NEWS FROM **THE RESEARCH COUNCIL OF NORWAY** AUTUMN 2007

# TELL'US

SCIENCE IN NORWAY

## CUTTING-EDGE RESEARCH-BASED INNOVATION




The Research Council of Norway

**MONA G. RYGH**
*Photo: Susanne Moen Stephansen*

# NORWAY
## – more than deep fjords and rugged mountains

**Norway's academe is not quite as famous** on the international arena as the country's fjords and mountains. This is not so strange, really, considering that the country was a relatively poor agrarian society only about a century ago. However, times have changed and Norwegian research is now world-class in a number of fields. It has laid the foundation for prodigious economic development.

The Research Council of Norway, its 'owner' (the Ministry of Education and Research), and the Norwegian government have high ambitions for the further advancement of Norwegian research. Their targets include increased internationalisation and heavy emphasis on quality.

**One of the instruments available** for attaining these targets is the establishment of special centres for outstanding research groups. The centres receive long-term funding which allows them to concentrate on carving out a position in the vanguard of international research. In 2002, Norway's first Centres of Excellence (CoEs) were established (see: www.forskningsradet.no, and select English/Publications/Tell'Us 2003).

A recent evaluation indicates a high success rate for these centres, and eight more were added to the list this year after a new competition. The CoEs address basic research issues. In addition, the Research Council of Norway recently conferred special status on 14 Centres for Research-based Innovation (CRIs), which are presented in the current issue of this magazine.

**The CRI scheme is intended to promote** the development of research groups that can earn a position on the cutting edge of international research, and which are part of strong international networks. One of the scheme's goals is to strengthen competitiveness. The CRIs span the range from oil production and stem cell therapy to the further development of concrete technology and telemedicine.

**This magazine also presents** another new internationalisation initiative, the mobility programme ERA-MORE, a joint project between the European Commission and more than 30 countries. The goal is to enhance researcher mobility between the countries.

The CRI scheme and ERA-MORE are just two of many international cooperative efforts and schemes under the auspices of the Research Council, and Norway's interest in cooperation is in no way limited to Europe. For more information, please see www.forskningsradet.no, select English/International, and read about Norway's cooperation with Africa, Asia, North America or South and Central America.

First, however, we hope you will allow yourself to be inspired by this magazine, and possibly also to learn more about the advantages offered by Norwegian research communities as potential partners and of Norway as an interesting country for visiting researchers.

*Mona Gravningen Rygh*
*Editor-in-Chief*

sfi = Centre for Research-based Innovation

The centres for Research-based Innovation (CRIs) (SFI in Norwegian) is launched by The Research Council of Norway. The Centres' main objective is to enhance the innovative capability of the business sector by focusing on long-term research based on the forging of close alliances between research-intensive enterprises and prominent research groups. For more information, see: **www.forskningsradet.no** (select English, Centres for Research-based Innovation (CRIs).

ERA-MORE
European Network of Mobility Centres

ERA-MORE is a network of mobility centres in more than 30 countries whose task is to make it easier for scientists to work in other countries. The EU funds part of the project, and the individual countries fund the rest. In Norway, the Research Council acts as bridgehead and hosts the mobility centre.
Norway: **www.eracareers.no**
International portal:
**www.ec.europa.eu/eracareers**

*"More mobility is needed inside, outside and across Europe to promote the quality of research and the quantity of researchers."*

‹ 4

*"We urgently need to develop a new, improved type of search technology."*

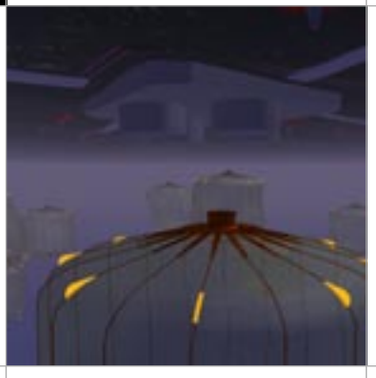
‹ 10

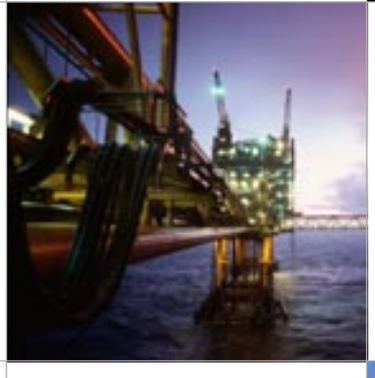
*"These organisms often have far better chemical defence systems than humans have."*

14 ›

*"A centre that aims at developing technology for the fish farming industry is a global innovation."*

18 ›





*"Norway's oil production has already peaked, while gas production is still on the rise."*

‹ 22

*"An error of just one-tenth of one per cent in an installation can mean billions in losses for a company."*

32 ›

# Contents



**TELL'US** **is published by The Research Council of Norway.** The magazine has been published sporadically since 1994. Articles from this production may be reproduced, provided the source and publisher are acknowledged. **Editor-in-Chief:** Mona Gravningen Rygh / **Editor:** Anita Thorolvsen Munch/ **Journalist:** Susanne Moen Stephansen / **Editorial assistant:** Inger Helen Weigård / **English translation:** Linda Sivesind, Informatic / **Publication design:** Haugvar Communications & Design / **Printing:** PDC Tangen. **Cover photo:** Pulpit Rock at Lysefjorden in Norway. A well known tourist attraction towering 600 meters over sea level. Photo: Harald Tjøstheim

**The Research Council of Norway** is a national strategic and funding agency for research activities. The Council serves as a chief source of advice on and input into research policy for the Norwegian Government, the central government administration and the overall research community. Moreover, the Research Council works together with research institutions as well as the private and public sectors to enhance financial and quality targets in Norwegian research and innovation activities. It is the task of the Research Council to identify Norway's research needs and recommend national priorities. The Council utilises specifically targeted funding schemes to help translate national research policy goals into action. Increased internationalisation is a main priority. The Research Council provides a crucial meeting place for those who fund, carry out and utilise research.

The Research Council of Norway

**The Research Council of Norway**
P.O. Box 2700 St.Hanshaugen
N-0131 Oslo, Norway

Telephone: +47 22 03 70 00
Telefax: +47 22 03 70 01
E-mail: forskning@rcn.no

www.forskningsradet.no/english/

# SCIENTIST, GET A MOVE ON!

Europe aspires to be the world's leading knowledge region by 2010. This requires more researchers in circulation and the free movement of knowledge across national frontiers. A European network of mobility centres – ERA-MORE – is on the case.

By Susanne Moen Stephansen

**RUNE NILSEN**
Head of the steering group for ERA-MORE Norway.
*Photo: Jon Solberg*

What is it about the USA that has enabled the country to produce the best scientists, and the most Nobel laureates, patents and published scholarly articles? What must Europe do to outcompete other regions?

The European Commission pondered that particular question around the turn of the millennium and decided that money was the answer at the EU level as well as in the individual countries. The upshot was the establishment of a common European Research Area (ERA). The goal was for each country to spend three per cent of its gross domestic product on research by 2010, and a vast framework programme for research and technology was the result: 6FP began in 2002 and 7FP now in 2007.

However, there was another factor involved as well. A comparison of the research cultures in the US and Europe revealed an important difference: mobility. While scientists in Europe have a tendency to stay in their positions for a long time, US scientists change jobs frequently. A survey indicates that European researchers actually stay in their jobs no less than three times as long as researchers in the USA do. There may be several reasons for this, but it is largely a question of deep-rooted habit. The Commission decided that something had to be done. More mobility is needed inside, outside and across Europe to promote the quality of research and the quantity of researchers. This led to the establishment of ERA-MORE, a European network of mobility centres.

## Easier to cross borders

In 2004, the Commission concluded contracts with 32 European countries, including Norway, in addition to Turkey and Israel. The 34 countries have undertaken a commitment to establish national mobility centres to disseminate information about current requirements and opportunities for foreign researchers in participating countries, and for their own researchers abroad. The centres will also strive to simplify the formal procedures required for scientists to cross borders.

"ERA-MORE is a fantastic programme", states the head of the steering group for ERA-MORE Norway, Rune Nilsen, enthusiastically. A professor at the Centre for International Health, University of Bergen, he works extensively with researcher mobility, not least with a view to Africa. He is fascinated by the idea that the governments of no fewer than 34 countries have joined forces and declared that they are going to work together to build a knowledge base for Europe, and he was pleased to agree to chair the steering group for the Norwegian project. The secretariat is at the Research Council of Norway, which also hosts the Norwegian mobility portal.

## A treasure trove of intellectual capital

"There are three reasons why ERA-MORE is such a good idea", observes Nilsen. "First of all, it is a good programme for harmonisation and for gathering knowledge about framework conditions for scientists. It organises knowledge about everything from day care centres to tax rules, social security, residence permits, social benefits and research schools.

"Second, this is a formidable recruitment programme. The international portal features job vacancy advertisements and it is possible to post one's own CV, making the site akin to a treasure trove of intellectual capital. I recently served on a committee for hiring research fellows. Nine were recruited from the database on the portal", reports Nilsen.

"Third, the programme focuses on research culture and clarifies what rights and obligations researchers are to have across national borders."

## Must deserve the researchers

Nilsen refers to the *European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers* that were adopted and published by the Commission in 2005. It is a little book about 20 pages long that defines how researchers should be recruited, what rights they have as regards inclusion in research communities, the social rights to which they are entitled and, not least, what recognition researchers should have when they cross borders.

"This facilitates a shift of focus from younger researchers in particular who are happy just to get a job to researchers being 'awarded' to institutions that deserve them", explains Nilsen. "That is good."

Represented by the Research Council, Norway signed the agreement in October 2006, and ERA-MORE Norway has been working ever since to get Norwegian research institutions to implement this European Union policy.

*"More mobility is needed inside, outside and across Europe to promote the quality of research and the quantity of researchers."*

"This is an important, powerful set of agreements, and I hope it will be implemented and followed up in actual practice by all European research institutions", says Nilsen. "It will make Europe a highly attractive area for making a career in research."

### Also for non-European scientists

Europe also needs non-European researchers, and the European Commission has issued a directive to make it easier and faster for researchers from so-called Third Party States (countries that are not members of the EU or part of the EU framework programme for research) to come to Europe. The scheme has been named 'Scientific Visa' and requires European countries to grant foreign researchers work and residence permits within 30 days after they are hired by an institution approved by the scheme. Norway is not a member of the EU and is thus not obligated to follow these rules. The Norwegian authorities are nonetheless of the opinion that their current practice in such matters is not at odds with the directive.

"The directive involves treating scientists from Third Party States as equal partners. That is splendid because it is all about equal opportunity. However, we have to be careful not to allow the policy instrument to drain intellectual capital from countries that need that capital themselves. ERA-MORE is wonderful, but it would be dangerous if it were exclusively a tool for a selfish Europe", Nilsen points out.

"This is a challenge throughout the entire ERA. We have to demonstrate solidarity with the European as well as the global knowledge communities, at the same time as we ourselves develop."

### Mobility decisive

"Mobility is absolutely decisive for development", asserts Nilsen. "Research *per se* is international. All high-calibre scientists operate in networks across national borders. Creating and maintaining these networks calls for travel. Obviously, we also need foreign scientists here in Norway. We definitely need to internationalise Campus Norway."

*"Why should foreign researchers come to Norway, Nilsen?"*

"Norway is a good place for visiting scientists. We have many strong research communities and there are several fields in which we excel. Norway also has a stable university and research system, and we can offer good social benefits, not least maternity and paternity leave for new parents. Norway is a country that enjoys political peace and harmony and, of course, Norwegian nature is also very, very beautiful!"

ERA-MORE
European Network of Mobility Centres

**ERA-MORE is a joint initiative on the part of the European Commission and more than 30 countries are participating in the EU Framework Programme for Research.**

The initiative is designed to create a more favourable environment for researchers' career development. Assistance is provided in two ways: Researcher's Mobility Centres and Researcher's Mobility Portals.

The centres offer free, customized assistance and information to mobile researchers who are planning to conduct research in Europe. In Norway, the mobility centre is operated by the Research Council of Norway. The Portals provide relevant information on reserach opportunities, grants and fellowships, as well as general and practical information required for the mobility of researchers.
Norway: **www.eracareers.no**
International: **www.ec.europa.eu/eracareers**

## ERA

In 2000, the idea for a common European Research Area was enshrined in a document which confirmed that research efforts in Europe needed to be strengthened significantly. It was ascertained that Europe needed a common research policy and to coordinate research funding. Among other things, ERA will ensure common research infrastructure, the linking of centres of excellence and greater researcher mobility. **www.cordis.europa.eu/era**

When the idea for Centres for Research-based Innovation (CRIs) was conceived, its intention was to create or strengthen Norwegian research groups that cooperate closely with prominent innovation communities. The scheme is intended to improve Norway's industrial competitiveness and to support Norway's participation in strong international research networks.

By Mona Gravningen Rygh

# FROM INNOVATIVE IDEAS TO INNOVATIVE RESEARCH CENTRES

**SPECIAL ADVISER DAG KAVLIE**

*Photo: Elisabeth Salvesen*

When the scheme to enhance basic research through Centres of Excellence (CoEs) proved a formidable success in Norway, people at the Research Council began discussing a comparable, innovation-oriented scheme.

"International experience indicates that centres based on cooperation between research groups and businesses constitute a cogent instrument for promoting innovation. The crucial issue was whether Norway had enough businesses that were motivated to become partners in long-term research", explains Special Adviser Dag Kavlie of the Research Council. He is project manager for the CRI scheme.

"Interest was considerable, right from the very first briefings. As of the closing date, we had received 58 applications, far more than most people expected", he reports.

*"At the Research Council, we have great expectations that the CRI scheme will have an impact on Norway's research landscape."*

## A huge potential

Most of the applications described extremely high-calibre research projects. This opinion was shared by the international scientific experts who took part in processing the applications and the expert committee established in Norway to evaluate the CRI applications. The potential for innovation and value creation was also considered to be extremely high for the majority of the applicants. These qualities were assessed by three separate industrial panels.

"Consequently, there were far more than the 14 centres ultimately determined to be sufficiently well-qualified to establish a CRI", underlines Kavlie.

## International competence networks

The Research Council supports the idea that cooperation between research groups and industry is the optimal point of departure for developing dynamic, competitive research and development communities in Norway. The CRIs are to promote the development of research groups on the cutting edge of international research which are part of strong international networks.

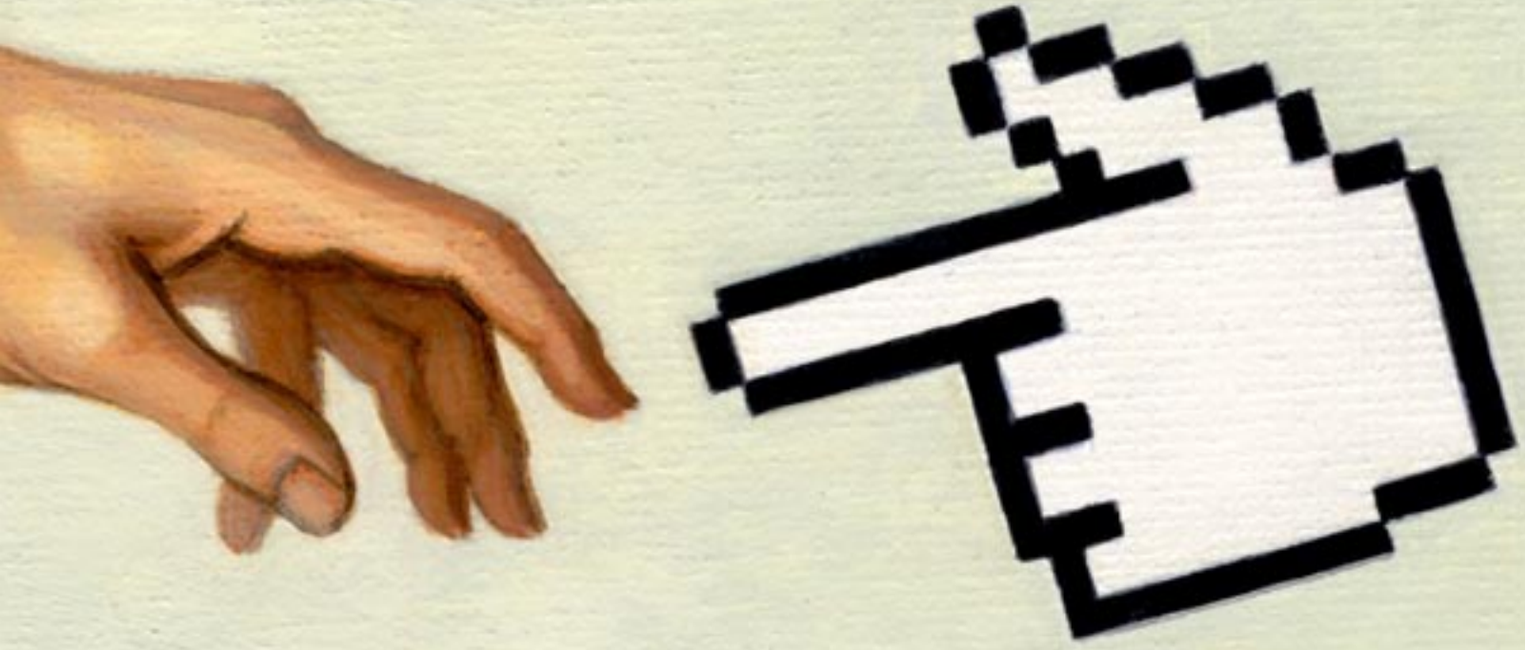
The centres designated CRIs are among the best research communities in Norway, and they are to serve as catalysts for increasing cooperation between research and industry. They are intended to be stellar examples of how such cooperation gives broad access to issues that can only be resolved by generating new knowledge. The CRIs will also be valuable players for ensuring continuous utilisation of the knowledge produced.

## A red-letter day

Director General Arvid Hallén of the Research Council described the day on which the CRIs were selected as a red-letter day for Norwegian research. "The CRI scheme was an important addition to the Research Council's toolbox for addressing business and industry. Now we cover the full range: from development activities within enterprises on the one hand, to targeted efforts devoted to advanced basic research in collaboration with the best research communities and the most innovative enterprises on the other.

"The applications we received for the CRI scheme showed that our best research communities are of exceptionally high quality, and that they have good relationships with robust, innovative enterprises. Consequently, we have great expectations that the CRI scheme will have an impact on Norway's research landscape", concludes Hallén.

*"The crucial issue was whether Norway had enough enterprises that were motivated to become partners in long-term research."*



**DIRECTOR GENERAL ARVID HALLÉN** of the Research Council described the day on which the CRIs were selected as a red-letter day for Norwegian research.

*Photo: Bård Gudim*

sfi = Centre for Research-based Innovation

## Among the chosen few

Being designated a Centre for Research-based Innovation involves passing through the eye of a very small needle. The applicants were strictly judged on scientific quality and innovation potential. The CRI scheme is intended to boost innovation by emphasising long-term research in close cooperation between research-intensive enterprises and prominent research groups. Research institutes, universities, university colleges and research-intensive enterprises can be host institutions. A host institution must have carved out a strong reputation within the fields or industrial areas the respective centre will be researching. Applications are to be supported by the potential host institution's administration, and they should be accompanied by declarations of intent from user partners (e.g. companies or public enterprises) and any other research institutions involved as long-term partners. Partners are required to invest their own efforts, infrastructure or financing. The Research Council's overall budget allocation for the 14 centres in the CRI scheme will aggregate MNOK 1120 over an eight–year period. Each centre will receive an allocation from the Research Council of roughly MNOK 10 per year, based on matching (or better) funding from the host institution and partners.

