane. Italian company Alfa Laval Artec built the heat exchanger which was tested at ENEA, while the Polytechnic University of Valencia worked on the com-



The guts of the HEAHP reference heat pump unit and measurement instrumentation



CRAFT

JOE3-CT97-0077

pressor and tested the whole system. KTH in Sweden advised on the use of propane as a refrigerant. In laboratory tests the propane heat pump performed better than pumps using conventional refrigerants. "We delivered it to a European certification lab and we got results much better than we expected at the beginning, so it was a complete success," says Mr de Blas.

Energy from the ground

Now that the research phase is over, CIATESA has begun marketing the heat pump. Although the initial plan was to develop a pump for southern Europe, they see northern Europe as the most promising market in the short term. "Our target markets are countries that are concerned with environmental issues," explains Oscar Noguera of CIATESA. "We think that in northern Europe there is a much higher awareness of the environment and systems that use natural refrigerants and renewable energy." While the pump can extract heat from the air in Mediterranean countries, this version of the pump will be designed to extract heat from the ground or from a body of water such as a lake or river, so it will be suitable for countries with cold winters. The new pump is 10% more efficient than pumps using

conventional refrigerants, and has a power of 20 kilowatts. Meanwhile a follow-up EU-funded research project is developing a reversible water-to-water propane heat pump for the Mediterranean region. CIATESA employs about 280 workers and Mr Noguera hopes to see that figure rise by 10-15% over the next two years as the pump comes on to the market. So far there are no competing propane pumps from overseas manufacturers. "The use of propane is something that was born in Europe and came from this concern for the environment," he says. "I think that's quite important for the European people. It will be a well-accepted product." Mr Blas points out that there is still work to be done on safety. Although European Standard EN 378 allows propane as a refrigerant, it has still not been adopted in all European countries. "It's like the introduction of hydrogen as a fuel. Everybody thinks of the Hindenburg disaster, but that happened over 60 years ago. My company is also involved in fuel cells and we have no problem with hydrogen, it's just another gas. People happily cook with propane in their kitchens – which is much more dangerous than using it in a heat pump. We have made the research a success, but now we have to win public acceptance."

Full Title:

HEAHP – A new high efficiency reversible air-to-water heat pump working with propane for commercial applications in Southern Europe

Industrial Sector:

NACE 40 Electricity, gas, steam and hot water supply

Supporting Technologies:

0213 Environmental Technology/ Engineering, Pollution Control; 0533 Refrigeration and Cooling

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Proposers:

- Prime: Asociación Española para la Diagnóstico y Investigación de la Energía (AEDIE), E
- Compañía Industrial de Aplicaciones Térmicas SA (CIATESA), E
- Alfa Laval Artec SpA, I

RTD Performers:

- Universidad Politécnica de Valencia, E
- Ente per le Nuove Tecnologie l'Energia e l'Ambiente (ENEA), I
- Kungliga Tekniska Högskolan (KTH), S

Duration:

03/98-02/00

References:

JOE3-CT97-0077

Programme:

NNE JOULE C

Project Cost:

€1,600,000

Range of SME Contributions:

€300,000

EC Funding:

€1,000,000



Driving towards tomorrow

CRAFT

JOE3-CT98-7044



Autonomy: the MUE prototype can drive for three hours on one charge

Experts have been talking for years about the environmentally friendly vehicle of tomorrow, but electric car technology is still not cheap or practical enough to win over the driver in the street. All that could be about to change with a prototype car which uses an interesting battery set-up. A test model has been designed by a CRAFT consortium of French, Italian, Dutch and English manufacturers and it appears to have cracked the problems associated with 'filling up' electric cars. Designed for city centre use, the Mobile Urbain Electrique (MUE) car allows drivers to swap batteries in and out in just a couple of minutes.

The market for cleaner cars is developing too slowly. Every car manufacturer knows about the ecological and social problems road traffic causes, and the research is keeping pace with changing consumer attitudes. Economically viable small urban vehicles, such as the Swatch-Mercedes Smart, have emerged here and there, but this welcome trend has not been accompanied by zero emission propulsion. Governments have been half-hearted in encouraging clean vehicles, electric or otherwise, and they are still a rare sight on our roads. But nobody enjoys poisoning the air they breathe, and clean cars still benefit from a lot of latent consumer goodwill. There is probably room in the market for an electric vehicle that is at home in the town or city – as long as it is reasonably priced and has a functional yet pleasing design.

