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The conquest of the oceans

Norway is first and foremost a maritime country. The future and continued development of prosperity in Norway depends on how we manage the sea and invest in ocean space technology. Here lie the solutions to the great challenges of our time: energy supply, climate and food.

The oceans

From the beginning of time, the sea has been an important means of transport, as well as a provider of resources which we have harvested. To begin with, let us present two key figures: The oceans cover almost 70 per cent of the planet's surface. About 80 per cent of the oceans are deeper than 3000 metres, which is the maximum depth at which the offshore oil and gas industry operates today. It is an accepted fact that the oceans are the world's most important reservoir of resources for the future, which will be of crucial importance when global challenges connected with the food supply situation, energy demands and climate change are to be tackled.

At the same time – to put it bluntly – we can say that we currently have more knowledge of outer space than we do of the oceans. We still need to improve our knowledge of what lies below the surface of the sea. Research-based knowledge will be the key to conquering the oceans, and Norwegian research centres can make a difference here, contributing to solutions which can be applied globally.

For generations, Norway's most important resources and competitive advantages have been linked to the sea. Marine technology research and development has been at the centre of the development of the technological community in Norway, providing important con-

tributions to Norway's development as a maritime world power, and not least to the nation's economic development. Today, maritime operations employ about 100 000 people in Norway and contribute about NOK 100 billion in wealth creation. We have the fifth largest registered shipping fleet, specialised shipbuilding yards adapted to our offshore operations and our coastal shipping infrastructure, a world-leading maritime equipment industry and marine consultants in addition to a large maritime services sector. Maritime technology and expertise are essential factors in oil and gas operations, shipyards and industry, as well as in the fisheries and aquaculture industries. Also in the context of renewable energy, marine technology research is likely to be essential in the future.

The starting point is that we are confronted by a new geopolitical reality. Countries which have been in the technological forefront for generations are now being challenged by aggressive world powers who are positioning themselves and taking the lead in the fields of research and development. In some fields Norway has been a world-leading supplier of expertise. Marine technology and experience in technology connected with the oceans has been – and still is – among these fields, and this has contributed to making Norway a maritime world power. It cannot be taken for granted that we will maintain this position in the future.

Few people doubt that the world today is confronted by major challenges. Food shortages, energy crises and climate change come readily to mind. The majority of the Earth's surface is, as is well known, covered by water. The enormous unexplored oceanic areas present great potential, and new levels of expertise must be reached in order to solve the major challenges of our time. There is no doubt that research-based knowledge is becoming more important than ever.

In deep water

Most human activities on and in the sea have an impact on ecosystems and the environment. That this applies to the petroleum industry was clearly demonstrated by the recent accident the Gulf of Mexico, which many people believe will result in a completely new era as regards oil and gas exploitation at sea. When we attended the major ONS Conference in Stavanger in August, a large number of journals and magazines were handed out to us and the other participants. Among these there were two in particular which held our attention, because their front covers illustrate an important point. The cover of the August edition of the Norwegian technical journal *Teknisk Ukeblad* bore the following headline: "*BP-ulykken kunne ikke skjedd i Norge*" (The BP disaster could not have happened in Norway). In contrast, the headline of the journal *Industrien* was as follows: "*Oljekatastrofen kunne skjedd i Norge*" (The oil catastrophe could have happened in Norway).

From our point of view it is important to emphasise the need for research-based knowledge and for offshore petroleum exploitation to take place in as responsible a manner as possible. We must certainly hope that the Deepwater Horizon catastrophe was the last incident of this type ever to occur, although nobody can say in all honesty that such things could not also happen in Norwegian waters. Magne Ognedal, Director General of the Norwegian Petroleum Safety Authority, stated to *Teknisk Ukeblad*: "*The safety situation in Norway is good, but we have to admit that there is risk connected with petroleum operations,*" and he reminded us that, "*We have also experienced catastrophes and near-catastrophes here in Norway*". The key to safer exploitation of natural resources at sea will continue to lie in the development of expertise and technology.

It is sometimes claimed that we have so far extracted the "easiest" oil, and that in future we are literally advancing into deeper water. Some years ago, "deep water" meant up to 1500 metres, but now it means 3000. Year by year the development moves in the direction of human activities and resource extraction in deeper waters, and at the same time operations move ever further north and south. In a number of areas operations are struggling with aging infrastructure, and there is an increasing need for maintenance in parallel with technological developments. This places additional demands on considerable, knowledge-based operations, and is a challenge for forward-looking knowledge-based communities.