**www.forskningsradet.no**
(select English, Centres for Research-based Innovation (CRIs)).

# PETROLEUM PERFORMANCE

**Today's technology for exploring and producing petroleum on the Norwegian Continental Shelf can be compared with driving a car while staring at the road through a hole in the floor. "It is faster and safer to steer when you look through the windscreen", smiles Professor Jon Kleppe.**

By Bjarne Røsjø

*"The volumes of data are so vast these days that it can take up to 18 months to update a model."*

Comparing petroleum production with driving may not be an entirely appropriate analogy since what is taking place on the Continental Shelf is vastly more complicated than driving. Nonetheless, the example illustrates what Professor Kleppe and his colleagues at the petroleum-related CRI in Trondheim are going to be addressing. The key phrase is 'integrated operations' (IO), which involves improved information, more rapid decisions, higher speeds and greater cost efficiency.

The IO Centre is pulling out all the stops and has recruited 12 Norwegian and international industrial partners, all of which have undertaken a commitment to contribute pilot projects. The CRI is intended to develop ideas that can lead to new products as well as new enterprises, but its most important tasks may possibly be that the Centre will be performing prestigious research and training young people who will eventually move into key roles in the petroleum industry in future.

"The Centre will consist of 15 professors and 25 researchers from the Norwegian University of Science and Technology (NTNU), SINTEF and the Institute for Energy Technology (IFE), as well as about five scientists from leading foreign universities. In addition, we plan to produce roughly 150 graduates with master's degrees and 30 PhDs, and we will offer continued and further education programmes for approx. 400 experts from industry", Kleppe points out.

The CRI's commercial and socioeconomic returns can potentially be formidable. "It will never be possible to recover 100 per cent of the oil from a reservoir. If we could manage, for example, to enhance the average recovery rate from today's 46 per cent to 47 percent, Norway's oil wealth would increase by NOK 300 billion at today's oil prices. Our goal is absolutely realistic", maintains Kleppe.

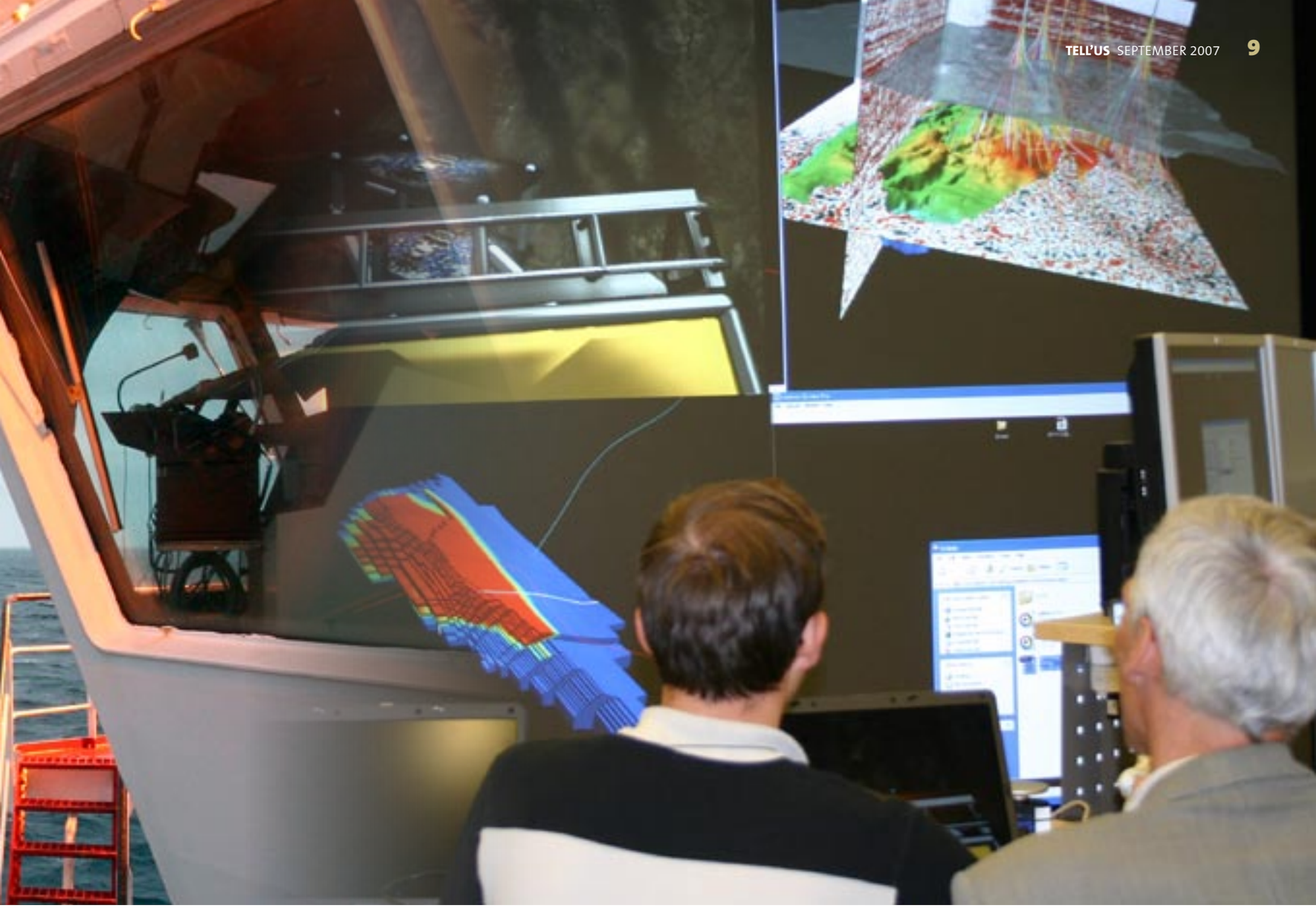
### A rose by any other name is still a rose

'Integrated operations' or IO is becoming the established Norwegian name for the latest bud on Norway's rose bush: Other names include Smart Fields, Field of the Future, eField and iField. "In Norway, the Norwegian Oil Industry Association (OLF) been a driving force in talking about IO, and the term is really most appropriate. Future petroleum production will involve collecting large volumes of data from the reservoir, processing it so that it can serve as a platform for decisions, making the data available to experts from different disciplines, who are sitting in the same room, and then implementing the decisions swiftly and efficiently. OLF has estimated that the introduction of IO on the Norwegian Continental Shelf will enhance value creation by roughly NOK 250 billion between now and 2015. This CRI will contribute significantly to achieving those gains", confirms Kleppe.

### Billions for the taking

The oil fields of the future will have no visible oil platforms at all, because all operations will take place on the seabed and be operated from advanced control rooms onshore. Operators will no longer have to spend a lot of time on safety procedures and helicopter rides. Instead, they can sit at a big screen that can display data streams, reservoir models, telephone conferences and other data all at the same time.

"IO will boost cost efficiency and improve the situation with a view to health, safety and the environment. The most significant advantage of all is that the operators can make more correct decisions more quickly, and thus recover a higher percentage of the



**WAITING FOR THE FUTURE:** In future, petroleum production will be operated from control rooms similar to NTNU's visualisation laboratory in Trondheim.

*Photo: Roger Hardy / Samfoto, Synnøve Ressem/ NTNU info.*

## *"The oil fields of the future will not have any visible production platforms at all."*

petroleum in the reservoirs. I mentioned that increasing the recovery rate by one per cent would result in a gain of NOK 300 billion, but it is absolutely possible to boost the recovery rate by far more than that. On the Statfjord field, it is probably possible to reach a rate of 70 per cent", continues Kleppe.

### Thinking outside the box

Petroleum production usually begins with the companies engaging in exploration and test drilling to collect information, and then using that data to build up digital models of the reservoir. The models are used to plan production, and once production begins, more data is collected to make adjustments to the models. That being said, the volumes of data produced these days are so vast that it can take up to 18 months to update a model.

"In the meantime, the reservoir has changed considerably. Clearly, we need to develop simpler, faster ways to accomplish this. We would like to collect 10 times as much data, and yet still be able to processes them far more quickly", points out John Ivar Haugland, head of the Visualisation Laboratory at NTNU's Department of Petroleum Technology and Applied Geophysics. The laboratory plays a key part in the IO CRI.

The IO Centre will concentrate on the following five areas: visualisation, data processing, geographically scattered teams, sensor technology and laptop computing. "International oil companies can afford to buy the very best technology from anywhere in the world. That means we have to be best in certain niches, if we are going to survive. We plan to do this by thinking a little differently from the major oil companies, which have a tendency to stay 'inside the box', i.e. they take the main roads. We have the time, opportunity and expertise to explore side streets and search for new solutions 'outside the box'." I think that is the approach that will make this CRI a success", contends Kleppe.

### Centre for e-Field and Integrated Operations for Upstream Petroleum Activities

**Professor Jon Kleppe**

The CRI's objective is to develop new knowledge, methods, tools and educational programmes with a view to making the transition to the next generation's integrated operations (IO) for upstream petroleum activities. This should result in increased efficiency, improved safety and stricter environmental standards.

**Host institution:** The Norwegian University of Science and Technology

**Research partners:** NTNU's Department of Petroleum Technology and Applied Geophysics, NTNU Department of Engineering Cybernetics, NTNU Department of Computer and Information Science, NTNU Studio Apertura, SINTEF Petroleum Research, MARINTEK, Sintef Technology Management, the Institute for Energy Technology (IFE), Halden.

**Corporate partners:** Statoil ASA, Hydro ASA, Total, Petoro, Gaz de France, ConocoPhilips, Kongsberg Maritime, Aker Kværner, FMC, IBM

**Budget:** Approx. MNOK 40 (2007)

**Staff:** Approx. 30 (2007)

**Director/contact:** Professor Jon Kleppe, e-mail: kleppe@ipt.ntnu.no

**Website:** www.ntnu.no/io

# FINDING THE NEEDLE ...

Photo: Shutterstock

Every week, the amount of digital information available to us increases by two to three per cent. The quantity of data we are dealing with has become vast, and we are beginning to drown in search results. Now Norwegian enterprises and universities have decided to put their proverbial heads together. Spearheading their efforts is the search engine enterprise FAST.

By Siw Ellen Jakobsen

*"We urgently need to develop a new, improved type of search technology."*

We are impatient. When we search for something on the Internet, we can't be bothered to wait more than a fraction of a second for an answer. It has to be lightning-fast, and the search results have to be relevant. But with the dramatic increase in the quantity of global data available, it will soon be impossible to find the needle in the haystack. When Google gives you 1 793 502 hits, you hardly have the time or energy to take a close look at more than the first 20. We urgently need to develop a new, improved type of search technology.

**Precision searches**

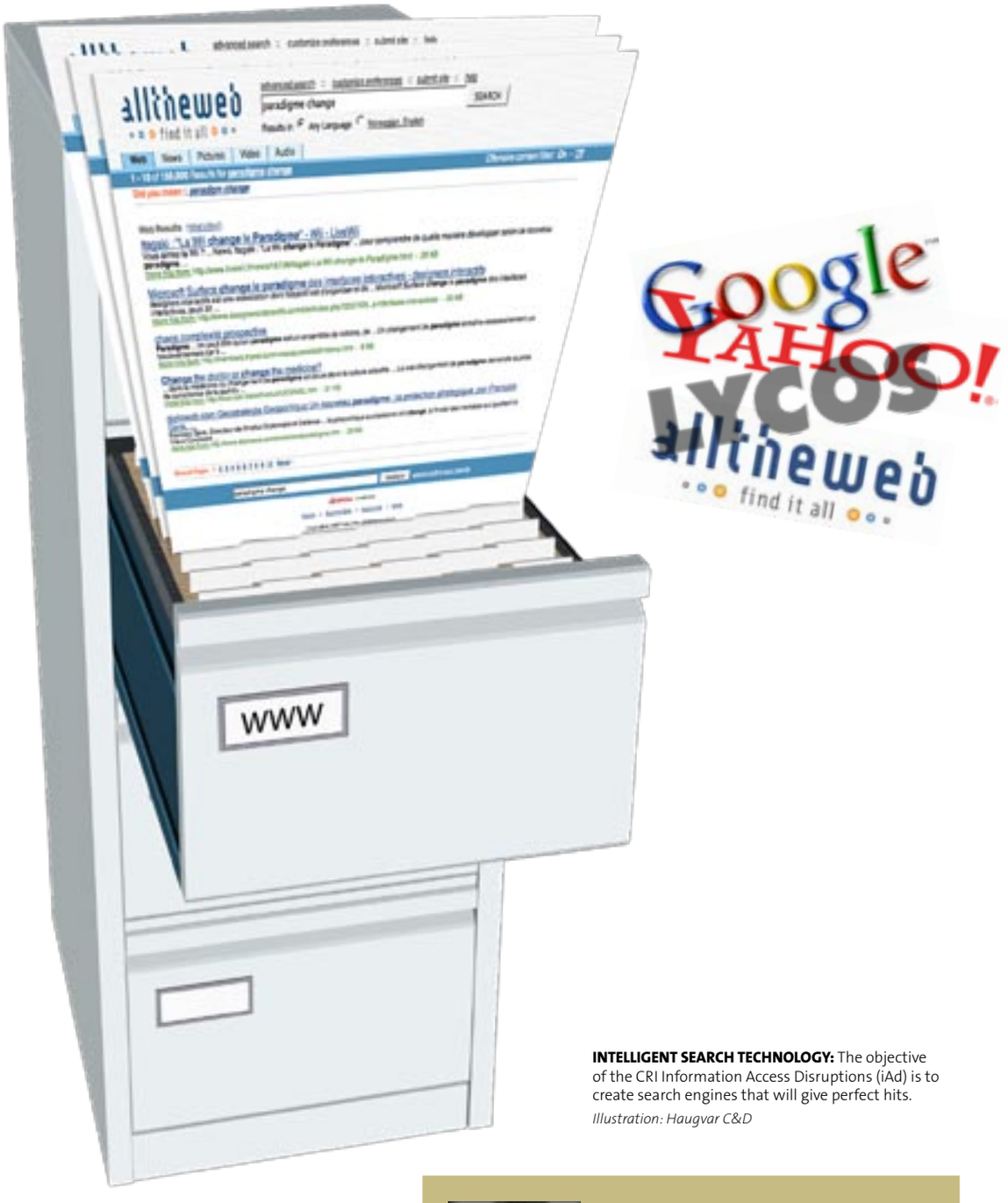
"The main challenge in future will not be our ability to gather enormous amounts of information. Sorting information will also be relatively simple. The challenge will lie in making searches as relevant as possible for you as a user," observes Bjørn Olstad. He accepts the challenge. As head of the CRI Information Access Disruptions (iAd) in Oslo, Olstad wants to make a technological quantum leap.

"Since we have such high ambitions for the search technology of the future, we need to contact the brightest people, i.e. those who delve most deeply into the science of search technology. That means going to the universities," smiles Olstad, himself a professor at the Norwegian University of Science and Technology. He has brought together individuals from universities all over the world to work on resolving these problems in the decades ahead. Here in Norway, the universities of Oslo, Trondheim and Tromsø are research partners on the IT side. Universities in the USA and Ireland will also be participating.

**Batteling the portal giants**

FAST was established in 1997, and is currently acknowledged as the leading supplier of search platforms. Its client base includes major international enterprises in areas such as the media, telecommunications and finance. FAST's partnership with these players has resulted in the world's largest innovation network for searches. What many of the members of this network have in common is their participation in the battle against US portals such as Google, Yahoo and MSN. The big search portals are in the process of monopolising the delivery of information to end users. A partnership with FAST to improve searches, combined with the strengths and capabilities of the individual enterprises, has become the standard for establishing a constructive online strategy. If these enterprises are to remain competitive, they need to make quantum leaps

*"Finding academics with a nose for business was the real secret behind FAST's success."*




**INTELLIGENT SEARCH TECHNOLOGY:** The objective of the CRI Information Access Disruptions (iAd) is to create search engines that will give perfect hits.
*Illustration: Haugvar C&D*

in the basic technology for connecting people and information. The new Centre will help to ensure that FAST is at the forefront of the race.

The Norwegian media giant Schibsted and the international consulting company Accenture are among the Centre's corporate partners. They will serve as trial users for iAd's researchers when they put their technological solutions into practice. The Schibsted Group was already a close acquaintance of FAST. When Schibsted launched its search page, Sesam, the corporation chose FAST technology – not because it was Norwegian, but because it was the best in the world. Now Schibsted is investing more than MNOK 20 in long-term research efforts because the corporation regards this as a major business opportunity. Schibsted's unique values and expertise, combined with search possibilities, could give the Group a distinct advantage in today's information society.

The BI Norwegian School of Management is also part of the team. The institution will research how searching can be a disruptive technology in various markets. "Together we comprise a unique team, representing the entire spectrum from university research to pure business," says the CRI director.

## More than the Internet

"The goal of the new research Centre is to develop more 'intelligent' search technology. If we want to create search engines that will give perfect hits, we will have to find a technology that understands the user's search habits and Internet preferences. But who is this user? And what is this user interested in? Searching gives businesses and individuals an opportunity to engage in smarter communication with clients, partners and staff," contends Olstad.

When Olstad talks about searching, he is not referring exclusively to Web searches. He envisages a paradigm shift, in which a common technological platform will make it possible to search for all kinds of data and all kinds of content, regardless of whether we are talking about the Internet, mobile telephony, radio, television or your own PC. His vision is to be able to search across all formats, platforms and channels. "Take television, for example. In future, TV channels as we know them will probably cease to exist. Which channel you are watching will be irrelevant. Instead, you will use a search engine to find what you want to see," Olstad predicts.

## Research and business

The story of FAST is one of the best examples in Norway of how close cooperation between the academic world and the commercial sphere can generate success in the stock market.

It all started in a small office in the electronics building of the Norwegian University of Science and Technology (NTNU) in Trondheim in the late 1980s. Arne Halaas, considered one of the key figures behind the FAST technology, began his research on search technology there. Gifted students were attracted to Halaas's research, which eventually began to focus more on ideas from business and industry. The community at NTNU rapidly became a leader in the field of Internet searches.

In other words, finding academics with a nose for business was the real secret behind FAST's success. This same instinct will drive the new CRI in Oslo towards its goals. "Our ambition is to revitalise the university communities. If we are to become global leaders in search technology, our students must see this as a competition. We will not get far without first-rate students who can combine theory with practice," remarks Olstad.

**Bjørn Olstad**
*Photo: FAST*

## Information Access Disruptions (iAd)

The CRI will identify opportunities and develop the next generation of search tools to elicit user-friendly information from large volumes of complex data.

