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## Notat

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Til: Studieveilingen ved Jon Inge Resell

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Kopi til:

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Fra: Fakultet for ingeniørvitenskap og teknologi

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Signatur: Svein Remseth

## Forslag fra IVT til studieprogramportefølje 2011/2012

Hermed oversendes forslag til nye studieprogram for 2011/2012 ved IVT-fakultetet. Det foreslås bare et nytt program.

### Nytt studieprogram:

#### Nordic master program: Maritime Engineering (NMME)

Programmet vil gi en dobbel grad mellom to og to av de samarbeidende nordiske universitetene: DTU, KTH, Chalmers, Aalto og NTNU. Programforslag med bakgrunnsdokumenter følger som vedlegg.

### Andre endringer:

Det er ikke planlagt noen nedlegging av eksisterende studieprogram ved IVT for studieåret 2011/2012.

### Vedlegg

- Søknad Nordic Master Program: Maritime Engineering (NMME)
- Utkast til Consortium Agreement for NMME
- Foreløpig forslag til studieplaner NMME
- Memo fra DTU: Framework for establishing joint N5T master programme
- Godkjenning av NMME fra FUS

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All korrespondanse som inngår i saksbehandling skal adresseres til saksbehandlende enhet ved NTNU og ikke direkte til enkeltpersoner. Ved henvendelse vennligst oppgi referanse.

## Notat

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Til: Studiedirektøren v/Jon Inge Resell

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Kopi til: FUS, Anette Moen, Anne Marie Snekvik, Eilif Pedersen

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Fra: Fakultet for Ingeniørvitenskap og teknologi

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Signatur: Svein Remseth

### SØKNAD om opprettelse av The Nordic Master Program in Maritime Engineering

Gradsnavn: Master of Science

#### Bakgrunn og søknadsstruktur

Styret har tidligere godkjent at dette studieprogrammet opprettes, S-sak 58/09. Det tilnærmet endelig programforslag legges nå fram. I samsvar med retningslinjene fra Nordisk Ministerråd som har bevilget midler til utvikling av programmet, anmodes det nå om at masterprogrammet godkjennes for å gi en Double Degree. Et forslag til Consortium Agreement mellom de fem universitetene i Nordic Five Tech legges ved. Dette utkastet til rammeavtale er også ment å skulle tjene som mal for kommende N5T masterprogrammer. Avtaleforslaget er uferdig, og i vedlegg fra FUS datert 03.09.2010 følger foreslåtte endringer til avtaleforslaget som må oppfylles i forhold til NTNUs deltakelse. Også IVT-fakultetet ved undertegnede har vært aktivt involvert i prosessen med å etablere kommentarene til avtaleutkastet

Søknaden er utformet mest mulig i samsvar med "Kravspesifikasjon til hjelp for fakultetene i forbindelse med etablering av nye studieprogram, datert januar 2010".

#### 1. Strategisamsvar

Innenfor programmet er det ett universitet som er hovedansvarlig for hver av fem studieretninger. Marin Teknikk ved IVT-fakultetet er hovedansvarlig for "Marine Structures" som er del av et av satsningsområdene for NTNU, og hvor fagmiljøet har betydelig internasjonal anerkjennelse både innen forskning og samsvarende utdanning.

#### 2. Krav til masterprogram i følge forskrifter

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Postadresse	Org.nr. 974 767 880	Besøksadresse	Telefon	Søknad om
opprettelse av The Nordic Master Program	Pro-dekan			
7491 Trondheim	E-post: postmottak@ivt.ntnu.no <a href="http://www.ivt.ntnu.no/">http://www.ivt.ntnu.no/</a>	Hogskoleringen 6 Gløshaugen	+ 47 73 59 45 01 <b>Telefaks</b> + 47 73 59 45 06	Svein Remseth  Tlf: + 47 +47 73594678

All korrespondanse som inngår i saksbehandling skal adresseres til saksbehandlende enhet ved NTNU og ikke direkte til enkeltpersoner. Ved henvendelse vennligst oppgi referanse.

Det foreslåtte studieprogrammet oppfyller NTNUs studieforskrift. I den studieretningen NTNU er ansvarlig for gir vi totalt 60 studiepoeng, hvorav masteroppgaven utgjør 30 studiepoeng. Alle emner som inngår fra NTNU er på 7,5 studiepoeng og er alle eksisterende emner som gis på engelsk i masterdelen av det integrerte 5-årige masterprogrammet i Marin Teknikk.

### 3. Studieplan, emnebeskrivelser

Som nevnt under 1) består studieprogrammet av 5 studieretninger eller "study tracks" med et av universitetene som hovedansvarlig. Det betyr blant annet at studentene det andre studieåret med masteroppgave skal studere ved det universitetet som har hovedansvaret. Studieretninger og hovedansvarlig er som følger:

- Small crafts (KTH)
- Ship design (Chalmers)
- Ship operations (DTU)
- Marine structures (NTNU)
- Arctic operations (AALTO)

For NTNU sin del er de vedlagte studieplaner så godt som komplette på de fire studieretningene der NTNU vil bidra, nemlig Marine structures, Ship design, Ship operations og Arctic operations. En kan merke seg at for retningen Ship design forutsettes det opphold ved TU Delft i ett semester i samsvar med den avtale Marin teknik har med Delft innen dette området. Ordninger er godkjent av de andre universitetene.

Studentene søker til studieretning. De har da valgfrihet i forhold til hvilket universitet de vil gjennomføre det første året ved, men som nevnt vil studiested for det siste året være gitt av hovedansvarlig universitet for studieretningen som en blir opptatt til.

Emnebeskrivelser finnes for våre emner for de fagnumrene som er angitt i studieplanmatrisene i vedlegget.

### 4. Læringsmål

Læringsmålene som gjengitt nedenfor fra studieplanvedlegget er ikke helt i samsvar med vårt kvalifikasjonsrammeverk, men gir en kort overordnet beskrivelse av programmet og forventet læringsutbytte

#### **Maritime Engineering, short description**

The Master programme in Maritime Engineering is concentrated on ships, including small craft and yachts and offshore structures, their design, construction and operation, and their interaction with the environment. Students learn to apply rational methods within mathematics, numeric analyses, fluid mechanics and structural mechanics to analyze, design and technically operate ships and offshore structures. Moreover, students learn to understand the special, high demands to these structures for instance with respect to safety and consideration for the environment.

### **Competences given by the master programme**

On completion of the programme the candidate will have qualifications on high level within naval architecture and offshore engineering, i. e. ships and offshore structures and their design, construction and operation. This includes waves and wave loads, interaction between water and structure, stability of ships and platforms, dynamics of small craft, propellers and propulsion and advanced steel and lightweight structures. The candidate will be able to analyze and design ships, small craft, yachts or offshore structures with respect to building and operation, and he will have a deep understanding of the many conflicting demands, both technical, environmental, safety and economic.

### **5. Fastsettelse av studieplan**

Det vises vedlagte notat fra FUS, der det påpekes at studieplan kan vedtas under forutsetning av at de uferdige fagbeskrivelsene for noen emner fra samarbeidende universitet skal foreligge før opptak av studenter. Fakultetet vil også påse at dette kommer på plass der dette mangler. For emnene ved Marin teknikk ved NTNU foreligger det imidlertid beskrivelser for alle aktuelle emner.

### **6. Kostnadsberegning og finansiering**

Utviklingskostnadene dekkes av bevilgning fra Nordisk Ministerråd. Driftskostnadene knyttet til undervisning ved vårt samarbeidende institutt, Marin teknikk forutsettes dekket av studiepoeng- og kandidatproduksjon. Dette bør være mulig ettersom emnene gis for de øvrige studenter ved instituttet.

En ekstra utgift er knyttet til medveiledning for masteroppgaven og felles vurdering av denne. Dekning av disse utgiftene diskuteres fortsatt av partene. FUS påpeker også dette som en viktig avklaring og forutsetning for å motivere fagmiljøene til å delta i slike program.

### **7. Oppdragsundervisning, egenbetaling**

For NTNU er ikke egenbetaling aktuelt for dette programmet. For de samarbeidende universitetene som har eller i ferd med å innføre egenbetaling, skal dette være dekket i vedlegg til rammeavtalen.

### **8. Antall studenter**

Det vurderes et antall på 30 studenter for første opptak. Dette antallet kan bli øket for etterfølgende opptak, men for blant annet å sikre kvalitet i starten og vinne erfaring, er studenttallet satt lavt. Det vurderes å bruke en kvotering for å sikre at det blir studenter på alle studieretninger.

### **9. Opptakskrav og rangeringsregler**

Det er generelt krav om bachelor-grad for opptak. Det gis imidlertid også mulighet for noen skoleslag i Finland, Danmark og Sverige til å ta noen ekstra emner for å kvalifisere seg til opptak. Tilsvarende for de norske ingeniørhøgskolene er fortsatt under vurdering.

Det foreligger en generell godkjenning av de tre første årene ved de integrerte 5-årige studieprogrammene ved NTNU som opptaksgrunnlag til Nordic Five Tech-masterprogram.

#### 10. Samarbeidende fakulteter

Ved NTNU er det bare Fakultet for ingeniørvitenskap og teknologi som inngår i det nordiske samarbeidet for dette programmet.

#### 11. Eksterne samarbeidspartnere

Her henvises det til vedlagte utkast til Consortium Agreement.

#### 12. Fellesgrader og felles program

Det henvises innledningsavsnittet i dette søknadsnotat, samt vedlagt Note fra DTU og vedlagt notat fra FUS v/ Åge Søsveen.

#### 13. Markedsvurdering

Den posisjonen som de nordiske landene har internasjonalt innenfor Maritime Engineering sammen med dagens internasjonale aktualitet for området, burde sikre et godt marked for dette programmet i hvert fall etter en første periode med innarbeiding. Utviklingsfinansiering fra Nordisk Ministerråd baseres vel også på en positiv markedsvurdering.

#### 14. Særskilte programaspekter

Etter det foreslåtte opplegget for programmet vil studentene oppholde seg et helt studieår ved to av de samarbeidende universitetene. Det første året kan studenten velge universitet, mens studiested det andre året er gitt av hvilket av universitetene som er hovedansvarlig for den studieretningen studenten er tatt opp ved. De to universitetene som samarbeider om undervisningen for den angjeldende student vil så tildele en dobbel grad til studenten.

Beautiful photo

**Maritime Engineering, short description**

The Master programme in Maritime Engineering is concentrated on ships, including small craft and yachts and offshore structures, their design, construction and operation and their interaction with the environment. Students learn to apply rational methods within mathematics, numeric analyses, fluid mechanics and structural mechanics to analyze, design and technically operate ships and offshore structures. Moreover, students learn to understand the special, high demands to these structures for instance with respect to safety and consideration for the environment.

Read more ([link to Maritime Engineering](#))

**Competences given by the master programme**

On completion of the programme the candidate will have qualifications on high level within naval architecture and offshore engineering, i. e. ships and offshore structures and their design, construction and operation. This includes waves and wave loads, interaction between water and structure, stability of ships and platforms, dynamics of small craft, propellers and propulsion and advanced steel and lightweight structures. The candidate will be able to analyze and design ships, small craft, yachts or offshore structures with respect to building and operation and he will have a deep understanding of the many conflicting demands, both technical, environmental, safety and economic.

Read more ([link to Competence profile](#))

**Career opportunities**

The candidate will typically be employed as naval architect or offshore engineer by consultancies, ship owners, maritime administrations, offshore companies, classification societies or suppliers of special equipment. The roles in the enterprise may be those of chief executive, development manager, team manager, consultant, specialist, or researcher.

Read more about the programme ([link to Programme description](#))

### **Programme description**

The Nordic Master in Maritime Engineering is based on the expertise of the participating universities within naval architecture, offshore engineering and maritime engineering. The programme targets international students wishing to profit from the Nordic Five Tech universities' long standing tradition and competence in the field and Nordic students wishing to specialize in a specific area of expertise offered within the alliance.

In the programme the education is based on first principles within design, construction and operation of ship and offshore structures, including hydrostatics and stability, hydrodynamics, wave and wind loads, structural analyses, etc. . The teaching comprises lectures, assignments and project work. Theory is supported by experimental work and computer simulations are used intensively.

### **Programme structure**

The programme is structured in two parts:

1. In the first year the student learns topics of maritime engineering (naval architecture and offshore engineering) on Master level : basic naval architecture (depending on entrance qualifications), stability, resistance and propulsion, seakeeping, manoeuvring and ship structures. In addition to maritime engineering courses, the student must do courses on general and special engineering competences, such as CFD, structural analysis, composite materials etc. The emphasis on each subject will depend on the entrance university and entrance qualifications.
2. In the second year the student specializes in one of the five subjects: arctic operations, offshore structures, ship design, ship operations and small craft. Each of the subjects defines a study track.

It is required that a student starts at one of the partner universities for part 1 and finishes the studies at another university for part 2.

### **Study tracks**

Each of the five study tracks is defined below, with the partner university responsible for the track given in parenthesis:

#### **Arctic operations (Aalto)**

Short description by Aalto

Link to: [Study track: Arctic Operations](#)

#### **Offshore structures (NTNU)**

There is a trend that more of the new activities related to exploration and exploitation of the offshore oil and gas resources take place in deeper water than before or at marginal fields. Financially viable and safe exploitation of these resources will demand lightweight floating platforms and shiplike vessels. Other advanced marine operations in the ocean space from all-year service vessels or platforms are a prerequisite for laying pipelines or cables, for installing subsea equipment as well as inspection, maintenance and

repair/replacements of underwater facilities. The combination of deepwater, harsh wave conditions and ocean currents makes the design and operation of floaters, risers and mooring systems particularly challenging .

Link to: [Study track: Offshore structures](#)

**Ship design (Chalmers)**

[Short description by Chalmers](#)

Link to: [Study track: Ship Design](#)

**Ship operations (DTU)**

In popular terms the definition of this study track is that it mainly deals with naval architecture and maritime engineering from the point of view of the ship owner , i.e. it deals with sailing ships . The student will learn to apply rational methods in analysing and optimizing the performance of ships (container ships, tankers, bulk carriers, ro-ro ships etc.) with respect to safety, efficiency, economics and environmental considerations.

