

Strategy for the Department of Marine Technology

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Objective: The Department of Marine Technology shall contribute to environmentally and economically sustainable ocean industries in Norway and worldwide.

Our most important contribution and instrument is the candidates we educate, both with master's and doctoral degrees. Candidates who can and will contribute! We will also contribute with research results – both in the form of results that drive the research front further, and results that can be of direct benefit to the industries. The latter type of results shall be refined as far as possible into innovations¹.

Recruitment is essential for us to achieve our goals. We're going to recruit and retain;

- Enough of the best students to fill our programs of study
- The best budding researchers in our PhD programme
- The best researchers and educators as permanent scientific personnel

So, we're going to develop these people into:

- Very well qualified and motivated master's candidates
- Independently thinking, hardworking and highly skilled researchers with a PhD
- World-leading researchers and educators

It's not an easy task. This strategy document aims to provide inspiration and some guidelines for how we can achieve the goals described above.

The strategy document will last for several years, and will be followed up by annual action plans that will operationalise the strategy.

The strategy relates to, and should be in line with, NTNU and IV faculty's strategies.

¹ Definition of innovation: Innovation is a new or significantly changed product, service, mode of production, way of organising or marketing activity, and which has been adopted.

A virtuous circle

Good permanent academic staff educate good master's candidates. Some of these are recruited as good PhD candidates. Together, they create good research results, which provide a good reputation and strengthened funding, which in turn provides a basis for recruiting more and better students and PhD candidates, and attracting the best research talents. This creates a virtuous circle, as illustrated in Figure 1

However, it is crucial to provide the academic staff and students with the best framework conditions – the department must facilitate! The academic staff needs a skilled and well-organised administration, technical support, laboratories and other infrastructure. How we are going to create it is also the topic of this strategy.

As indicated in Figure 1 There are also a number of external factors that we cannot influence to any significant extent, but which we must deal with.