**Host institution:** FAST asa

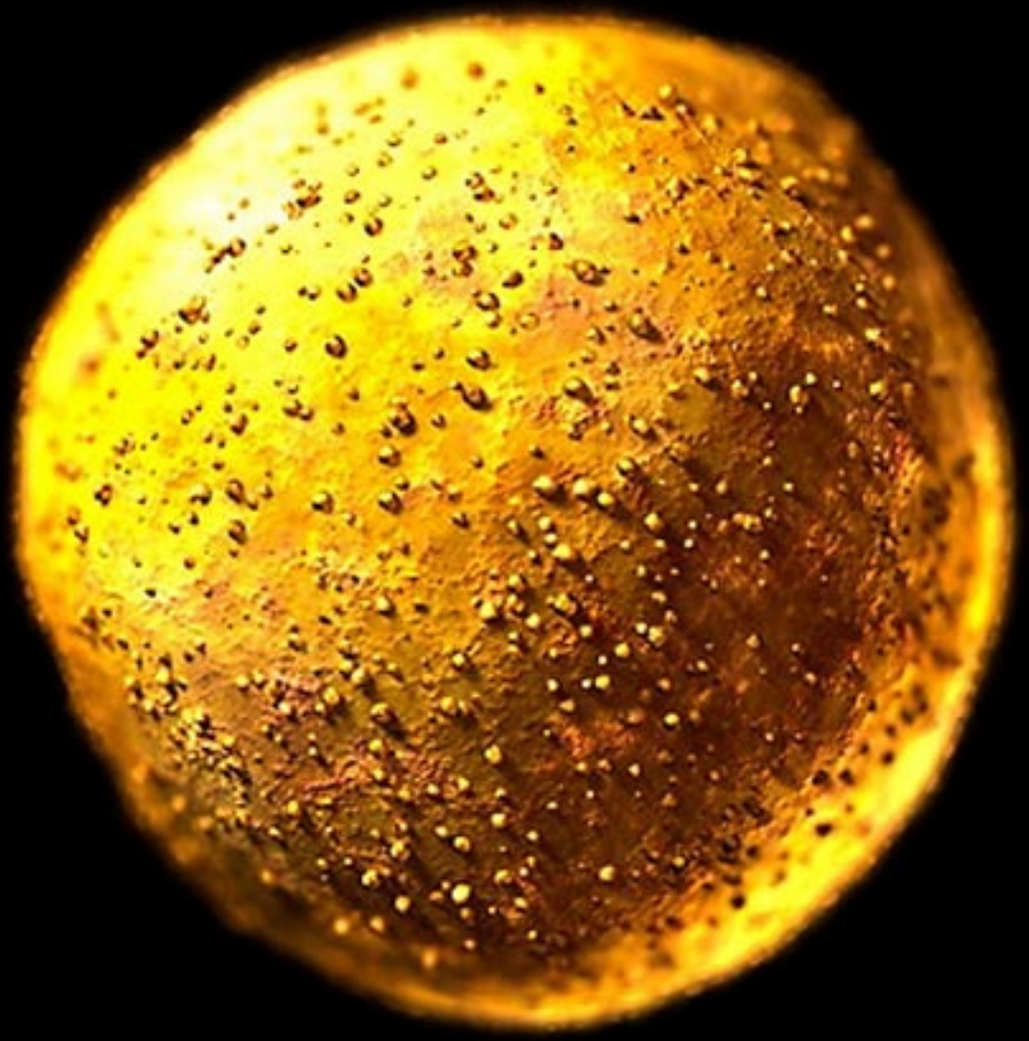
**Research partners:** NTNU, University of Oslo, University of Tromsø, the Norwegian School of Management BI, Cornell University, "Dublin" (scientists from Dublin City University and University College Dublin)

**Corporate partners:** Schibsted, Accenture

**Staff:** 53 (full time and part time)

**Director/contact:** Chief Technology Officer Bjørn Olstad, e-mail: bjorn.olstad@fast.no

**Website:** www.fast.no



# LIFESAVERS

**Major breakthroughs in cancer research are opening up entirely new possibilities for treatment. Stem cell researchers and the biotechnology industry have now intensified their collaboration in order to shorten the path between research results and patients. This will help save lives.**

By Anita Thorolvsen Munch

*"We often see that the most dangerous cells in a tumour display stem cell properties."*

At the Research Park in Oslo, much of which is currently a construction site, the director of the Center for Stem Cell Based Tumor Therapy, Stefan Krauss, tries to make himself heard above the din of the excavators outside. His voice is calm, but his message is dramatic. He talks about giving new hope to the many individuals diagnosed with cancer each year.

"Ground-breaking discoveries have been made in the diagnosis and treatment of cancer. Stem cell technology has given us a new approach to cancerous tumours.

"We often see that the most dangerous cells in a tumour display stem cell properties. This means that we can target those few cells that contribute to the recurrence of a tumour instead of targeting the entire tumour," explains Krauss. He believes that if we can control stem cells, we can control cancer, and he is enthusiastic about the future of the Center.

"We have brought together some of the key representatives from stem cell research communities and the Norwegian pharmaceutical industry, and I am convinced that we will be able to contribute towards better treatment of severe as well as common forms of cancer in the near future. Given that 30 percent of the population dies of cancer, this is obviously something that affects a large number of people."

*"Could you be more specific about what you mean by 'near future'?"*

"We definitely need to find an answer while the CRIs are in operation," says Krauss with a laugh, but he is not joking, at least not entirely. "I firmly believe that the tumour/stem cell approach will yield results very soon."

## Paradigm shift

"We are facing a paradigm shift in tumour therapy. It will change the way we look at cancer today," according to Stefan Krauss.

"We now know, for instance, that tumours are extremely heterogeneous by nature. This means that the cells in a tumour are not all identical," says Krauss, continuing: "Up to now we have looked at the size of a tumour, treated it to reduce its size, and then measured the success of the therapy by the reduction in the tumour's size. But this approach entails a grave risk that we will fail to reach the most dangerous cells in the tumour. Instead of targeting the entire tumour, we must examine what kinds of cells it contains: then determine which of them are dangerous and which are less dangerous. We often see that the most dangerous cells display stem cell properties, making them stronger and more resistant to treatment than the other cells. We also assume that many tumours begin with a stem cell. As they grow, these cells retain the stem cell properties that make growth possible.

"Now we face challenges such as improving methods for identifying potential cancer stem cells at an early stage, developing new medi-

*"We expect to see exciting developments in future in terms of both legislation and funding."*

**USING STEM CELLS AS WEAPONS:** Stem cell technology gives Professor Stefan Krauss and his research group a new avenue of approach to treating cancerous tumours. Krauss is convinced that the stem cell approach to tumours will save many lives.

*Photo: Trond Isaksen. Main illustration of stem cell: SPL/GV-press*

cines, developing possible cancer vaccinations and antibodies against cancer stem cells, improving the visualisation of the cells, improving cancer therapy *per se*, and adapting therapy to the needs of individual patients.

### Core activities in future

"At the CRI, we are very insistent that the path between research results and patients must be shortened and that new health products and methods of treatment should be made available quickly," continues Krauss. He is a firm believer in the CRI scheme.

"Having CRI status enables us to cooperate even more closely with innovative industrial enterprises to develop new diagnostic and therapeutic methods for treating cancer. All these industries believe this field will be a core activity in future. Meanwhile, rigorous international assessment was a part of the CRI selection process, giving the groups granted CRI status a certain international prestige. This is important. This field is flourishing at the international level, and large-scale investments are being made. For instance, our group has forged strong ties with extremely competent American R&D people, both as cooperation partners and as consultants."

In Krauss's view, another vital task is to inform the public about the work being carried out.

"It is imperative that society-at-large understands what we are doing. It will be important for us to explain our work to professional and more popular circles alike in future, also in the international arena," he adds.

### The best among us

This is not the first time Krauss is working with the best in his field. He is renowned in the international research community for having been involved in the discovery of the 'sonic hedgehog', whose somewhat special name, incidentally, was inspired by a character in a video game: 'Sonic the Hedgehog'. This supersonic hedgehog provides an important platform for the R&D activities in which the group is currently involved.

"We were among the first to conduct research on very central genes. Among them was a gene for a pheromone that proved to be a key to what is called embryogenesis or the development of embryos. This pheromone plays an important role in stem cells, tumours, and the overall regulation of abnormal cell growth.

"To put it in simple terms, a 'sonic hedgehog' is a signal that decides whether a cell becomes a stem cell," Krauss explains. This signal is used for recruitment within tumours to maintain their stem cell qualities, and there are traces of such activity in a large number of different types of cancer.

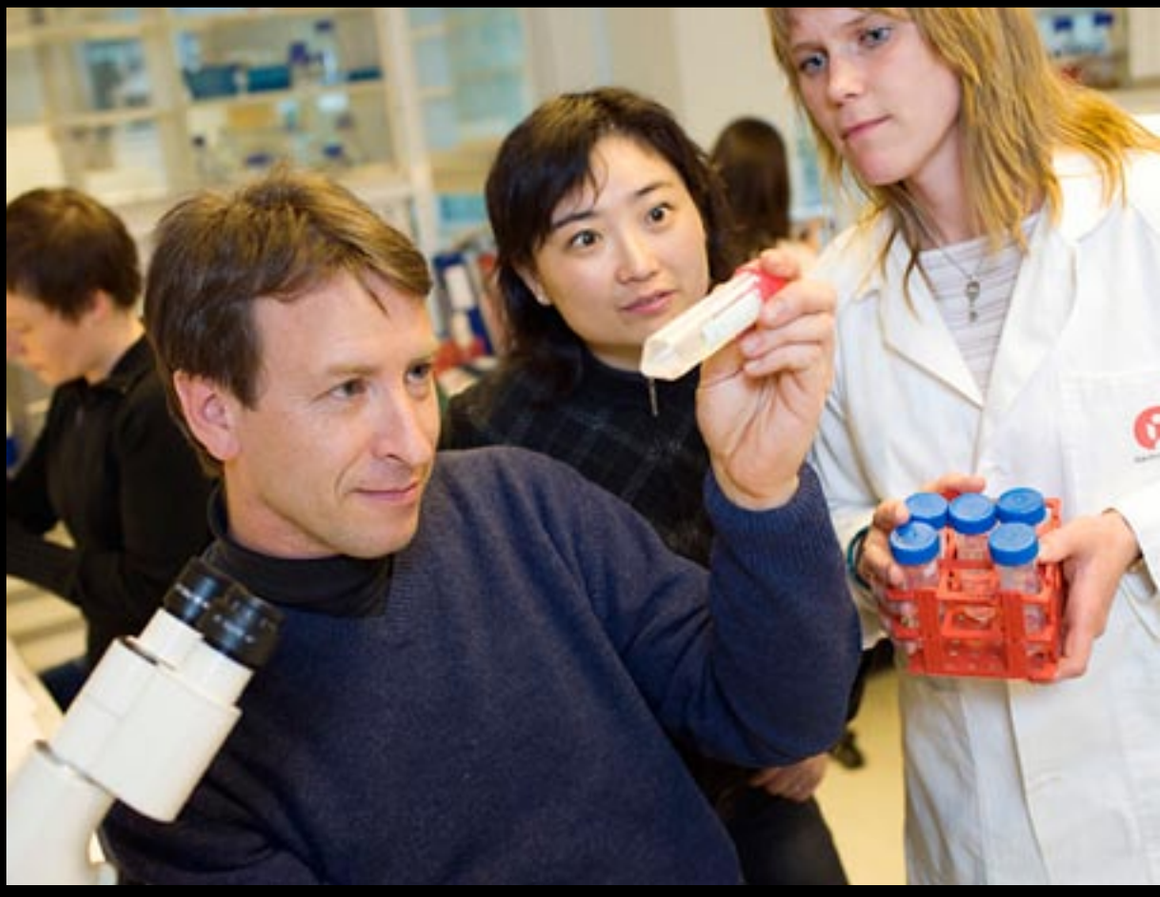
### Norway attractive

"We know that stem cell technology will be extremely important in future, and we have great faith that the government will make significant investments in this area in future." Krauss takes a pragmatic view of the controversy that has raged around stem cell research.

"Anything new will always have its share of sceptics. This is an entirely natural process. In time, when they see that there is nothing to be afraid of and that this can actually have enormous benefits, most people will calm down. We expect to see exciting developments in future in terms of both legislation and funding," predicts Krauss.

"I am also convinced that Norway will carve out more of a name for itself internationally. Norwegians are simply too modest," he smiles. In his view, Norwegians focus too much on their belief that Norway is not sufficiently attractive to international researchers.

"Norway is in a superb position to attract top international researchers in this field. We have the technology, we have the knowledge, we have the industry, and now we also have the political green light. In fact, the future is looking very bright."



*"It is imperative that society-at-large understands what we are doing."*

**Center for Stem Cell Based Tumor Therapy**

**Stephan Krauss**
*Photo: Trond Isaksen*

The objective of the Centre is to develop new diagnostic and therapeutic methods for cancer treatment.

**Host institution:** Rikshospitalet-Radiumhospitalet Medical Center

**Research partners:** Rikshospitalet-Radiumhospitalet Medical Center, University of Oslo

**Corporate partners:** Invitrogen/Dynal, Affitech, Alpharma and Amplius, GemVax/Pharmexa, Photocure

**Staff:** Approx. 20 (full-time/part-time)

**Director/contact:** Professor and Head of Research Stefan Krauss, e-mail: stefan.krauss@medisin.uio.no

**Website:** www.stemcell.no

# BIOPROSPECTING ON THE ARCTIC SEABED


**TREASURE HUNT:** Bottom dwellers and sessile fauna in the High North are about to reveal their secrets. The main responsibility of the MabCent's CRI is to create products from substances discovered in Arctic waters. This benthic jellyfish – a tiny, sessile medusa – may be a possible target for the hunt.

*Photo: Stein Johnsen/Samfoto*

The seabed around the Svalbard archipelago is home to about 2000 benthic species. We are familiar with the make-up of 10 of them. At the MabCent CRI in Tromsø, everything is now in place for Norway to play a leading role in prospecting for bioactive substances in the High North.

By Bård Amundsen

Some might call it a treasure hunt. All in all, that is not a bad description. If the researchers at the Centre on Marine Bioactives and Drug Discovery (MabCent) in Tromsø find what they are looking for, the economic potential is formidable. MabCent's job is to create products from what the Tromsø researchers discover in Arctic waters.

The marine research done at the University of Tromsø has led to the establishment of companies in northern Norway. Thus far, the marine biotechnology cluster in the Tromsø area counts about 20 companies and accounts for annual sales of roughly MNOK 500. "However, there is nothing very high-tech about these newly founded companies. Raw materials for feed production and nutrition make up a large part of their production", comments MabCent's Director Trond Ø. Jørgensen.

Jørgensen believes this will be changing now that the hunt for new opportunities is being systematised in earnest, primarily thanks to fresh funding from the Research Council and the Ministry of Fisheries and Coastal Affairs.

### Battery of chemicals

The probability that the Tromsø researchers will not find something really exciting is actually quite small. The Arctic offers a combination of low temperatures and a host of other special circumstances in a very special marine environment, where evolution has taken much of the life in directions not observed anywhere else. Many organisms have developed unique characteristics, opening up possibilities for finding bioactive substances with effects that can help us fight diseases, for example.

"On dry land and in warmer seas, scientists have been engaged in extensive surveying and bioprospecting for many years. This has resulted in a number of new products, not least medicines that have an effect on bacteria, viruses, cancer and immune defence.

In the cold High North, the Tromsø researchers are moving into virgin territory. However, the scientists know that the organisms they are hunting for are often equipped with far better chemical defence systems than what humans have. "These creatures may have entire batteries of chemicals available to overcome viruses, bacteria and parasites. We want to take advantage of this", comments Jørgensen, continuing: "We're finding many exciting substances that may have an effect on cancer, for instance. But it is still too early to tell whether any of them can be used. At this point, our work is almost like some kind of extreme sport. We are constantly throwing ourselves out into the unknown, and we hardly ever know what to expect or what we might stumble over. Call it a treasure hunt, if you will", says Jørgensen.

### Marbank and Marbio

"The first thing we will address systematically is the benthos around Svalbard. We believe there are about 2000 different species of benthic organisms there. Thus far, we have not managed to analyse the make-up of more than fifty of them. That leaves us approximately 1950 species to go. With the equipment now in place here in Tromsø, we expect to analyse about 200 species a year. This suggests that we will need about 10 years to examine all of them", observes the CRI director.

The researchers will also be searching for treasure among bacteria, algae and larger animals. Initially, however, it is the bottom dwellers and sessile fauna that they hope to convince to disclose their secrets.

In October 2005, the institutions Marbank and Marbio opened in Tromsø. Marbank plans to collect, identify and store materials from the High North. Marbio is an analysis platform with a laboratory where a robot takes the lids off sample boxes, draws up and releases liquids from pipettes, reads bar codes, replaces the lids, shakes lightly, and finally stacks the sample boxes into an incubator for cultivation. The robot, which can work 24 hours a day with precision down to the millimetre, is one of the most important participants in the treasure hunt in the High North.

With CRI status for the last link in their treasure hunt team, the Tromsø researchers have noticed that the international 'pressure' on them is increasing. "More and more people are aware that Norway has something unique here", confirms Jørgensen.

### Commercialisation

MabCent will be moving into premises under the same roof as Marbio and Marbank in the Research Park in Tromsø. The area will accommodate the collective efforts of everything from biologists to mathematicians, physicians to marketers. Interdisciplinarity is required to make the team effective.

''We know we will be facing a myriad of challenges related to the commercialisation of what we find. So far, we have four Norwegian corporate partners and, naturally, we are very happy with them.

"What we really miss is a major Norwegian pharmaceutical company with considerable resources. Regrettably, there is no such 'animal', so we have to go outside the country's borders more often to find partners", maintains Jørgensen.

"Otherwise, we are in a fantastic situation. Now the institutions are in place, the equipment is in place, we have allocations for many years ahead, and many of the talented employees we need have been hired. This marks the beginning of a whole new era for the kind of research we do. Now we simply have to roll up our sleeves and get started."

*"These organisms often have far better chemical defence systems than humans have."*

*"What we really miss is a major Norwegian pharmaceutical company with considerable resources."*

**Centre on Marine Bioactives and Drug Discovery (MabCent)**

**Trond Ø. Jørgensen**
*Photo: Bård Amundsen*

The Centre will pave the way for the development of bioactive products of high value by screening organisms from the marine Arctic habitat.

**Host institution:** University of Tromsø
**Research partner:** Norwegian Institute of Fisheries and Aquaculture Research
**Corporate partners:** Lytix Biopharma, Biotec Pharmacon, ProBio Nutraceutical, Pronova Biocare, University Hospital of North Norway
**Budget:** Approx. MNOK 180 over eight years
**Staff:** 25–30 (full-time), 10–30 (part-time)
**Director/contact:** Professor Trond Ø. Jørgensen, e-mail: trondj@nfh.uit.no
**Website:** www.mabcent.no

# CONCRETE STRIKES BACK – HARD

**The concrete community in Norway was highly innovative and a world leader in several areas in the 1980s and 1990s. As a result, unique expertise on concrete was developed here in this country, but there are fears in several quarters that this expertise is beginning to crumble. Now, however, the concrete community is striking back hard.**

By Bård Amundsen

When concrete is used correctly, the material has an exceptionally long life time and requires almost no maintenance. Concrete is a unique product, but it is struggling with a certain image problem.