Link to: [Study track: Ship Operations](#)

**Small craft (KTH)**

[Short description by KTH](#)

Link to: [Study track: Small Craft](#)

**Prerequisites**

[short description](#)

[Link to prerequisites](#)

**Thesis assessment and degree**

[short description](#)

[Link to thesis assessment and degree](#)

**Application**

[short description](#)

[Link to application procedures](#)

**Practical matters**

[short description](#)

[Link to practical matters \(are there any specific?\)](#)



**Study track: Arctic operations**

description by Aalto

the structure of the section similar to: Study track. Ship Operations

**Study track: Ocean structures**

Main contributors: Chalmers and NTNU

**Curriculum**

The last two semesters (2<sup>nd</sup> year) must always be done at NTNU. The first two semesters can be done at either of the following universities:

- Chalmers
- DTU
- Aalto

Semester	Study track: Ocean structures Students start: Chalmers	ECTS
1 Autumn	MMA136 - Ship geometry and hydrostatics	7.5
	MMA126 - Marine transport systems	7.5
	MMA155 - Ship resistance and computational hydrodynamics	7.5
	MMA131 - Marine structural engineering	7.5
2 Spring	MMA140 - Marine propulsion systems	7.5
	MME062 Fundamental structural dynamics	7.5
	MMA145 - Wave loads and seakeeping	7.5
	Elective	7.5
	Elective: MMA115 - Fatigue design OR MPM052- Composite and nanocomposite material	
3 Autumn	TMR4500 Ocean structures - specialization project	7.5
	TMR4505 Specialization courses - modules (select 2 of:)	7.5
	- Structural analysis	
	- Dynamic analysis of marine structures	
	- Ice 1 / Ice 2	
	- Experimental methods in hydrodynamics	
	- Hydro elasticity	
	TMR419X Design offshore structures (exam spring ?)	7.5
	Electives:	7.5
	TMR4115 Design methods	
TMR4130 Risk analysis		
TMR4200 Fatigue/fracture		
TMR4235 Stoch theory sealoads		
TMR4215 Sea loads		
4 Spring	Master Thesis, NTNU	30

Proposer: NTNU DTU	Study track: Ocean structures Students start: DTU	
Semester	Prerequisite BSc Naval Architecture	ECT
1 Autumn	41210 Ship motions and sea loads	5
	4122X Ship structures assessment	5
	41275 Ship operations	5
	41220 Ship propulsion hydrodynamics	10
	02431 Risk management	5
2 Spring	41115 Marine structures 1	5
	42490 Technology, economics, management and organisation	10
	41323 Advanced fluid mechanics	10
	41514 Dynamics of machinery	5
	41315 Applied CFD (a total of 30 ECTS for this semester)	5
3 Autumn	TMR4500 Ocean structures - specialization project	7.5
	TMR4505 Specialization courses - modules (select 2 of:)	7.5
	- Structural analysis	
	- Dynamic analysis of marine structures	
	- Ice 1 / Ice 2	
	- Experimental methods in hydrodynamics	
	- Hydro elasticity	
	TMR419X Design offshore structures (exam spring ?)	7.5
	Electives:	7.5
	TMR4115 Design methods	
TMR4130 Risk analysis		
TMR4200 Fatigue/fracture		
TMR4235 Stoch theory sealoads		
TMR4215 Sea loads		
4 Spring	Master Thesis, NTNU	30

Proposer: Aalto DTU	Study track: Ocean Structures	
	Students start: Aalto	
Semester	Prerequisite: BSc Naval Architecture	ECTS
1 Autumn	Kul-24.4350 Passenger Ship Architecture	5
	Kul-24.4120 Ship Structural Design	5
	Kul-24.4230 Safety and Risks of Marine Traffic Machinery, fluid mechanics, cfd? 15 ECTS	5
2 Spring	Kul-49.4250 Models for Beam, Plate and Shell Structures	5
	Kul-49.4350 Fatigue of structures	5
	Kul-49.3400 Dynamics of Structures	5
	Kul-49.4100 Finite Element Method II Machinery, fluid mechanics, cfd? 10 ECTS	5
3 Autumn	TMR4500 Ocean structures - specialization project	7.5
	TMR4505 Specialization courses - modules (select 2 of):	7.5
	- Structural analysis	
	- Dynamic analysis of marine structures	
	- Ice 1 / Ice 2	
	- Experimental methods in hydrodynamics	
	- Hydro elasticity	
TMR419X Design offshore structures (exam spring ?)	7.5	
Electives:	7.5	
TMR4115 Design methods		
TMR4130 Risk analysis		
TMR4200 Fatigue/fracture		
TMR4235 Stoch theory sealoads		
TMR4215 Sea loads		
4 Spring	Master Thesis, NTNU	30

**Study track: Ship design**

**Ship Design - Chalmers**

The most dominating course of the track is the Ship design project. The purpose is to participate in a problem oriented ship design project. Student teams will be assigned real design problems, guided by professional engineers from industry and faculty members from Chalmers. The initial design process prior to an order of a new ship is covered during the project following the demands of the customer. In parallel with the project course the student will take a course in Environmental aspects on logistics and transportation and a choice between a course in FE simulations in design and Computational fluid dynamics .

Semester	Study track: Ship Design Students start: NTNU	ECTS
1 Autumn	TMR4115 Design methods	7.5
	TMR4253 Marine systems design	7.5
	TMR4170 Marine structures BC	7.5
	Electives:	
	TMR4310 Marine technique 4 - Machinery	7.5
	TMR4130 Risk analysis	7.5
	TMR4125 Building of ships and platforms	7.5
2 Spring	TU Delft:	(30)
	MT113 Design of advanced vehicles	3.0
	MT525 Marine propulsion systems	2.0
	MT713 Marine engineering C	2.0
	MT514 Ship motions/manoeuv	3.0
	Electives: (20 ECTS)	
	MT728 Ship repair/salvage	3.0
	WB4408A Diesel Engines A	3.0
	MT727 Shipyard processes	3.0
	MT044 Naval ship design	4.0
	MT723 Ship finance	4.0
MT313 Shipping management	3.0	
MT816 Composite materials	2.0	
	+ General courses	
3 Autumn	MMA150 - Ship design project	15
	ITR361 - Environmental aspects on logistics and transportation	7.5
	Elective:	7.5
	TME125 - Finite element simulations in design OR MTF072 - Computational fluid dynamics	

4 Spring	Master Thesis, Chalmers	30

### **Study track: Ship operations**

In popular terms the definition of this study track is that it mainly deals with naval architecture and maritime engineering from the point of view of the ship owner, i.e. it deals with sailing ships. The student will learn to apply rational methods in analysing the performance of ships (container ships, tankers, bulk carriers, ro-ro ships etc.) with respect to safety, efficiency, economics and environmental considerations. In this way the candidate will be able to improve and optimize vessel performance from a technical point of view for operation and he can participate in design of new vessels with better operational performance.

In the study track the topics of classical maritime engineering (basic naval architecture, stability, resistance and propulsion, seakeeping, manoeuvring and ship structures) are applied in an approach where the ship operation is in focus. In this view, for instance the ship in waves is not only important for the sea loads and motions, but also for the ship structures and the fatigue life of the structural elements. The ship motions also result in added resistance and drift forces that should be taken into consideration not only when designing the ship, its propeller(s) and selection of its engine(s), but also for evaluation its best course and speed under given weather conditions.

In addition to the subjects mentioned above, the track contains the following topics:

- decision support systems for navigational and operational guidance of ships,
- risk-based approaches in the prediction of statistical response values for operational and design evaluations,
- human factors that affect ship operations,
- human factor disciplines in the design process with regards to decision support systems.

The candidate will typically be employed by a ship owner in the technical department, a consultancy, a classification society, a supplier of marine equipment or a research institution. The work of the candidate will involve a large degree of development, if not entirely directed at research, and it will be done in an entirely international atmosphere and require cooperation with people with different backgrounds, mainly from the maritime world.

### **Curriculum**

The last two semesters (2<sup>nd</sup> year) must always be done at DTU. The first two semesters can be done at either of the following universities:

Aalto  
Chalmers  
KTH  
NTNU

Click on either to see the corresponding curriculum

Curriculum

Study track Ship Operations, start Aalto

Some remarks about this particular combination

Proposer: Aalto DTU	Study track: Ship Operations Students start: Aalto	
Semester	Prerequisite: BSc Naval Architecture	ECTS
1 Autumn	Kul-24.4350 Passenger Ship Architecture	5
	Kul-24.4120 Ship Structural Design	5
	Kul-24.4230 Safety and Risks of Marine Traffic	5
	Machinery, fluid mechanics, cfd? 15 ECTS	
2 Spring	Kul-49.4250 Models for Beam, Plate and Shell Structures	5
	Kul-49.4350 Fatigue of structures	5
	Kul-49.3400 Dynamics of Structures	5
	Kul-49.4100 Finite Element Method II	5
3 Autumn	Machinery, fluid mechanics, cfd? 10 ECTS	
	41210 Ship motions and sea loads	5
	41220 Ship propulsion hydrodynamics	10
	41275 Ship operations	5
	4122X Ship structures	5
4 Spring	Elective	5
	Master Thesis, DTU	30



Proposer: NTNU DTU	Study track: Ship Operations Students start: NTNU	
Semester	Prerequisite: BSc Naval Architecture equivalent	ECTS
1 Autumn	TMR4115 Design methods	7.5
	TMR4253 Marine systems design	7.5
	Electives:	
	TMR4170 Marine structures BC	7.5
	TMR4310 Marine technique 4 - Machinery	7.5
	TMR4130 Risk analysis	7.5
	TMR4125 Building of ships and platforms	7.5
2 Spring	TU Delft:	(30)
	MT113 Design of advanced vehicles	3.0
	MT525 Marine propulsion systems	2.0
	MT713 Marine engineering C	2.0
	MT514 Ship motions/manoeuv	3.0
	MT728 Ship repair/salvage	3.0
	WB4408A Diesel Engines A	3.0
	MT723 Ship finance	4.0
	MT313 Shipping management	3.0
	MT816 Composite materials	2.0
	Electives: (5 ECTS)	
MT727 Shipyard processes	3.0	
MT044 Naval ship design	4.0	
	+ General courses	
3 Autumn	41210 Ship motions and sea loads	5
	41220 Ship propulsion hydrodynamics	10
	41275 Ship operations	5
	4122X Ship structures	5
	Elective	5
4 Spring	Master Thesis, DTU	30

Curriculum

Study track Ship Operations, start Chalmers

Some remarks about this particular combination

Proposer: Chalmers DTU	Study track: Ship Operations	X
	Students start: Chalmers	
Semester	Prerequisite: BSc Mechanical Engineering	ECTS
1 Autumn	MMA136 - Ship geometry and hydrostatics	7.5
	MMA126 - Marine transport systems	7.5
	MMA155 - Ship resistance and computational hydrodynamics	7.5
	Elective:	
	TME125 - Finite element simulations in design	7.5
	MTF072 - Computational fluid dynamics	7.5
2 Spring	MMA140 - Marine propulsion systems	7.5
		7.5
	Elective:	7.5
	MMA115 - Fatigue design	(7.5)
	MPM052 - Composite and nanocomposite materials	(7.5)
	Elective:	7.5
	MPM080 - Engineering polymers OR	(7.5)
	MME062 - Fundamental structural dynamics	(7.5)
3 Autumn	41210 Ship motions and sea loads	5
	41220 Ship propulsion hydrodynamics	10
	41275 Ship operations	5
	4122X Ship structure assessment	5
4 Spring	Master Thesis, DTU	30

Curriculum

Study track Ship Operations, start KTH

Some remarks about this particular combination

Proposer: KTH DTU	Study track: Ship Operations Students start: KTH	X
Semester	Prerequisite: BSc Mechanical Engineering	ECTS
1 Autumn	SD2701 Introduction to Naval Architecture	8
	SD2704 Hull structural design	6
	SD2411 Lightweight structures	8
	SD2707 Marine innovation	5
	SD2706 Sailing for performance	6
2 Spring	SD27xx Small craft design	10
	Fluid mechanics, CFD	7.5
	Marine dynamics	8
	Elective: Applied CFD	5
	Meteorology	
Risk management Acoustics and vibration		
3 Autumn	41210 Ship motions and sea loads	5
	41220 Ship propulsion hydrodynamics	10
	41275 Ship operations	5
	4122X Ship structures	5
	Elective	5
4 Spring	Master Thesis, DTU	30

*Nordic Master in Maritime Engineering*

*Study track: Small Craft*

**Study track: Small craft**

description by KTH

the structure of the section similar to: Study track. Ship Operations

## **Competences imparted: Nordic Master in Maritime Engineering**

### **Competence Profile (MSc)**

A graduate from the Nordic Master Programme in maritime engineering has a research -based education at a high technological level that qualifies the graduate to take on specialized business functions and participate in scientific development. The master's degree also gives access to further education within research (e.g. research positions or a PhD).

The graduate has:

- basic understanding and knowledge of the natural sciences and technological principles. The graduate can use this knowledge for innovative purposes such as solving technological problems in business or societal contexts.
- extensive technological expertise within a specific area and knowledge of current trends and opportunities within this area.
- a clear professional profile which includes elements of current research at an international level. The graduate has the ability to use this knowledge in developing new ideas and solving new problems.
- a thorough understanding of how elements of a technological problem interact. The graduate is able to develop relevant models, systems and processes to solve the problem in question using creative analysis and modeling.
- the ability to assess and delimit complex issues, put them into a broad professional and societal context, and, on this basis, propose relevant courses of action.
- the ability to combine technological expertise with knowledge of economics, management, organization and project work. The graduate is able to examine technological solutions in a business and societal perspective

### **General competences (MSc)**

The graduate:

- is proficient in both oral and written communication, and is able to present professional results in a convincing manner
- commands technical problem solving at a high level, primarily through project -related approaches. The graduate is able to handle all phases of a project, including the drafting of project timelines, design and solution proposals, and documentation
- can use and assess technological solutions, while applying principles of ethics and sustainability
- is experienced in the use of systematic methods of constructions and/or advanced mathematical models driven by the laws of mechanics and hydrodynamics.

### **Formal conditions (MSc) , to be changed and re-written**

- Admission requirements: BSc Eng or BSc Naval architecture or BEng Naval architecture (180 ECTS points)
- Program duration: The master's program covers two years of full -time study (equal to 120 ECTS). This framework ensures that all graduates acquire professional core competences through technological specialization (and a master's thesis (minimum 30 ECTS). Program participants also acquire specialized knowledge through elective courses (minimum 30 ECTS). The program also includes 30 elective ECTS credit points.
- Title: Master of Science ??
- Further education: Research, PhD (3 years)
- Executive order: The master's program complies with executive order BEK 338 dated May 6, 2004 (and subsequent amendments) issued by the Danish Ministry of Science, Technology and Innovation.???

PROFESSIONAL COMPETENCE OBJECTIVES (MSc)

**The Nordic Master programme in Maritime Engineering**

Maritime engineering constitutes a large number of fields covering naval architecture, applied solid and fluid mechanics, applied risk analyses and application of advanced mathematical models. The graduate engineers of Maritime Engineering have obtained competences to participate in the development of new and better solutions for ships, small craft and offshore structures. The focus for the solutions may range from microstructures such as parts for hearing aids to the mechanical solutions in mobile telephones, entertainment electronics, medical devices and analysis equipment, engines, turbines, pumps, wind turbines, ships and offshore structures. Through their education the students obtain extensive knowledge of physical principles, strength of structures, and fluid flows and during the education they have freedom of choice to focus on one or several of these fields.

Applied mathematics is used in many practical contexts and the mathematical modeling often involves extensive use of computer simulation.