Clean thinking

Yet electric vehicles still cost too much for the average person to buy and use, and the facilities they rely on – such as filling stations serving up electricity rather than petrol – are still too thin on the ground. The electric vehicle also still tends to be thought of as a long-distance car that uses an electric motor as a straightforward replacement for the internal combustion engine, and is driven very much like a conventional, petrol-powered vehicle. The thought-provoking 'Osmose' concept – shown at the Paris Motor Show in 2000 – has been at the vanguard of a rather different car design. It presents a vision of responsible car use that suggests a new way forward for drivers and pedestrians alike. People share travelling to and from

the city centre, catching an electric car rather like they would a bus, thereby cutting down on the volume of everyday road traffic and capitalising on a source of clean energy at the same time.

François Venel of the French research consultancy CETIOP (Conseil Expertises Technologies Industrielles Organisation de Production) latched on to this vision of the clean car three years earlier at an event he organised in Limoges. Osmose became the basis for his Mobile Urbain Electrique (MUE) project. "We hope the project produces a new type of car that is perfect for use by car hire companies and car-sharing schemes, so that it will do a lot to cut city centre parking problems. We think this is quite innovative," he says. "We are also thinking of niche applications such as parks maintenance and light deliveries."

The power to weight ratio is critical to a vehicle's overall performance. The project's SME partners also wanted to get a vehicle to market that would be cheap for them to make, as well as cheaper for their customers to buy. To avoid the red tape that typically slows up the development of such a car, the SMEs therefore decided to concentrate on a class of lightweight runabout that benefits from simpler licensing requirements, while being rigid enough to carry two passengers. They sit inside a new type of glass bubble cabin which has been specially designed to improve comfort. This it achieves by creating a feeling of space inside the car and providing the passengers with a 270-degree field of view. However, there is also ample room at the back for fittings and storage.

Fast fill-up

Over the last couple of years the MUE consortium of French, Italian, Dutch and English SMEs have therefore worked closely together in a co-operative research project under the



The MUE's batteries are mounted on a quick-change rack that slides in between the rear wheels. Changing the batteries takes just under two minutes.



CRAFT

JOE3-CT98-7044

EU's JOULE non-nuclear energy programme. They have designed, developed and tested a prototype weighing only 320 kilograms that is powered by a high-performance six-kilo-watt motor. A set of lead-acid batteries (still the most cost-effective choice) keeps the car running for three hours at a top speed of 45 kilometres per hour.

Topping up with electric power is straightforward. The bank of 12 batteries is mounted in a specially-designed rack. The driver uses a jack and trolley to slide the rack of depleted batteries out and put a new rack of full batteries in. The work of moments. "The idea was to think of the batteries like a tank of energy which you can replace without constraints, just as you can with a conventional vehicle," says Mr Venel. Importantly, changing the batteries is a very simple process that needs no tools or external assistance. It is also quick, with the change being done in around the same time it takes to fill up a conventional car with petrol – under five minutes. In tests this has been reduced to less than two minutes. So far, the vehicle has performed well on the test track. Because it is light and has a very low centre of gravity, it holds the road well, although the rear suspension has had to be reinforced to allow for the weight of the battery rack.

"We also asked ourselves whether the vehicle needed to be heated, but we noted that when the outside temperature was 4° C, even with a strong, cold wind blowing, a small amount of sun bursting through the car's glass warmed up the cabin very quickly," recalls Mr Venel. "We're now thinking of installing air-conditioning."

Quadruple bottom line

According to Mr Venel, the MUE project meets a number of social and environmen-

tal objectives. "We wanted to reduce urban pollution by using clean energy, to reduce traffic congestion by building a small car, and to reduce the consumption of fossil fuels," he says. Mr Venel also believes the development of clean vehicles will bring about major changes in the industrial strategies of manufacturers who will be obliged to share their skills with specialised SMEs.

"This could have significant economic consequences – in terms of maintenance, after-sales service, the training of staff in handling this type of vehicle, and the need to devote substantial resources to research and development," he says.

The MUE project's European consortium skills span the complete range of auto manufacturing. The French SME Automobiles Chatenet will manufacture and sell the MUE car when it eventually reaches the market. Italian SME Comex is a pre-assembly specialist. Sotiag – a French SME – worked on the car's chassis, and Dutch SME Benning has worked closely with lead-acid battery expert Hawker, an English company, to manufacture the car's power supply equipment. As well as CETIOP, a technology transfer consultancy which specialises in research and technology development programmes, the project's other RTD Performers are LTL, an English automotive styling company which has worked with Hawker to develop, produce and test the rack system, and LMB from France, which has assembled the electric motor and generator, cooling and airflow systems.