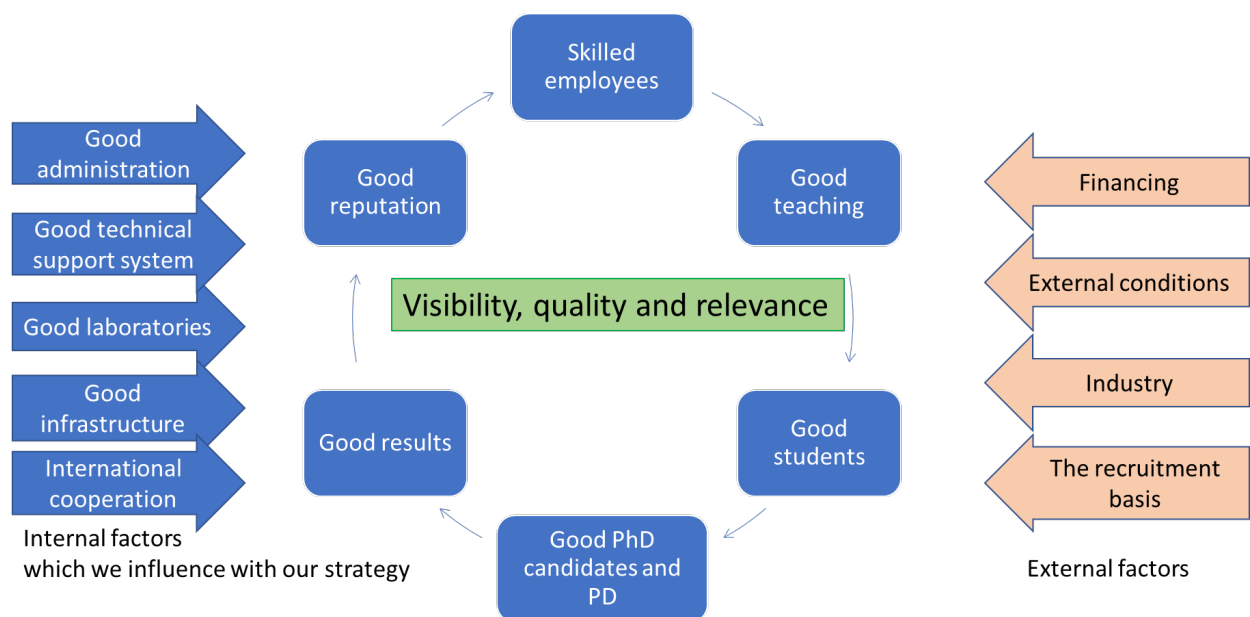


Figure 1 A virtuous circle

Teaching

IMT will provide courses where elements that are special (unique) to marine technology are important. We will not give more courses than necessary, and we will use generic courses given at other departments where it is good enough.

We will emphasize basic and generic knowledge and skills within the marine technology field. Relevant applications should be used as examples and to motivate the generic aspects.

Our teaching shall maintain high quality at an international level, and our teaching methods shall be updated and adapted to our times. We will use digital tools in teaching where appropriate. Our teachers shall have updated and relevant teaching competence.

We will listen to the feedback from the students – both what the students themselves express, and by analysing the results in the courses.

Programming and use of computer tools shall be integrated into teaching where appropriate. However, we should be cautious about emphasizing training in various special software packages.

Sustainability considerations shall be included in study programmes and courses wherever relevant. A short-term and necessary measure is that we as a collegium must define what the concept of sustainability entails for us.

Our study programmes will contribute to realising the objectives of the Technology Studies of the Future.

Lifelong learning in the form of Continuing Education (EVU) is part of our social mission, and an opportunity to nurture our contact with Norwegian business. We want to significantly increase our offer within EVU, but this requires that the framework conditions are good enough.

Research

Our research must be of high international quality. This must be shown by publishing in reputable journals and by quoting and noticing our publications.

IMT will "own" domain knowledge of marine technology and its application. It will provide a basis for us being a natural participant in larger projects aimed at applications in the ocean-based industries, and we aim to lead major initiatives/projects at all times.

IMT shall be an attractive partner for industries in our domain, and contribute to research-based innovation by striving to ensure that our research results are used and contribute to strengthened competitiveness and value creation in our sector.

Our philosophy for both research and teaching is to maintain and develop a strong generic academic base, which is used as a foundation to quickly and powerfully address emerging applications.

Generic subject areas that are important at IMT are:

- Marine structural engineering
 - Analysis of the reliability of structures
 - Stochastic response
 - Ultimate, fatigue og accidental limit state
 - Load effects and capacity of structural elements, including cables and slender structures.

- Hydroelastic (and hydroplastic) response
- Marine operations
 - Real-time wave measurement and prediction.
- Structural monitoring methods
- Properties of new materials, including non-metallic ones.
- Marine hydrodynamics
 - Wave loads and wave-induced movements of structures
 - Resistance and propulsion of ships
 - Hydrodynamic interaction between multiple bodies
 - Bio-hydrodynamics
 - Sloshing
 - Wave kinematics, including breaking waves
- Marine energy systems
 - Internal combustion engines, combustion and reduction of harmful emissions through the use of new types of fuels
 - New concepts for power and energy for propulsion
 - Energy efficiency in composite hybrid propulsion plants
 - Condition monitoring and powertrain analysis
 - System analysis and optimization
 - Hybrid-electric systems and control of such systems
- Marine cybernetics
 - Automatic control, by feedback and forward coupling, of marine structures, vessels, and systems
 - Autonomy in marine systems and operations
 - Risk monitoring and management in autonomous control systems
 - Marine robotics – control algorithms, autonomy, and applications
 - Digitalisation of fjords, oceans, the Arctic and marine systems
 - Error detection and error handling in automatic systems
 - Use of artificial intelligence in marine control systems
- Marine system design
 - Design theory for different system levels within marine systems
 - Optimization/simulation/data analysis
 - Multi-goal analysis of complex marine systems – technical performance, risk, environment, economy

The freedom for individual researchers to choose the topic of their research is a key element of academic freedom, and this naturally also applies at IMT. This limits our ability as an institute to implement powerful strategic initiatives. Nevertheless, we would like to highlight some areas of application that we believe are particularly important, and which we will prioritise when using our own funds.