**The graduate can:**

- formulate, model and analyze a technical problem focusing on strength of structures, fluid flow, often with the use of advanced numerical models and experimental techniques
- account for the physical principles governed by the laws of mechanics applied in analyzing (analytically/numerically/experimentally) a technical problem
- develop and apply numerical simulation techniques based on applied mechanics and applied mathematics
- stretch out a total solution space based on engineering design methodology
- account for the engineering design basis of theory and methods
- analyze and classify existing solutions as well as put forward ideas to new solutions based on engineering design methodology and/or a strength/flow analysis
- give practically useful interpretations and assessments of the obtained synthesis, analytical, numerical and/or experimental results as well as evaluate the quality of the applied method of analysis focusing on systematic engineering design, strength, and/or flows
- evaluate the obtained solutions with respect to relevant aspects like safety, efficiency, quality, costs, and environmental considerations
- report the obtained results well structured, complete, clear and concise, critically assessing/concluding and otherwise confirming to accepted standards for written presentation in the subject area
- present and put into perspective the obtained results in writing and orally as well as communicate with specialists in the subject area

## **Maritime Engineering**

Maritime engineering deals with ships, small craft, yachts and offshore structures. It includes their design, construction and operation and their interaction with the environment. It covers the engineering disciplines naval architecture and offshore engineering.

Maritime engineering is important. The earth can be called the blue planet with 71 per cent of its surface covered by water.

The oceans provide us with many vital resources:

- 90 per cent of world trade is ship borne – it is the most energy efficient mode of transportation,
- the oceans have vast living resources in form of fish, plankton etc.,
- there are gigantic resources of raw materials below the seas such as oil, gas and minerals.

75 per cent of the energy of the sun that is absorbed by the earth is absorbed by the oceans. This energy can be utilized by offshore wind turbines and wave energy converters, and it is the basis for the life in the oceans that can be utilized for food.

Only by being better at utilizing the resources of the seas will it be possible to feed the growing population of the earth. And only by improving our activities at sea can we reduce our harmful impact on the environment and in this way make the living conditions better, for both humans and animals. This is the paramount future challenge for naval architects and other engineers dealing with maritime engineering.

### ***Maritime Engineering and the Nordic countries***

The Nordic countries have for centuries been strong in shipping and shipbuilding. This position has been driven by hard and sheer necessity in a harsh environment and under conditions where only the utmost care, the best qualifications, the hardest work and the highest degree of innovation could secure survival, physically and economically. On the other hand, those conditions have been crucial in the development of the high quality shipping that is characteristic for the Nordic countries. Today, people in the Nordic countries design, build and operate large fleets of modern, highly sophisticated ships and offshore units of all kinds, and there is a large industry of suppliers of equipment.

### ***The Nordic maritime industry***

The maritime industry includes ship designers, consultancies, ship owning companies, a classification society, offshore oil companies and engine manufacturers. To this one must add a large number of sub-system developers and subcontractors such as manufacturers and suppliers of equipment, from ropes, winches and paint to IT service, weather routing etc. Within each field one can mention large, world-leading companies such as Wallenius, A.P. Møller Mærsk, Barber WW, Det Norske Veritas, MAN Diesel<sup>1</sup>, Stena, SSPA, ABB and Wärtsilä. The importance of the maritime industry for the Nordic countries can be seen from Table 1.

### ***Industrial need***

It is common for the maritime industry that engineers of many kinds: naval architects, marine, chemical and civil engineers, are vital for the activities. Today there is a great need in the industry for qualified naval architects and other engineers with maritime specialization. The future challenges for safer, more energy efficient and more environmentally friendly activities in the maritime field will enhance this need. In particular the Nordic countries have good traditions in this

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<sup>1</sup> Although the company is German owned, the large two-stroke diesel engines are designed and developed in Denmark.

field and they will be able to drive the development towards better performance and higher standards, provided that there are enough engineers to do the work. Moreover, highly qualified candidates are one of the most efficient means of conveying the newest and most rational engineering methods and disciplines into the daily work of companies.

Industry also needs strong universities and research institutions. This is because teaching and research can be made with a view to the particular needs of the local industry. Furthermore, by being a part of the international scientific community, universities will attract knowledge and know-how from abroad for the benefit of their candidates and hence the industry. By participating in research projects universities will give but also get access to knowledge that is usually not directly and quickly available to third parties.



**MEMO**

SAK2010/642

**To** Nordic Five Tech

**Reg.** Framework for establishing joint N5T master programmes

**From** DTU, based on the results of the NMME administrative project group

July 7, 2010  
AMH

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Annex:

1. Illustration of the programme model and list of members of the administrative project group

The development of the Nordic Master in Maritime Engineering (NMME) is used as basis for elaborating an N5T platform for the establishment of joint programmes. The development of the programme is co-ordinated by DTU Mechanical Engineering and is supported with funding from the Nordic Council of Ministers (1 million DKK, call April 2009). The development process began in September 2009 and the programme is scheduled to start in September 2011. The preliminary outcome in terms of elaborating an N5T platform for the establishment of joint programmes can be identified at two levels:

- 1) Organization of the development process
- 2) Recommendations for main features of an N5T master programme

**1) Organization**

In order to be able to use the NMME development process as a basis for developing an N5T-platform for the establishment of joint master programmes, it was considered crucial to establish a consortium including academic as well as administrative representatives. The consortium thus includes key professors and key administrative staff working together and as separate project groups reporting to each other to ensure a continued dialogue between contents and the legal/administrative framework. The participants have expressed satisfaction with and enthusiasm for this collaboration model which is considered as a way to ensure feasibility of the project and the establishment of a well-functioning programme. The model is recommended to future joint master programme initiatives.

The administrative project group recommends that the collaboration is governed by a consortium agreement that specifies the principles for organisational, administrative and legal aspects of the collaboration. The Consortium Agreement may be supplemented with annexes and protocols specifying common procedures in further detail. It is recommended to elaborate the consortium agreement as part of the programme development process.

**2) Recommendations for main features of an N5T master programme**

Through its discussions on the development of the NMME, the administrative project group has identified a number of features that are recommended to form the basic elements of future joint N5T

master programmes. The main features are can be separated into two sections: programme structure and programme administration.

#### A. Programme structure

- **Added N5T-value:** Joint N5T programmes must be based on a concept of added N5T-value. The added value may be identified in terms of complementary strengths within an engineering field where the member institutions have a strong tradition. This added value should constitute the structuring principle of the programme and at the same time provide the main selling points for marketing the programme to prospective students, N5T and international.
- **Double Degree Programme:** The Nordic Council of Ministers requires that a Nordic Master Programme results in either a joint or a double degree. Not all countries represented within N5T are able to issue joint degrees and the NMME project group has decided to develop the programme according to a double degree framework. The model suggested ensures that all five institutions are able to issue a (double) degree.
- **60 ECTS + 60 ECTS:** There is consensus between the partners on a model where students spend one year in each of the two degree awarding institutions. Students will thus have to choose between combinations of institutions offering specified programme components. The model implies the possibility of having multiple entry institutions, depending on the structure of the programme (for illustration see annex).
- **Co-supervision of thesis work:** This concept serves a two-fold purpose:
  - b) Thesis work conducted with supervision from each of the two degree awarding institutions involved in the study track is a way to ensure integration of the programme components. It supports the credibility of the programme.
  - a) In order to issue a diploma, all five institutions require that thesis work is conducted with a supervisor from the institution.

Co-supervision will be governed by a set of guidelines in order to provide supervisors and students with a clear framework.

- **Pre-defined study tracks with competence profiles:** In order to ensure progression and integration of the programme components, it is highly recommended that the programme is structured with clear competence profiles for each of the mobility tracks proposed.
- **Summer school/intensive programme:** Establishment of a joint summer school or intensive programme is recommended as a way to bring the students together from all five institutions and stimulate an "N5T-group-feeling".

### Programme administration

- **Admission:** Due to the structure of the programme with students starting in different institutions depending on their mobility track, the NMME consortium has decided to apply local admission with common pre-screening criteria. This means that the applicants apply to the N5T university where they wish to start their studies using the local admission system but that applications will be pre-screened using a consortium determined pre-screening criteria (e.g. English language qualifications, level of first degree). There will be one common deadline.
- **Tuition fees:** In September 2011, three out of five N5T member institutions will be charging tuition fees to non-EU students. Due to the structure of the programme with students studying at different institutions, the NMME consortium has decided that students will pay fees according to their mobility track and directly to the two institutions involved in the track.
- **Student counselling:** In order to ensure that the programme is coherent for the individual student, it is recommended that all students prepare a study plan as part of their application and that two supervisors are appointed to the each student, one from each of the two degree awarding institutions.

**Annex 1**

**Illustration of the 60 + 60 ECTS model**

<b>Semester 1</b>	<b>University 1</b>
<b>Semester 2</b>	<b>University 1</b>
<b>Summer School</b>	
<b>Semester 3</b>	<b>University 2</b>
<b>Semester 4</b>	<b>University 2</b>

**Members of the NMME administrative project group:**

**KTH:** Karin Knutsson, Project Co-ordinator, Mia Brandelis, legal adviser, International Office  
**Aalto:** Saraa Sokolnicki, International Co-ordinator, Faculty of Engineering and Architecture  
**NTNU:** Annette Moen, Higher Executive Officer, International Office  
**Chalmers:** Gustavo Perrusquia, International Co-ordinator  
**DTU:** Maria Runering, MSc Admissions Officer, International Affairs, Office for Study Programmes and Student Affairs  
 Anne Mette Holt, Special Adviser, Study Development, Office for Study Programmes and Student Affairs

## Notat

Til: Studiedirektøren v/Jon Inge Resell

Kopi til: FUS, Anne Rossvoll, Anette Moen, Anne Marie Snekvik, Eilif Pedersen

Fra: Åge Søsveen

Signatur:

### **Nordic Master in Maritime Engineering. Godkjenning i hht. fullmakt fra FUS**

Styret har tidligere godkjent at dette studieprogrammet opprettes, S-sak 58/09. Det endelige programforslaget legges nå fram. Det foreslås nå, i hht. retningslinjer fra Nordisk Ministerråd som har bevilget midler til utvikling av masterprogrammet, at masterprogrammet godkjennes for å gi Double Degree. Som vedlegg følger også forslag til mal for overordnet prinsippavtale for nordiske masterprogram i Nordic Five Tech-regi.

**A. FUS anbefaler at det nordiske masterprogrammet Nordic Master in Maritime Engineering blir vedtatt som et Double Degree-program, iverksatt med første opptak høsten 2011, med de anmerkninger og forutsetninger som FUS anfører. Graden tildeles i hht. ordningen for Double Degree-program med betegnelsen Master in Maritime Engineering, med spesialisering i hht. valgt studieretning**

B. FUS har følgende anmerkninger og stiller følgende forutsetninger for implementering av programmet:

1. Overordnet rammeavtale. Rammeavtale for nordiske masterprogram, datert 7.juli 2010, legges til grunn med følgende anmerking:
  - a. Bestemmelsen om Double Degree må ivaretas ved en mer presis beskrivelse om gjennomføring og sensur av masteroppgaven ved at det er gjennomføringsansvarlig institusjon er hovedansvarlig for masteroppgaven, men at samarbeidende institusjon har en medveileder på oppgaven, og oppgaven sensureres av en felles sensurkomite for begge de institusjonene som utsteder grad, med en omforent karakter.  
Studieretningene hvor Double Degree omfatter samarbeid med Aalto må eventuelt utsettes inntil avtalen om dette punktet er godkjent av Aalto
  - b. I framlegget forutsettes det en sommerskole for de opptatte studentene. NTNU kan ikke tilby et sommerskoleopplegg, men dette er det aksept for i konsortiet. NTNU-studentene får delta på sommerskole hos en av de andre institusjonene.

<b>Postadresse</b>	<b>Org.nr.</b> 974 767 880	<b>Besøksadresse</b>	<b>Telefon</b>	<b>Seniorrådgiver</b>
7491 Trondheim	E-post:	Hovedbygget	+ 47 73 59 52 00	Åge Søsveen
	<a href="http://www.ntnu.no/studieavd">http://www.ntnu.no/studieavd</a>	Høgskoleningen 1	<b>Telefaks</b>	
		Gloshaugen	+ 47	Tlf: + 47 73.59.37 01

All korrespondanse som inngår i saksbehandling skal adresseres til saksbehandlende enhet ved NTNU og ikke direkte til enkeltpersoner. Ved henvendelse vennligst oppgi referanse.

- c. Det forutsettes at konsortieavtalen som hovedregel redigeres i to deler, en som gjelder generelt for alle N5T-masterprogram, og en spesifikk for vedkommende program, jfr. vedlegg om overordnet NMME-avtale. For NMME-programmet anses det ikke å være behov for noe programspesifikk avtale.
2. Den generelle konsortieavtalen om NMME-programmet forutsettes følgende:
    - a. Den enkelte institusjons bidrag til masterprogrammet skal godkjennes av vedkommende instans som er ansvarlig for godkjenning av studieplanene ved den enkelte institusjon (FUS ved NTNU). Masterprogrammets studieprogramråd er ansvarlig for å koordinere det endelige programmet
    - b. Det er fagansvarlig miljø ved institusjonene som oppnevner hhv. veileder og medveileder. Studieprogramrådet samordner informasjonen og gjør den tilgjengelig.
    - c. Det skal utarbeides presise læringsmål for studieprogrammet i hht. gjeldende retningslinjer.
    - d. Opptaksgrunnlaget til masterprogrammet spesifiseres i en generell del (felles opptaks-krav, eks. til matematikk), og en studieretnings-spesifikk del (ulike fagkombinasjoner)
    - e. Det bør ikke angis et konkret tall for antall studenter man ønsker å ta opp. Det bør være et relativt lite antall ved første opptak slik at man opparbeider erfaring med ordningen. Det bør være en viss kvotering av studenter ved opptaket slik at alle institusjonene får en rimelig andel av studentene til 1.årskurs.
    - f. Medveileder vil etter gjeldende inntektsfordelingsmodell ikke bli budsjettmessig dekket på ordinær måte. Institusjonene bør vurdere en ordning for å dekke dette
    - g. Det kan kun være ett opptak pr. studieår (høstsemesteret).
    - h. Studenten oppholder seg ett sammenhengende år pr. institusjon.
    - i. Studenten retter seg etter studiereglementet for angjeldende institusjon, inklusive eksamen og eventuelt gjentak. Jfr. likevel bestemmelsen om masteroppgaven, pkt.a
    - j. Det må avtales en felles søknadsfrist og opptaksprosedyre for masterprogrammet
    - k. Det utstedes ikke eget Nordic Five Tech- sertifikat for mastergraden, men det fremgår av Diploma Supplement at programmet er Nordic Five Tech-fellesprogram.
    - l. Bestemmelsene om Tuition fee bør tas ut av avtalen og utarbeides som et vedlegg til avtalen.
  3. Spesifikke anmerkninger vedr. studieplanen for NTNU-delen av programmet:
    - a. Delft-semester. To fagkombinasjoner fra NTNU innebærer at det ene semesteret undervises ved TU Delft. Dette kan medføre praktiske utfordringer for studentene, men formelt oppfattes dette semesteret som "undervist ved NTNU".
    - b. Ordinært emne som ledet selvstudium
    - c. Det forutsettes at de uferdige fagbeskrivelsene ferdigstilles før opptaket starter
    - d. Faglige vurderinger i studieprogrammet må naturlig ligge hos fagansvarlig miljø

Third draft, AMII, DTU, March 25, 2010 with remarks from Third Project Meeting 8<sup>th</sup>  
April 2010, compiled by Poul Andersen

## **Consortium Agreement**

### **Between**

**Aalto University School of Science and Technology, Finland,  
Chalmers University of Technology, Sweden,  
KTH, Royal Institute of Technology, Sweden  
Norwegian University of Science and Technology, Norway,  
Technical University of Denmark, Denmark,**

### **Concerning**

**The Nordic Master in Maritime Engineering, NMME**

### **Preamble**

This Agreement has been concluded by and between Aalto University School of Science and Technology (hereafter Aalto), Chalmers University of Technology, Sweden (hereafter Chalmers), KTH, Royal Institute of Technology, Sweden (hereafter KTH), Norwegian University of Science and Technology, Norway (hereafter NTNU) and the Technical University of Denmark, Denmark (hereafter DTU), hereafter referred to as the Consortium.