By developing advanced new materials, new construction techniques and new design concepts, the Concrete Innovation Centre (COIN) will once again bring Norwegian concrete research to the forefront as an international leader. COIN is allied with some of Europe's largest companies in the concrete area, and aspires to be a leader when it comes to concrete research in Europe.

## Structures of the century

From 1975 to 1995, numerous gigantic oil platforms were built out of concrete in Norway. The world had never before seen anything like these gargantuan structures. This era culminated proudly with the largest structure ever to be moved by man, the Troll A platform. It was selected as the Norwegian Engineering Feat of the century by the readers of *Teknisk Ukeblad* (The Norwegian Technology Review Weekly). It is less well known that Norwegian contractors, on commission from the Public Roads Administration, erected concrete bridges based on entirely new construction technology during the same years. Accordingly, Norway built up considerable expertise in the field of concrete.

"However, since the beginning of the new millennium, there has been a growing feeling that the appropriating authorities think that we have done all the research that can be done on concrete here in this country, i.e. that we have nothing more left to learn. Of course, that is not the case, and COIN has most definitely proven it. We are rolling up our sleeves again and are eager to demonstrate the fantastic things that can be made from concrete", states COIN Director Tor Arne Hammer.

## Working on a broad front

The Norwegian building industry has an annual turnover of more than NOK 350 billion. Expenses related to concrete works alone account for somewhere between 10 and 20 per cent of that amount. We cast eight million metric tonnes of concrete in Norway every year.

Given that the amounts and volumes are so vast, even small improvements in production processes and products offer a tremendous upside financial potential.

"We do research in an area in which innovation can open new horizons. A survey performed for the Norwegian Concrete Association concluded that every Norwegian krone spent on research and development on concrete from 1980 to 2000, resulted in a return of 19 kroner," says Hammer.

"COIN has high ambitions, and we are well aware of it. Experience tells us that it is not enough simply to invent new and better types of cement. We must also get developers to use the cement. To do that, we have to cover the entire value chain. In our line of business, every link is related to the next link, and we need to have the entire industry on our side in order to generate the desired level of innovation".

Concrete has little tensile strength so it has to be reinforced with steel. The fact that steel corrodes often places a limit on the lifetime of structures, and represents the largest degradation problem for the integrity of concrete structures.

One challenge with a view to innovation is therefore the quest for alternatives to steel. Carbon fibre stands out as an exciting new material that can be used to produce reinforcement rods along with epoxy, for example.

Working with concrete is heavy work. Reinforcement is especially strenuous and sometimes leads to dangerous workplaces. Fewer and fewer employees are willing to take this sort of job, and the building industry is struggling to recruit sufficient labour.

"If reinforcement could be added to the concrete before it is delivered to construction sites, for example, by using carbon fibres, we could solve a number of problems. The need for manual labour would be reduced significantly. However, there is still a great deal of research and development to be done before we get that far. This is one important field that COIN will be examining closely", states the Centre director.

Environmental aspects related to concrete are also becoming increasingly more important. Cement production produces a great deal of carbon dioxide, among other things, and that translates into high environmental taxes for the industry. COIN will be cooperating with its corporate partner Norcem to find solutions to this problem.

## Design

The CRI has a very clear vision of creating attractive concrete buildings. We like to create buildings that are perceived by users as less 'hard' than concrete buildings often are. Concrete is a high malleable material, meaning there are definitely strong possibilities. People within the concrete area feel there are far too few single-family homes built of concrete in Norway.

In single-family dwellings and other buildings, experts and architects envisage that concrete will be used as a cold and heat reservoir in future. The material is highly appropriate for storing heat in the winter. However, in a society where convenience air conditioning is becoming increasingly more common, it may be just as likely that concrete will be used to store cooler temperatures in summer. In this way, concrete building can bring us closer to our vision of the zero energy house, at the same time as we get a better indoor climate.

"At our CRI, the corporate partners are at least equally important as the participating research institutions SINTEF and NTNU", underlines Hammer.

COIN has recruited as a partner one of the world's largest cement manufacturers, the German Heidelberg Group, which is participating through its Norwegian subsidiary Norcem, along with a number of other major players.

**A CONCRETE COMEBACK:** The Concrete Innovation Centre intends to breathe new life into Norwegian concrete research, bringing it once again into a role as an international leader. Concrete was used as a bearing element when the Focus Cinema was to be converted into a library in Tromsø. The building was formally opened in 2005.

*Photo: Trond Opstad*

*"We want to show what fantastic things can be done with concrete."*

*"Concrete is a unique product, but it is struggling with a certain image problem."*



## Concrete Innovation Centre (COIN)

**Tor Arne Hammer**
*Photo: Bård Amundsen*

The Centre's primary objective is to be a European leader in concrete research. Its goal is to develop advanced materials, effective structural technology and new design concepts, combined with more environment-friendly materials production. Fibres will replace steel reinforcement.

**Host institution:** SINTEF Building and Infrastructure

**Research partner:** Norwegian University of Science and Technology

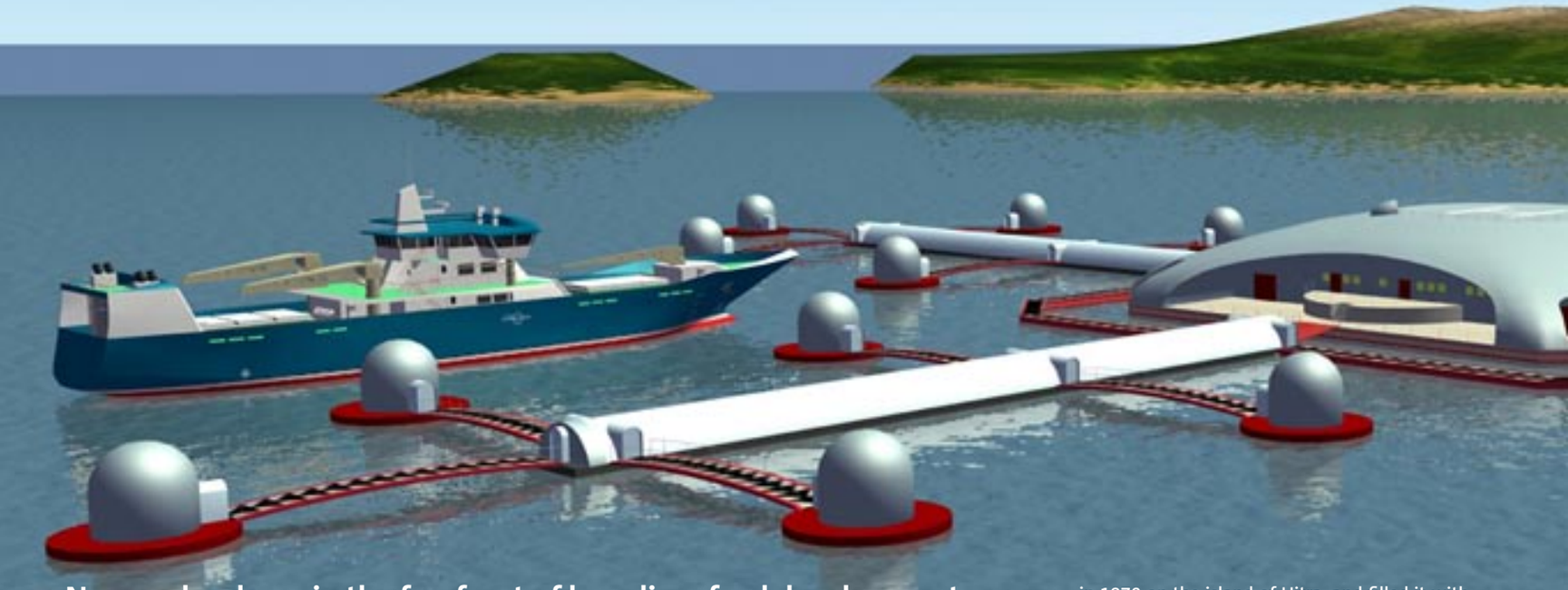
**Corporate partners:** Norcem, maxit Group, Borregaard, Rescon Mapei, Aker Kværner, Veidekke and the Norwegian Public Roads Administration

**Budget:** Approx. MNOK 200 over eight years

**Staff:** 15–20 PhD students, and SINTEF employees working on projects in the Centre, several of whom are affiliated with external enterprises

**Director/contact:** Senior Researcher Tor Arne Hammer, e-mail: tor.hammer@sintef.no

# TECHNOLOGY TO GIVE THE WORLD MORE FARMED FISH



**Norway has been in the forefront of breeding, feed development, vaccinations and other areas of the fish farming industry. This is, however, not the time to simply sit back and rest on our laurels. The new CREATE Centre in Trondheim will ensure Norway's position as a supplier of fish-farming technology.**

By Bjarne Røsjø

"Our prime focus is on enhancing innovation among the companies that supply equipment and technology to the fish farming industry. More innovative suppliers could improve our profitability as well as international competitiveness in the industry itself," remarks Arne Fredheim, a senior scientist at SINTEF Fiskeri og havbruk AS (SINTEF Fisheries and Aquaculture), and head of CREATE.

One of the reasons for the establishment of CREATE is that the international demand for processed fish is increasing. "People in the industrialised, western world are eating more and more fish because it's both tasty and good for you. On top of that, the global population is growing. The demand for food will increase, as will the demand for healthy food. You don't have to be a fortune teller to predict that the demand for fish will increase in the future," remarks Fredheim.

"This can only mean that mariculture, aquaculture, fish farming, call it what you will, will most likely be a very prudent target area." Fish farming is the answer to the increasing demand, because fisheries as such have more or less reached their maximum sustainable yield. In fact, the UN's Food and Agriculture Organization, FAO, estimates that 25 per cent of today's fisheries involve species that are being overtaxed. There are still some species that can tolerate heavier exploitation, but any future increase in food production must come from farming," he adds.

## A technological edge

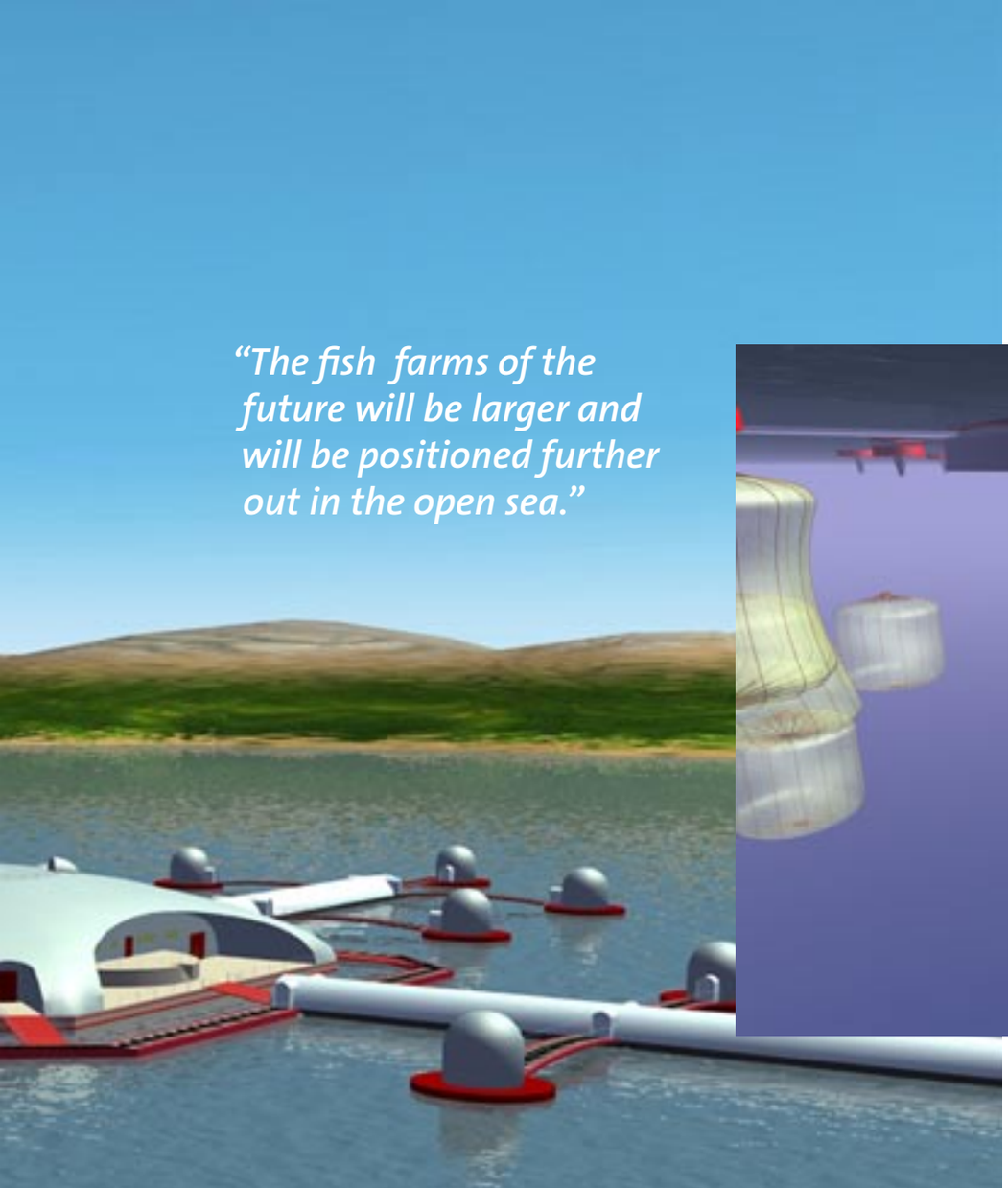
The Norwegian fish farming industry has come a long way since the brothers Ove and Sivert Grøntvedt constructed the world's first fish pen in 1970 on the island of Hitra, and filled it with salmon smolt. The farming of freshwater fish dominates on a global basis, but there is every reason to believe that the greatest future growth will occur in the area of mariculture. "Norway has always been in the vanguard of this industry, and it is obvious that marine farming has several advantages. The water quality is better, and the danger of spreading diseases is lower, to mention just a couple. At the same time, however, marine fish farming is more demanding in terms of technology," Fredheim observes.

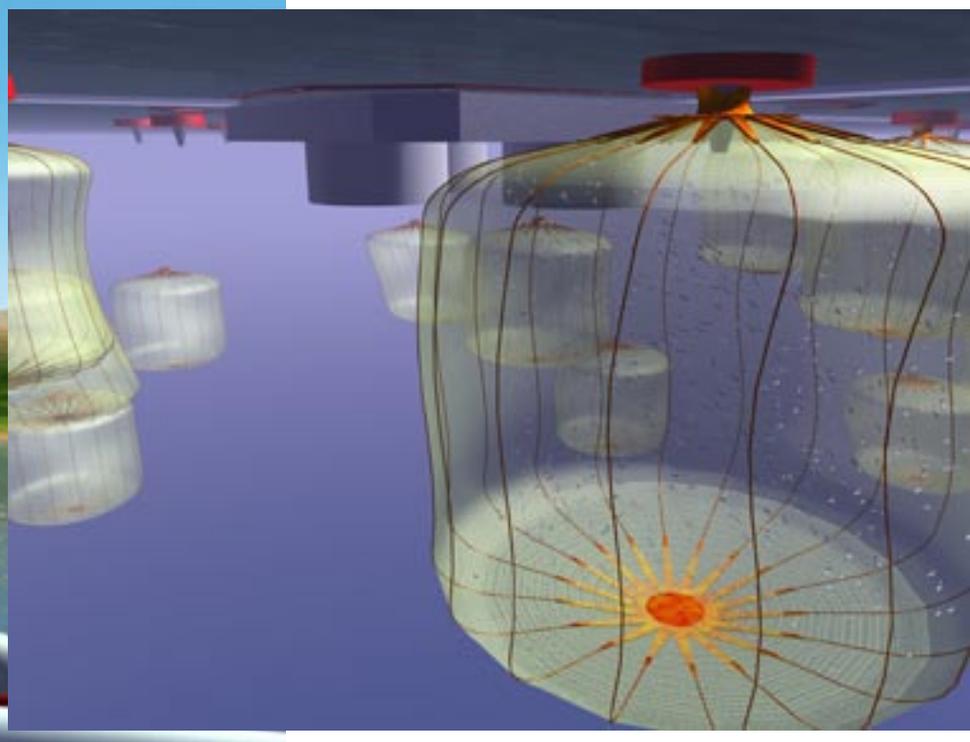
Norway and Chile are the main marine fish-farming nations of the world, but Norway has consistently had a technological edge with regard to breeding, feed development, vaccinations, reducing the use of antibiotics, etc. CREATE intends to help sustain and expand this advantage. There is significant export potential not only for processed fish, but also for fish farming technology.

Arne Fredheim points out that CREATE will be focusing on the technology that surrounds the fish from the time they are stocked until they are collected by a well boat to be shipped to a harvesting plant. "There is also a need for continued research and innovation in areas such as fish breeding and fish feed, but these are outside the scope of the Centre," he points out.

*"You don't have to be a fortune teller to predict that the demand for fish will be growing in future."*

*"The fish farms of the future will be larger and will be positioned further out in the open sea."*





**TAKING THE PLUNGE:** The marine fish farms of the future will probably not be so very different from those of today, but they will most likely be larger and placed further out in ocean waters. Submersible fish farms offer advantages, for example, in inclement weather or when farms are threatened by algae invasions.

*Illustration: Sintef*

### Intelligent fish farming

"What kind of technology does the fish farming industry actually need?" "We have defined three pillars of research. The first pillar involves equipment and design, in other words, innovations in areas such as new net materials, floating collars and feeding systems. The second pillar focuses on routine operations. In this context, it is important to examine the procedures governing feeding times, feed amounts, how live fish are handled, etc. The third pillar is an entirely new concept that we are in the process of developing. We have called it intelligent farming. We believe the fish farms of the future will gather extensive digitised information about all the conditions that concern the growth and welfare of fish, and will use this data to make better decisions about feeding, the use of artificial light, etc."

Fredheim does not believe that fish farms will be fundamentally different in the next five to ten years from what they are today. "However, I envisage that the facilities of the future will be larger and will be positioned further out in the open sea. This is more important on the international arena than in Norway, where we are lucky enough to have fjords, islands and a coastline that all provide good opportunities for fish farming without much trouble with wind and waves. Fish farmers in Norway are heading out towards the ocean all the same, mainly in order to ensure good water quality and oxygen levels," he says.

### Technology for the whole industry

CREATE will also investigate new technology for submersible installations, a 'hot topic' internationally. "Here at home, we are used to exploiting natural resources, and very few people are bothered by the sight of a fish farm. In many other places like the Persian Gulf and around the Mediterranean, however, people simply don't want to see fish farms. Multi-millionaires who own beach front property on the east coast of the USA don't want to see them either. Submersing the facilities can solve this problem," continues Arne Fredheim.

While the other CRI centres are to some extent addressing technological areas, CREATE is focusing on an industry that calls for a far broader range of technology. "A centre that focuses on developing technology for the fish farming industry is, quite simply, a new concept from a global point of view. I think that the Research Council is demonstrating great vision in choosing us, and we will do our utmost to fulfil its expectations," Fredheim promises.

### Centre for Research-based Innovation in Aquaculture Technology (CREATE)

**Arne Fredheim**

CREATE will maintain and enhance the position of Norwegian equipment suppliers to the fish farming industry, and will be a leading provider of knowledge and equipment to the global aquaculture industry.