"Certainly the success of the MUE project has depended on the SME partners working closely to create a supply chain of expertise," adds Mr Venel. "The manufacturers are currently waiting for the market demand for electric vehicles to develop further before actually launching the car".

Full Title:

Mobile Urbain Electrique (MUE)

Industrial Sector:

NACE 34 Manufacture of motor vehicles, trailers and semi-trailers

Supporting Technologies:

0199 Energy Management System; 0656 Vehicle Technology

Information:

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Proposers:

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- Automobiles Chatenet (F)
- Benning (NL)
- Comex (I)
- Hawker (UK)
- Sotiag (F)

RTD Performers:

- Conseil Expertises Technologiques Industrielles Organisation de Production (CETIOP) (F)
- Le Moteur de Brive (F)
- Ligvale Technology (UK)

Duration:

01/99 – 01/01

References:

JOE3-CT98-7044

Programme:

JOULE-THERMIE

Project Cost:

€ 895,000

Range of SME Contributions:

€ 89,000

EC Funding:

€ 445,000



Coeliac disease: it's bigger than we thought

CRAFT

QLK1-CT-1999-00037

People with coeliac disease cannot tolerate gluten, an elastic protein found in European staple crops such as wheat, barley and rye.

Coeliac disease – intolerance to gluten – used to be thought of as a rare disease of children, but doctors now believe it affects one in every 100–200 people in Europe, including adults. This groundbreaking study spanning six European countries has confirmed both the high prevalence of coeliac disease and the effectiveness of the latest methods of diagnosis. This is important because although its symptoms can be alleviated by dietary treatment, the disease is time-consuming to diagnose by traditional methods. The deeper understanding of coeliac disease that this study has helped build will lead to new tests to identify people who may develop the condition in later life. Other possible developments are new ways of treating cereal products to make them safe for coeliac sufferers.

Coeliac disease is a medical condition now thought to affect one in every 100–200 Europeans. In coeliac sufferers, gluten and other proteins found in cereals such as wheat, rye and barley damage the lining of the intestine. Symptoms range from chronic tiredness to severe malnutrition. Once coeliac disease is diagnosed, treatment is straightforward, if drastic: a lifelong avoidance of all foods containing gluten. It is the diagnosis, however, that is often the problem.

The Coeliac-EU project showed the value of the latest diagnostic blood tests, and confirmed that coeliac disease is much commoner than was once thought. Further results from the project will improve scientists' understanding of the genetic basis of coeliac disease, yielding tests that could single out people likely to develop the disease in the future, and improve our understanding of other types of food intolerance. Further into the future are new ways of treating foodstuffs to make them safe for coeliac patients.

The project, which ran from January 2000 to March 2003, was co-ordinated by the Belgian starch manufacturer Amylum. It brought together the work of 16 European laboratories in seven countries. The large scale of the study, which would not have been possible without EU support, allowed the researchers to put the problem into a European context and to discover subtle genetic effects that would not have been visible in smaller studies.

Better tests and growing awareness

The low profile of coeliac disease means that many cases remain undiagnosed, especially if symptoms are mild, says Enzo Bravi, international diagnostics marketing manager with Eurospital, the Italian SME partner in the Coeliac-EU project. "Many people in Finland, Italy and the UK know about coeliac disease," he says, "but in Germany, for instance, awareness is much lower."

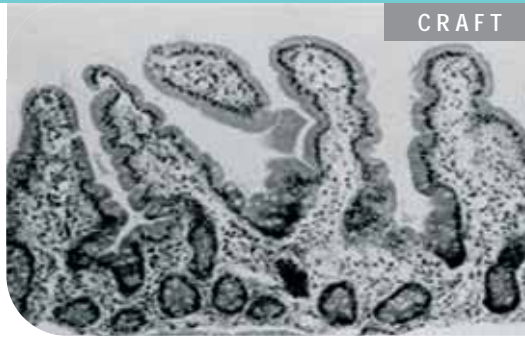
The main reason for lack of awareness is that until recently doctors have classed coeliac disease as rare, and affecting mainly children. The condition has been known since the 1950s, but as recently as the early 1990s its prevalence was believed to be just one in 2,000 people. And the belief that coeliac disease is rare is linked, in turn, to the fact that until the late 1980s there were no suitable blood tests. Instead, diagnosis relied on taking samples from the gut wall and examining them for visible changes that characterise coeliac disease – an invasive and time-consuming procedure. The original blood tests were useful, but not accurate enough to be used for mass screening. The latest test, for an enzyme known as tissue transglutaminase (tTg), is more reliable.