The consortium partners are all founding members of the Nordic Five Tech university alliance (N5T). It is a strategic goal of the alliance to become the Nordic check point for international M.Sc. Eng. students and to create synergy between existing study offers in order to provide high class study programmes with an added N5T value to N5T as well as international students. The NMME materializes this goal.

The faculties/departments responsible for implementing the NMME programme are: the Department of Shipping and Marine Technology at Chalmers; the Faculty of Engineering and Architecture, the Department of Applied Mechanics at Aalto; DTU Mechanical engineering, Section of Coastal, Maritime and Structural Engineering; the Faculty of Engineering Science and Technology at NTNU; the School of at KTH. The cooperating institutions should have same level as far as possible,

### **Article 1. Purpose and scope of the agreement**

The purpose of this agreement is to outline the principles and terms of implementing the joint Master's programme NMME by the Consortium. The programme has received the Nordic Master Programme acknowledgement from the Nordic Council of Ministers in 2009.

This Agreement has to be implemented within the legal requirements of each participating institution. The provisions of this agreement shall not be construed so as to diminish the fully autonomous position of any one university.

## **Article 2. Structure and Organisation of the Cooperation**

The NMME is coordinated by DTU. The implementation of the programme is overseen by a joint Programme Board, with two representatives from each institution, one professor and one administrative representative<sup>1</sup>. The Programme Board is chaired by DTU. The Programme Board can invite representatives of the Consortium universities who are not members of the Board to participate in individual tasks and projects. The Programme Board shall be responsible for ensuring that the teaching offered in the framework of NMME programme is delivered of the highest academic standards. Any considerable changes implemented to the courses and modules of NMME programme must be submitted to the Programme Board for approval. The Programme Board will meet at least once a year.

## **Article 3. Financing of the Programme**

The development of the programme is supported financially by the Nordic Council of Ministers. Each university covers its own expenses related to the teaching and administration of the Programme.

Co-financing might be foreseen for some activities.

Tuition fees: DTU charges tuition fees to non-EU students. At the time of recruitment for the programme, KTH and Chalmers will be charging tuition fees.

The consortium as such will not charge a tuition fee. The board may decide in future to charge tuition for the programme as a whole.

## **Article 4. Purpose of the Programme**

NMME is a two-year Master's degree programme (120 ECTS) in .....Engineering offered jointly by the Consortium. The NMME is based on the expertise of the participating universities within naval architecture, offshore engineering and maritime engineering. The aim of the programme is to:

- Provide and offer high quality education based on first principles within design, construction and operation of ship and offshore structures, including hydrostatics and stability, hydrodynamics, wave and wind loads, structural analyses and machinery .

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<sup>1</sup> Representatives are listed in annex



- Exploit the strong complementary specialties of the N5T partners in areas such as: CFD, yacht design, ship operations, decision support, emissions, high-speed craft, composites, offshore, fishery and agriculture, ice navigation, cruise liner design, These details seem unnecessary, they should be deleted, or maybe substituted with the study tracks to be worked out.
- Foster highly qualified candidates for industry and research.....**competence profile**

**Reflection of labourmarket needs and changes, Maritime eng. In the Nordic countries...**

### **Target group**

The programme targets international students wishing to profit from the N5T universities' long standing tradition and competence in the field and N5T students wishing to specialise in a specific area of expertise offered within the alliance. The programme is open to international and N5T students with a **background in... a proven academic record... ..are highly skilled within...**

### **Article 5. Programme Structure**

The programme is structured as a double degree programme, offering the possibility to study one year in two different institutions (**with variations/flexibility in some cases?**). It need not be one full year at two different institutions, but two semesters at university 1 and two semesters at university 2.

The length of the study period in each university corresponds to 60 ECTS. In order for the consortium members to issue an M.Sc. diploma, the following regulations apply:

- Students graduating from Chalmers must have obtained a minimum of 45 ECTS credits, including the Master's thesis, at Chalmers.
- Students graduating from NTNU must have obtained a minimum of 60 ECTS credits at NTNU, including the Master's thesis.
- Students graduating from Aalto must have obtained a minimum of 60 ECTS credits at Aalto including the Master's thesis. The Master's thesis must have an Aalto supervisor or co-supervisor and the thesis must be assessed at Aalto. This applies also to NTNU, in practice actually to all partners.
- Students graduating from DTU must have obtained a minimum of 60 ECTS credits at DTU including the Master's thesis. The Master thesis must have a DTU supervisor or co-supervisor and the thesis must be assessed at DTU.
- Students graduating from KTH must have obtained a minimum of 30 ECTS credits at KTH, including the Master's thesis.

### **Definition: institution 1 and institution 2**

**Institution 1 is where the student is admitted. Institution 2 is where the student conducts his/her thesis. This may be a little too rigid. A student may be admitted to Univ 1, go to Univ. 2 for two semesters and the come back for the thesis.**

Depending on the courses on offer, some universities may not be able to deliver the courses needed to function as institution 1 or institution 2. Possible combinations and recommended study tracks must be clearly described in the admission material.

#### **Language**

The language of the programme is English.

#### **Article 6. Contents of the Programme**

See annex.....

#### **Article 7. Degrees and Diplomas**

Students successfully completing the programme will be awarded a double degree, one diploma from each of the two universities where the student has studied. A Diploma Supplement and official transcript will be issued from both institutions.

The names of the degrees are:

Aalto:	Master of Science (Technology) Master's Programme in Maritime Engineering? Or/and Degree programme in Mechanical Engineering...
Chalmers:	Degree of Master of Science (two years) Master's programme in Naval Architecture within the main area Shipping and Marine Technology
DTU:	Master of Science in Engineering Degree programme: Master of Science in Engineering, Engineering Design and Applied Mechanics, Maritime Engineering
KTH:	Teknologie masterexamen, Master of Science (2-years) Degree programme: Master's Programme in Maritime Engineering
NTNU:	Master of Science in Degree programme: MSc in Marine Technology

Students who have met the requirements of the joint NMME programme will also receive a Diploma Supplement and a Nordic Five Tech document describing the consortium and the NMME programme.

#### **Article 8. Master's thesis**

As it is there is some overlap between the following and Article 5. This should eventually be removed.

The topic of the Master's thesis must be approved jointly by the two degree awarding universities that are part of the students study plan. The Programme Board will delegate the approval decision to the two tutors appointed to the student. The two universities will provide co-supervision for the thesis which will also be assessed at both institutions. Supervision and assessment will take place according to commonly defined guidelines.

The university where the student conducts the thesis work (*is physically present*) will act as the main supervisor and the thesis will be assessed according to the procedures and regulations of that university. Basically the same rules should apply to all students, if possible.

#### **Article 9. Student admission**

The annual intake of the NMME programme is 30 students. The Consortium aims to equally share the students among the Consortium members.

The common admission requirements are:

- A Bachelor degree (or equivalent – minimum 180 ECTS credits) in a relevant field, obtained at an international recognized university. We must allow intake both with and without Naval Architecture, see minutes from 8 April meeting. Minimum 180 ECTS is fine, but the subjects studied must also be checked, for instance by professors reviewing applications.
- Applicants from Polytechnics (FI), Högskoleingeniör (SE) and Diplomingeniører (DK) will be expected to do extra course work to qualify for the programme. The extra requirements range from 10-30 ECTS credits (FI).
- Anette Moen should please check Ingeniørhøyskolen i Norge
- Students must have obtained at least 75% of the maximum obtainable grade. Check the 75 %. Maybe the grade should be translated into A, B, C etc. and minimum C required.
- Documented coursework in basic .... /minimum requirement in...., example...
- Good knowledge of written and spoken English. Applicants must provide proof of their proficiency in English through the internationally recognised tests TOEFL or IELTS. The required minimum scores in the language tests are defined by the highest minimum requirements at the Consortium universities.

At present this is:

TOEFL:

Paper-based: minimum 580 (written section grade 4)

Computer-based test: minimum 237 (essay writing grade 4)

Internet-based test: minimum 92 (written section grade 22)

IELTS:

At least 6.5, no section lower than 5.5 (only IELTS Academic Training accepted).

#### **English language exemptions:**

1. Applicants who have completed a [university] degree instructed in English at a university that is physically located in one of the following countries:

- USA
- Canada
- UK
- Ireland
- Australia
- New Zealand

2. Applicants who have completed at least a 3-year degree instructed in English in an EU/EEA country.

3. Applicants whose first language is English and who have a citizenship from; USA, Canada, UK, Ireland, Australia or New Zealand.

For candidates fulfilling the above requirements, the ranking of students is done on the basis of student's academic achievements and a motivation letter by the applicant will also be considered.

Admission requirements will be evaluated annually. The student may start either with the fall or the spring semester, even if only one admission per year will be made.

When students apply they must indicate the two universities from which they wish to graduate and submit a draft study plan in order for the NNME programme co-ordinator to assign the relevant tutors and assess the track. Students may change the study plan and the university where they wish to conduct their thesis work during their first year of studies and at ?? at the latest,

The applicant must indicate which track (specialization) he wishes to follow and enrolment will be considered for the relevant specialization.

The students apply locally through each of the five consortium member institutions. Institutions will undertake a first screening based on common admission criteria and submit a shortlist for approval by the programme board. There must be consensus on students admitted between the two universities involved in the students study plan.

Which documents must be included in the application? Should the application also include a motivation letter?

There will be one deadline for the programme disregarding the local deadlines set by the individual member institutions. This deadline will be:???????

Students who have complaints regarding the admission must refer to the appeals policy and procedures of the institution where they applied.

#### **Article 10. Rights and status of the students**

For semesters one and two all students are registered as degree seeking students at institution no. 1. For semesters three and four students are registered as degree seeking students in institution no. 1 and 2. There should be a little more freedom in the selection as commented on earlier

Students will be subject to the regulations and procedures of the institution where they attend courses and sit for examinations in a given semester. Re-sits will take place according to the rules and regulations of the institution where the student attended the course. NMME students will be provided with the same academic resources and support services that are available to all students at that institution.

Courses/modules included in the student's NMME curriculum will be recognized fully and automatically by the two institutions issuing the double diploma. Upon completion of the stay in each of the two institutions involved in the study plan, the university will provide the student with an official transcript of records in order to provide for credit transfer.

### **Supervision and study plan**

All students will have two supervisors, one from each of the two institutions issuing the double diploma. The main supervisor will be from the institution where the student conducts his/her thesis work. The supervisors are appointed by the co-ordinator. There should also be one professor (the supervisor) who checks the study plan.

### **Article 11. Use of ECTS and grading system**

The Consortium universities will use the national grading scale for the assessment of course work and thesis. All universities use a credit system equal to the ECTS (European Credit Transfer System). The Programme Board will compile a scaling table/conversion table of all the grading systems used within the Consortium.

### **Article 12. Tuition fees and Student Union fees**

Danish Higher Education institutions charge tuition fees to non-EU students. Sweden will do so as of autumn 2011.

DTU charges tuition fees from degree seeking students who are non-EU/EEA citizens. The following non-EU/EEA citizens are exempted from tuition fees:

- Students studying at DTU as exchange students according to agreements between DTU and one or more universities abroad.
- Students with a "permanent residence permit" or a "time-limited residence permit issued with a possibility of permanent residence in Denmark, Finland, Iceland, Norway and Sweden".
- Students who have dual citizenship in both an EU country and a non-EU country.

In Norway and Finland there are currently no tuition fees. Should the national legislation change in this respect in any of the Consortium countries, the Programme Board will make the necessary amendments to the fee policy, which will reflect on this agreement.

At NTNU all students enrolled pay the semester fee.<sup>2</sup>

At Aalto, all degree seeking students enrolled as present at Aalto are obliged to pay the Student Union membership fee.

### **Co-supervision and tuition fees**

In cases where there is co-supervision between two institutions and one or both of institutions charge tuition fees, students will only pay half a tuition fee

### **Article 14. Collaboration and dialogue with Industry**

Scholarships...?

Competences needed?

Major stakeholders?

### **Article 15. Rights and obligations of the parties**

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<sup>2</sup> 430 NOK each semester in academic year 2009-2010. The fee goes to the Student Welfare Organization.

The Parties to this Agreement commit themselves to organizing and implementing the joint NMME programme for a period of five academic years starting from the academic year 2011-2012 maintaining the content of the programme substantially in the form approved by the Nordic Council of Ministers. The Parties to this Agreement shall individually and collectively, through their teaching and assessment, be responsible for the quality of the NMME programme and for the high standards of the degrees.

As the project coordinator, DTU will be responsible for;

- the general coordination of NMME and the managerial matters relating to the project, including the convening of Programme Board meetings,
- the financial management of the NMME project funding,
- the communication and reporting to programme sponsors,
- all communication to the partners on issues of general interest for the Consortium,
- keeping a register of NMME students,
- organizing the admission committee meeting and procedure

All NMME Consortium members will be responsible for;

- ensuring that the programme receives accreditation according to national standards
- organizing teaching in the NMME programme according to the jointly approved curriculum and division of tasks,
- providing academic support, counselling and tutoring for all NMME students, ensuring that appropriate library and computer facilities are made available for students,
- providing possibilities for learning elementary/basic skills in the national language for all NMME students, when applicable and if offered to international students. Anne Mette, could you please clarify this.
- sending appropriate representatives to Programme Board meetings,
- appointing one academic and one administrative representative to the Programme Board
- performing continuous evaluation of the NMME programme according to the institutional quality assurance procedures
- providing updated lists of enrolled students to the programme board and the coordinator

The NMME Programme Board will be responsible for;

- overseeing the implementation of the programme,
- ensuring that the teaching offered in the framework of NMME programme is delivered to the highest academic standard,
- planning and implementing specific joint NMME quality assurance activities, which will supplement the national and institutional quality work,
- seeking external funding for NMME,
- ensuring communication and cooperation between NMME and the appropriate local authorities responsible for the Master-level education and international administration,
- taking decisions on the structure of the NMME programme and on possible changes in the content of the programme, as well as on changes in the Consortium.

