

Annual Report 2004

The Strategic Area Marine and Maritime Technology

What are the Strategic Areas at NTNU?

One of the main goals of NTNU is to be useful to society, by developing and maintaining the national technological skills needed to build a sustainable society. To realize this goal NTNU has given priority to six strategic areas where we aim to be among the internationally leading universities.

These are:

- Energy and Petroleum – Resources and Environment
- Globalization
- Information and Communications Technology (ICT)
- Marine and Maritime Technology
- Materials
- Medical Technology

Visit us at www.ntnu.no/satsingsomraader/

The Norwegian University of Science and
Technology

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About Marine and Maritime Technology at NTNU

Norway's extensive coastline and its rich oil and fish resources make for favourable conditions for what are the country's most important industries today. These industries jointly account for 60 percent of Norway's total exports.

Over the years, NTNU has established considerable programme activity connected to shipping, fishing, aquaculture and oil extraction.

NTNU has national responsibility for developing the relationships among technology, culture, society and nature. The potential for creating sustainable industries and economic value from the sea's living resources offers the possibility of providing more income for Norway than what is currently produced by offshore oil production. But the main issue in the development of a system for exploiting Norway's living marine resources is to do so in a sustainable way that recognizes economic, ecological and social limits. This will be a core subject at NTNU for further strategic research, and NTNU researchers will generate, manage and disseminate knowledge that is required to create sustainability and competitiveness in the marine industries.

A total of approximately 260 researchers are working in the marine and maritime fields at NTNU, with around 25 PhD students graduating annually. Marine/maritime research groups in Trondheim spend a total of around 600 man-labour years annually on their research. NTNU has several comprehensive laboratories for both marine technology and biology. The Marine and Maritime Technology strategic area is responsible for spearheading NTNU's activities in establishing national and international multidisciplinary cooperative efforts and networks.

Visit us at www.ntnu.no/marin/



*Professor Anders Endal
is the director of the strategic area
Marine and Maritime Technology*

(Photo: NTNU Info/Tor H. Monsen)

MAIN STRATEGIES IN 2004 AND BEYOND

One of the ongoing efforts in Marine and Maritime Technology is to develop a strategy for the further development and expansion of an interdisciplinary network in Trondheim, with the goal of establishing NTNU as an important participant in generating, managing and disseminating knowledge for sustainable coastal zone development. The process involves building alliances with central stakeholders and companies in coastal Norway to establish a basis for future projects.

NTNU has established cooperative efforts with small and medium sized enterprises and students for summer jobs, projects and Master theses. Our experience is that this approach is often interdisciplinary and demands input from students with different areas of specialisation.

In 2004, Marine and Maritime Technology conducted a "foresight study" in fishing and aquaculture. Nearly forty essays by national and international experts in the field constituted the basis for the study, along with seminars and other activities. The main drivers for future development appear to be:

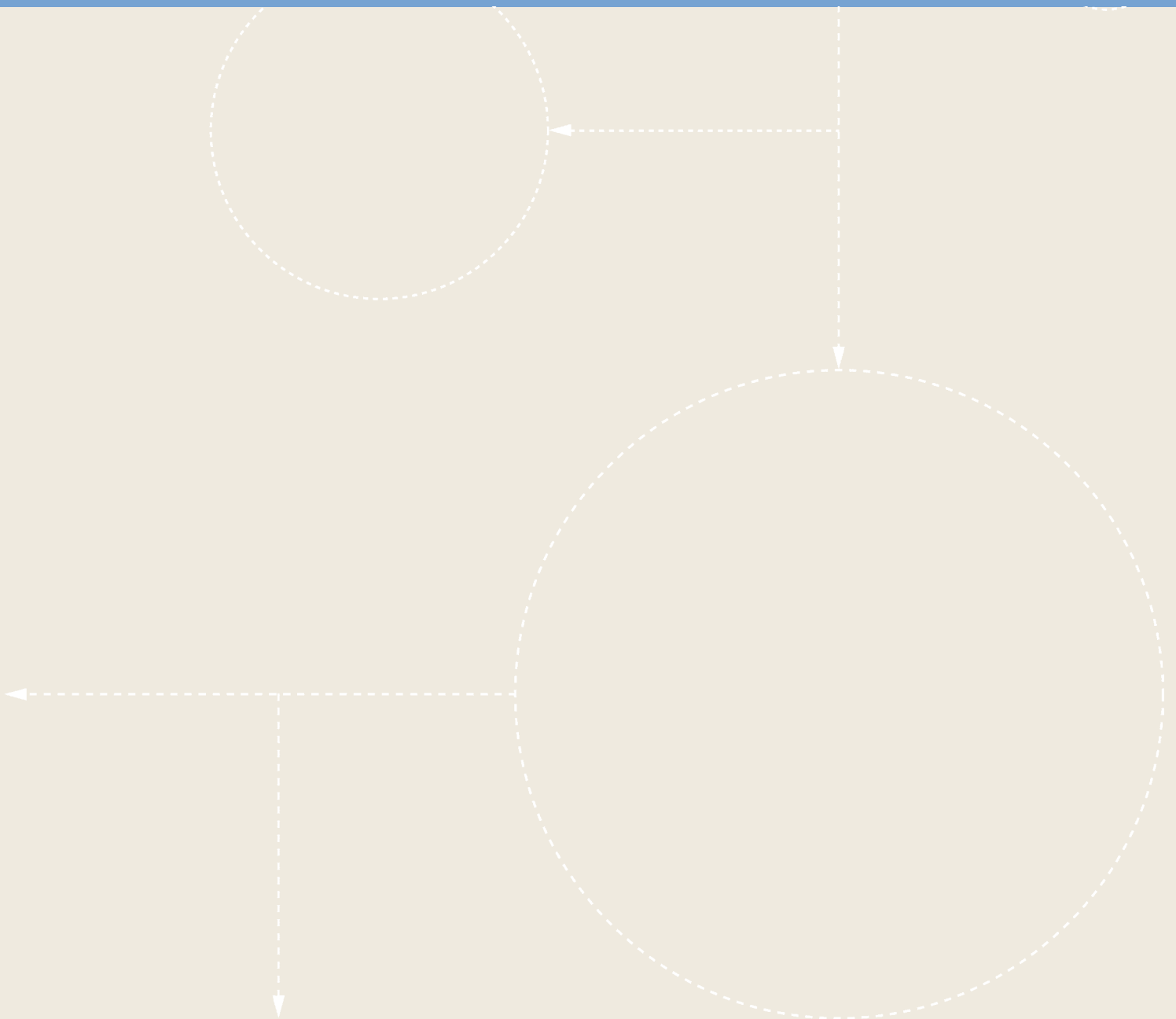
1. Availability of water, food and energy resources for the world community
2. Attitudes tied to ethics, the environment and health

3. Our ability to develop knowledge and innovations

For NTNU, the main challenges for future development in the marine sector will be to:

1. Apply systems thinking and holistic approaches to problems.
2. Integrate knowledge from individual disciplines.
3. Develop strong disciplines, robust research groups and international top competence within selected areas.

In response to these challenges, the strategic area is planning a new master's program. The program will give students more relevant knowledge for coastal zone development. The results from the foresight study will help ensure that the program is future-oriented.

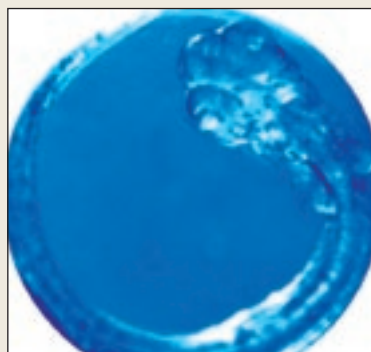


Activities in 2004

Marine and Maritime Technology projects cover a wide spectrum of disciplines such as marine and maritime technology, coupled with biology, biochemistry and the social sciences. The common denominator for these projects is that they identify problems that require interdisciplinary solutions.

CodTECH

CodTECH was initiated in 2003. In cooperation with biological, chemical and engineering disciplines at NTNU and SINTEF, the project aims to develop systems for process control and automatization of the production of cod fry. The methods will form the foundation for the establishment of



Cod egg. (NTNU Info)

a second-generation fry technology for marine species, and the system will in principle be applicable to the majority of marine species.