A bigger and better study across Europe

Confirming the suitability of the tTg test for mass screening was one of the aims of the Coeliac-EU project. At the same time, the researchers wanted to measure the prevalence of coeliac disease across Europe, perhaps revealing geographical differences that were not apparent from previous smaller studies.



Coeliac disease is a genetic disorder that damages the lining of the small intestine, preventing sufferers from absorbing nutrients in their food. It can therefore lead to diarrhoea, weight loss, malnutrition, anaemia and osteoporosis.



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QLK1-CT-1999-00037

Eurospital developed a new form of the tTg test kit, and research institutions in Italy, Finland, Northern Ireland and Germany used this to screen blood samples from more than 29,000 people. "Organising a trial on this scale was a big challenge, but everyone worked very well together," notes Mr Bravi. The tests showed an incidence of coeliac disease of around 1%, with some national differences that remain to be analysed. The researchers have still to confirm that results from the tTg test match those obtained by biopsy, which remains the "gold standard" in coeliac diagnosis.

The other main aims of the project were to understand more about the genetics of coeliac disease, and the exact way in which gluten damages the lining of the intestine. The researchers confirm links to three different genes, two of which had not previously been implicated in coeliac disease. One of the new genes seems to lie at the heart of the body's auto-immune response, says genetics specialist Professor Luigi Greco of the University of Naples, and will tell us more about diabetes as well as other types of food intolerance.

Professor Greco believes that knowledge gained during the project could eventually help coeliac sufferers in two ways. First, it may be possible to develop drugs to damp down the body's autoimmune response. Second, special enzymes could be used to treat cereal products, breaking down the

gluten molecules so that they do not trigger an immune response.

Shared experience

Underlying the whole study was an unprecedented openness in the sharing of biological material and data, says Professor Greco. "Usually people share only their published results," he explains. "We shared the raw materials, which was challenging to do but also very rewarding."

Mr Bravi is confident that the new tTg test is accurate and cheap enough to be used for mass screening. "The project did not directly support the development of the new test kit, which is already a fully commercial product," he says. "But it did help us to confirm the accuracy of the test, raised our profile among researchers and helped us understand where future research is heading. Our test kit is now the European market leader."

The market for the new kits will be much smaller than, for example, hepatitis test kits, says Mr Bravi. Nevertheless, the company hopes to sell several thousand test kits in each country where it is introduced.

The benefits for Europe will be much greater, he says: "There must be hundreds of thousands of people who do not feel as well as they should do, and a diagnosis of coeliac disease could be a huge help to them. This will open up a big market for the gluten-free food industry, too."

Full Title:

Evaluation of the prevalence of the coeliac disease and its genetic components in the European population

Industrial Sector:

NACE 85 Health and social work

Supporting Technologies:

0159 Diagnostics, Diagnosis;
0382 Medical Technology

Information:

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Proposers:

Prime: Amylum-Belgium NV (B)

RTD Performers:

- GSF-Research Centre for Environment and Health (D)
- University of Erlangen-Nürnberg (D)
- Institut National de la Santé et de la Recherche Médicale (F)
- University of Tampere (FI)
- Finnish Red Cross Blood Transfusion Service (FI)
- Eurospital SpA (I)
- Università degli Studi di Ancona (I)
- Università degli Studi di Napoli 'Federico II' (I)
- University of Oslo (N)
- University of Göteborg (S)
- Queen Mary and Westfield College (UK)
- King's College London (UK)
- Queen's University of Belfast (UK)
- University of Southampton (UK)
- The Mathilda and Terence Kennedy Institute of Rheumatology (UK)

Duration:

01/00 – 03/03

References:

QLK1-CT-1999-00037

Programme:

Quality of Life: Food, Nutrition and Health

Project Cost:

€5.19 million

Range of SME Contributions:

€227,000

EC Funding:

€3.96 million



Eating to diminish cancer risk

CRAFT

QLK1-CT-1999-00706

A balanced diet gives us all the nutrients we need to keep healthy. But 'functional foods', engineered to increase the amount of certain ingredients they contain – are especially beneficial in warding off specific illnesses.

The FFACC project set out to discover more about the causes of colorectal cancer, especially those linked to diet. The ultimate aim was to produce a laboratory assay that food companies can use to screen ingredients for anti-cancer properties, allowing them to create new “functional foods” that can protect against cancer. From the start this was an extremely ambitious project, so much so that without EU support it would probably never have seen the light of day. Although the EU funding phase is now over, work will continue for at least 3–5 years. There have been direct business benefits to the project's three SMEs, which deal with dissection techniques and software for genetic analysis. The potential benefits for the food industry, and for the health of Europe's citizens, are huge.