- The Programme Board will evaluate the project co-ordination and propose changes with regards to the division of responsibilities
- ensuring continuous development of NMME,
- selecting students and agree upon said selection
- evaluating the admission criteria
- maintaining dialogue with major stakeholders and industry with regards to candidates' competence profiles, labour market needs and scholarship possibilities
- defining a marketing strategy for the programme and contributing accordingly in marketing activities

#### **Article 14. Quality assurance**

Quality assurance will be based both on the ongoing national and university level practices and policies and on specific NMME quality assurance activities agreed upon by the Consortium and implemented by the Programme Board.

In 2013, the programme will be evaluated as a whole based on the experience from the first student cohort. The evaluation will be financed by the consortium,....

#### **Article 16. Renewal, termination and amendments**

This Agreement will come into effect with the appropriate signatures of each university of the Consortium and it will be in force for a period of five years. Parties to this Agreement may withdraw from the Agreement, and consequently from the Consortium, by giving six months notice to the other parties in writing. In the case of such withdrawal, it is agreed that any student, who at the date of the withdrawal has been accepted for the NMME programme and has commenced studies at the institution withdrawing from the Consortium, may complete the NMME courses under the terms of this Agreement within 4 years from the time he/she was accepted into the Programme. The Agreement is renewable and may be amended by mutual written consent of all the Parties.

#### **Article 17. Conflict resolution**

The NMME programme board shall endeavour to jointly resolve any disputes arising from interpretation of this Agreement. Any disputes that cannot be solved by the Programme Board shall be subject to negotiations between the Presidents on the Consortium universities. If the Presidents are not able to reach a decision, the case will be submitted to the Danish national court system.

This Agreement has been signed in six originals, of which each institution has taken one.

<b>Institution</b>	<b>Signature</b>	<b>Place and date</b>
<b>Aalto University School of Science and Technology</b> .....		
Prof. Matti Pursula		
Executive Dean		

**Chalmers University of Technology**

Prof. Karin Markides

President and CEO

.....

**Royal Institute of Technology**

Peter Gudmundsen

Title

.....

**Norwegian University of Science  
and Technology**

Torbjørn Digernes

Title

.....

**Technical University of Denmark**

Lars Pallesen

President

.....

DRAFT



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## Notat

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Til: Studieavdelingen v/ Jon Inge Resell

---

Kopi til: Ingvald Strømmen, Åge Søsveen, Hilde N Lysne

---

Fra: Fakultet for ingeniørvitenskap og teknologi

---

Signatur: Svein Remseth

## Studieprogramporteføljeendringer 2011/2012

### Eksisterende studieprogram:

Ved Fakultet for ingeniørvitenskap og teknologi er det følgende studieprogram:

#### **Master i teknologi/sivilingeniør:**

Bygg- og miljøteknikk, 5 og 2-årig masterprogram

Industriell design, 5 og 2-årig masterprogram

Ingeniørvitenskap og IKT, 5-årig masterprogram

Petroleumsfag, 5 og 2-årig masterprogram

Produktutvikling og produksjon, 5 og 2-årig masterprogram

Marin teknikk, 5 og 2-årig masterprogram

Tekniske geofag, 5-årig masterprogram

Energi og miljø, 5 og 2-årig masterprogram, IME er vertsfakultet

Geofag og petroleumsteknologi, 5-årig masterprogram, programmet utgår i fra 2012 (erstattet av Petroleumsfag og Tekniske geofag).

Undervannsteknologi, 2-årig masterprogram

#### **Realfag:**

Geologi, 3-årig bachelorprogram

Geologi, 2-årig masterprogram

#### **Internasjonale masterprogram, 2-årig:**

Hydropower Development

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Postadresse  
7491 Trondheim

Org.nr. 974 767 880  
E-post:  
postmottak@ivt.ntnu.no  
<http://www.ivt.ntnu.no/>

Besøksadresse  
Høgskoleringen 6  
Gløshaugen

Telefon  
+ 47 73 59 45 01  
Telefaks  
+ 47 73 59 3790

Seniorkonsulent  
Marit Snilsberg  
Tlf: + 47 +47 73594967

Alli korrespondanse som inngår i saksbehandling skal adresseres til saksbehandlende enhet ved NTNU og ikke direkte til enkeltpersoner. Ved henvendelse vennligst oppgi referanse.

Petroleum Engineering  
Petroleum Geosciences  
Marine Technology  
Coastal and Marine Civil Engineering  
Geotechnics and Geohazards  
Industrial Ecology  
Reliability, Availability, Maintainability and Safety  
Coastal and Marine Engineering and Management, Erasmus Mundus  
Marine Coastal Development  
Natural Gas Technology  
Innovative Sustainable Energy.

### **Mulige endringer i studieprogramporteføljen:**

#### **Deltakelse ved Erasmus Mundus-søknader 2010:**

Det er sendt inn søknad om opprettelse av EM-programmet Int. master of Science in Aquaculture (Aqua Mundi) fra dekanene ved IVT og NT-fakultetet 27.04. 2010, NT-fakultet er vertsfakultet.

#### **Søknad om opprettelse av Nordic Master Programme in Maritime Engineering**

Her er papirer sendt pr 10.09.2010 til studieavdelingen v/Jon Inge Resell og kopi til FUS v/ Åge Søsveen.

#### **Søknad om opprettelse av Nordic Master Program in Environmental Engineering**

På grunn av noe intern kommunikasjonssvikt har denne søknaden ikke blitt kjent for fakultetet før de siste dagene. Eventuell oppstart for dette programmet ønskes fra 2012/2013. Programmet vil ha to foci " i) Understanding and sustainable management of impacts on the environment caused by human activities ii) The development of new technologies to address environmental challenges."

Det vedlagte foreløpige utkast til søknad har ikke med fagplaner. Opplegget vil imidlertid bli mye det samme som for studentene oppholder seg ett år ved hvert av to valgte universiteter og det siste av årene vil være ved det universitetet som tilbyr masteroppgaven innenfor aktuell studieretning:

- Urban Water and Water Resources (NTNU/Chalmers)
- Residual Resources Engineering (DTU/NTNU)
- Environmental Informatics (Aalto/KTH)
- Risk Assessment (Chalmers/DTU)
- Environmental management (KTH/Aalto)

Av det som er anført i den foreløpige søknaden av opplegg/aktiviteter er det Summer School som ikke vil være aktuelt for IVT sitt vedkommende med nåværende regelverk.

Ved IVT-fakultetet er det Institutt for vann og miljøteknikk som vil være vårt primære fagmiljø. Instituttet har god kompetanse innenfor området og vil i et slikt samarbeid ytterligere kunne heve sin kompetanse. Det legges blant annet opp til tosidige evalueringer mellom de deltakende universitetene. DTU vil være koordinator for programmet.

IVT-fakultetet går inn for at vi deltar i en N5T-søknad innenfor dette området forutsatt at det bevilges utviklingsmidler fra Nordisk Ministerråd.

### **Søknad om fornyelse Erasmus Mundus-programmet**

#### **Coastal and Marine Engineering and Management**

Inneværende periode går nå mot slutten for dette programmet hvor vi deltar sammen med TU Delft (koordinator), University of Southampton, City University London og The Technical University of Catalonia Barcelona. Programmet har ved siden av et godt samarbeid om utdanning også bidratt til forskningssamarbeid spesielt med TU Delft.

Studenttallet for den inneværende periode har vært i underkant av 20 studenter pr år og med omtrent lik fordeling mellom universitetene i forhold til avsluttende studiested.

Hvis en får innvilget en ny periode vil det enten bli TU Delft som fortsetter som koordinator eller at denne rollen overtas av NTNU.

Hvis det blir en ny periode med dette Erasmus Mundus-programmet ønsker fakultetet å legge ned det internasjonale 2-årige masterprogrammet Coastal and Marine Civil Engineering.

Vedlegg: Application – Project information Nordic Master Program in Environmental Engineering



# Nordic Master Program 2010

## Application

### Project information

Title of the Nordic Master Program  
eNviro5Tech

Project number  
NMP-2010/10105

## A - Project partners

### A.1 Co-ordinating institution

#### A.1.1 Co-ordinating institution

Name of institution: DK-Technical University of Denmark

#### A.1.2 Project coordinator

Name: Binning, Philip  
Gender: Male  
Title: PhD, MA  
Position: Associate Professor  
E-mail address: pjbi@env.dtu.dk

Correspondence address: DTU Environment,  
Miljoevej, Building 113,  
DTU  
2800 Lyngby

Phone (including country and area code): +45 4525 2171

Mobile number:

Fax (including country and area code):

Institution: DK-Technical University of Denmark  
Department: Department of Environmental Engineering

#### A.1.3 Administrative contact person

Name: Holt, Anne Mette  
Gender: Female  
Position: Special Advisor, Study Division  
E-mail: amho@adm.dtu.dk  
Address: Study Division  
Technical University of Denmark  
Anker Engelundsvej, Bygning 101A  
Building 101A, room lokale 025  
2800 Kongens Lyngby  
Denmark

Phone number: +45 45251017

Mobile number:

Fax number:

Institution: DK-Technical University of Denmark

Department: Study Division

#### **A.1.4 Person in charge of finance on behalf of the Consortium**

Name: Binning, Philip

Gender: Male

Title: PhD, MA

Position: Associate Professor

E-mail address: pjbi@env.dtu.dk

Correspondence address: DTU Environment,  
Miljoevej, Building 113,  
DTU,  
2800 Lyngby,  
Denmark

Phone  
(including country and area code): +45 4525 2171

Mobile number:

Fax (including country and area code):

Institution: DK-Technical University of Denmark

Department: Department of Environmental Engineering

#### **A.1.5 Legal representative (Rector or equivalent)**

Name: Pallesen, Lars

Gender: Male

Position: Rektor

E-mail: rektor@adm.dtu.dk

Address: Rektoratet  
Technical University of Denmark  
Anker Engelunds Vej 1  
Building 101A, room 224  
2800 Kgs. Lyngby  
Denmark

Phone number: +45 45251000

Mobile number:

Fax number:

Institution: DK-Technical University of Denmark

Department: Rektoratet

## A.2 Partner institutions providing Master's degrees

### Partner institution

Name of institution: NO-Norwegian University of Science and Technology  
Name of department: Department of Hydraulic and Environmental Engineering  
Contact person: Walsø, Geir  
Gender: Male  
E-mail address: geir.walso@ntnu.no  
Correspondence address: Vassbygget\*415, S. P. Andersens veg 5,  
Institutt for vann- og miljøteknikk  
Trondheim  
N-7491  
Norway  
Phone (including country and area code): +47 73594768  
Fax (including country and area code):

Name of institution: FI-Aalto University - School of Science and Technology  
Name of department: Department of Civil and Environmental Engineering  
Contact person: Kaila, Juha  
Gender: Male  
E-mail address: juha.kaila@tkk.fi  
Correspondence address: Niemenkatu 73  
FI-15140  
Lahti  
Finland  
Phone (including country and area code): +358 40 354 8403  
Fax (including country and area code):

Name of institution: SE-Chalmers University of Technology in Göteborg  
Name of department: Department of Civil and Environmental Engineering  
Contact person: Wilen, Britt-Marie  
Gender: Female  
E-mail address: britt-marie.wilen@chalmers.se  
Correspondence address: Chalmers University of Technology  
Department of Civil and Environmental Engineering  
SE-412 96 Göteborg, Sweden  
Phone (including country and area code): +46 31 772 21 53  
Fax (including country and area code):

Name of institution: SE-KTH (Kungliga Tekniska Högskola) - Royal Institute of Technology in Stockholm  
Name of department: Architecture and the Built Environment  
Contact person: Brokking, Peter  
Gender: Male  
E-mail address: peter@infra.kth.se  
Correspondence address: School of Architecture and the Built Environment  
Royal Institute of Technology (KTH)  
100 44 Stockholm  
Sweden  
Phone (including country and area code): +46 8 790 92 70  
Fax (including country and area code):

### A.3 Other partners

### A.3 Other partners

## B - Content of the master programme

### B.1

#### B.1 Subject area of the master programme

##### Subject area

The eNviro5Tech Nordic Masters program is in the subject area of Environmental Engineering and Technology. The program has two foci i) Understanding and sustainable management of impacts on the environment caused by human activities ii) The development of new technologies to address environmental challenges. It addresses some of the most pressing current political issues such as climate change, sustainable generation of energy, management and renewal of aging urban infrastructure, provision of safe drinking water, contaminated land and waste management.



Environmental Engineering is an interdisciplinary science, bridging all the sciences and placing them in a social, economic and legal context. Within the discipline, there are areas of specialization, or small subject areas. For example, the development of new information technologies for environmental applications (Environmental Informatics) is currently a niche area of the discipline, but which is expected to grow dramatically in future as requirements for environmental monitoring and IT driven solutions increase.

## B.2

### B.2.1 Description of the master programme

#### Description

eNviro5Tech

A Nordic Masters Program in Environmental Engineering

#### Relevance

Environmental technologies are experiencing very strong growth and are a megatrend in technological development. For example, the environment industry had a 4% share of GDP in Germany in 2005 and is expected to rise to 16% of GDP in 2030 (Janicke, M., and S. Lindemann (2010), Governing environmental innovations, Environ. Polit., 19(1), 127-141.). Similarly, IBIS World, the world's largest independent publisher of U.S. industry research, predicted earlier this year that Environmental Consultancy will be among the 6 fastest growing markets world wide (<http://finance.yahoo.com/news/Six-FastGrowing-Markets-for-tsmf-1548669226.html?x=0&.v=1>). The fast growth is fueled by innovation as companies develop new products to satisfy societal demands (Janicke, M., and K. Jacob (2004), Lead markets for environmental innovations: A new role for the nation state, Global Environmental Politics, 4(1), 29-46).

Universities must develop the capacity to generate the graduates to meet increasing market demand and must develop innovative and flexible educational products which can respond to the needs of a rapidly changing market. This proposal aims to address these needs.

Scandinavia is a world leader in the development of Environmental Policy and Technology (see Janicke and Jacob 2004). Scandinavia is therefore the ideally positioned to take advantage of the Green Megatrend. This proposal aims to develop a Scandinavian educational center that can take advantage of this and can provide global leadership in the development of Environmental Technologies.

#### Objectives

- Provide through the consortium, the most comprehensive environmental engineering degree program in the world.
- A more dynamic degree program is needed to drive innovation in the growing environmental sector. Because of resource limitations, it is more difficult for single universities to address new challenges in Environmental Engineering with comprehensive programs. By pooling resources of 5 top Nordic Universities, the resourcing barriers for new programs are smaller. This should lead to more dynamic degree programs.
- Education is linked to innovation through research. The proposal will enhance Nordic research in Environmental Technologies by providing a vehicle for joint Nordic research in Environmental Engineering, based on collaboration on MSc theses.
- By pooling resources, it will be possible to offer degree programs with increased depth and opportunity for specialization.
- eNviro5Tech will be a marketing vehicle for Nordic excellence in Environmental Engineering.
- Increase quality of degree programs through regular (5 yearly) inter-university QA reviews of MSc degrees.
- Facilitate a Nordic marketplace for MSc graduates based on a Nordic MSc platform in Environmental Engineering.
- Facilitate a better use of resources. For example, Scandinavia does not need more than one world class hydraulics lab. These facilities are expensive, highly specialized, and the market for graduates is

too small to sustain labs at all consortium universities. The eNviro5Tech degree will enable students from all 5 university partners to access and use these facilities. Other examples of highly specialized labs amongst the consortium are the Environmental Informatics lab at Aalto.