Calanus

Calanus is a multi-disciplinary project with the objective of developing technologies and methodolo-

gies required to exploit zooplankton (*Calanus* spp.) as a bio-resource for fish feed and industrial raw material. The programme explores the possibilities, limitations and consequences of harvesting zooplankton as fish feed. The programme's third year included work on a low-energy harvesting system. Research on salt water removal processes have shown positive results. The distribution of zooplankton in the sea and the environmental consequences of harvesting will be investigated using a three-dimensional eco-system model. The adaptation of the existing oceanic model for inshore waters is being completed. Studies of the usability of zooplankton as a raw material for fish feed and for the biopolymer industry have made considerable progress. The main basic research projects regarding processing are linked to strategic projects for handling and processing of *Calanus* spp. and atmospheric freeze-drying. The main achievements have been the development of processing technologies using heating, belt pressing for separating solids and liquids masses and the use of tricanter for oil, water and solids separation.



Photo: NTNU Info, Tor H. Monsen

All Electric Ship

All Electric Ship is an interdisciplinary KMB (Knowledge-building projects with user involvement) project where the aim is to find energy-efficient solutions for the generation and use of electric energy. The work involves several sub fields such as diesel and gas (hydrogen and LNG) technology, and power management and power electronics. Additionally, the project is working on the design of new electric motors and actuators.

IntelliSTRUCT

IntelliSTRUCT is a new Strategic Institute Programme (SIP). The objective of the program is to develop intelligent ocean structures for fisheries and aquaculture applications. The emphasis is on modelling and automatic control of highly flexible ocean structures, such as fish cages

or trawls, where the main structural element is flexible netting.

The work combines the disciplines of hydrodynamics, structural mechanics, cybernetics and fish ethology to design structures that adapt to sea loads and optimise fish well-being.

SITAR

SITAR (Seafloor Imaging and Toxicity:

Assessment of Risks) looks at the risks caused by buried waste and is a RTD project under the 5th EU Framework Programme. SITAR's goal is to investigate and develop innovative solutions for the assessment of the environmental risks of toxic dumpsites on the seafloor. A significant part of these toxic wastes is buried in the sediments.

SEISMOAKUSTIKK

SEISMOAKUSTIKK is a project funded by Statoil for the years 2002-2006. The project finances an adjunct professorship in seismo-acoustics.

SUSHIMAP

SUSHIMAP is a project that focuses on marine habitats as the support system for all organisms that constitute Norway's marine biodiversity.

city and support its fisheries. These habitats are subject to a number of activities that can influence their quality and quantity. SUSHIMAP proposes to combine the most advanced multibeam acoustic technology for rapid large-scale mapping of the seabed with medium-scale visual surveys and discrete sampling of sediment types and benthic fauna. The project will also develop the use of backscatter data from multibeam echosounding to interpret sediment type. These data will be integrated with related information on human activities in a central database to produce high-quality seabed habitat maps using the latest Geographical Information System (GIS) technology.