**Host institution:** SINTEF Fisheries and Aquaculture

**Research partners:** NTNU Centre for Ships and Ocean Structures (CeSOS), NTNU Department of engineering cybernetics, Institute of Marine Research (IMR), Institute of Aquaculture Research (Akvaforsk)

**Corporate partners:** AKVA Group, Egersund, Net, Erling Haug, Helgeland Plast

**International partners:** Open Ocean Aquaculture Group at the University of New Hampshire (USA), AquaNet/Network of Excellence (Canada)

**Budget:** MNOK 160 over eight years

**Staff:** 15–20 (full time/part time)

**Director/contact:** Senior Scientist Arne Fredheim, e-mail: arne.fredheim@sintef.no

# IMAGING TECHNOLOGY FOR BETTER HEALTH

The field of medical imaging technology has progressed by leaps and bounds since Wilhelm Conrad Röntgen discovered a new type of radiation, X-rays, in 1895. However, the potential for further development is still tremendous, and Professor Olav Haraldseth predicts a technological revolution in the next decade.

By Bjarne Røsjø

"We often say, half-jokingly, that we are engaged in two types of innovation here at the Centre. The one type will create jobs in business and industry, while the other will eliminate jobs in the public health service," says Olav Haraldseth, assistant dean of the Faculty of Medicine at the Norwegian University of Science and Technology (NTNU), and a professor in the Department for Circulation and Medical Imaging.

"Of course, this really has nothing to do with getting the health sector to reduce its work force," he hastens to add. "On the contrary, we want to help the public health service become more cost-effective, in the sense that it 'produces more health per employee'."

There are many possible approaches to promoting more cost-effective health services, but Haraldseth and his colleagues at the CRI MI Lab in Trondheim have chosen to focus on medical imaging (MI). When used in the right way, MI can reduce expenses in the health sector by contributing to quicker diagnoses, fewer post-operative complications, shorter hospital stays, etc. Accelerated patient recovery can also translate into reduced costs for society in connection with sick leave, follow-up treatment, care and nursing, and so on.

## A revolution is in the offing

"Magnetic resonance imaging (MRI) and ultrasound are emerging as the most important imaging techniques in today's health sector, and we expect them to consolidate their position in the years ahead. These techniques are currently used to produce images of soft tissue, blood circulation, organ functions and physiology. We believe that new, improved MRI methods will be developed, and that they will also be able to supply information about metabolism and molecular activity.

"Ultrasound holds great potential for further development with regard to areas of application as well as image quality. When it comes to ultrasound, we are on the verge of a technological revolution comparable to the PC revolution," Haraldseth predicts.

MI Lab is determined to be in the vanguard of the coming technology revolution. For example, the Centre is developing ultrasound technology that can provide images that will contain ten times more information than today, thanks to a combination of improved technical equipment and smarter contrast agents. However, the greatest change will be that we will see much broader use of this technique.

"We believe ultrasound will become 'the new stethoscope' in the sense that the equipment of the future will be user-friendly enough to be used by general practitioners (GPs). We also envisage the development of MRI equipment that can be used at local hospitals and in special imaging centres, even though this technology is currently restricted to specialist hospitals.

"This structural change means that GPs will be better able to diagnose cases of serious illness without the patient having to consult a specialist. It will also be easier for GPs to follow up chronically ill or post-operative patients. All in all, new technology may mean that more jobs can be done by GPs and at local hospitals rather than at the expensive specialist hospitals," continues Haraldseth.

## Most important innovations not yet planned

MI Lab can build on the proud traditions Norway already has in the area of medical imaging with regard to contrast agents and more advanced forms of ultrasound. Three of MI Lab's corporate partners (GE Vingmed Ultrasound, Mison and FAST) won the prestigious European Information Society Technologies Prize in 1995, 2002 and 2004, respectively.

Haraldseth is concerned that technological developments have had a tendency thus far to increase costs in the health sector, rather than generating health benefits for the general public. "Our goal is actually to develop more cost-effective solutions. We don't want to promote technology for its own sake, but for the sake of the public health service and the patients," he comments.

Haraldseth emphasises that MI Lab will focus on developing technology, but will also train a large number of talented individuals who will be able to fulfil vital functions in the public health service and in corporate R&D departments.

MI Lab will establish its new research community and have all corporate partners in place by the end of 2007. "The first prototype for ultrasound examinations of heart function will be available to GPs in 2008. By 2009, we will be able to generate ultrasound images with a resolution down to 0.1 cubic millimetre. That being said, it's easy to talk about the innovations we are planning now, because they will be implemented in two, four, or six years. The most significant innovations are those we haven't planned yet, because we don't know what they will be," Haraldseth concludes.

## Medical imaging

Medical imaging, or MI, is the designation for various methods and techniques that can be used to examine and diagnose organs or structures within the body. The most important imaging techniques in today's health sector are ultrasound and magnetic resonance imaging (MRI). Ultrasound is based on the use of high-frequency sound waves that are reflected differently by body tissues of varying density. MRI combines powerful magnets with radio waves in order to register the hydrogen atoms in the body's water molecules.

*"We don't want to promote technology for its own sake, but for the sake of the public health service and the patients."*

*"When it comes to ultrasound, we are on the verge of a technological revolution comparable to the PC revolution."*

**SURGERY:** The red area shows a brain tumour, the orange indicates the part of the cerebral cortex that controls tongue movement, and the green area shows the body's neural pathways. The image highlights the areas near the tumour that must not under any circumstances be damaged, and surgeons need such images sorely when planning operations. This image was compiled from four different MRI scans.

*Illustration: (Erik Magnus Berntsen, fMRI gruppen, NTNU) mi Lab*



## Medical Imaging Laboratory for Innovative Future Healthcare (MI Lab)

**Olav Haraldseth**

The Centre will facilitate a cost-effective public health service and improve patient care by promoting innovation in the field of medical imaging, and thereby engendering new economic activity in Norway.

**Host institution:** Norwegian University of Science and Technology, Faculty of Medicine

**Research partner:** SINTEF

**Corporate partners:** GE Vingmed Ultrasound, FAST, Medistim, Mison, Odetect, Nordic Neurolab, CorTechs Labs, St. Olav's Hospital/Central Norway Regional Health Authority

**Budget:** Approx. MNOK 40 (2007)

**Staff:** Approx. 20 (2007)

**Director/contact:** Professor Olav Haraldseth, e-mail: olav.haraldseth@ntnu.no

**Website:** www.medisin.ntnu.no/isb/MILab

**Norway currently sends 99 per cent of its natural gas straight out of the country in pipelines. This state of affairs can not continue: There are billions to be earned by refining this gas. Better catalysts hold the key – and the CRI headed by Unni Olsbye is on a quest to find it.**

By Susanne Moen Stephansen

# FROM GAS

"Research results can give our corporate partners the edge they need to out-compete their international competitors," says University of Oslo chemistry professor Unni Olsbye enthusiastically. She is head of Innovative Natural Gas Processes and Products (inGAP), and collaborates with groups from SINTEF, the Norwegian University of Science and Technology (NTNU), Statoil, Hydro and Borealis. This is truly an all-star line-up. Each of these groups is already among the global elite. According to Olsbye, together, they have a golden opportunity to achieve the national goal of promoting Norway as a gas refiner rather than merely a supplier of raw materials.

Our meeting takes place at one end of a laboratory-lined corridor at the Department of Chemistry at the University of Oslo. The conference room is filled with models of molecules and piles of paper, and its walls are lined with desk spaces. Far too many chairs are packed around the table in the middle of the room.

"As you can see, we are hard at work while we wait for bigger, brighter premises at the other end of the building," Olsbye says before answering a question about what the Centre will actually be doing.

## Hair care with gas

"In a nutshell, we will be working to promote more environment-friendly, profitable gas refinement by developing better catalysts," says the head of the Centre, explaining why this is important.

"Petroleum will be our most important source of energy in the foreseeable future, and natural gas is its most environment-friendly component. In addition, Norway's oil production has already peaked, while gas production is still on the rise. As a matter of fact, estimates indicate that two-thirds of Norway's total gas deposits have not even been discovered yet," she says, adding that global demand is growing for a number of other products in which natural gas is used: hair gel, toys, boots, automobile interiors, artificial fibres, the plastic in computers, telephones, balls – in fact, everything imaginable that is made of plastic.

*"What is the real story behind these catalysts?"*

## Chemical short-cuts

Petroleum refinement involves initiating different chemical processes, depending on which materials and products one wants to produce, according to Olsbye. Ninety per cent of these processes are carried out with the help of catalysts, i.e. chemical agents that facilitate chemical reactions, for example, by decreasing the amount of energy required to obtain the desired reaction.

"We will accurately design the catalysts we need to convert natural gas into the products we want in the most energy-efficient manner without creating by-products," says the director of the Centre. The conversion of methane gas (the chief component of natural gas) into methanol is a prime example of this. Methanol is a primary reactant for making gasoline and plastic raw materials. In today's industrial plants, methane is heated to approximately 900 °C before being converted. Methanol synthesis is a two-step process: First, it is converted into treat gas, and then to methanol.

"This is an expensive and complex process, but it is the only method available to us today. In nature, on the other hand, methane is converted into methanol directly and at entirely different temperatures. If we can manage to design a catalyst that is exactly right, it will be possible to copy Mother Nature. This would have major consequences, not least in the economic sphere. Developing such alternative processes is one of our long-term objectives. To start with, though, researchers at the Centre will respond to the needs of our corporate partners to acquire the knowledge needed to improve the processes they are carrying out today."

## Problems for industry

Special Adviser Erling Rytter is one of Statoil's people at inGAP. He is very pleased that Norway's largest petroleum company will be gaining a competitive advantage on the international arena thanks to the CRI scheme.

"The industry faces very specific problems that are not really addressed by academia. Researchers often work with model systems to investigate chemical reactions, but we are now asking them to look at real reactions. Of course, at the end of the day we are hoping this research will give us knowledge that will enable us to develop the technology to refine gas more profitably, and thus help Norway process more than the one per cent that we refine today."

*"Is there any estimate as to the scope of the economic potential inherent in gas refinement?"*

"I don't want to give any exact figures, but some analyses show that Norway could earn billions by refining 10 per cent of her natural gas instead of one per cent, as we do today," says Rytter. He adds that there is also a considerable increase in price from raw materials to specific products. For instance, if natural gas is processed to form olefins, and then further processed into polyethylene and polypropylene, the basic components of plastic materials, its value will increase by approximately five to seven times. If it is then further processed to make finished plastic products, it will be worth 10 to 50 times its original value.

## Only woman to head a CRI

Achieving economic profitability as a result of innovation is clearly a key objective for the 14 Centres for Research-based Innovation. But at inGAP, environment friendliness is also a key concept. While our coffee is cooling among the red and blue molecules cluttering the desk, we ask Unni Olsbye: *"Which is more important – money or the environment?"*

"They are connected. That's what is so nice. When we find the best catalysts, they will also be the substances that help to generate reactions that require less energy and have no polluting by-products that the industry has to spend money to get rid of," reports Olsbye.

*"Are you the only woman to head a CRI?"*

"Yes, it's a pity that the active recruitment of women that we see in the educational system has not yet resulted in more women in top positions. We also see this in the field of catalysis, where there is a significant imbalance between the percentage of women who attend international conferences and the percentage who deliver papers. This is one of the things we will strive to change here at the Centre by encouraging capable young women to seek leading positions in their fields. There is no doubt that the talent is there, among women as well as men."

*"Do you think inGAP will be a success?"*

"We have the natural resources we need, top-notch research expertise and corporate partners that are willing to invest in us.... Yes, definitely. We are going for the gold."

*"Norway's oil production has already peaked, while gas production is still on the rise."*

# TO GOLD

*"If we can manage to design a catalyst that is exactly right, it will be possible to copy Mother Nature."*

**ON THE RISE:** Norway's oil production has peaked, while gas production is still on the rise. Better catalysts will make it more profitable to refine this gas, increasing its value significantly.
*Photo: Willi Hansen/Samfoto*



**Innovative Natural Gas Processes and Products (inGAP)**

**Unni Olsbye**
*Photo: Ståle Skogstad/UIO*

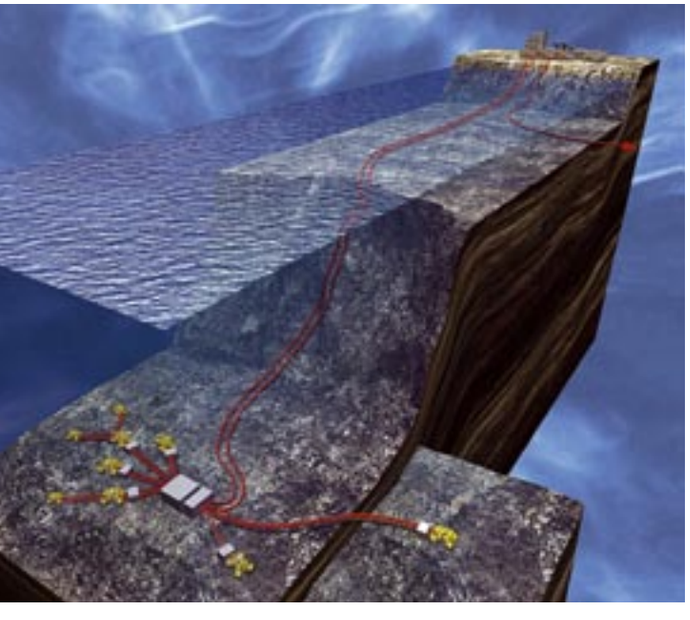
The Centre will pursue the development of catalysts to refine natural gas.

**Host institution:** University of Oslo
**Research partners:** Norwegian University of Science and Technology (NTNU), SINTEF
**Corporate partners:** Borealis, Hydro, Hydro Polymers and Statoil
**Budget:** Approx. MNOK 210 over eight years
**Staff:** Approx. 30
**Director/contact:** Professor Unni Olsbye,
e-mail: unni.olsbye@kjemi.uio.no

# CHALLENGING MULTIPHASE FLOWS

Norway is at the international forefront when it comes to developing innovative subsea solutions. The Multiphase Flow Assurance Innovation Centre (FACE) is intended to help ensure that we maintain this position.

By Elisabeth Salvesen



**BILLIONS IN ADDED VALUE:** The plans for Ormen Lange include a subsea production facility with satellites. Everything will be sent through two pipelines directly to shore, before the gas is sent on to Great Britain in a separate pipeline. Multiphase technology has led to billions in added value in Norway over the past 10 to 15 years.

*Illustration: Norsk Hydro*

"The goal is to ensure the transport of oil, gas and water from wells on the seabed through pipelines in a cheaper, better manner than today." Those are the words of Kjell Arne Jacobsen, one of the original founders from SINTEF and former director of the CRI known as the Multiphase Flow Assurance Innovation Centre (FACE). Erik Holm of the Institute for Energy Technology (IFE) was recently appointed the new director of the Centre.

"Multiphase flow transport implies a myriad of new challenges. When a blend of two or more substances flows together without dissolving into each other, we have a multiphase flow that can lead to unstable production. For example, oil and water can come out of the pipeline intermittently, causing serious problems for the processing plant.

"At other times, oil and water can form viscous, insoluble components that can lead to exceptionally large losses of pipeline pressure and thus reduce production substantially. Wax and ice-like crystals can also form, increasing flow resistance. Under unfavourable conditions, they can clog the pipeline completely. Where the amount of water and the water chemistry are unfavourable, the pipeline can corrode from the inside. All this can entail huge financial losses or, in the worst case, fatal incidents related to oil and gas spills."

## In the forefront

The Centre is made up of three equal partners: the Institute for Energy Technology (IFE), the Norwegian University of Science and Technology (NTNU) and SINTEF. The Centre's three institutions have robust, complementary research groups working to develop new knowledge and technology, especially in the field of multiphase flow transport and processing. The Centre will officially open in August under the management of the new CRI Director Erik Holm.

"In an area in which innovative new subsea solutions are being developed constantly, Norway is in the forefront at the international level. To maintain this position, it is essential to perform research and develop new knowledge and technology. The Centre's contribution to research-driven innovation will be an important element in this revitalisation process", states Jacobsen.

## Difficult systems

Today, there is considerable uncertainty in respect of the development of oil and gas fields that contain fluids that are difficult to transport and process. The goal of FACE is to develop insight and knowledge which make it possible to develop such fields by eliminating some of that uncertainty.

New knowledge and new methods will make production possible on oil and gas fields that cannot currently be developed. This will also

*"Oil and brine can, for example, spout out of the pipeline intermittently and create serious problems."*

**COMPLICATED FLOWS:** Complex blends arise between gas (grey), light oil (yellow) and water (blue). Knowledge about how fluid systems impact flows in pipelines and process equipment makes it possible to plan safe, reliable oil and gas production.
*Photo: SINTEF*

open up new opportunities in remote areas such as the Arctic, for example. The goal is to be able to transport well streams through pipelines on the seabed over long distances.

"We will link the research being done on a micro scale at the Ugelstad Laboratory at NTNU with research on medium and large scales at the Institute for Energy Technology and SINTEF.

The new aspect is the inclusion of the chemistry dimension and the micro dimension. If this linkage is successful, there is substantial potential for new industrial development", maintains Jacobsen.

## Ensuring exports

"The challenge is to build up expertise and knowledge that will form the foundation for further industrial activities in the area. Accordingly, it is important to educate new assets with a view to basic research as well as more applied research, to ensure that Norwegian subsea technology continues to be a major export in future as well.

"We plan to educate 16 PhD students at FACE. The students will have exchanges with universities abroad, and more post-doctoral research fellows will be hired. The Centre plans to collaborate with the Colorado School of Mines and Florida State University and relations will be established with several international research partners."

Thus far, the Centre has seven industrial partners (see box) which contribute financially and do research at the Centre. All the companies are among the international elite when it comes to using or building advanced multiphase subsea production solutions.

## The knowledge gap

The commercial challenge for the future production of oil and gas lies in using the existing infrastructure as long as possible for sunset fields. There is a gap between the industry's level of ambition for advanced subsea production and what we have available today in terms of methods and tools to predict the behaviour of complex multiphase flows. Besides, in future, a large part of the world's unproduced oil reserves will be heavy oils that are significantly more complicated to transport than today's oil and gas. To develop new oil fields in a safe, financially sound manner, we need more knowledge about the behaviour of complex well streams.

## Creates values

In the North Sea, huge oil platforms used to be erected on the seabed, and they were equipped to separate oil, gas and water (brine). The gas was sent to market in a pipeline, while the oil was loaded onto vessels or transported in another pipeline. Such solutions require that the oil or gas fields are exceptionally large if development is to be profitable. Today, most offshore fields are being developed with subsea solutions. This cuts development and operating costs substantially. Fields that would not otherwise have been produced are now being put into production. This generates billions in assets for the industry and the people of Norway.

"By securing reliable data about fluid systems and how they affect flows in pipelines and process equipment, it is possible to achieve safe, reliable oil and gas production. That makes it possible to design a good production facility that produces in a predictable, stable manner throughout the life of the field. Sketchy knowledge about the area would engender a great risk of making the wrong design. Accordingly, huge amounts of money rest on good design and the prudent operation of such installations", concludes Jacobsen.