- Internationalization of education is critical in a global marketplace. This proposal aims to increase mobility of students and academics between Nordic Universities with equal exchange between partners. This will be facilitated through clearly defined and visible (to students) study tracks so that it is easy for students to move between universities.
- To provide a common pool of well trained MSc graduates for potential PhD study. These students are mobile, and meet a common standard for all 5 university partners. This should increase the potential pool of applicants and increase the ability of universities to hire MSc students from another university.

## Content

- Double degree program of 120 ECTS, with 60 ECTS from each of two universities in the N5T consortium.
- Thesis jointly supervised and examined by the two universities.
- Student earns a MSc degree at both institutions.
- Language: English.

## Study tracks

A set of predefined study tracks in 7 areas chosen from the best classics from a set of well established MSc programs and the newest hits which address current environmental challenges in new degree structures.

### Study Track Lead Institution Partner Institution

- A. Urban Water and Water Resources NTNU Chalmers
- B. Residual Resources Engineering DTU NTNU
- C. Environmental Systems Analysis
- D. Environmental Informatics Aalto KTH
- E. Risk Assessment Chalmers DTU
- F. Sustainability
- G. Environmental Management KTH Aalto

Competence profiles for five of these study tracks are currently under development. At this time, each of the five partners has been given lead responsibility for defining one study track. The distribution of lead and partner Universities is shown above. The remaining study tracks and other combinations of institutions will be added at a later stage.

## Structure

Two possible structures are available, with the choice being set by the study program for each study track.

### Model A:

Semester 1 Semester 2 Summer school Semester 3 Semester 4  
University 1 University 1 XXX University 2 University 2

The summer school will be rotated between the consortium partners so that each University hosts a 3 week summer school once every 5 years. All students enrolled in the program will attend the summer school.

### Model B:

Semester 1 Semester 2 Summer school Semester 3 Semester 4  
University 1 University 2 XXX University 2 University 1

## B.2.2 Summary

### Summary

Environmental Technologies and Green Engineering are amongst the fastest growing markets in the world. Scandinavia is a world leader in Environmental Engineering, but Universities must adapt to meet increasing demand for innovative solutions and many new graduates. The eNviro5Tech joint MSc degree addresses this demand by pooling resources to create the most comprehensive degree in Environmental Engineering in the world. The eNviro5Tech MSc will be offered by the Nordic Five Tech, a strategic alliance of the five strongest technical universities in Scandinavia, with partners in Denmark (DTU), Sweden (KTH, Chalmers University), Norway (NTNU) and Finland (Aalto University). The program involves a set of 7 predefined study tracks leading to double degrees in Environmental Engineering. The program allows the development of new specialist areas such as Environmental Informatics and strengthens capacities in established areas such as Urban Hydrology, Water Supply and Waste Water Management.

The program aims to increase graduate output, enhance innovation and research and be a visible flagship for Scandinavian excellence in Environmental Engineering and Technologies. It will also be a vehicle for enhanced quality of educational programs and internationalization of degree programs to respond to the demands of a global marketplace.

## B.3 Contribution of each partner

### B.3.1 Contribution of each partner

#### Contribution

The eNviro5Tech program will be offered by the Nordic 5 Tech (<http://www.nordicfivetech.org/>), a strategic alliance of Scandinavia's top technical universities. The goal of the alliance is to utilize shared and complementary strengths and create synergy within education, research and innovation. One of the activities of the Nordic 5 Tech has been to establish a Quality Assurance system for Nordic MSc degrees. Four of the five eNviro5Tech partners were involved in the pilot project which set up this system.

#### DTU

The Department of Environmental Engineering is amongst the top five environmental engineering institutes in Europe in terms of number of staff and the impact of its scientific research. It offers 53 specialist courses in its Bachelors and Masters programs. Research is conducted in 4 areas:

- Water Resources Engineering
- Urban Water Engineering
- Residual Resources Engineering
- Environmental Chemistry and Microbiology

Each year DTU Environment publishes more than 100 international refereed journal papers. In 2008 the Danish Ministry of Science and Technology selected the Environment as one of 6 priority areas for research in its FORSK 2015 Strategy. DTU has research strength in many of the areas named in the strategy.

#### Chalmers University

The Department of Civil and Environmental Engineering is divided into 6 divisions. Two divisions, Water Environment Technology (WET) and GeoEngineering (GEO), offer together 13 specialist courses in the Master's program Geo and Water Engineering (new name from autumn 2011 is Infrastructure and Environmental Engineering) and 6 courses at bachelor level in the Civil engineering program. The Master of Science degree program is strongly coupled to the research carried out in the following areas:

- Geotechnical Engineering
- Engineering Geology
- Sustainable Aquatic Systems
- Engineering Hydraulics
- Risk Assessment and Remediation of Contaminated Areas (both soil and water)

There are 5 research competence centers and two of them are strongly involved in this application: Forum for Risk Investigation and Soil Treatment (FRIST); and Framework Programme for Drinking Water

Research (DRICKS). Each year WET and Geo together publishes more than 20 internationally refereed journal papers.

#### NTNU

The Department of Hydraulic and Environmental Engineering performs research in three areas:

- Hydraulic Engineering
- Water and Wastewater Engineering
- Industrial Ecology

Engineering science was evaluated by an international expert committee set up by the Research Council of Norway in 2004. The two former groups were rated as "excellent". The latter was rated as "good", but has since then strengthened in both capacity and quality. The two latter groups are responsible for the Departments activity in the EU project TRUST. The Water and Wastewater Engineering group has recently been a part of the EU projects EUROMBRA and TECHNEAU.

The five year integrated study program Civil and Environmental Engineering at NTNU was recently renewed to address changing requirements to the MSc candidates from the society and industry.

The syllabus addresses problems and challenges on supplying and sustaining water, energy and the necessary infrastructure renewal both on a national and global scale, aiming at giving students a holistic perspective on the management of resources and recycling.

#### Aalto University

Aalto University was created through merger of top Finnish universities on their fields: Helsinki University of Technology, Helsinki School of Economics and University of Art and Design Helsinki. The ambitious goal for Aalto University is to be among the world top research universities. The theme Sustainable Communities is one of four strategic fields for Aalto. The Department of Civil and Environmental Engineering has at Lahti Center three professorships: Waste Management, Environmental Planning and Management Informatics and Environmental Protection Technology. Aalto Lahti Center has hosted a Master's Degree Programme in Environmental Technology since 2006. Aalto Lahti Center has also an innovative system of mentor professorships. There are currently five mentor professors nominated in Lahti, both Finnish and foreign. In Enviro5tech programme Aalto is responsible on the study track Environmental Informatics.

#### KTH

Fill in 100 words here.

### **B.3.2 Application and admission procedures**

#### **Application and admission**

The eNviro5Tech consortium will use local admission combined with common admission criteria. Students thus apply directly to the institution where they wish to spend their first year of study including a draft study plan indicating the two universities from which they wish to graduate. The programme will have one common deadline on January 15.

Institutions will undertake pre-screening based on common admission criteria and submit a shortlist to the programme board. The Admissions Committee will rank the applicants according to academic achievements and co-ordinate so that the programme as a whole enrolls the best students and ensures that there are no cases of double admission.

By handling admission in this way, all partners will have to contribute to the pre-screening process and make it a joint effort. Also, the consortium will benefit from existing IT systems and admission procedures which are likely to qualify the process.

#### Tuition Fees

In 2011, both Denmark and Sweden will charge tuition fees to non-EU/EEA citizens. Due to the programme structure (students enrolled at different consortium institutions), the eNviro5Tech will apply a tuition fee model where students pay according to their mobility track and directly to the two institutions involved in the track.

### **B.3.3 Joint study programmes and relation to national legislation**

#### **Study programmes and relations**

Anne Mette Holt (DTU) will provide this section in August.

### **B.3.4 PhD requirement**

#### **PhD requirement**

All five eNviro5Tech partners offer PhD degrees in Environmental Engineering.

DTU Environment has more than 70 PhD students and hosts two PhD Schools (Urban Water Technology – UWT, 3R Residual Resources Research) and participates in two others (International Research School of Water Resources (FIVA), Research School of Environmental Chemistry and Ecotoxicology (RECETO)). These PhD schools regularly offer courses that are free and open to international participants. DTU offers an 'Elite Module' in Environmental Engineering as part of its MSc with the specific aim of providing a research education leading to a PhD. It is one of 6 elite degrees offered at DTU.

#### **Chalmers University**

WET and GEO have 20 PhD students and is involved in one PhD School (Civil and Environmental Graduate School). There are specializations in Engineering Geology, Geotechnical Engineering and Water Engineering. The PhD programme is 4 years with generally one additional year of department duties such as teaching and administration. Besides, graduate courses of 60 ECTS credits must be passed. There is a second degree (Licentiate) that is passed after about 3 years and 45 ECTS credits of courses. The PhD school offers courses regularly that are free and open to international participants. Master students are allowed to attend some of the courses.

#### **NTNU**

The Department of Hydraulic and Environmental Engineering has at present about 30 PhD students in all the research areas. Most of the PhD scholarships are funded by external resources through various research programs. The Hydraulic Engineering group is part of a large national research program in Center for design renewable energy (CEDREN), and has in addition a collaboration agreement with Energy Norway. The other groups receive funding as part of EU projects as well as other cooperation agreements with authorities and industry partners.

#### **Aalto University**

In times of mounting environmental problems, over-exploitation of natural resources, and global warming, the need to seek for solutions and to pursue a sustainable development has grown. The increasing legislative demands are setting pressure on industry and society. The need for change is apparent, and the hunger for environmental innovations is tangible. Aalto Lahti Center responds to the challenge and is executing research strategy by focusing research on the development of a recycling society and creating a scientific platform for environmental innovations. Lahti offers a full doctoral program to students with a MSc degree.

#### **KTH**

Fill in at most 100 words here.

### **B.3.5 Number of ECTS (Study credits)**

#### **Number of ECTS**

There will be 7 Envirotech study programs. Each program will be offered by two Universities from the consortium. Each program will be 120 ECTS, with 60 ECTS at each of two of the universities involved.

### **B. 3.6 Language**

#### **Language**

All courses in the eNviro5Tech program will be delivered in English.

DTU delivers all MSc level courses in English.

Chalmers delivers all MSc level courses in English.

NTNU delivers all MSc level courses in English.

#### Aalto

Internationalisation is one strategic development area in the Aalto University strategy. There are seventeen Master's degree programmes offered completely in English. All the courses of an international programme are in English. Student services and the International Guide Book are available in English. All students of an international programme will get a Diploma Supplement in English. The degree supplement is attached to the Diploma.

KTH was the first of the partners to offer an English language MSc and has had a complete program since 1993.

## **B.4 Nordic added value**

### **B.4.1 Academic quality**

#### **Academic quality**

Quality will be increased by:

- QA reviews (see section B5)
- Better and more efficient use of resources. Technical solutions often require highly specialized skills and facilities. By sharing resources throughout Scandinavia, it will be possible to develop specialized facilities and centers of learning that can be accessed by all eNviro5Tech partners. For example, NTNU has one of the worlds best hydraulics labs. These types of facilities are not present at other eNviro5Tech Universities. eNviro5Tech will also create a greater pool of students to support highly specialized labs, a critical factor for their viability. Very specialized labs may not be sustainable with small student numbers at a single University.
- Mobility of students and academics. Exchange of experience between partners will accelerate improvements in educational programs.

### **B.4.2 Contribution to excellence and competitiveness**

#### **Contribution**

##### **Excellence**

The proposal aims to create the most comprehensive environmental engineering degree program in the world. This will provide leadership in an area of great economic importance for Scandinavia. The leadership will be in the form of quality graduates, research and readily available technical expertise for the benefit of society.

##### **Competitiveness**

Competitiveness will be enhanced by the creation of an attractive, visible, and internationally competitive degree program.

## **B.5 Quality assurance**

### **B.5.1 Measures to assure the quality of the master programme**

#### **Measures to assure the quality of the master programme**

In 2009 four of the five eNviro5Tech partners participated in a pilot project to set up a quality assurance review procedure for MSc degrees. The review started with a joint meeting of all participants, where the review criteria were presented. The participants were then paired for the review itself. Each university presented their program with following discussion. Each participant then produced a comprehensive written self evaluation, including documentation for the various quality measures required. This was then followed by a second meeting of the pairs, where the self evaluations were presented and discussed. Following the meeting, a written peer evaluation was produced, based on the documentation provided in the self evaluation. A response to each review was presented at a final meeting of all participants. The review had two main benefits: feedback on programs; and interaction/collaboration forming the basis for future joint activities. The current proposal is developed on the basis of this review. The QA procedure developed in the project will now be used by all Nordic Five Tech partners, with reviews of each degree program being planned at 5 year intervals.

All MSc theses will be jointly supervised by two universities, providing an inter-university review of quality that will increase both the quality of degree outcomes and research.

The collaboration will also improve the quality of administrative procedures for the degree programs through the development of a joint admission procedure and by increasing interactions between program partners.

Finally, quality of individual courses and degree programs will be improved by increasing mobility between universities. Weaker programs and courses will need to improve markedly in order to remain attractive to students.

### **B.5.2 Connection to research**

#### **Connection to research**

The eNviro5Tech program will be closely coupled to research activities at the participating Universities. One of the main aims of the program is to facilitate the development of a Nordic Center of Excellence in Environmental Engineering based on active research exchange and internationally competitive degree programs. The program will produce a pool of graduates who are ready to conduct PhD level research and who have been exposed to top level international research through their studies. Each of the 7 study tracks in the eNviro5Tech program will be based on research strength at the host institution.

All MSc projects will be supervised by active researchers, and will be part of the overall research strategy of the University where the research is conducted. In many cases industry will be involved in the development of MSc projects to ensure their societal relevance.

### **B.5.3 Evaluation of the master programme**

#### **Evaluation of the master programme**

Long term success criteria and measures

- Mobility: Increased number of students completing Environmental Engineering degree at more than one Scandinavian country. Aim to have a sustained enrolment of 30 students in the program.
- Increase in enrolments in Environmental Engineering degrees at all partner universities.
- Increased quality of degree offerings as measurable by completion of regular MSc QA review process.
- Increased Nordic research grant success at EU.