Particle Imaging Veloximetry

Marine and Maritime Technology has

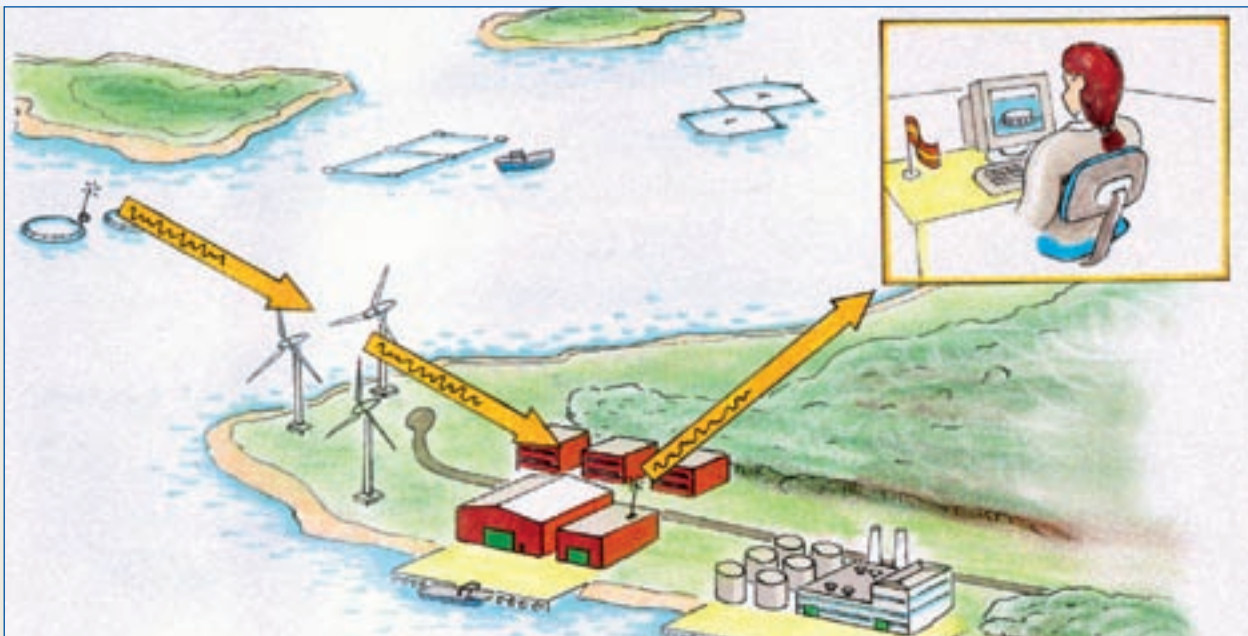
recently invested in equipment for Particle Imaging Veloximetry (PIV). The equipment consists of high-speed and high-resolution digital cameras and software for processing images in order to compute complex flow velocity fields. PIV is expected to be useful for Vortex-Induced Vibration (VIV) research and in particular to compare experiments with the results from computational fluid dynamics (CFD). The new tool will be used by a PhD student to study the flow behind an oscillating pipeline, in particular to understand the interaction between cross-flow and in-line vibrations.

Marine CFD

This work will be linked to a Research Council of Norway-sponsored Strategic University Programme Marine CFD, and involves research

Valsneset – the location of a European Aquaculture Centre of Technology

(Illustration: NTNU/SINTEF)



groups in marine hydrodynamics, fluid mechanics, and computational mathematics at NTNU. Important research issues are the simulation and understanding of turbulent phenomena, accurate and efficient computational methods for viscous flow, and simulation of physical phenomena of interest and relevance to marine applications, such as viscous flow around marine structures and ships. The programme is being administered by the Department of Marine Technology at NTNU.

The Centre for Ships and Ocean Structures

The Centre for Ships and Ocean Structures (CeSOS) is a national Centre of Excellence made possible by the Research Council of Norway. CeSOS is geographically and organizationally a part of the Marine and Maritime Technology strategic area. The CeSOS centre develops fundamental knowledge for the design and operation of the ships and ocean structures of the future. The focus of the centre is on obtaining insight into how structures behave when they are exposed to chaotic waves, currents and winds. Systematic experimental studies are being used to describe the behaviour of different ocean variables and their interaction with marine structures and ships; the centre also develops mathematical and probabilistic models to make predictions about how different structures will behave. Now in its second year of operation, CeSOS has reached its planned activity level and has accomplished significant results. CeSOS is a cooperative effort among research groups from hydrodynamics, structural mechanics and automatic control, which allows the development of new knowledge within each discipline

along with building on the synergies between them. The use of common laboratories also sets the stage for cooperative efforts. This interplay is well documented by the groups' joint publications.