Eating the right kinds of food can significantly cut your risk of cancer. This much is clear from scientific studies of population and diet, especially of groups such as immigrants who change their diet but keep their genes. Tumours of the colon, breast and pancreas, for instance, are known to be affected by your consumption of “macro-nutrients”, including fats, proteins and fibre, and “micro-nutrients” such as the carotenoids and flavonoids in green vegetables.

So it makes sense to switch to foods that are known to be good for you, including “functional foods” – commercial products that have been doctored to include health-giving substances such as fish oils or antioxidants. But how do scientists find out which nutrients are important in preventing cancer? The traditional approach is to do long-term studies of large groups of rats, or people, observing what they eat and what health problems they suffer from – which is a lengthy, expensive process that does not always provide clear results. Thanks to the FFACC project there is now a better way.

Taking a tip from pharmaceuticals

Cancer researchers are increasingly using the new disciplines of genomics and proteomics to focus on precise mechanisms: how individual cells become cancerous, and how the substances present in food affect this process. The FFACC project set out to develop a bioassay – a testing procedure –

that could identify food components which prevent or slow the growth of tumours of the colon and rectum.

“We are introducing to the food industry techniques that until now have mainly been confined to pharmaceuticals,” says project co-ordinator Dr Ruud Woutersen, who is a toxicologist at the TNO Nutrition and Food Research institute in the Dutch town of Zeist. The FFACC project ran from January 2000 to December 2002. It brought together researchers from the Netherlands, Denmark, Germany and the UK. The researchers studied samples from three sources: human tumours, laboratory animals and “cell lines” – living cells that have been bred to grow in test-tubes. The aim, Dr Woutersen explains, is to produce new cell lines that become cancerous only in the presence or absence of particular chemical compounds. Since such compounds change the genetic make-up of the cells and the proteins they produce, examining these changes will show which genes are implicated in carcinogenesis.

“We have plenty more work to do, but we have made good progress towards an assay that the food industry can use to screen promising compounds. The approach we have developed could be used for other diseases too,” adds Dr Woutersen.

Laser dissection narrows the scope

To home in on the tissue they wanted to study, the FFACC researchers used laser microdissection. This relatively new technique was developed by German company Palm Mikrolaser Technologie, one of the two SMEs that took part in the project.



The FFACC project used the technique of laser microdissection to isolate individual cells for analysis.



CRAFT

QLK1-CT-1999-00706

"Normally we work with complete organs," explains Dr Woutersen, "so we have a mixture of normal tissue and various kinds of cancerous tissue, plus blood cells. With laser microdissection, on the other hand, we can isolate individual cells, so that we can be sure of analysing only one type of tissue at a time."

Dr Karin Schütze, co-founder of Palm Mikrolaser Technologie, explains how her company trained the scientists in the project to use the microlaser dissection techniques she has developed. Working under a microscope, the researchers use a focused laser beam to "catapult" individual cells out of a tissue sample.

"This was the first time we had been involved with nutrition, and I realised that there are a lot of opportunities for us in this area," says Dr Schütze. "We were able to develop new protocols, and to show scientists our equipment in action. We can see a total market for perhaps 5,000 laser microdissection systems, and a significant fraction of these could be in the field of nutrition."

This was also the first time Palm Mikrolaser Technologie had worked on an EU project, and Dr Schütze was impressed with its quality. "Dr Woutersen was a very honourable and efficient co-ordinator," she says, "though I think the increased size of projects under the Sixth Framework Programme might be more challenging to manage!"

Laser microdissection harvests only small numbers of cells, so samples taken from

laboratory rats are often too small to analyse using current techniques. "We are still working on ways to 'amplify' and analyse these very small samples," admits Dr Woutersen, "and in the meantime we have been using larger samples taken from human tumours."

Using compounds already known to inhibit cancer, the team has been able to show that the process typically involves a couple of hundred genes out of a total of around 8,000. This is where project's software companies come in. "You cannot analyse the effects of so many genes in your head," says Dr Woutersen, "so Numico Research is working on ways to do it by computer."

The third SME involved, Nonlinear Dynamics, worked on software to analyse proteins – an even more complex task, and one which was probably too ambitious, Dr Woutersen admits.

Aiming high

"When we started, this was a very ambitious project – a completely new idea," says Dr Woutersen. "For instance, combining laser microdissection with molecular biology was a nice idea, but at that time no-one had shown that it would work.

"I think we knew that it would be hard work to reach our goal in three years. Even now it will probably take another five years to analyse all the data we have collected. But this would have been very hard to do without EU support, and the eventual benefits could be very great."