Schedule:

The proposed project will be completed at the end of 2012. At that time, the program will only just have enrolled its first students. Therefore the project success criteria will be:

- Successful completion of project program, including joint meetings to set up the degree.
- Successful launch of the eNviro5Tech MSc, with study tracks involving all 5 partners.
- A good uptake of students in the first year, with enrolments in all study tracks.

The long term measures will be evaluated 3 years after the program launch.

## **B.6 Innovation**

### **B.6.1 Innovative aspects regarding the content of the master programme**

#### **Regarding content**

Studies show new ideas and innovations are created in the interfaces (e.g. at the Finland Futures Research Center). Students should be encouraged to unorthodox and multidisciplinary study combinations. An example of innovation is the study track in Environmental Informatics which is an emerging field that is an essential part of Environmental Engineering. The only professorship of this field in the Nordic countries is located in Aalto University in Finland. The field is very international and with international importance. The program will combine IT courses such as Machine learning (Aalto course T-61.3050), with Environmental courses such as Cycle Techniques of Products Production Systems (Aalto course Yhd-73.3225) and bridge the gap between the disciplines via cross disciplinary courses such as Environmental Planning and Management Informatics (Aalto course Yhd-102.3321). The strong program in IT at Aalto will be complemented by programs in Environmental Engineering at other Universities.

Another example of innovation lies in the Residual Resources Engineering study track. Here the expertise of NTNU in industrial ecology (life cycle assessment, material flow analysis) is combined with

DTU expertise in solid waste technology and management, chemical risk assessment, modeling and bioenergy. Such a program is innovative because it involves the optimization of the use of resources/ materials throughout the production process. In particular, waste is regarded as a residual resource. DTU and NTNU are international leaders in each of these areas and the proposed study track is a good opportunity for Scandinavian synergy.

A third example is the study track in Environmental Risk Assessment which aims to address the societal need for qualified competence in planning, design, construction and maintenance of infrastructure systems in soil and water, which will contribute to long-term sustainable development. Contamination of soil and water, lack of access to drinking water, and unsustainable use of land and water resources remain major obstacles to global sustainability, while new challenges include threats from climate change and rapid urbanisation. The program promotes the personal development of knowledge, skills and attitudes that are needed to start working as a professional engineer in the field of infrastructure and environmental engineering, including development of roads, traffic planning, foundation of structures and buildings, tunnels, remediation of contaminated sites, protection of soil and water resources, design of drinking water and wastewater treatment plants and distribution systems. An important task is to be responsible for the interface between urban development and the environment. A common thread throughout the programme is sustainable development and sustainability is addressed in all courses. The program has a nationally and internationally unique profile as it deals with different aspects of infrastructure with integrated environmental and sustainability relevance. One of the courses in the study track is Urban metabolism (Chalmers) which will give the students knowledge about urban systems and the flows of energy and resources in urban areas – the proper use of our natural resources being a key to understanding the sustainable construction of our infrastructures. Another course in the study track is Contaminated Sites (DTU) which describes the processes governing contaminant mobility in soils and introduces soil and groundwater remediation technologies.

## **B.6.2 Innovative aspects regarding the teaching methods of the master programme**

### **Regarding teaching methods**

In many courses the learning approach is problem based learning (PBL) which is characterized by using real life situations and group work as starting point for learning, and the students' own responsibility for obtaining knowledge. PBL differs from traditional learning because of the focus on themes with many traditional disciplines represented. In traditional approaches to learning, education follows established scientific disciplines and generally starts with the basics first. In problem-based learning, we start from examples from real-life, but the same content is covered. It is important that the knowledge is meaningful, useful and relevant. Interaction between students is also important as the students acquire knowledge from each other as well as from the teachers.

Another aim of the programme is to prepare the student for a professional career through integration of professional experiences into education. This will increase quality and competitiveness, increase the study motivation and employability. In most courses, assignments are based on real data often in cooperation with companies, where professional engineers participate in the supervision of the projects. Often, projects are based on projects run between research groups at Chalmers and industry or government. Guest lecturers are common in most courses as well as study visits to companies and institutions. Many Master's thesis projects are taking place at companies where students participate in real projects and get valuable insights into the everyday work for a professional engineer. Most teachers involved in the program perform research projects in collaboration with industry.

eNviro5Tech will make extended use of Learning Management Systems for communication with students as well as the teachers involved. For example, one of the subjects in the NTNU program "Experts in team" focuses on bringing students from various disciplines together for solving problems on a multidisciplinary arena.

## **B.7 Dissemination**

### **B.7.1.Examples of good practice**

#### **Good practice**

Outputs: See section B5.3



#### Examples of Good Practice

- Common admission procedures which can be used by other Nordic Five Tech degree programs.
- Agreements on common degree fees across Scandinavia.
- Common QA procedures
- Creation of program structures for double degrees which can act as templates for other programs.
- Establishment of a platform for collaboration that can improve the performance of all partners, e.g. by increasing enrolments at all partner Universities.

### **B.7.2 Dissemination and exploitation of results**

#### **Dissemination and exploitation of results**

The proposed project will create the third joint MSc degree program offered by the Nordic Five Tech Consortium. These MSc programs aim to be the platform for a much more comprehensive set of common degree programs in the Nordic Five Tech by providing the additional resources to solve the problems inevitably arising when homogenizing international degree programs. For example, the four countries involved have different fee structures for non-EU students and the development of this proposal has led to the successful negotiation of an agreed common fee system for the Nordic Five Tech Universities. It has also led to the development of a common deadline for applications for admissions for the Nordic Five Tech Universities. These and other problems solved will rapidly be disseminated to all Nordic Five Tech partners through an existing schedule of regular meetings of the University leadership and administration.

## **B.8 Target groups and recruitment of students**

### **B.8.1 Target groups and marketing within the Nordic region**

#### **Within the Nordic region**

The target group for the eNviro5Tech program consists of 5 groups:

1. Bachelors of Science in Environmental Engineering from the five partner institutions
2. Bachelors from other suitable degree programs at the five partner institutions, for example Chemical Engineering, Biological Engineering, Civil (Water) Engineering, Geotechnical Engineering.
3. Bachelors from other institutions in Scandinavia.
4. EU Bachelors.
5. Non EU Bachelors.

The individual universities involved in the eNviro5Tech program have experience with enrolments in Environmental Engineering students from all 5 categories.

Application for admission to the degree will be increased by marketing. Research conducted at DTU shows that the most important form of advertising in higher education is the WWW, so emphasis will be put on this form of marketing.

### **B.8.2 Target groups and marketing outside the Nordic region**

#### **Outside the Nordic region**

The proposed eNviro5Tech degree in Environmental Engineering will be the biggest program of its kind in Europe. We therefore expect that it will be quite attractive for European students. For non-EU citizens, we are competing in a global educational marketplace and the degree must be paid for with full fees applying. Because of this, the success of the degree will depend on the international research performance of the program. In this regard, we are well prepared, with some of the world's leading researchers in Environmental Engineering being based in Scandinavia. For example, the ISI-Highly cited database contains the most highly cited scientists in the world. There are 31 such scientists in Denmark and two of them are at DTU Environment.

## **B.9 Sustainability**

### **B.9.1 Sustainability of the master programme**

#### **Sustainability**

The eNviro5Tech degree builds on 5 successful MSc degree programs in Environmental Engineering, with the expected benefits being synergy between degrees and a better profile for Environmental Technologies in Scandinavia. Because the current programs are successful, with a consistent enrolment, we expect that the eNviro5Tech will also be sustainable.

## **B.9.2 Financing**

### **Financing**

The eNviro5Tech program is built on a suite of existing MSc programs in Environmental Engineering. These programs and their anchorage to National needs will ensure continued funding for eNviro5Tech.

## **C - Development period of the master programme**

### **C.1 Description of the development period**

#### **C.1.1 Goals and achievements during the development period**

##### **Goals and achievements**

See section B2.1 for overall objectives of the eNviro5Tech program.

The main goals and achievements of the project are embodied in a set of milestones:

##### **Milestones:**

Sept. 2010-April 2011: Planning phase.

Jan 2011: Meeting 1: Kick off meeting 1 (Aalto).

May 2011: Meeting 2: Planning meeting 2. Program design. Agreement on advertising (KTH)

15 June 2011: Interim report on project due.

Summer 2011: Advertisement for eNviro5Tech program launched. WWW site created.

Jan 15 2012: First deadline for student admissions to eNviro5Tech program.

Feb 2012: Meeting 3: Candidate evaluation meeting and meeting on detailed degree rules (NTNU).

April 2012: eNviro5Tech degree rules updated, University handbooks updated

Sept. 2012: First students start in eNviro5Tech program.

Sept 2012: Meeting 4: Final project meeting (DTU)

15 Oct 2012: Final report on project due.

#### **C.1.2 Main activities during the development period**

##### **Main activities**

The eNviro5Tech program will be launched in Sept 2012. This project will support the costs of coordinating the development of a joint educational program across 5 institutions in 4 countries.

The main activities of the project are:

1. Project coordination. Development of joint programs, organisation of meetings etc.
2. Four joint meetings of all 5 partners to develop, coordinate and agree on program structure.
3. Dissemination of project results through a WWW site.

#### **C.1.3 Institutional and national anchorage**

##### **Institutional and national anchorage**

The eNviro5Tech program will be anchored in 5 existing Environmental Engineering programs at the five partner institutions. These existing programs will also ensure the national anchorage of eNviro5Tech.

#### **C.1.4 Monitoring and evaluation during the development period**

##### **Monitoring and evaluation**

Progress will be monitored and evaluated at a series of 4 coordination meetings of all project partners over the two year period of the project. To ensure involvement of all project partners, each of the four countries involved in the project will host one of the meetings.

### **C.2 Partnership**

#### **C.2.1 Previous collaboration**

##### **Previous collaboration**

The eNviro5Tech proposal builds on several years of collaboration on Environmental Engineering MSc education between the partners, including:

- 2007 proposal to Nordic Council of Ministers for a joint MSc degree (Chalmers, DTU, NTNU)

- 2009/10 MSc quality assurance pilot project run by the Nordic Five Tech. Four out of the five members of the current proposal consortium were part of the QA project which successfully introduced peer institutional review of MSc degrees to the Nordic Five Tech Institutions (Chalmers, KTH, NTNU, DTU).
- A May 2010 meeting was held at DTU of all five project partners to provide the foundation for the submitted proposal and future work.

The level of scientific collaboration between the partners is relatively modest at the current time. The table below shows the number of joint publications in the areas of Environmental Engineering, Environmental Sciences, Civil Engineering, Geosciences and Water Resources (Source: Web of Science) between 2005-9. The Nordic Five Tech had a total of 440 joint journal publications during that time. Despite the modest amount of collaboration, the individual universities involved in the proposal are productive, e.g. DTU Environment has published more than 400 journal publications in this period. This proposal has described the importance of enhancing Nordic collaboration in Environmental Engineering. The table demonstrates that initiatives such as the proposed eNviro5Tech MSc are critical to encouraging future trans-Scandinavian research in Environmental Engineering.

Table 1. Each entry in the table shows the number of joint ISI Web of Science journal publications between two of the University partners.

DTU NTNU Chalmers KTH Aalto

DTU -

NTNU 2 -

Chalmers 5 2 -

KTH 3 1 4 -

Aalto 0 0 1 1 -

\* Note: we regret that formatting of tables is not possible in the application system. The first set of numbers are in the DTU column, the second in the NTNU column etc.

### **C.2.2 Division of work between the partners**

#### **Division of work between the partners**

All 5 partners will be involved in detailed program development and will be coordinated by the post doctoral assistant and webmaster employed on the project. Because it is impractical to spread the coordination and web roles over 5 institutions, these resources will be concentrated at DTU, who will have the coordinating role on the project.

The project will include 4 meetings to coordinate the new program. Each country will host one of these meetings.

### **C.2.13 Division of funds**

#### **Division of funds**

Most of the funding is to support a coordinator and Webmaster for the project who will be a resource available to all 5 partners in the project. For practical reasons, these will be hosted at DTU Environment (see section C2.2). Travel and meeting money will be distributed equally between all partners.

**C.3 Work programme**

	<b>Activity</b>	<b>Start year</b>	<b>Start date</b>	<b>End year</b>	<b>End date</b>
1	Meeting 1: Kick off meeting 1 (Aalto)	2011	Jan 2011	2011	Jan 2011
2	Meeting 2: Planning meeting. Program design. Agreement on advertising (KTH)	2011	May 2011	2011	May 2011
3	Meeting 3: Candidate evaluation meeting and meeting on degree rules (NTNU)	2012	Feb 2012	2012	Feb 2012
4	Meeting 4: Final project meeting (DTU)	2012	Sept 2012	2012	Sept 2012
5	Consortium Agreement (See rectors letter, which is part of this proposal)	2010	Sept 2010	2010	Sept 2010
6	Curriculum	2011	Jan 2011	2011	April 2012
7	Interim report	2011	Jan 2011	2011	15 June 2011
8	Website	2011	Summer 2011	2011	Fall 2011
9	First application deadline for students	2012	Jan 15 2012	2012	Jan 2012
10	Start of Courses	2012	Sept 2012	2012	2012
11	Final report	2012	Jan 2012	2012	15 Oct 2012

## C.4 Budget

### C.4.1 Budget

	2010 (DKK)	2011 (DKK)	2012 (DKK)	Sum
<b>Development of study programmes/courses</b>				
Salaries / fees /employers' fees / general expenses	0	0	0	0
Travels	0	55 000	55 000	110 000
Costs for seminars, workshops, etc	0	5 000	5 000	10 000
Purchase of products and services	0	15 000	15 000	30 000
<b>SUM - Development of study programmes/courses</b>	<b>0</b>	<b>75 000</b>	<b>75 000</b>	<b>150 000</b>
<b>Dissemination</b>				
Dissemination of results, including printing costs	0	100 000	30 000	130 000
<b>SUM - Dissemination</b>	<b>0</b>	<b>100 000</b>	<b>30 000</b>	<b>130 000</b>
<b>Project management</b>				
Salaries, coordinating institution	0	140 000	140 000	280 000
Evaluation	0	0	0	0
Other costs	0	220 000	220 000	440 000
<b>SUM - Project management</b>	<b>0</b>	<b>360 000</b>	<b>360 000</b>	<b>720 000</b>
<b>SUM - Total</b>	<b>0</b>	<b>535 000</b>	<b>465 000</b>	<b>1 000 000</b>

#### Comments to the budget

4 one day meetings planned. Travel costs for each DKK 27500. As the meetings will be held on campus and will only involve day time catering, costs of the meetings are small (2500 per meeting).

Purchase of products and services includes is a general item for miscellaneous project costs.

The main dissemination will be via the WWW. The amount indicated is to support development of the WWW pages. These costs will be greatest in the first year of the project.

Salaries, coordinating institution includes salary for a project coordinator, who will be employed at DTU Environment. This will be a post doctoral research associate. The salary costs for such a position are DKK 541,203 and DKK 557,439 in 2011 and 2012 respectively (including pension, vacation payment, social expenses, severance pay). The budgetted amount of 140,000 per year is therefore equivalent to 3 months salary per year of the project.

Overhead is included as an 'Other cost' and is 44%.