Research continues to be dominated by the issues related to structures for use in ocean transport and deepwater exploitation of oil. Among the topics being studied are higher speed vessels, larger vessels for new uses in ocean transport, and structures for deepwater risers, pipelines and positioning systems. In 2004, research into aquaculture structures has gained momentum as a result of joint efforts between SINTEF Fishery & Aquaculture and NTNU, especially in conjunction with the Strategic Institute Programme IntelliSTRUCT. Close links have been established with several other research groups at NTNU through Strategic University Programmes. The Centre has also proved to be an attractive international partner, as demonstrated by cooperative efforts with CSSRC, INSEAN and MIT. The Centre has been invited to join several international projects and many foreign professors have visited the centre. CeSOS has also attracted significant interest from post-docs and PhD candidates who are interested in conducting research at the Centre. Roughly 60 per cent of the long-term researchers at the Centre in 2004 were from abroad. The Centre's international reputation is demonstrated by the many invitations to its researchers to present keynote presentations at conferences, to contribute survey papers and to organize conferences.

New research vessel

Plans to acquire a new research

vessel for NTNU were initiated in 2003. The vessel will be delivered in February 2006 and is designed for multiple research assignments related to marine technology, marine geology, marine biology, fisheries, fish farming and oceanographic research. Despite its moderate dimensions (31 meters long), the vessel will be equipped with a variety of different equipment and technology, such as fishing equipment, an A-gantry on the stern, a large deck crane and advanced instrumentation for dynamic positioning and ROV operations. The ship will be able to accommodate a crew of 3 and a research team of 6. The vessel will be powered by a diesel electric plant with 3 x 450 kW generator sets, 2 x 500 kW electric propulsion motors, each driving a FP propeller in a nozzle and a bow thruster of 200 kW. The vessel's design reflects the importance of limiting hydroacoustic noise levels. The new vessel has also been designed for educational trips with up to 20 students, in addition to its primary function as a research ship.

(The infrastructure and laboratory facilities in this research area are complex. Descriptions of the main laboratories can be found at <http://www.ntnu.no/marin/>)

SINTEF Sealab

NTNU has a close working relationship with the independent research institution SINTEF. In 2003, the SINTEF Group reorganised by integrating its marine/maritime activities and research units into a business entity called SINTEF Marine. At the same time, a process began to relocate all SINTEF's seawater-related activities at a common site. This effort will result in the establishment



*New research vessel at NTNU,
to be delivered in 2006.*

(Illustration: Polarkonsult as, Harstad)

of SINTEF Sealab - a large facility located at the harbour in the centre of Trondheim. This facility, which will be finished in the first half of 2005, includes offices and nearly 3500 square metres of laboratory space. Plans call for three laboratories: one for processing technology, one for marine environmental technology and one for marine fry technology. A total of approximately 150 people will

be employed. The new lab will also strengthen joint projects between

SINTEF Sealab (Illustration: SINTEF).



NTNU and SINTEF.