Full Title:

Functional food ingredients against colorectal cancer – development of a genomics and proteomics based screening assay

Industrial Sector:

NACE 33 Manufacture of medical, precision and optical instruments, watches and clocks

Supporting Technologies:

0350 Laser technology; 0401 Molecular biology; 0590 Statistics

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Proposers:

Prime: Netherlands
Organisation for Applied Scientific Research - TNO (NL)

RTD Performers:

- Palm Mikrolaser Technologie GmbH (D)
- Roskilde University (DK)
- State Institute for Quality Control of Agricultural Products (NL)
- Numico Research BV (NL)
- Nonlinear Dynamics Ltd (UK)

Duration:

1/00 – 12/02

References:

QLK1-CT-1999-00706

Programme:

Quality of Life: Food, Nutrition and Health

Project Cost:

€2.9 million

Range of SME Contributions:

€150,000 – €250,000

EC FUNDING:

€1.59 million



Measure for measure



CRAFT

SMT4-CT98-2213

A three-country project led by Germany's national metrology laboratory has developed a portable low-cost tool to ensure that simple laboratory instruments like micrometers are always accurately tuned

We live in a precision age, in which engineers increasingly specify the critical dimensions of end products in terms of nanometres. Yet many industrial components are still measured using traditional hand-held equipment such as micrometers and callipers. These tools, just like their advanced counterparts, require calibration. To date, this calibration has only been possible in standards laboratories, and is time-consuming and expensive. A German research institute and SMEs in Denmark, Germany and Spain joined forces under the CRAFT scheme. They have used laser interferometry techniques to develop a prototype trans-portable calibration device that is equally at home in the manufacturing plant and the standards laboratory. Extensive testing has shown that the equipment is accurate to one micrometre per hundred millimetres of length measured – that's one part in 100,000.

We are approaching the era of nanotechnological engineering.

Nanotechnology, the science and technology of precisely controlling the structure of matter at the molecular level, is widely viewed as the most significant technological frontier currently being explored. Materials and devices at the nanoscale (a nanometre is one billionth of a metre, or 1×10^{-9} metres) hold vast promise in fields such as health, electronics, transportation, and the environment. Nanotechnology has been heralded as the next industrial revolution.

Back to basics

There is, though, still the other end of the scale. Day-to-day production of engineering components often depends on technology far removed from the science fiction-like realms of the nanometre. Hand-held "simple measuring instruments" (SMIs) – such as micrometers, callipers and dial gauges – still have a major role to play in checking critical dimensions of the pieces produced.

Nanometre-accurate they may not be, but these instruments still need proper calibration if they are to work well, and at present they have to be taken to a laboratory where the requisite equipment and standard test pieces are available. It is a costly, time-consuming process and Ahmed Abou-Zeid wants to put an end to it.

Dr Abou-Zeid is head of the "Dimensional measuring equipment" laboratory at

Germany's national metrology institute, the Braunschweig-based PTB (Physikalisch-Technische Bundesanstalt). "We believed it was feasible to develop a low cost, trans-portable calibration device for SMIs," he says, "and we were pretty sure the way forward was to use diode laser interferometry."

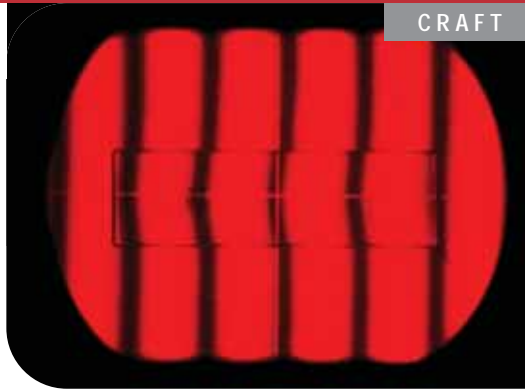
Beyond the fringe

An interferometer is an instrument that uses light waves of one single wavelength to make precise measurements of properties such as length, surface irregularities and refractive index. In essence, it divides a beam of light into a number of component beams that travel paths of unequal lengths and whose intensities, when reunited, add or subtract, or in other words interfere with each other. This interference appears as a pattern of light and dark bands known as interference fringes. Information derived from fringe measurements is used for the precise measurement of very small distances and thicknesses.