- Green shipping
 - New energy and propulsion systems
 - Energy-saving ship design
 - Use of wind and waves for propulsion
 - Digital twins for ships, which include big data analytics and decision support functions
 - Autonomous ships

- Logistics and operation (routing, scheduling, corridors, ...)
 - Life cycle analysis; Environmental analysis - LCA and MFA, uncertainty and flexible/robust designs
- Renewable ocean energy
 - Floating offshore wind
 - Reliability, especially for the powertrain of wind turbines
 - Design and analysis of wind farms
 - Floating sun
 - Wave power, tidal power
- Inspection, mapping and intervention
 - Autonomy
 - Underwater
 - Risk analysis for autonomous vessels and operations
- Marine minerals
- Offshore oil and gas
- Arctic operations
- Floating bridges and other large, floating structures
- Ocean observation and technology for this
 - The observation pyramid
 - Marine environmental modelling
 - Sensor platforms
- Aquaculture and fisheries technology
 - Technology on biology's terms
 - Offshore aquaculture
 - Closed and partially closed fish farms
 - Systems and structures for other species
 - Seaweed cultivation at exposed sites
 - Operations, logistics and emergency preparedness
 - Environment and environmental impact
 - Technology for sustainable fisheries

Research at IMT is largely focused on method development. This usually takes place in the context of a current application (see the list above), but the methodological focus nevertheless makes it more challenging to create visibility for the results and translate the results into innovations. To make our method development more efficient and powerful, we will develop and maintain systems and infrastructure for reuse of source code and software developed at IMT.

We will develop and maintain systems for storing and systematising research data so that they can be more easily reused in the future.

Laboratories

IMT operates a wide range of laboratories, which are relevant to most disciplines at the department. The establishment of the Norwegian Centre for Ocean Technology is expected to give a significant boost to the laboratory infrastructure.

The laboratories will support research and teaching. We will conduct high-quality research and teaching, and therefore we must have high-quality laboratories. The laboratories must be adapted

to the needs of the enterprise. Laboratories with particularly low utilisation will be in danger of being shut down, so that we can create new laboratories when new needs arise.

We will develop and operate our laboratories so that they are effective tools in teaching. We will increase the number of courses that use labs.

We will critically assess when we need to have our own laboratory, or whether our needs can be met by buying time in other people's laboratories – such as SINTEF Ocean.

We will keep track of the use of each laboratory – both orders and actual usage, and we will introduce appropriate computer tools to help us with this (Bookitlab is the most relevant solution). As a general rule, laboratories should be organised as rental locations. External parties should be able to buy time in the laboratories at the same rental rates as we use internally – this will in any case be a requirement in the Norwegian Ocean Technology Centre. Rent is collected from the projects that use the labs. Tuition is not rented, but the use must still be registered. We should know what the laboratories cost us, but we should not have an expectation that the laboratories in isolation will be profitable.

To ensure good utilisation of resources, the laboratories must have a joint manager. The exception is the AUR lab, which due to its location and special professional profile has its own manager.

Working environment and HSE

IMT will develop a performance culture at all levels. We must be conscious of the way it is done, so that we do not impose harmful pressure on our employees. It is important that people have the conditions in place so that they can perform, and they must feel that they have control over their work situation.

The support system is very important for the performance of the scientific. We will make it possible for the scientific researchers to concentrate on their core tasks to the greatest possible extent. This means that we must have a good and professional support system, in the form of administration and technicians in the lab and workshop. In the same way as for the scientific, administrative and technical staff must be enabled to perform at a high level, and they must experience the opportunity to have control over their work situation.

At IMT, there should be mutual respect between different employee groups, and between individuals.