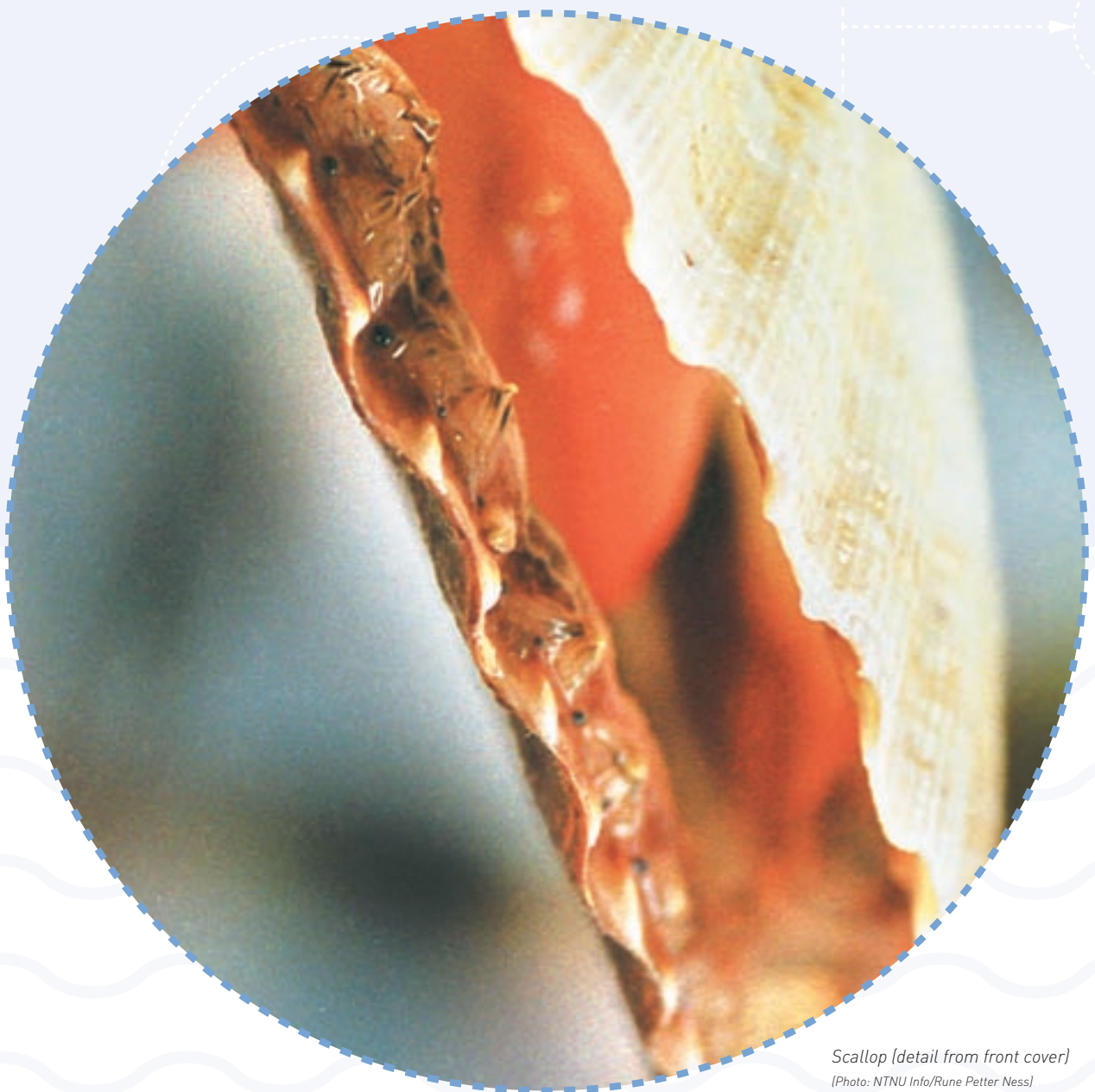
European Aquaculture Centre of Technology

NTNU and SINTEF have initiated the establishment of a European Aquaculture Centre of Technology (ACT) at Valsneset in Sør-Trøndelag. The aim of the centre is to facilitate research dealing with new species, offshore farming areas, newly

developed technology and production techniques that may lead to the exploration of new marine culture applications. Its establishment will also help stimulate and integrate existing basic and applied research in the

field of aquaculture technology. The NTNU proposal DesignACT, a study aiming to design a new large-scale experimental facility in Valsneset, has been approved by the European Commission (total budget 475,000€).

Over the next three years, the features of the new infrastructure will be defined and matched to the needs of potential European users.



Scallop (detail from front cover)
(Photo: NTNU Info/Rune Petter Ness)

What is the added value of the Strategic Area arrangement?

- **Better interplay among disciplines.** Strategic Areas allow for better communication and enable each individual area to keep informed of activities within other disciplines. Walls between disciplines are broken down and new cross-disciplinary arenas emerge.
- **Cross-disciplinary research is better suited to industry needs.** A Strategic Area opens up opportunities for the commercialization of research results.
- **Strategic Areas increase the opportunities for external funding for research projects.**

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- Karl Almaas: CEO, SINTEF Fisheries and Aquaculture (Research)
- Jan Bakke: Professor, Department of Chemistry, NTNU

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NTNU – Innovation and Creativity

The Norwegian University of Science and Technology (NTNU) in Trondheim represents academic eminence in technology and the natural sciences as well as in other academic disciplines ranging from the social sciences, the arts, medicine, architecture and the fine arts. Cross-disciplinary cooperation results in ideas no one else has thought of, and creative solutions that change our daily lives.

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