It soon became apparent that for the PTB to turn what was an interesting idea into a reality, it needed partners. Dr Abou-Zeid explains: "We have expertise in precision length measurement of line scales, tapes and laser range finders, frequency stabilisation of diode lasers, refractometry and laser interferometry, and a lot of experience in establishing laboratories in the field of simple measuring instruments for DKD, the German calibration service. But we needed complementary technology and know-how if we were to develop a prototype." Eventually a consortium was assembled, which comprised measuring equipment manufacturer Helios, laser measuring



Laser interferometry works by splitting a beam of light, bouncing one half off the object to be measured, and then analysing the "fringes" produced when the two beams are recombined.



CRAFT

SMT4-CT98-2213

systems experts Monocrom, and, as a potential end user Danfoss. The three companies were based in Germany, Spain and Denmark respectively.

Good things come in small packages

The partners applied for, and were granted, EU funding for a CRAFT co-operative research project in the Standards, Measurements and Testing section of the Fourth Framework Programme. The research work was split into a series of distinct packages, with each of the partners contributing where it could be most effective. PTB developed the specially designed diode laser interferometer and the required length references. Helios designed and developed the basic device including its components – the interferometer and accessories for calibrating SMIs – and integrated it into a fully functional working prototype. Monocrom helped in the basic design of the interferometer and set up the electronics of the diode laser. PTB, Helios and Danfoss tested the prototype in the laboratory, as well as under workshop conditions.

And the results? "We are very encouraged," says Dr Abou-Zeid. "The key to the technology has been to develop techniques to compensate for the refractive index of air and the thermal expansion of the materials to be measured. Our aim at the outset was to develop an instrument with an uncer-

tainty of 10^{-5} – one part in 100,000 or one micron for every hundred millimetres measured – with a maximum measuring capacity of 300 millimetres. Both these targets have been achieved. The prototype has proved itself equally at home on the factory floor and in the laboratory, which opens up the possibility of production workers carrying out simple, quick calibrations with the minimum disruption to manufacturing processes."

Dr Abou-Zeid is a little more circumspect when it comes to the commercial prospects for the new machine. "The current economic environment, particularly as it affects engineering companies, is not easy," he says. "There is little cash around to invest in new equipment, so we can only expect to make sales in the medium rather than short term. When things are brighter, a concerted marketing effort will be required. The equipment will be manufactured and sold by Helios, and we see a potential European market of up to 20 machines per annum, at a unit price of around €20,000."

Of equal interest to Dr Abou-Zeid is the lasting relationship that has grown up between the partners. "This project has allowed us at PTB to develop stronger links with industry," he says, "and it looks like at least two of the partners will go on to co-operate further in the field of interferometry. As I am sure you will agree, it is difficult to place a commercial value on a project that produces such long-term relationships."

Full Title:

Development of a transportable calibration device for simple measuring instruments

Industrial Sector:

NACE 33 – Manufacture of medical, precision and optical instruments, watches and clocks

Supporting Technologies:

0350 Laser Technology;
0390 Metrology, Physical instrumentation; 0611 Testing, Conformance Testing.

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Proposers:

- Prime: Physikalisch-Technische Bundesanstalt, D
- Danfoss, DK
- Helios, D
- Monocrom, E

RTD Performers:

Physikalisch-Technische Bundesanstalt + partners

Duration:

01/98-12/01

References:

SMT4-CT98-2213

Programme:

SMT

Project Cost:

€774,000

Range of SME Contributions:

€50,000-€250,000

EC Funding:

€461,000



Calibration carved in stone

CRAFT

SMT4-CT98-5517

Still life. Granite is the best material to use if you want a calibration standard that will stay the same size and shape under all normal conditions

How do engineering companies check that the pieces they turn out are exactly the right size? They use something called a co-ordinate measuring machine or CMM. But how can the accuracy of the CMM itself be verified? A 12-member consortium from four European countries has joined forces under CRAFT to develop an answer. It has produced a proposed new standard for machine calibration based on laser interferometry techniques, and has devised a test piece – made of granite – to assess whether CMMs are working properly. The new test piece is easy to use, and the analysis takes just ten minutes, making it suitable for daily checks. The worldwide sales potential could be as much as €4.5 million per year.

In biblical times, a cubit was the length from your elbow to the tip of your middle finger. So, if you were buying cloth, it was perhaps a good idea to take a tall friend along with you to measure it out. The merchants, though, probably employed salesmen with short arms, so one can imagine a good deal of negotiation going on. These days, we are a little more sophisticated. A litre of water weighs a kilogram, and a cubic metre of it weighs a tonne – both by definition. Time is measured by the speed of atomic vibration, and the metre has long ceased to be length of a piece of platinum held at the *Académie des Sciences* in Paris. It is now the distance travelled by light in a vacuum during a time interval of $1/299,792,458$ of a second. So now you know.