Global responsibility

Early in September 2009, a few days before the Norwegian parliamentary election, Unni Steinsmo, President of SINTEF, and Torbjørn Digernes, Rector of NTNU, published a feature article in the major Norwegian daily, *Aftenposten*. Under the title "*En global veiviser*" (A global guide), they argued that, "*Norway has both a national and an international responsibility for mobilising the country's human and economic resources in order to create technological systems, knowledge and expertise in the fight against the negative impacts*

of global climate change". It is also natural to consider investments in marine operations and marine technology development in this perspective.

The Climate Summit in Copenhagen in December 2009 showed all too clearly that we have a long way to go before the necessary measures are adopted. The need for knowledge of the planet we live on will only increase as time goes by. Since its foundation, the SINTEF subsidiary MARINTEK's activities have been built on two pillars: The maritime sector and the oil and gas industry. At present, a reorientation is in progress which will lead to a third field to supplement these. Renewable energy connected with the sea will to an increasing extent become an important field of work. Experience gained from the testing of Hywind, Statoil's pilot project for floating wind power generation, indicated in an early phase in 2005 that MARINTEK will be able to play an important role in the development of offshore wind power. Marine-based renewable energy generation is an immature field which will call for considerable investment in research in the near future. It will be natural to view Europe as the domestic market with regard to offshore wind power. Incidentally, after six months' operation of the Hywind installation, floating in the exposed area between Utsira and Karmøy, off Norway's west coast, Statoil's project management stated in *Teknisk Ukeblad* in March 2010 that it "functions far better than anticipated". Time will show what potential lies in offshore wind power generation, but what is certain is that this is an extremely interesting field for research and development.

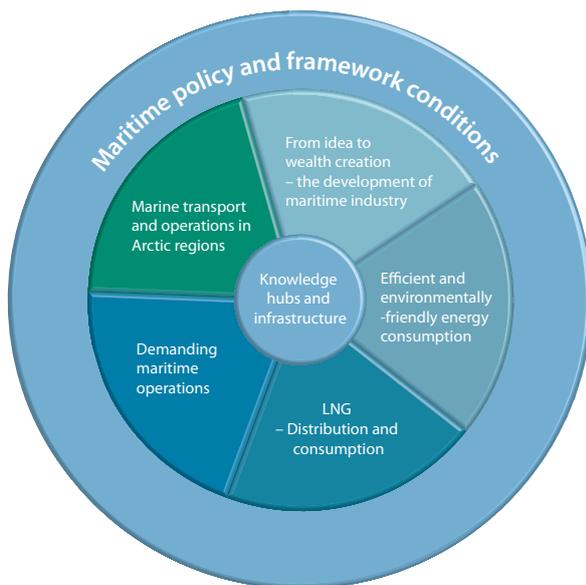
One of mankind's greatest challenges in the future will be food production, with the need to feed an ever-growing world population. According to the UN Food and Agriculture Organization (FAO), the world must produce enough food for 9 billion people in 2050. Norway's position as a supplier of marine products and related know-how and technology is unique, and involves both potential and responsibility. Unknown potential exists in the oceans for innovation and enhanced expertise which can be of benefit to mankind if the right investments are made.

Recommendation No. 1: Follow up the "Maritim21" R&D strategy

Norway has perhaps the most comprehensive maritime cluster in the world, with leading operators in most fields. There has for a long time been a need for better collaboration between the various players in the Norwegian maritime cluster. The breakthrough may have occurred at the beginning of June 2010, when the entire Norwegian maritime industry sector presented "*Maritim 21 – en helhetlig maritim forsknings- og innovasjonsstrategi*" (Maritim21 – an integrated maritime research and innovation strategy) to Trond Giske, the Minister of Trade and Industry.

The strategy was developed by the industry at the request of the Ministry of Trade and Industry between September 2009 and June 2010, by means of a unique process in which several hundred people representing large and small players in the industrial and research communities throughout Norway participated in regional seminars, working parties, direct interviews and web-based consultation rounds. The outcome was a strategy report which recommended systematic, focused effort in seven high-priority fields of work. The first item, and the very core of the proposed areas of involvement, is "Knowledge Hubs and Infrastructure". Knowledge has been, is and will of course continue to be, the very driver of maritime development. Maritime policy and framework conditions define the field of potential for the industry.