We will have zero serious personal injuries, and we will develop a culture for incident reporting and risk mapping that helps us identify risk elements and thus prevent serious incidents.

Organization

Project procurements (applications)

External funding (BOA) is expected to play an even more important role in the department's research and project activity due to reduced transfers to NTNU. In order to help increase focus on this, and to better utilize our academic and administrative depth and breadth at the department, we will establish a project promotion process based on experience with similar people from the Department of Energy and Process Engineering (EPT). Part of this will be to establish an IMT internal formal organisation of review of applications.

Quality shall govern all project applications, and the quality of the grant application shall take precedence if the application deadline is set before the quality of the application has been deemed to be good enough.

In order to succeed with strategic focus in project applications, IMT must also participate in various forums that help set the topic and agenda for what comes as project announcements. This applies in particular to EU projects.

Two types of project applications must be submitted. The first group consists of tactical applications, where we can use the breadth of the department's research expertise. Tactical projects should contribute to research volume (PhD candidates), as well as reduce entry into the department's research arena from other stakeholders (who want to take a larger part of marine technical research), where we must get into position and invite to cooperation under our project management. The second group consists of strategic projects, which will help support our strategic development, and larger projects/strategic initiatives, with orientation/focus that is important for our strategic development. Strategic projects require good process, time and resource management towards important low frequency milestones (SFF, SFI, SFU, ERC, ...).

Student participation in projects

Our students are a resource that we must make good use of – to their and our benefit. To support this, we will use a model and procedure for how students (master's thesis primarily) can contribute to projects - in a pyramid with FVA, postdoc, PhD and master students. This can help to take further experience processes from the capstone subject in the sixth semester, as well as also try out multiple-student master's theses.

Collaboration across the department (esk. Academic groups and research groups), common meeting places, etc.

Cooperation across the department will be strengthened by using FVA across all subject groups in review committees for project applications, and we will seek to increase the proportion of project applications developed across disciplines. New capstone course in the sixth semester where FVA from all specializations will contribute to bringing the department's full academic breadth into a common course in the study program.

Joint lunch and 'Wednesday coffee' in rotation between the professional groups will help to maintain the good social conditions that were developed at Tyholt.

Visibility

Visibility is an important factor in making the virtuous circle work. An outstanding academic environment only has a recruiting effect if those who are to be recruited learn about the academic environment and its achievements. There are many factors that contribute to our visibility, such as scientific publishing, popular science publishing and general dissemination, a clear presence online and in relevant social media, news reports, profiled employees, advertising, etc.

IMT has hired a communication advisor who is an important resource in this field, but as can be seen from the list of elements that provide visibility, what the other employees contribute is just as important – visibility is a shared responsibility!

IMT will develop and maintain a communication strategy, owned by the communications adviser, that describes how we will develop our visibility.

Cooperation

Internationally

We shall seek to cooperate with the best universities and research communities worldwide. This means that we must take the necessary initiatives.

The use of sabbaticals is an important tool for building collaborative relationships internationally. This means that sabbaticals must be taken abroad, and that we will seek to carry out sabbaticals in good research environments. Guest researchers are also an important instrument. To make it easier to combine sabbaticals with modern family life, the department will also support shorter international research stays.

Collaboration produces results only when individuals find benefit from working with each other. We should therefore prioritise building collaborative relationships from below. In some relationships – especially in Asia, an MoU or similar overarching agreements are necessary "at the bottom", but we must remember that such agreements do not in themselves create cooperation – they are at best a start.

Internally

We must respect "One NTNU". We must be aware of what resources exist internally – and use them. If NTNU gains more than IMT loses by choosing to share or act internally, then we should share or act internally.

With SINTEF

SINTEF Ocean is a natural preferred partner for IMT. We will maintain close contact with SINTEF Ocean at all levels, and develop appropriate arenas for cooperation. We will do our part to maintain and develop a close and trusting cooperation. At the same time, we must be aware of our value and make reasonable demands when we participate in joint projects.