Heavy metal problems

It is all a question of standards and norms, which is not a subject most of us spend time dwelling on. Tony Hope does. He works for the Southampton Institute, a research and higher education organisation on the south coast of England that co-ordinated this CRAFT project. Its aim was to give engineers making precision metal components a way to check that their machined products conform with ultra-tight dimensional specifications. Professor Hope specialises in co-ordinate measuring machines (CMMs). "Companies producing critical components must be able to ensure that they are dimensionally accurate," he

explains. "CMMs are the pieces of equipment used to assess these critical pieces. Effectively, CMMs consist of a table, on which the machined component is placed, and a computer-controlled 'touch trigger' probe that moves in the X, Y and Z axes, monitoring surface positions at specific points, and relaying them back to the computer, which produces the analysis. The problem is making sure that the co-ordinate measuring machine itself is calibrated." There were two aspects of the project team's approach. "These machines should normally be rigorously inspected every six or twelve months," Professor Hope says. "But the partners all felt that there was a gap in the International Standards Organisation (ISO) testing norms, because they do not allow for the use of laser interferometry techniques. So we decided to develop proposals for a new standard."

All done with mirrors

Interferometry – splitting a beam of electromagnetic radiation by the use of appropriate mirrors, shining the two components back on themselves, then analysing the resulting interference patterns – is widely seen as the technological way forward in CMMs. The technique is accepted by some national standards institutions, particularly those in the USA and Germany, and the team hope the ISO will soon accept their proposal. The other, and perhaps more immediate, part of the project was to develop an 'artefact' to carry out regular 'quick checks' on a machine tool. To those in the standards and norms trade, an artefact is a standard test piece that is used to calibrate the machine tool. "Our aim was to develop a



CRAFT

SMT4-CT98-5517

A CRAFT project has developed a simplified standard using laser interferometry to check whether measurement tools are accurate.



standard shape that could be used every day to verify the CMM," says Professor Hope. "We came up with a 'universal' artefact, machined from granite, that can be used to test the machine in little more than ten minutes. The operator can test the machine's performance by a few simple measurements of calibrated lengths and angles." Why granite? "Because it has extraordinary dimensional stability in varying ambient conditions," he says, meaning that under most conditions it will not bend, twist, shrink or stretch. "The way we have devised this artefact, it is machined and then the critical surfaces are lapped. The three measured distances and the three angles at the corners are calibrated in a standards laboratory before delivery to the user. It could usher in a new age in CMM verification."

Testing the test

How though did the partners test their new idea? "We had a nicely integrated set of partners," says Professor Hope. "CMM man-

ufacturers, a touch trigger probe producer, users, and specialist research centres all had their input. We had all the ground covered. If this project was going to work for anyone, it was going to work for us." Work it did. Professor Hope is bullish about the commercial prospects for the new artefact. "We believe that every new CMM machine should be delivered with one of these pieces," he says. "They will be made and sold by ITP, with the other partners receiving royalties on sales." But what does this boil down to in figures? "Well," says Professor Hope, "the European market for CMM machines is around 2,000 units per year, with similar sales in the USA and in Asia. The unit price of the artefacts is around €750. This means potential sales for ITP of €1.5 million a year in Europe and three times that worldwide. There is some way to go yet, but negotiations with a leading CMM manufacturer are at an advanced stage, and the outcome looks as though it should be positive. All the partners look destined to profit from this project."

Full Title:

Accuracy verification of coordinate measuring machines, of all sizes, types and configurations, using lasers and a universal artefact

Industrial Sector:

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

Supporting Technologies:

0350 laser technology; 0560 sensory science, sensors, instrumentation; 0588 standardisation, standardisation of new technologies

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Proposers:

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- Krypton Electronic Engineering (B)
- Atlas Aluminium (IRL)
- Lister Machine Tools (IRL)
- Lufthansa Airmotive Ireland (IRL)
- Costruzione Macchine Utensili Speciali SaS Coord 3 (I)
- Intelligent Information Technology (UK)
- Renishaw (UK)

RTD Performers:

- Katholieke Universiteit Leuven, (B)
- University of Limerick, (IRL)
- Servizio Tecnico Autonomo Normalizzazione Italiana
- Macchine Utensili e Collaudi (STANIMUC), (I)
- Southampton Institute, (UK)

Duration:

02/99-01/01

References:

SMT4-CT98-5517

Programme:

Standards, measurement and testing IV

Project Cost:

€965,000

Range of SME Contributions:

€34,000 – €125,000

EC Funding:

€483,000

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