**KJELL ARNE JACOBSEN:** One of the founders, and former director of CRI.

### Multiphase Flow Assurance Innovation Centre (FACE)

**Erik Holm**
*Photo: Anita T. Munch*

The oil industry needs better knowledge and computational models to develop new oil fields containing difficult well fluids. The Centre will develop better methods for describing difficult oil/gas/water systems by virtue of mathematical models that can be used in multiphase flow models.

**Host institution:** The Institute for Energy Technology (IFE)
**Research partners:** SINTEF and NTNU
**Corporate partners:** Statoil, Norsk Hydro, Total, ConocoPhilips, AkerKværner, Vetco and Scandpower PT
**Budget:** MNOK 240 over eight years
**Staff:** 60–80
**Director/contact:** Senior Adviser Erik Holm, e-mail: erik.holm@ife.no

# CHAMPIONS LEAGUE IN MANUFACTURING

Few countries in the world are better suited to modern manufacturing than Norway, in the view of the primus motors behind the new CRI: Norwegian Manufacturing Future. The Centre's ambitious goal is to increase production per employee from MNOK 1 to MNOK 4. Norwegians do, in fact, know how to do more than produce petroleum and fish.

By Bård Amundsen

*"The competition is mainly a question of who will manage to develop the smartest product."*

It is a well-kept secret for most people that one of Norway's most advanced centres for industrial development is located in Raufoss, a village about 100 km north of Oslo. With a total work force of roughly 3500 employees, around 35 businesses have been established on the site of a former state-owned munitions factory in Raufoss. Today these businesses produce goods and provide support services valued at roughly NOK 4 billion a year. The new CRI's first goal is to increase annual production value to MNOK 2 per employee. Once that has been accomplished, the Centre will re-target at MNOK 4 annually per employee.

Norwegian Manufacturing Future will be headquartered in Trondheim and have an industrial hub in Raufoss. This will reinforce the importance of the Raufoss-SINTEF/Trondheim connection, which currently plays a central part in the Norwegian manufacturing industry. Enterprises located in other parts of the country, , are also participating in the CRI project. Altogether, the industry consortium consists of 16 companies.

"Five years ago, we would probably not have received the go-ahead for a centre like this," says Odd Myklebust, director of the new CRI.

"The fact that we are one of only 14 groups whose applications were approved is, in my view, indicative of an international trend. The EU states, Japan, the US and Canada are all investing heavily in retaining their domestic production. Norway is also part of this cooperation, which encompasses everything from funiture to the aircraft industry."

**Raufoss is the locomotive**

"The town of Raufoss is the locomotive driving production technology in Norway today," Myklebust explains. What is more, most of the companies located in Raufoss are doing very well now. "It makes the evening news on TV every time a company in Raufoss loses a major contract for automotive parts. Yet every time one of them wins a major contract, it attracts no more attention than an item on the back page of the local newspaper. The fact is that many enterprises in Raufoss have been doing quite well after restructuring," continues Myklebust.

Automobile manufacturing is one of the world's most advanced mass production industries. Norwegian enterprises compete on this market, manufacturing auto parts valued from

**ADVANCED INDUSTRIAL DEVELOPMENT:** Norwegian Manufacturing Future intends to double the production value per employee in Norway. Advanced industrial development is flourishing in Raufoss. These photos show the production of bumpers at Hydro Automotive.

*Photos: Norsk Hydro*

*"Norwegian Manufacturing Future intends to double the production value per employee in Norway."*

NOK 7 to 8 billion each year.

"No other manufacturing sector is as highly developed and poses such rigorous demands as the automotive industry.An advanced subsupplier today has to develop the product from scratch, while also describing the production process. In addition, stringent requirements apply to quality and costs. This is a good example of modern engineering, and of the decisive role knowledge plays in manufacturing today. These days, there are actually car-makers that do not produce one single part of their cars themselves. Everything is outsourced."

### At the head of the class

"If we want to compete, we have to be at the head of the class in developing products and production. When we do something, we have to do it 'smarter' than everyone else. The good news is that our qualifications for accomplishing this are very good in Norway. For example, the biggest problem facing the automotive industry today is that vehicles are too heavy. The solution lies in aluminium, plastic and composite materials. We have a great deal of expertise in these areas in Norway.

"There is no longer a second division in the field of international manufacturing. Everyone is competing in the Champions League," comments Myklebust, casting a glance at Norways leading Football Club Rosenborg, whose training pitch is located a mere 500 metres from CRI headquarters.

Myklebust cannot tell whether the trips between Raufoss and Trondheim will be more frequent in the years ahead. However, he is convinced of one thing: "For Raufoss and other Norwegian industrial clusters, the fact that we have been named a CRI implies acknowledgement of the real importance of these communities."

### Interdisciplinary

Norwegian Manufacturing Future will be involved in several long-term projects. All of them will conclude with a demo version or a demonstrator. The Centre will be located under the same roof as SINTEF in Trondheim. In addition, the CRI will have a separate department located at the industrial park in Raufoss.

The corporate partners recruited by the Centre include some of the most important industrial players in Norway (see box).

During the eight years that the Centre hopes to be in operation, participants will become involved in the long-term development of products for sectors such as the automotive and engineering industries, the food processing industry, electronics, the defence industry, furniture production and clothing production. The production processes and value chains that underlie the products are as important as the products themselves.

**Norwegian Manufacturing Future**

**Odd Myklebust**
*Photo: Bård Amundsen*

The centre will carry out multidisciplinary research on the next generation of production technology. This will pave the way for the Norwegian manufacturing industry to carve out a strong position in the face of global competition.

**Host institution:** SINTEF (the Foundation for Scientific and Industrial Research at the Norwegian Institute of Technology)

**Research partners:** NTNU (the Norwegian University of Science and Technology), RTIM (Raufoss Technology and Industrial Management)

**Corporate partners:** Elko, Helly Hansen, Pipelife Norge, Steertec, Teeness, Ekornes, Plasto, Gilde Norsk Kjøtt, Hexagon, Hydro Automotive, Kongsberg Automotive, Nammo, Raufoss Technology, Volvo Aero, Raufoss Industrial Tools, Mills

**Budget:** MNOK 160 over eight years

**Staff:** 15–20

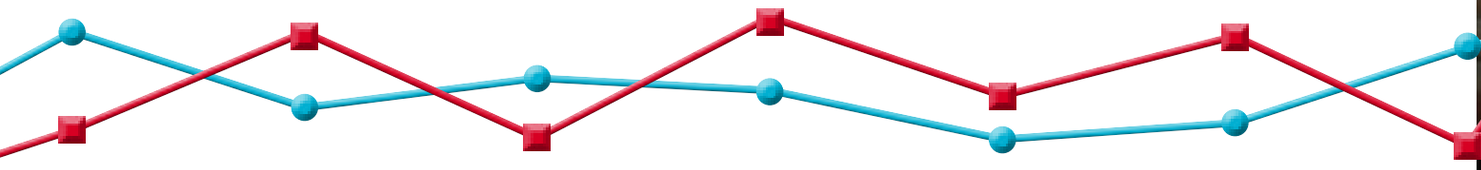
**Director/contact:** Senior Researcher Odd Myklebust, e-mail: odd.myklebust@sintef.no

**Website:** www.sintef.no/norman

"High-quality statistical analyses could give a substantial boost to the competitiveness and profitability of business and industry. One of our goals is to help enhance the profitability of Norwegian oil production by one per cent in the course of the eight years this centre will exist," says the director of the CRI Statistics for Innovation.

By Siw Ellen Jakobsen

# TOP STATISTICAL SCIENCE FOR NORWAY'S FUTURE



Arnoldo Frigessi is director of the new CRI Statistics for Innovation, and he has set his sights high. That being said, he has every reason to place his faith in the centre. "This research group ought to be regarded as a national treasure", was one of the comments made by the international group of experts that reviewed the centre's application for CRI status. Based at the University of Oslo and the Norwegian Computing Center, this research community is already one of the best in the world, according to the same group of experts. In collaboration with a number of research partners and corporate partners (see box), over the next few years, the group intends to become the best applied statistics community in Europe.

Frigessi is pleased that the statisticians managed to earn the status of a Centre for Research-based Innovation (CRI). "I'm glad the Research Council and the committee of experts that assessed our application understood how vital statistical science is in today's world. Unfortunately, this kind of insight cannot always be taken for granted. Huge amounts of money are invested in collecting data, but many leaders think the process of analysing these data is a simple corollary. Every day, fatal statistical errors are made in research, business, industry and the public sector. Such errors can have significant consequences, not least for the economy," he contends.

When we met with Frigessi in his office at the Institute of Basic Medical Sciences, where he is a professor, he came straight from a meeting at a hospital in Oslo. The hospital had invested millions of NOK in collecting data about a particular type of cancer. Now they want to have the data analysed, and have allocated NOK 20 000 for that purpose. "This is a typical example. It illustrates the gross imbalance between the amount invested in the collection of data and the meagre amounts of time and money people are willing to spend on analysing it."

## Drowning in data

The petroleum, marine, financial and health sectors are the four areas in which the new Centre will be working. The financial sector needs to assess risk. The petroleum industry needs to know how much oil and gas are in the reservoirs. The fisheries sector wants to know how many fish are in the sea, and how stocks will develop over time. Physicians want to know, for example, which genes determine whether a medical treatment will work.

"These four areas all depend on applying the appropriate statistical method, but the statistical toolbox is almost infinite. The challenge lies in choosing the right tool for each individual situation, or constructing new ones if need be. At Statistics for Innovation, we will devise methods that will be vital for our partners in future, not necessarily today. We will develop the statistics they will need in future in order to solve their problems," smiles Frigessi.

## Facing the challenge together

Despite the differences between the four sectors with which the centre will be working, they share a common challenge: They must deal with vast amounts of data and with new types of data that cannot be handled by current analytical instruments. It is often very hard to extract useful information from data, which can help increase understanding and improve competitiveness and profitability.

"The field of data collection has undergone dramatic changes in the past five years", according to Frigessi. "Today's technology is so advanced that it is possible to gather huge quantities of data in a short time. Just imagine the vast amount of information we have amassed about our genes. Yet in this mountain of data, only a few items are of genuine interest. For instance, there may only be 10 genes out of 30 000 that are important for understanding how a particular disease develops, or only a few places along the Gulf of Mexico where it is worthwhile to search for oil. But where are they? Statistics can make a difference!"

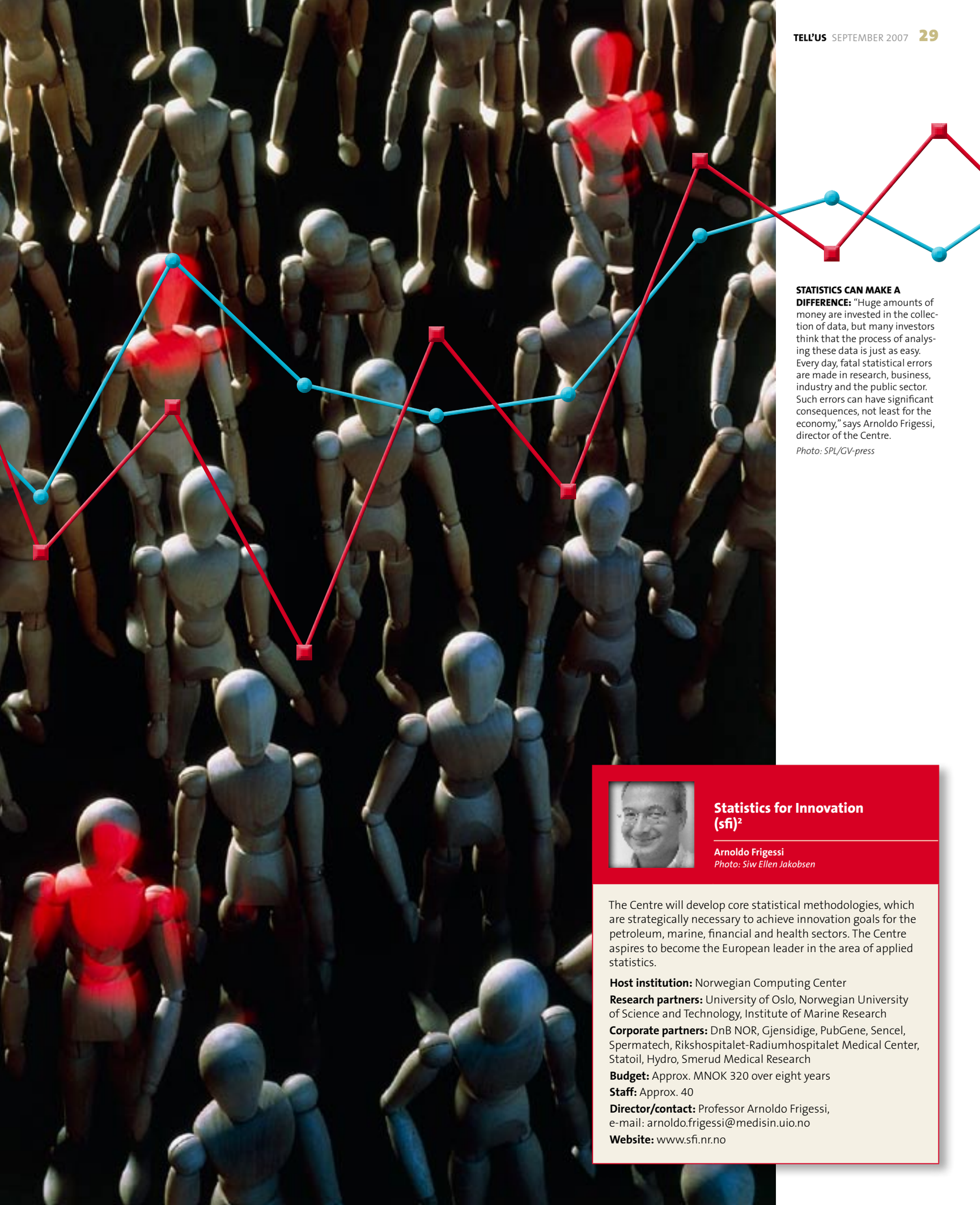
## Random patterns

When the amount of data reaches such critical levels, it is no longer possible to apply classical methods of statistical analysis. Coincidences, in fact, have an amazing ability to create patterns when large volumes of data are studied with classical statistics methods, according to the statistician. The danger lies in finding non-existent causal connections. It is easy to draw the wrong conclusions, and that could have serious consequences.

Nick Fisher, president of the Statistical Society of Australia, wrote in an article in *Nature* in 2003 that he is afraid that sloppy statistics could destroy the gene revolution and biotechnology. Unless professional statisticians are charged with analysing the genome, he claims, the wrong conclusions can be drawn, putting both public health and the environment at risk.

## Unique collaborative effort

Frigessi, an Italian, finds it extraordinary that a small country like Norway has developed a statistics community that is among the best in the world. "This is largely because the field itself and the universities have attracted so many unusually talented individuals, and because the Norwegian Computing Center has consistently maintained contact with 'the real world', generating interesting challenges for researchers, who have been able to devote their energies to truly demanding problems," he remarks. In his view, being granted CRI status is an extremely important factor for being able to continue this tradition. "We have put together a unique construction here, which I believe will attract talented students and researchers from abroad. There is quite simply nothing else like it anywhere else in the world," he concludes.



**STATISTICS CAN MAKE A DIFFERENCE:** "Huge amounts of money are invested in the collection of data, but many investors think that the process of analysing these data is just as easy. Every day, fatal statistical errors are made in research, business, industry and the public sector. Such errors can have significant consequences, not least for the economy," says Arnoldo Frigessi, director of the Centre.

*Photo: SPL/GV-press*



## Statistics for Innovation (sfi)²

**Arnoldo Frigessi**
*Photo: Siw Ellen Jakobsen*

The Centre will develop core statistical methodologies, which are strategically necessary to achieve innovation goals for the petroleum, marine, financial and health sectors. The Centre aspires to become the European leader in the area of applied statistics.

**Host institution:** Norwegian Computing Center

**Research partners:** University of Oslo, Norwegian University of Science and Technology, Institute of Marine Research

**Corporate partners:** DnB NOR, Gjensidige, PubGene, Sencel, Spermatech, Rikshospitalet-Radiumhospitalet Medical Center, Statoil, Hydro, Smerud Medical Research

**Budget:** Approx. MNOK 320 over eight years

**Staff:** Approx. 40

**Director/contact:** Professor Arnoldo Frigessi, e-mail: arnoldo.frigessi@medisin.uio.no

**Website:** www.sfi.nr.no

*"Road traffic claims an inconceivable 1.2 million lives world-wide each year."*

# SIMULATED CRASHES SAVE LIVES

**At the CRI SIMLab, materials and structures are treated very roughly to see how much abuse they can take. The objective is to make the world a safer place.**

By Bjarne Røsjø

**SAFETY IN THE DRIVER'S SEAT:** Car-makers want the body of their vehicles to absorb as much of the force of a collision as possible, leaving the passengers unharmed. Aluminium extrusions (crash boxes) are tested at SIMLab.

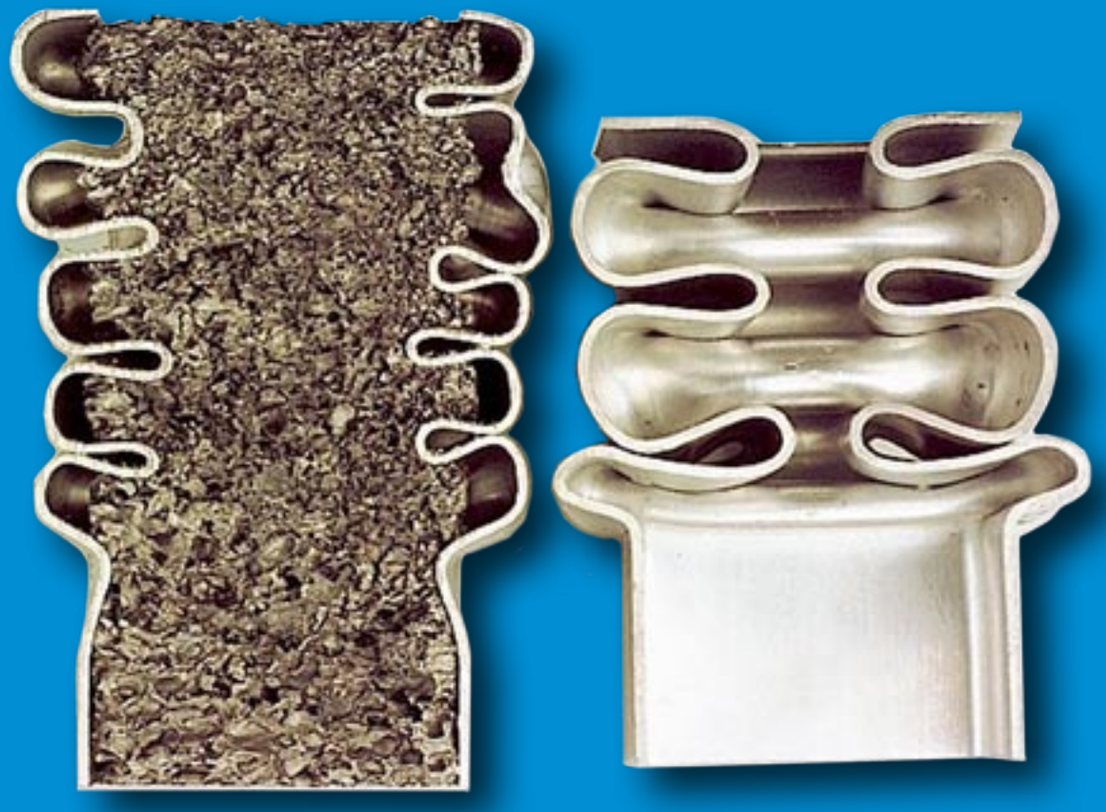
*Photo: GV-press and Mentz Indergaard/NTNU info, montage*

Professor Magnus Langseth and his colleagues at SIMLab have at their disposal a veritable torture chamber for testing materials and structural components. The laboratory's equipment includes the world's largest, and presumably only, kicking machine, not to mention a gas gun that can fire projectiles at speeds of up to 1000 metres per second. There is also a great deal of other equipment that would be suitable for 'materials hell', if there were a religion with a niche for such a thing.