The areas of involvement are demonstrated by the following model:



Specific plans of action shall be prepared for the implementation of the selected areas of involvement. These plans of action shall provide specific input on the best way for the public funding system and private sector industrial players to co-operate in order to implement the strategies. The work shall be led by MARUT (a collaboration between the Ministry of Trade and Industry, the Norwegian Shipowners' Association and the Federation of Norwegian Industries, with contributors such as the Research Council of Norway, Innovation Norway, MARINTEK, Det Norske Veritas and the Norwegian Confederation of Trade Unions).

MARINTEK has played an important role in the development of Maritim21 from its inception. In the near future, the principal focus will be on the implementation of the maritime research and innovation strategy which will realise the vision of Norway as *“the most attractive location for global, knowledge-based, environmentally sound maritime industry”*.

Recommendation No. 2: Build the marine technology research institute of the future

The question is how one can obtain more knowledge of the oceans, as well as securing a future with Norway as a world leader. One of the answers is, clearly, through modern laboratories and other research infrastructure. In the report documentation which was submitted with the pre-study for the Ocean Space Centre to the Ministry of Trade and Industry early in 2010, the gap between the existing laboratories and the coming demand was described in detail, as well as the infrastructure which will be needed in a long-term perspective, by 2050.



The principal elements of tomorrow's marine technology research institute are as follows: A larger and deeper ocean testing basin to enable complete modelling of systems in ultra-deep water. This is important in view of the challenges connected with oil and gas production at great ocean depths and renewable energy generation. A unique 3D flow tank for study-

ing the effect of complex current conditions and internal waves affecting slender structures. A large, combined towing tank and wave action basin, as well as a combined flow tank and so-called cavitation tunnel, designed to meet the challenges connected with shipping operations, fisheries and aquaculture, advanced marine operations under extreme weather conditions and the development of offshore renewable energy generation. A wind tunnel capable of simulating cold climate, a laboratory for studying oil in ice, and laboratories with facilities for testing marine operations in marine ice conditions. In addition, a flexible coastal and oceanic laboratory.

The overall result will be facilities for research which currently do not exist anywhere in the world and which will set a new standard for infrastructure and laboratories for marine technology. This will give Norway new advantages and help effect an enhancement of expertise of global proportions. In addition, conditions must be created for modern methods of collaboration and working, as well as co-operation across disciplinary boundaries, with the industrial sector and the academic community interacting in new ways.

In our opinion, this project is visionary, realistic and necessary. Few people are in doubt as to its visionary nature, and in professional circles there is also little disagreement that a project like the Ocean Space Centre will be necessary to provide opportunities for knowledge development to meet future requirements. As regards the realism in the project, this is reinforced by the fact that Norwegian domestic decision-makers have, in a number of political key documents in recent years, emphasised the importance of renewing the infrastructure for marine technology R&D in Trondheim, and explicitly endorse the project.

In the spring of 2005, the Norwegian parliament's Standing Committee on Education and Church Affairs voted unanimously to issue a statement on the government's Research White Paper. The Committee pointed out that *“NTNU and MARINTEK in Trondheim represent Europe's most authoritative technical research environments”* and maintained that *“We have a common national responsibility for ensuring that MARINTEK becomes a European laboratory”*. This was in many ways the starting shot for a visionary, realistic and essential project for which MARINTEK took the initiative, and which today has become almost a household word.

In its maritime strategy for 2007, the Norwegian government established that there was *“a need for significant upgrades and new investment if the institutes are to be able to maintain their international competitiveness”*. In 2008 the government reiterated this in its Innovation Report, and went on: *“If the research centre and laboratories in Trondheim are to continue to maintain their internationally leading position, it is important that they satisfy the Norwegian maritime industry's needs today and in coming years”*. At the same time, the government allocated NOK 8 million in financial support for a pilot project to study the possibility of establishing a next-generation marine research and laboratory institute – now known as the Ocean Space Centre. The condition was that industry and the research communities should contribute a corresponding amount, which they did. This was followed up in 2009 when the government cited the project in its Research Report as an example of “public-private sector collaboration”, and tomorrow's way to organise research.

We have noted that prominent politicians from all parties – from the Progress Party to the Socialist Left Party – have publicly expressed a desire for the project to be implemented and that the present Minister of Trade and Industry has referred to the institute as his “dream project” (in an article in the Norwegian newspaper *Adresseavisen* on

24 December 2009). All the political signals point towards a major development in Trondheim. We understand of course that nothing resembles writing in the sand more than the wording of a parliamentary white paper, and that statements of this kind are themselves no guarantee of realisation. We certainly shouldn't be taking anything for granted. If the Ocean Space Centre is to be realised, broad-based involvement and considerable effort will be required from many quarters.