Meanwhile, the researchers at SIMLab are not satisfied to merely let real structures collide. They are also working full time to simulate collisions and crashes on their computers. "SIMLab's strength lies in our ability to run simulated collisions and crashes on our computers and to compare the simulated collisions with 'the real thing' in our laboratory. This is the only way in which we can be certain that the models are validated," says Langseth.

## A myriad of irons in the fire

Figuratively speaking, SIMLab has a large number of irons in the fire, and literally speaking, it has a large number of samples of aluminium, magnesium, high-strength steel and polymers in its computers and in the laboratory. The laboratory has been working on the development of safer, more cost-effective structures since it was established in 1999. The CRI allocation from the Research Council is now making it possible to intensify these efforts and elevate them to a higher plane. "Our primary objective is to carry out basic research, but our corporate partners will help us to define research tasks that can be beneficial for large segments of the Norwegian manufacturing industry insofar as innovation and value creation are concerned. We are convinced that everyone who intends to engage in the mass production of goods in future will need to know more about this field," adds Langseth.



**DEFORMATION:** When an auto collides at moderate speeds, only the crash box is deformed.
*Photo: Gorm Kallestad, Scanpix/NTNU info*

## The story of SIMLab

SIMLab can trace its roots back to the mid-1980s, when the Institute for Steel Structures at the Norwegian University of Science and Technology launched a project together with the Norwegian petroleum industry. "We started thinking about what would happen if, for example, a drill pipe were to be dropped from a crane onto the deck structure of an offshore platform. At worst, one of those pipes could fall from a height of 40 to 50 metres and hit a well head, entailing a severe risk of deaths as well as blowouts. Accordingly, we began thinking about how we could design structures that were better suited to withstanding impacts and collisions. This led NTNU to enter into collaboration with Hydro Aluminium in the late 1980s in an effort to develop lighter and stronger bumpers for the European automotive industry," recalls Langseth.

The Norwegian Defence Estates Agency eventually joined the project. As a result, SIMLab has been involved in the development of light-weight protective panels made of aluminium. The panel consists of two plates of aluminium divided by a sandwich-like structure in which the hollow areas are filled with sand, making it extremely resistant to both projectiles and explosions.

Against this background, SIMLab was founded in 1999. The laboratory immediately joined several major research projects under the auspices of the Research Council. Two programmes, a strategic university programme from 2001 to 2007 and the NorLight programme from 2001 to 2006, focused on developing new expertise of value to the nation.

## Saving lives

The Norwegian Defence Estates Agency, Hydro Aluminium, the Norwegian Public Roads Administration, and three major European automotive manufacturers are now supporting SIMLab for the same reason: better structural components can save lives.

"Among other things, we hope that we will be able to help the Norwegian Public Roads Administration achieve its 'zero vision', i.e. that road traffic in Norway will not claim a single human life. This means, for example, that all the structures that line Norwegian roads, including signposts, light poles, central reserves, etc., must be designed so that motorists will not be killed if they crash into them", Langseth points out.

## Bizarre beauty

The kicking machine and the other 'instruments of torture' in the SIMLab laboratory are capable of deforming most materials, and sometimes the 'victims' are left with a sort of bizarre beauty.

*"The shelves of Langseth's office are decorated with deformed aluminium extrusions that could almost be mistaken for modern art."*

The shelves of Langseth's office are decorated with deformed aluminium extrusions that could almost be mistaken for modern art. In fact, a number of them were actually exhibited at the Museum of Decorative Arts and Design a few years ago.

He emphasises that the work undertaken at SIMLab is not only about safety, but also about efficient product development. Today, competitive mass production requires that the production process and the function of the component be optimised. "The only way this can be achieved is by using computer simulation to support product development," continues Langseth.

In addition, the European automotive industry requires that subcontractors deliver not only auto parts such as bumpers, but also numerical models that the car-makers can use in their own collision simulations. There is, quite simply, no way in which manufacturers who want to survive in this business can avoid performing simulations and devising numerical models.

"It would have been impossible for us to get to where we are today without the backing of the Research Council. Now we want to thank them for their support by intensifying the laboratory's research for the benefit of business and industry," concludes Langseth.

### Structural Impact Laboratory (SIMLab)

**Magnus Langseth**
*Photo: Gorm Kallestad, Scanpix/NTNU Info*

SIMLab is to provide a technological platform for the development of safe, cost-effective structures. The main focus is on the ability of light structures to withstand impacts and collisions.

**Host institution:** Norwegian University of Science and Technology (NTNU)

**Research partners:** NTNU's Department of Structural Engineering, NTNU's Department of Materials Technology and SINTEF Materials and Chemistry

**Corporate partners:** Hydro Aluminium, BMW, Renault, Audi, the Norwegian Public Roads Administration, and the Norwegian Defence Estates Agency

**Budget:** MNOK 216 over eight years

**Staff:** Approx. 20

**Director/contact:** Professor Magnus Langseth, e-mail: magnus.langseth@bygg.ntnu.no

**Website:** www.bygg.ntnu.no/ktek/simlab


*"We must actually get out onto the ice, up on the platforms and into the fishing boats."*



## The Michelsen Centre for Industrial Measurement Science and Technology

**Cato Bjelland**
*Photo: CMR*

The Centre's interdisciplinary work on measurement techniques and sensor technology will provide fundamental knowledge for applications related to petroleum activities, environmental monitoring and fisheries.

**Host institution:** Christian Michelsen Research AS
**Research partners:** University of Bergen, Bergen University College
**Corporate partners:** Roxar, FMC, AADI, CGG, Seadrill, Tendos
**Budget:** Approx. MNOK 200 over eight years
**Staff:** Approx. 20 (full time/part time)
**Director/contact:** Research Director Cato Bjelland, e-mail: cato@cmr.no
**Website:** www.cmr.no

*Photo: Samfoto*

# MEASUREMENT UNDER EXTREME CONDITIONS

**Fish, petroleum and the environment. In certain quarters, the combination of these three sectors translates into conflict, not least under extreme conditions such as those in the Barents Sea. At a new CRI in Bergen, there are plans to demonstrate that the three areas can also generate synergies as a result of opportunities ensuing from the use of modern sensor technology.**

By Siw Ellen Jakobsen

Fisheries management, petroleum production and environmental monitoring all depend on accurate measurement instruments. The Michelsen Centre for Industrial Measurement Science and Technology aspires to be in the vanguard of the development of such instruments.

"Our vision is to exploit the synergies between fisheries, petroleum and the environment. Rather than devising technological solutions that function entirely independently of each other, as is currently the case, we want to create common solutions that can help the three sectors benefit from each other," reports Cato Bjelland. He is director of the Centre, which consists of researchers from Christian Michelsen Research AS (CMR), the University of Bergen, and Bergen University College. Several corporate partners in the Bergen and Nordmøre areas are also involved.

Bergen is not an industrial hub. Most of the enterprises located in the city are related to the maritime sector, which gives them a good point of departure for innovation. However, in the current situation, enterprises often work in isolation, struggling to address the same technological challenges – challenges that they have traditionally dealt with by seeking individual solutions.

"We want to generate solutions based on a common technological platform at the same time as they are fully adapted to each individual user. To accomplish this, we must engage in research and development on the terms and conditions set by industry. We must actually get out onto the ice, up on the platforms and into the fishing boats. There we will ask the people we meet: 'How would you like things to be?'", says Bjelland.

## Accurate measurement pays

CMR is the Centre's host institution. Its researchers have already ascertained that the same technology used to measure how much oil is pumped up from a well can be used to measure the size of a catch being pumped up from a fishing net. Rapid development over the past few years in the field of sensor technology is helping create new opportunities for researchers.

For example, in the petroleum sector, it is extremely difficult to measure accurately the amount of oil in pipelines. When oil from different oil fields is collected in a pipeline shared by several oil companies, it is vital to ensure that the oil is distributed correctly among the companies for delivery to customers. An error of just one-tenth of one per cent in an installation can mean billions in losses for a company, according to Bjelland. "A large percentage of the Norway's revenues comes from taxes and duties levied on the oil companies, so accurate measurements are crucial for the public sector too. Several hundred million Norwegian kroner have been invested in developing good measurement technology to address this problem. The question we asked ourselves was: "why not apply the same methods and the same technology in the fisheries sector,?" smiles Bjelland.

Fishermen also struggle with errors in measurement. "Measuring fish catches spawns significant problems and conflicts. Fishing boat owners are sometimes heavily fined and accused of cheating if they land too large a catch. However, it is not exactly easy to estimate the weight of fish," Bjelland explains. "On traditional fishing vessels, the fish are loaded straight from the nets into large tanks. Fishermen themselves estimate the volume and weight of the catch. They are usually way off target. The average discrepancy between their estimates and the actual weights ranges from 20 to 30 per cent. Often, there is no question of deliberate deception, but if a catch is inspected and found 'heavy', reactions can be harsh."

Researchers at the new Centre have made inroads towards developing an instrument that uses electromagnetic fields and advanced sensors to determine the average weight of fish when they are pumped up from the nets. This catch scale is creating quite a stir on national and international markets.

## The Barents Sea

Potential oil activities in the Barents Sea are also giving researchers at the Centre some inspiring food for thought. This extreme environment is chock-a-block with technological challenges. Traditional surface platforms are not feasible there. Solutions must be found that will allow all oil and gas tanks and pipelines to be placed on the seabed.

"Information about conditions in the Barents Sea is sketchy at present. Oil companies planning to invest in the High North need to learn more about the movement of ice fields, for example. Using advanced instruments and control systems originally devised for other purposes, we can measure the thickness of the ice and observe how it drifts. Thus we can ensure safer operations for petroleum installations by transferring technology from one area to another and finding common solutions as often as possible," explains the director of the Centre.

## Cold, deep and difficult

Researchers at the CRI must also be prepared to face extreme conditions themselves. "Now that we are developing new technological solutions for some of the most extreme areas on earth, we are fully aware that we must recruit untraditional people, adventurers, if you will. In fact, it would be an advantage if our researchers were skydivers or active in other extreme sports. Of course, it is equally important to recruit staff members with good common sense. All our research projects are supposed to end up in the construction of something new," confirms Bjelland.

*"All our research projects are supposed to end up in the construction of something new."*

# WIRED UP FOR THE AGING BOOM

*"Estimates from the USA indicate that 100 000 people die there every year because of improper use of medicines."*

Photo: Izabela Habur

**Pressures on the public health service are mounting. The average age of the population is on the rise, and our expectations of public health services are following suit. The Norwegian Centre for Telemedicine in Tromsø has been awarded CRI status. Accordingly, it will have funding available to intensify its efforts to address the challenges that will face the health services of tomorrow.**

**By Bård Amundsen**

Ten years ago, almost no one believed in the future of telemedicine except the researcher and institute founder Steinar Pedersen of Tromsø. Today, telemedicine has become a familiar concept in Norway as well as abroad. In 2002, the Norwegian Centre for Telemedicine (NST) in Tromsø reached a major milestone when it was designated the World Health Organization's first Collaborating Centre for Telemedicine. The centre's status as a CRI marks yet another milestone.

The results of the research at what has now been renamed Tromsø Telemedicine Laboratory (TTL) will provide a basis for the establishment of new companies and products in the health and ICT sectors that will target a global market.

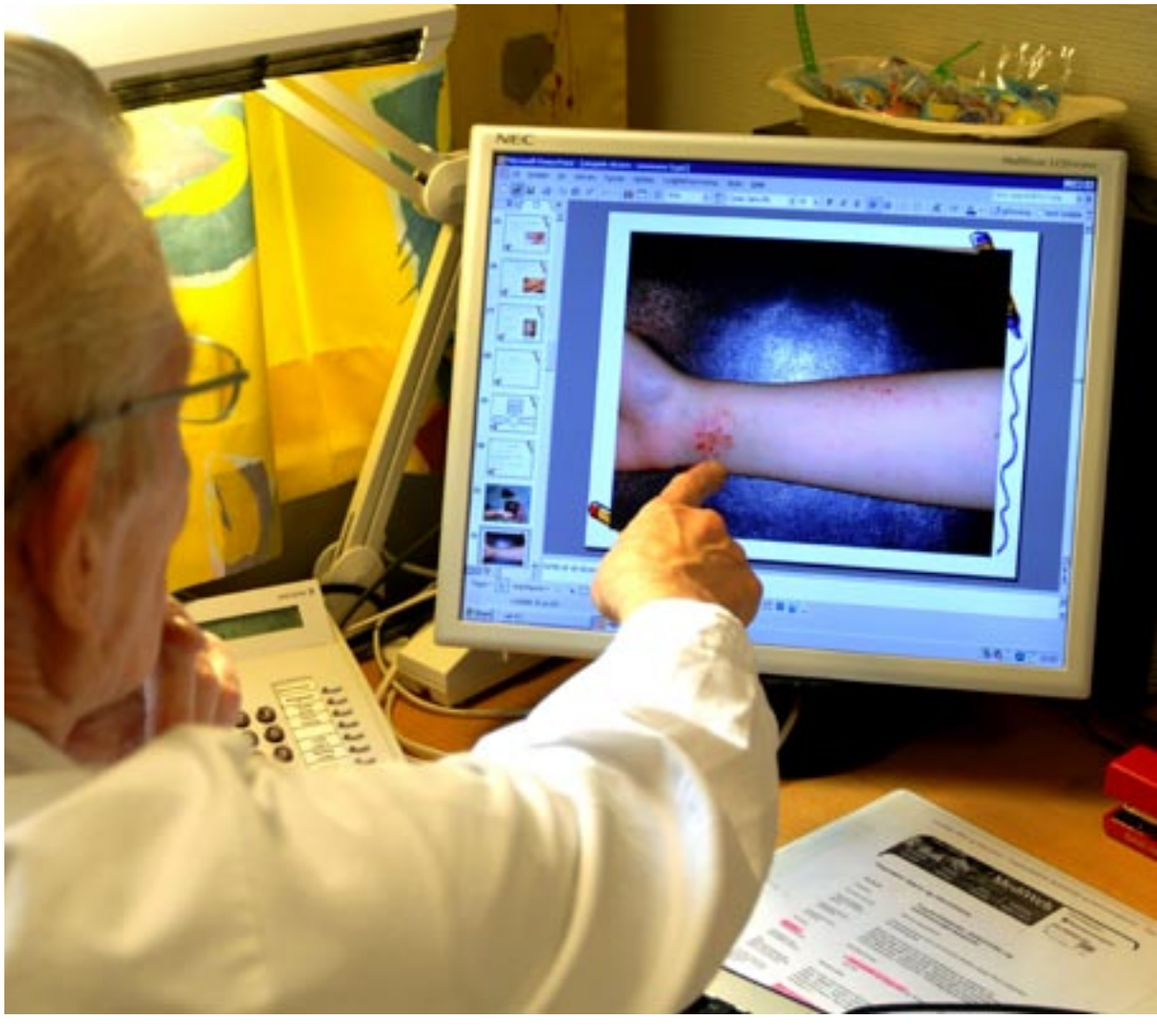
**Focusing on the patient**

Just a few years ago, telemedicine focused primarily on finding better cooperative solutions between hospitals and other institutions in the public health service. Now the focus has shifted to primary health services and patients' homes.

The challenges presented by the aging boom, or the "grey wave" as it is sometimes called, and the wishes of many seniors themselves have led the health service to rely increasingly on home-based services. Accordingly, TTL plans to develop commercially viable telemedical solutions that can make it easier for the health services in Norway and other countries to ensure that the elderly and the chronically ill receive good, reliable care at home.

Gunnar Hartvigsen is a professor of Medical Informatics at the University of Tromsø, and now also research manager at TTL. "NST's trademark thus far has been to develop products and e-health services that the health sector can make use of straight-away. We will continue to focus on this area. At the same time, now that we are receiving long-term funding from the Research Council and have been granted status as a Centre for Research-based Innovation, we envisage entirely new opportunities for making the results of our research available commercially. Now we can plan up to eight years ahead. This can help us become better at documenting the results of our activities. We will also work harder to build competence among the users of telemedicine."

*"It is entirely possible to devise advanced solutions based on relatively simple, inexpensive technology."*



**E-HEALTH:** Telemedicine allows funding earmarked for health to be spent more efficiently, and enables hospitals to increase their capacity for providing help to those who need it most. Here, we see a physician treating a patient suffering from eczema.

*Photo: S. Bertinussen/Scanpix*

### Northern Norway is unique

The Tromsø Telemedicine Laboratory is already a world leader in its field. In the view of the researchers in Tromsø, this may be due in part to the centre's geographical location.

"In terms of health, northern Norway is a unique place. There are close links between the different segments of the health sector here. This enables us to carry out trials that would probably not be possible anywhere else in the world. This, in turn, makes it easier for us to develop new products and services. We collaborate very closely with the public health service in northern Norway."

The Tromsø Telemedicine Laboratory emphasises the importance of learning from its users, especially the patients. Every year, potential users of telemedical services are invited to a major telemedicine and e-health conference in Tromsø to discuss their experiences.

A number of groups are collaborating at the Centre today, including technologists, health personnel, social scientists and lawyers. Its new status as a CRI will enable the Tromsø Telemedicine Laboratory to expand its research activities significantly. About 10 students are currently working on their PhDs there. The additional funding will enable the Centre to increase this number to at least 18 PhD students and seven post-doctoral students.

### Improper use of medicines

Several of the projects on which the Tromsø Telemedicine Laboratory is working are related to one of the most serious problems confronting the health sector, i.e. the improper use of medicines (non-compliance). Estimates in the USA indicate that 100 000 people die in that country every year as a result of the improper use of medicines. In Norway, studies show that 10 per cent of all hospital stays are due to the improper use or side effects of medicines.

"Take a group such as thrombosis patients, for example, where the improper use of medicines can be fatal. Studies that have been carried out in this area indicate that the mortality rate has been reduced by 30 per cent in a trial group as compared with a control group," Hartvigsen points out.

The Centre recently conducted its first experiments on a remotely controlled pill box, that is, a pill box that communicates with the patient as well as with the public health service.

"Technological developments are moving quickly in a number of areas that are crucial for us. One example is the area of sensor technology, where a lot is going on right now. However, this does not mean that the technology itself always has to be so terribly advanced. It is entirely possible to devise sophisticated solutions based on relatively simple, inexpensive technology."

### Ambitious visions

"One project we are working on is placing sensors on the doors of refrigerators and WCs in the homes of mildly senile patients who live at home. This will enable home nursing services to keep track of whether a patient living at home is eating enough and going to the toilet, factors which are otherwise often difficult to determine."

Staff members at the centre have begun working on several projects that may help determine whether a patient needs to be hospitalised.

"It is a tremendous advantage for the health services to be able to determine as early as possible whether a patient will require hospitalisation. This leads to more efficient use of financial resources, at the same time as hospitals are in a better position to help the people who need it most."

"Our ambitious visions have evolved at a pace commensurate with the Centre. Now we are also striving to create a comprehensive tool that will enable a country's public health authorities to maintain almost an hour-by-hour overview of public health. Called 'symptom-based health monitoring' by the TTL researchers, this concept is based on collecting data from a large number of sources at the same time. Most of this data has already been collected, but it currently takes a long time for it to be collated and acted upon by the health authorities. Stepping up the pace could help us detect an imminent influenza epidemic far earlier, for example."

### Tromsø Telemedicine Laboratory (TTL)

**Gunnar Hartvigsen**
*Photo: Bård Amundsen*

The primary goal of the centre is to establish an interdisciplinary research community in the fields of telemedicine and e-health. The centre will provide a basis for the development of new systems and products for treating chronic illnesses and diseases related to ageing and lifestyles.

**Host institution:** Norwegian Centre for Telemedicine at the University Hospital of North Norway

**Research partners:** University of Tromsø , NORUT IT

**Corporate partners:** Telenor, IBM, DIPS, Well Diagnostics, NHN, Northern Norway Regional Health Authority ICT

**Budget:** Approx. MNOK 180 over eight years

**Staff:** Approx. 25

**Director/contact person:** Professor Gunnar Hartvigsen, e-mail: gunnar@cs.uit.no

**Website:** www.telemed.no/ttl

# WHAT'S LOVE GOT

The number of foreign researchers in Norway has more than doubled in the past 10 years. What is it that entices researchers from around the world to work and live in this cold, distant country in the north? Is it our dynamic research landscape? The spectacular nature with its fjords and mountains? Its liberal family policy? Or is it simply love?

By Anita Thorolvsen Munch

A few years ago, the Norwegian Research Institute for Studies in Innovation, Research, and Education (NIFU STEP) conducted a survey among foreign researchers who were working in the Norwegian system. It turned out that love, along with career opportunities and work conditions, is one of the most important reasons why foreign researchers move to Norway. We decided to do a small study of our own, and asked a random sample of foreign researchers in Norway the following questions:

**1. What brought you to Norway?**

**2. What is it like to work as a researcher in Norway compared with having the same position in your home country?**

**STEFAN LEUTGEB** (Austria) and **JILL LEUTGEB** (USA), Centre for the Biology of Memory, NTNU, Trondheim

**1. What brought you to Norway?** "We came here to work", responded Stefan and Jill Leutgeb in unison. They never intended to stay, but now they've been here for five years. The researcher couple met in the USA when he was taking his PhD. Then they moved on to Germany, where he did post-doc work and she completed her PhD, before they finally landed at the Norwegian University of Science and Technology (NTNU) in Trondheim. "The Centre for the Biology of Memory has a sterling reputation in the field of neuroscience. That was why we applied to come here", recounts Stefan.

**2. What is it like to work as a researcher in Norway compared with having the same position in your home country?** "Every country has its pros and cons, for better or for worse. People work hard here, but they also focus strongly on having a life outside of their jobs. They are not overly competitive and that is liberating. Norwegians are family-oriented and the government has a good family policy. Women are not forced to make the gut-wrenching choice between children or career. If I were to have negative comments, it would be that Norwegians can be hard to get to know and that they tend to shy away from conflicts. That is very different from what I am used to from the USA", remarks Jill.

"I thought language was going to be a problem", adds Stefan, "but I was wrong. Everyone speaks great English which vastly facilitates communication. Although Norway is doing a great deal of work in our field and the funding is good, compared to Austria, they need to do more to retain the really talented researchers. There should be a better transition scheme for moving from a post doc programme into a tenured position."

**BEATA GRALLERT** (Hungary), Department of Cell Biology, Institute for Cancer Research at the Norwegian Radium Hospital, Oslo

**1. What brought you to Norway?** "Originally from Hungary, I had been working in England for four years when Professor Erik Boye at the Norwegian Radium Hospital invited me to work in Norway. I had long experience working with the model organism he wanted to introduce at his lab, and the group now works with this organism exclusively."

**2. What is it like to work as a researcher in Norway compared with having the same position in your home country?** "In Hungary, science careers are very difficult due to poor funding. England is a great place to work in basic science, though, especially in my field. I've felt a bit isolated here in Norway at times, but thanks to a wide range of contacts and good collaboration, this isn't a serious problem. Funding is adequate and we have a wonderful group of interested, hard-working students. When it comes to combining work with family life, I think we are happier in Norway than we would have been in England. I'm married to an Englishman and we have two children, ages three and five and a half. Comparing pros and cons of living in the three countries, we always conclude that Norway is the best for us as a family of four that loves nature and outdoor activities, and wants to combine family life with the careers of two parents who are devoted to their work."

# TO DO WITH IT?

**CURT RICE (USA)**, Centre for Advanced Study in Theoretical Linguistics (CASTL), University of Tromsø.

**1. What brought you to Norway?** "When taxi drivers discover that I'm a foreigner who has been in Norway for a long time, they often ask me 'What's her name?' " That's actually not such a dumb question! It was with generous support from the Department of Linguistics at the University of Trondheim (now NTNU) and the American Scandinavian Foundation that I was able to move to Trondheim in 1991 – together with my Norwegian wife - before moving on to Tromsø in 1993."

**2. What is it like to work as a researcher in Norway compared with having the same position in your home country?** "Working life in general in the United States is more demanding and more competitive than in Norway, and life in the academy is no exception. To earn tenure in the US, assistant professors often have to sacrifice much of their non-job lives. I view it as positive that balance in one's daily life is both accepted and encouraged in Norway.

"Of course, I'm not the first person to suggest that it would benefit Norwegians if they were to accept excellence in thinking as easily as they accept excellence in skiing. One thing I am focused on right now is the widespread resistance in the humanities and social sciences to putting 'education' into PhD education. I would like to see the emergence of proper graduate schools in which PhD students are substantially shaped by a local research community. And I'm full of ideas about how to accomplish this!"

**CAMILLE LI (Canada)**, Bjerknes Center for Climate Research, Bergen.

**1. What brought you to Norway?** "I visited Bergen twice during my PhD studies and met a lot of interesting researchers who were doing very exciting work at the Bjerknes Centre. It was the combination of these people, the goals of the Bjerknes Centre, the city of Bergen itself, and a desire to see how academia functions outside of North America that attracted me to Norway."

**2. What is it like to work as a researcher in Norway compared with having the same position in your home country?** "The research landscape here seems to me as energetic and exciting as in North America. I would say that it is more structured and actively coordinated, that is, it is treated more as a job than a way of life, the way it is in the US especially. I believe the University of Washington (Seattle) and the Bjerknes Centre both strive to foster a research environment that encourages open dialogue, interdisciplinary cooperation and creativity. Here, however, I see a more conscious effort to achieve these goals through surveys, leader forum workshops and mandated status reports. Newcomers feel included and part of the team more quickly. I think the system in Norway is less hierarchical than in the US in general. One of the biggest advantages is for women who want to have families, and for men who wish to be active caregivers in their families. Of course there are the practical issues, e.g. paternity and maternity leave, government support, social services, etc. But beyond that is the acceptance that people in senior research positions are also entitled to have a family life. In the US, you are considered fortunate if you work at a university that will add a year to your 'tenure clock' when you have a child, but there is still an unspoken belief that having a family can be a very real obstacle to having a successful academic career, especially for women."

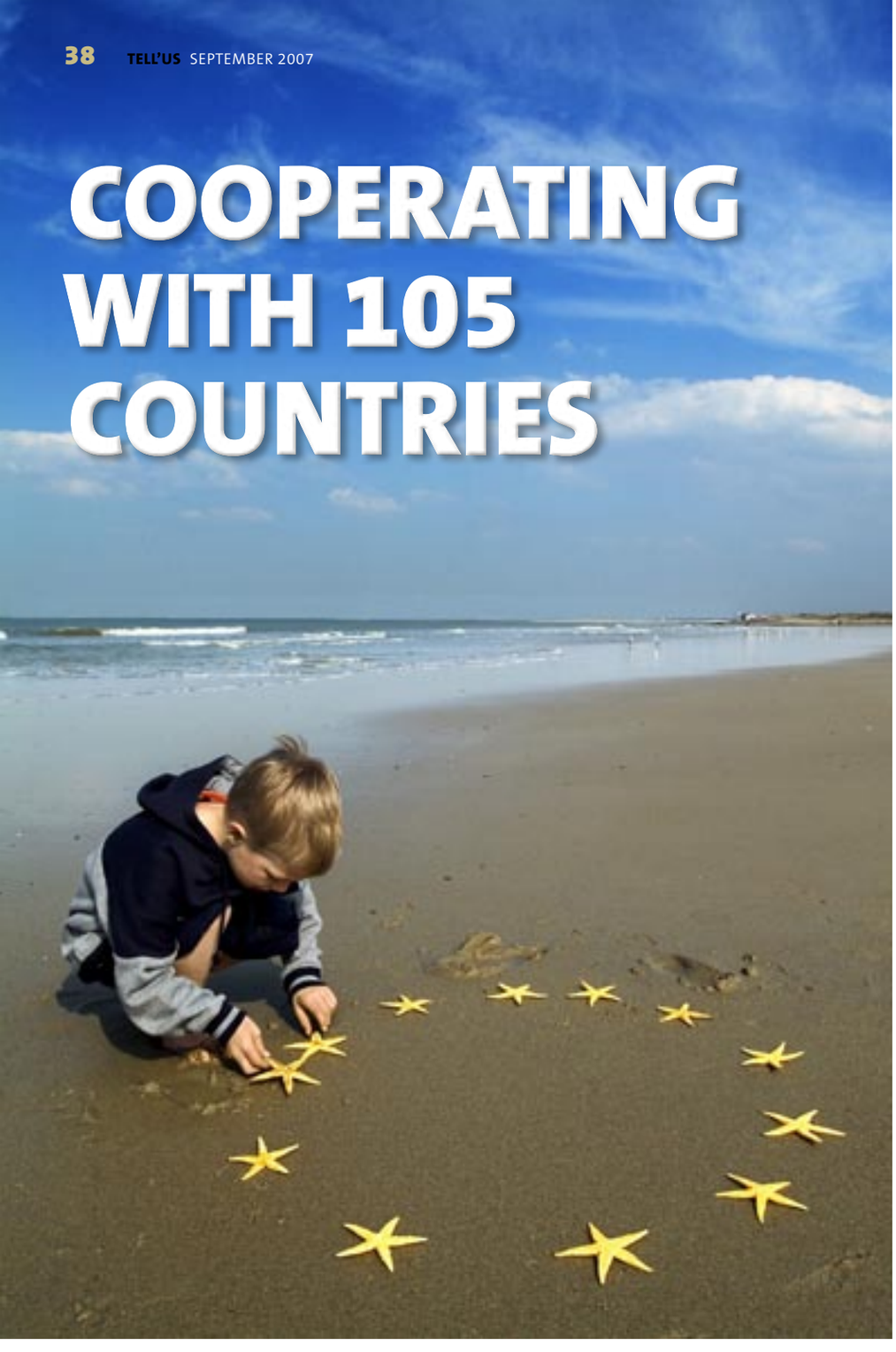
**YAN ZHANG (Kina)**, Simula Research Laboratory, Oslo.

**1. What brought you to Norway?** "My primary motivation was the offer of a good job. One ordinary day at work in Singapore, I received a broadcasted email about an open position at Simula Research Laboratory. The job requirement was a good match with my background, and the research project sounded very interesting. This caused me to delve into more sources of information about Simula and Norway. My own research focus is on wireless networks and communications, and it is well-known that wireless technology originates from the Nordic countries. Hence, This was a good opportunity to learn more about wireless technology as well as Europe."

**2. What is it like to work as a researcher in Norway compared with having the same position in your home country?** "Research funding is sufficient here. This is extremely important for researchers who carry out basic research and actively participate in professional activities. I receive support when it comes to finding research assistants, attending conferences, exchanging ideas and building up a broad-based network of contacts. My project members and I also enjoy great freedom when it comes to selecting specific research topics within the framework of our project. The bulk of my contacts are in Asia, and it is a fact that there is too little interaction between researchers in Norway and Asia. I expect to make more contacts with researchers in Europe. While this may take some time and effort, it is a great opportunity to build up links between my lab and universities in Asia, such as Singapore, China and Hong Kong.

"There are indeed some challenges. The Norwegian language for one. Fortunately, English is popular. The long, dark winters represent another challenge. I have now officially survived in my first winter in Norway. Perhaps this winter I will turn my attention to winter sports instead of simply staying inside."

# COOPERATING WITH 105 COUNTRIES



Figures from the EU's sixth framework programme for research and technology (FP6) indicate that Norway was one of the leading nations in the programme. Norway cooperated with no fewer than 105 countries on this, the world's largest arena for international research cooperation.

By Susanne Moen Stephansen

The four-year framework programme so ceremoniously kicked off in Brussels in 2002 has now been reviewed, and Norway came out of it exceptionally well. With a budget of 18 billion Euros from the EU, the projects were required to comprise partners from several countries working together on common European issues. Thirty-five countries (EU states and associate states) participated in the framework programme which also included other countries, i.e. so-called Third Party States. The post-programme statistics show that Norway cooperated with 105 different countries.

"This represents a significant contribution towards the internationalisation of Norwegian research", observes Simen Ensby, head of the EU office at the Research Council of Norway.

### Highest success rate of all

Measured by the ratio of applications granted to application submitted, Norway was at the top of the class for FP6, with a success rate of 24.45 per cent. This suggests that every fourth application with Norwegian participation was granted. Norway was followed by Belgium, The Netherlands and France with success rates of 22 to 23 per cent. Sweden and Denmark came in 6th and 7th, while Great Britain placed 14th, with a success rate of 18.14 per cent.

"With such a high success rate, we can safely say that Norwegian research communities and enterprises maintain high research standards, not least with a view to the framing of applications", continues Ensby. "It is also clear that we are attractive on the European research and development market and that we can both cooperate and compete with the best research communities in Europe."

### Best at environmental, food and marine research

FP6 is divided into seven thematic priority areas and Norway has taken part in research projects in all of them. Norway has participated in no less than 15 per cent of the projects in the thematic priority areas, and in 10 per cent of the projects in the entire framework programme as a whole. Our strengths are in the thematic priorities related to the environment, the social sciences, and food quality and safety. Norway is a major player in all the thematic areas that involve marine and maritime projects.

"Our success rate here is overwhelming", comments Ensby, adding that Norway has also done very well in renewable energy, aviation and aerospace research. "The areas of FP6 in which Norway has seen success coincide with the target areas defined in the White Paper on Research submitted to the Norwegian Storting in 2005 'The Will and the Way: Research in Norway'," Ensby points out. "Norway's success in FP6 is key to achieving our national research and development targets. Meanwhile, this success also makes this country attractive to foreign researchers. By cooperating with Norway, they gain access to vast networks of researchers the world over. This is the best testimony to the quality of Norwegian research", concludes Ensby.

## FP7 underway

FP6 was superseded by FP7 in early 2007. The framework programme is going all out to make the EU the most dynamic competitive knowledge-based economy in the world by 2010. There has been a substantial increase in its overall budget, which will total EUR 50.5 billion. Norway will pay dues of NOK 8.9 billion, and the new programme is scheduled to run for seven years, compared with four years for the earlier framework programmes.
**www.cordis.europa.eu/fp7**
**www.forskningsadet.no** (select English, Centres for Resarch-based Innovation (CRIs)).

# GLIMPSES OF NORWAY

**LOCATED IN LONGYEARBYEN** at 78° N, the University Centre in Svalbard (UNIS) is the world's northernmost institution of higher education.

*Photo: Nils Petter Dale*

**AFTER SHAKESPEARE,** Henrik Ibsen is the most frequently performed dramatist in the world, even now one hundred years after his death. This statue of Ibsen is located in front of the National Theatre in Oslo.

*Photo: © Bård Løken/ NN/Samfoto*

**AS A RESEARCHER** in Norway, you will find great working conditions and first-rate research communities.

*Photo: Haagen Waade*

**NORWAY IS RENOWNED** for its spectacular nature and panoramic scenery. This picture is from Børsheimholmen on the west coast of Norway.

*Photo: Per Eide, edelpix*

**BEING A FAMILY-FRIENDLY SOCIETY** is one of Norway's greatest attractions, along with its high standard of living .

*Photo: Anita T. Munch*

**ARVID HALLÉN**

*Photo: Bård Gudim*

# An all-embracing research council

**In 1993, Norway's five research councils** were merged into one overarching research council. Since then, Norway has had one single all-embracing research council that bears responsibility for all subject areas and disciplines, and for basic as well as applied research.

The Research Council of Norway (RCN) is a strategic agency which identifies target areas, allocates research funding (some NOK 5.4 billion annually) and evaluates the research performed. The RCN is the government's main advisor on research policy questions and serves as meeting place and network builder for Norwegian research.

**Important tasks for the RCN** include promoting the internationalisation of Norwegian research and paving the way for international cooperation. Accordingly, one of the Research Council's fundamental principles is that all projects should have an international component to qualify for funding. Such a component can consist of anything from publishing cooperation, to contractual agreements which refer to research and technology contributions, to targeted large-scale research projects. Meanwhile, mobility is the cornerstone of international relations. We want Norwegian scientists to participate in foreign R&D groups, and we welcome foreign researchers to Norway. We also hope that foreign players will find it interesting to invest in Norwegian research.

**The Research Council facilitates** international cooperation through the financial instruments available to it. These include incentives for researchers and research institutions, as well as coverage of additional expenses associated with conducting research in large networks and consortia. Special grant schemes are in place to encourage foreign researchers to work in Norway for shorter or longer periods of time. Foreign researchers are welcome to participate in projects funded by the Research Council. The only requirement is that projects must include a Norwegian contract partner.

The Research Council's competent staff helps promote contact and cooperation between Norwegian and foreign researchers, allowing the RCN to initiate and coordinate network- and alliance-building. The NCP (national contact point) scheme under the auspices of the EU's framework programme is instrumental in this respect, and all Norway's NCPs are employed by the Research Council.

**Through cooperation** with research institutions and the central government authorities, we aspire to pave the way for talented foreign researchers to expand their cooperation with Norwegian researchers, and possibly also to work and enjoy life in Norway. The world of Norwegian research welcomes you to establish broader contact and cooperation with Norwegian researchers!

Arvid Hallén
General Director of the Research Council of Norway

# TELL'US

## Some links

Welcome to Norway – the official site:
**www.norway.info**

Ministry of Education and Research:
**www.regjeringen.no/en/dep/kd.html?id=586**

The Research Council of Norway:
**www.rcn.no** (choose English)

The official site of the Norwegian Tourist Board:
**www.visitnorway.com**

Researcher's Mobility Portal – Norway:
**www.eracareers.no**

The Research Council of Norway