In this context it is very promising that Maritim21, the maritime sector's above-mentioned integrated research and innovation project, highlights in one of its specific recommendations *"the establishment of the Ocean Space Centre and an associated network to facilitate research, development and education at the highest international level"*.

The project is not a MARITEK effort but a far more broadly based project supported by both industry and the research community throughout Norway. This is reflected not least in the fact that the management and reference groups studying and developing the project include important figures in DNV, Ulstein, Teekay, Statoil and Statkraft, in close collaboration with research communities such as MARITEK, SINTEF, NTNU and the Institute of Marine Research.

In the report "Norway – a global maritime knowledge hub" (BI Research Report 5/2009), Professor Torger Reve documents that *"If an industrial research institute is to succeed in attracting the leading talent and the most demanding clients in the world, a specialised expertise-related infrastructure must be developed which will make outstanding research and development possible"*. He goes on to point out that there will probably only be room for two or three global concentrations for marine technology in coming years, and that positioning is clearly in progress internationally. In Reve's opinion, Norway can become "a global maritime knowledge hub", and he concludes his report by stating: *"What we must do is to develop, finance and establish the Ocean Space Centre, in order to develop future expertise in the field of marine technology. Investments in infrastructure for research and development at this scale call for close collaboration with the maritime sector and energy operators, as well as contributions from Norwegian authorities with regard to financing and implementation."* In *Bergens Tidende* on 10 September 2010, Reve stated that if the Ocean Space Centre becomes a reality, it will *"attain a place among the cream of the world's maritime research institutes"*. This must be the objective – and nothing less.

To promote future knowledge of complex relationships in the oceans – and the ability to find solutions to the great challenges of our time – there is a need for infrastructure. This is the very core of the Ocean Space Centre, which will provide opportunities for studying central issues connected with the oceans which are of great importance for the environment and climate, for the balanced exploitation of maritime resources, for access to energy and for development in the Arctic regions. Norway has special international obligations with regard to the management of resources in the oceans, not least in the Arctic. This international position is another powerful argument for Norway having a leading role in the maritime technology of the tomorrow.

In the future there will be room for very few globally leading maritime research communities. Norway should aspire to be one of these – based on the enhancement of the position which it has developed over many generations. It is 70 years since the private and public sectors jointly invested in the ship model testing tank in Tyholt – which is still in use. The Ocean Basin Laboratory was established 30 years ago. In their time, these facilities were ground-breaking and represent a national infrastructure for marine technology R&D which to this day attracts discerning clients from all over the world.

The ambition of making the next-generation of marine technology research institute a reality around 2020 brings new relevance to King Lear's pronouncement that "Nothing will come of nothing". The project depends on broad support from the political and academic communities, both locally and centrally. International participants must recognise the need for a project of this type and the commercial and industrial sectors must understand the value of it. And if society as a whole is to prioritise this, the Norwegian public must grasp the importance of reinforcing one of the sectors in which Norway already has special advantages. This will take a lot of work.

We do not know at present what requirements for expertise will exist in fifty years time. What we do know is that real advances will be made in expertise and technology. We also know that there is a need and potential for closer links between both national and international research institutes. Modern infrastructure, adapted to tomorrow's requirements for marine technological innovation and knowledge development, is a prerequisite for maintaining and reinforcing Norway's role as a maritime world power.

Knowledge is the driver

The avowed objective of the Norwegian authorities is that *"Norway shall become a world leader in the field of research and innovation"*. This sort of ambitious goal demands purposeful involvement and it is fairly clear that the knowledge-based communities in Trondheim will play an important role in its attainment.

Among the reasons why Norway has been – and is – one of the world's leading nations in the fields of shipping and marine technology is that the industry and the state have assumed responsibility for the development of national infrastructure for technological advances and innovation. As we see it, the Ocean Space Centre will make Norway into a marine technology knowledge hub – a global "Centre of Gravity". The realisation of the marine technology research institute of tomorrow will be an important contribution to maintaining Norway's role as a maritime world power also in the future, as well as to solving the major challenges facing modern society. Because knowledge is the driver.

Recommendations

- Follow up the integrated R&D strategy in "Maritim21".
www.maritim21.no
- Build the marine technological expertise centre of the future.
www.oceanspacesentre.no