### C.4.2 Detailed financial plan

	Title	2010 (DKK)	2011 (DKK)	2012 (DKK)	Sum
1					

#### Comments to the financial plan

See section C.4.1



## Notat

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Til: Jon Inge Resell

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Kopi til:

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Fra: Fakultet for naturvitenskap og teknologi

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## Studieprogramporteføljen 2011-2012. Forslag til endelig studieprogramportefølje 2011/2012 for fakultet for naturvitenskap og teknologi.

### Gjennomgang av studieprogramporteføljen ved Fakultet for naturvitenskap og teknologi

Fakultet for naturvitenskap og teknologi har i 2010 på sin handlingsplan å gjennomgå studieprogramporteføljen med sikte på forenkling av denne. Som et ledd i dette arbeidet har fakultetet satt i gang en vurdering av sitt studietilbud i bioteknologi. Mulighetene for å legge ned enkelte program innenfor dette fagfeltet vurderes. Dette arbeidet er ikke avsluttet. Endringer vil derfor bli foreslått i forbindelse med behandlingen av studieprogramporteføljen for 2012/2013.

NT-fakultetet utreder videre muligheten for overgang til internasjonale masterprogram for samtlige av sine toårige mastergrader. Endringer basert på denne utredningen vil bli foreslått i forbindelse med behandlingen av studieprogramporteføljen for 2012/2013.

I sitt innspill til studieprogramporteføljen for 2011/12 innsendt 23.04.2010 anbefalte Fakultet for naturvitenskap og teknologi at det internasjonale studieprogrammet Medical Technology ikke skulle videreføres i sin nåværende form. På basis av styrevedtaket i styresak 42/10 har fakultetet i samråd med leder for studieprogramrådet for dette studieprogrammet og tematisk satsingsområde Medisinsk teknologi gjort en ny vurdering av om studieprogrammet bør videreføres. Det er et sterkt ønske fra satsingsområdet at studieprogrammet opprettholdes. Programrådet for MSc in Medical Technology ble, som et ledd i denne vurderingen, bedt om å foreslå en handlingsplan for å bedre rekrutteringen til dette studiet siden rekruttering har vært et alvorlig problem for dette studieprogrammet. Planen er vedlagt, vedlegg 1. Det må i denne sammenheng påpekes at det ved studiestart høsten 2010 har møtt 9 studenter på dette studieprogrammet. På basis av innspillene fra studieprogrammet og det tematisk satsingsområdet Medisinsk teknologi foreslår Fakultet for naturvitenskap og teknologi at studieprogrammet videreføres for en periode på ytterligere 3 år, som vil svare til opptak til og med høsten 2013. Fakultetet foreslår videre at studieprogrammet evalueres sammen med det tematiske satsingsområdet som er vedtatt videreført til utgangen av 2013. I denne evalueringen bør rekruttering

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All korrespondanse som inngår i saksbehandling skal adresseres til saksbehandleren ved NTNU og ikke direkte til enkeltpersoner. Ved henvendelse vennligst oppgi referanse.

inngå. Videre bør det vurderes om organiseringen i form av ett internasjonal masterprogram er hensiktsmessig i forhold til organisering og synliggjøring av studietilbudet innenfor feltet medisinsk teknologi ved NTNU på den internasjonale arenaen. Fakultetet mener at en forutsetning for en eventuell videreføring av studieprogrammet utover opptaket 2013 må være at studieprogrammet fyller minimum 20 studieplasser med godt kvalifiserte studenter ved opptaket høsten 2013. Fakultet har på nåværende tidspunkt ikke ressurser til opprettelse av egne emner for dette studieprogrammet.

Fakultet for naturvitenskap og teknologi foreslår på denne bakgrunn ikke å legge ned noen studieprogram i forhold til porteføljen for 2010/11.

### **Søknad om opprettelse av nye studieprogram**

Fakultetets søknad om Erasmus Mundus programmet "Aqua Mundi" ble ikke innvilget. Det fremmes derfor ikke noe forslag om opprettelse av dette studieprogrammet ved NTNU for studieåret 2011/12.

I løpet av sommeren 2010 har Fakultet for naturvitenskap og teknologi fått forespørsel om deltakelse i en søknad til nordisk ministerråd om støtte til opprettelse av et nordisk masterprogram "Aquatic Food Production – Quality and Safety". Et notat som beskriver det foreslåtte studietilbudet fra professor Turid Rustad er vedlagt, vedlegg 2. Fakultetet har i dag ingen studietilbud i samarbeid med utenlandske institusjon verken i Norden eller Europa for øvrig. Som et ledd i sin internasjonalisering ønsker fakultetet å delta i nordiske og/eller andre internasjonale samarbeid om utdanningstilbud.

Det foreslåtte studietilbudet "Aquatic Food Production – Quality and Safety" er knyttet til det tematiske satsingsområdet Marin og maritim forskning ved NTNU. Fagmiljøet ved NTNU er ikke så stort, men vår forskningsmiljøer ved NT-fakultetet og IVT-fakultetet har en kompetanse som gir et sterkt faglig bidrag til det foreslåtte studietilbudet, og som utfyller tilbudet gitt ved de samarbeidende institusjonene. Fakultetet har vært i kontakt med IVT-fakultetet, som så langt har gitt en positiv tilbakemelding på forslaget. Noen av emnene som vil inngå i dette tilbudet gis ved IVT-fakultetet. Fakultet for naturvitenskap og teknologi mener dette er et studietilbud som NTNU bør delta i og fremmer på denne bakgrunn forslag om at NTNU støtter at søknaden om støtte til etablering av studietilbudet "Aquatic Food Production – Quality and Safety" sendes nordisk ministerråd til fristen 15. september. Studietilbudet er planlagt opprettet fra studieåret 2012/13. Det gjøres oppmerksom på at det foreslåtte studietilbudet ikke er organisert innenfor Nordic 5 Tech samarbeidet.

Fakultet for naturvitenskap og teknologi foreslår på denne bakgrunn ikke å opprette ned noen studieprogram i forhold til porteføljen for 2010/11, men en eventuell innvilgning av støtte fra nordisk ministerråd til oppretting av studietilbudet "Aquatic Food Production – Quality and Safety" vil medføre et forslag om oppretting av et studieprogram ved NTNU fra 2012/13.

### **Videreføring av studieprogram**

Fakultet for naturvitenskap og teknologi foreslår å videreføre følgende studieprogram i 2011/2012:



*Realfag, lavere grad*

Biologi og kjemi - årsstudium

Biologi - bachelorstudium

Fysikk - bachelorstudium

Kjemi – bachelorstudium

*Sivilingeniørstudiet*

Fysikk og matematikk - masterstudium (5-årig)

Industriell kjemi og bioteknologi - masterstudium (5-årig)

Industriell kjemi og bioteknologi - masterstudium (2-årig)

Materialteknologi - masterstudium (5-årig)

Materialteknologi - masterstudium (2-årig)

Nanoteknologi - masterstudium (5-årig)

*5-årige masterprogram, realfag*

Bioteknologi (5-årig) – masterstudium

*2-årige masterprogram, realfag*

Biologi – masterstudium

Bioteknologi – masterstudium

Cellebiologi for medisinsk/teknisk personell – masterstudium

Fysikk – masterstudium

Kjemi – masterstudium

*Internasjonale masterprogram*

MSc Chemical Engineering

MSc Condensed Matter Physics

MSc Environmental Toxicology and Chemistry

MSc Light Metals Production

MSc Medical Technology

MSc Natural Resources Management

MSc Silicon and Ferroalloy Production

Med vennlig hilsen

Anne Borg /s/

Prodekanus utdanning



## Notat

Til:	Anne Borg, Prodekanus utdanning				
Fra:	Tore Lindmo, Programleder Internasjonal master i medisinsk teknologi				
Kopi til:	Catharina Davies, Leder tematisk satsingsområde medisinsk teknologi				
Gjelder:	<b>Rekrutteringsplan for internasjonalt masterprogram i medisinsk teknologi.</b>				
Saksbehandler:	Tore Lindmo				
Dato:	02.09.2010	Signatur:		Arkiv:	

Mulige tiltak for å øke rekrutteringen til Internasjonal master i medisinsk teknologi har vært diskutert i Programrådsmøte 24. august, og vi har også mottatt innspill fra Rådsmøtet i Tematisk satsingsområde medisinsk teknologi, hvor saken ble diskutert 1. september.

Gjennomsnittlig antall opptatte studenter over de 5 år siden oppstart av programmet har vært 5, med tendens til en viss økning de siste to år med henholdsvis 6 og 9 opptatte studenter.

For at NT-fakultet skal foreslå en forlengelse av programmet i ytterligere 3 år, blir det bedt om en plan for å styrke rekrutteringen til programmet, med krav om å besvare følgende punkter:

- Beskrivelse av hvor studentene primært skal rekrutteres fra.
- Hvilke tiltak som skal settes i verk for å få disse potensielle studentene til å søke vårt studieprogram.
- En vurdering av kostnadene knyttet til de planlagte rekrutteringstiltakene.

### Hvor skal studentene primært rekrutteres fra?

Universitetene i Norden synes å være de eneste i Europa som tilbyr gratis masterutdanning, og dette burde være et godt utgangspunkt for å rekruttere internasjonale studenter. Basert på erfaring om studentenes kunnskapsgrunnlag og hvor vi hittil har rekruttert flest studenter fra, er det naturlig å målrette studietilbudet mot studenter fra Asia og Europa. I tråd med NTNUs strategiske satsning vil det passe godt med rekruttering av studenter fra Kina og India, og NTNUs tilbud om internasjonal masterutdanning forventes å inngå i profileringen mot disse landene. Vi må imidlertid innse at vi er i konkurranse med en rekke andre tilbud om internasjonale masterprogram innen dette fagfeltet fra andre europeiske universiteter (215 slike program listet på nettstedet <http://www.mastersportal.eu>).

### Tiltak for økt rekruttering:

#### A. *Forbedre programmets webside*

1. Endre programnavnet til *Medical technology and biomedical engineering*.

Mens vi på norsk er godt tjent med begrepet medisinsk teknologi, så er Medical technology på engelsk bare delvis dekkende for vår virksomhet. Nettstedet [mastersportal.eu](http://mastersportal.eu) viser 215 masterprogrammer i kategorien Engineering and technology>Bio and biomedical engineering, hvorav Norge har 2 og NTNU er et av disse, mens det i kategorien Life sciences, medicine and health>Human medicine og med søkeord medical technology finnes bare 16, men fortsatt med NTNU som et av disse.

2. Øke synligheten på web-siden ved å legge inn flere relevante søkeord og om mulig sørge for at NTNUs tilbud kommer høyt opp på listen ved nettsøk fra studenter i land vi gjerne vil rekruttere fra (Kina, India, europeiske land).
3. Legge inn pekere til aktuelle forskningsmiljøer i Trondheim for gjennomføring av prosjekt- og hovedoppgaver for programmets studenter.
4. Kople websiden tydelig opp mot websiden for tematisk satsingsområde (TSO) medisinsk teknologi, slik at studietilbudet blir en integrert del av profileringen av TSO medisinsk teknologi.
5. Sørge for god kopling til <http://www.mastersportal.eu> som er et nettsted som gir oversikt over utdanningstilbud i Europa, hovedsakelig masterprogram (15186). Portalen kopierer tydeligvis inn informasjon fra universitetenes egne web-sider, så her er det viktig å få en god profilering i de få linjene som vises på den første siden, og med gode pekere til fullstendig informasjon.

#### ***B. Overgangsordning for utvekslingsstudenter***

Utvekslingsstudenter som kommer til NTNU har allerede i noen tilfelle søkt overgang til internasjonal master i medisinsk teknologi. Dersom dette ikke skaper vanskeligheter i forhold til studentenes hjemmeuniversitet, så er det en mulighet som kan utnyttes for rekruttering, og som kan profilere bedre mot de utvekslingsstudentene som kommer hit.

#### ***C. Samarbeid med Internasjonal seksjon og bedre oppfølging av søkere***

Flere søkere som får tilbud om opptak ved NTNU har trolig parallelt med dette også fått tilbud om opptak ved andre studiesteder. Oppfølging av de studentene som tilbys plass blir derfor viktig for å få dem til endelig å velge NTNU. Dette skjer hovedsakelig gjennom Internasjonal seksjon, men det kunne være aktuelt at også fagmiljøene kommer tidligere inn med informasjon til de søkerne som får tilbud om studieplass.

#### ***D. Bruke nåværende og tidligere studenter som ambassadører***

Nåværende og tidligere studenter på programmet er en kilde til informasjon om hvordan vårt studietilbud blir oppfattet (jmf. spørreundersøkelsen i evalueringsrapporten). Forutsatt at denne oppfatningen er positiv, kunne dette være en kanal for videre profilering av programmet mot studenter fra vedkommendes hjemmeuniversitet.

#### ***E. Bedre kvaliteten av studieprogrammet***

Det kan synes som vi har et forbedringspotensiale, for ved opptaket i høst viser det seg at tre emner på programmets studieplan ved IME-fakultetet ikke ble tilbudt med engelsk undervisning. Dette illustrerer at de administrative problemene som ble påpekt i evalueringen er høyst reelle. Ementilbudet kan også forbedres, for eksempel ved å etablere et eget fellesemne som også ville inkludere de ordinære norske studentene på studieretninger rettet mot medisinsk teknologi. Studieplanens ordning med K-emner og EiT kunne trolig benyttes for slike nye emnetilbud. Utarbeidelsen av slike nye emnetilbud bør skje i samråd med TSO medisinsk teknologi.

#### ***Tiltak som er diskutert, men ikke synes aktuelle:***

##### Opprette gruppe på Facebook?

Dette kunne være et naturlig tiltak i samarbeid med TSO medisinsk teknologi, men det vil kreve en kontinuerlig aktivitet med oppdatering og nyheter. (Høgskolen i Oslo er aktive på Facebook under

overskriften Medisinsk teknologi/Biomedical engineering og har en imponerende liste av nyheter, selv om disse ofte er gjentak av generell profileringsinformasjon)

#### Samarbeid med andre universiteter?

Det finnes europeiske samarbeidsprosjekter under Erasmus Mundus som tilbyr masterutdanning i medisinsk teknologi, for eksempel CEMACUBE som er et samarbeid mellom universitetene i Groningen, Aachen, Dublin, Ghent, Brussel og Praha <http://www.biomedicaltechnology.eu/>. Et samarbeid om studietilbud kunne være naturlig i forhold til universiteter som TSO medisinsk teknologi samarbeider med, men TSO har for tiden ingen slike samarbeidsavtaler med andre universitet.

Direkte markedsføring mot andre universiteter eller bachelorutdanninger er ressurskrevende og blir vanskelig pga konkurranseforhold.

#### **Vurdering av kostnader**

Nødvendig ressursinnsats for de ovennevnte tiltakene er ikke bare bevilgninger, men også tilgang på personer med riktig kompetanse til å gjennomføre tiltakene og sørge for nødvendig oppfølging av dem over tid. Det er bare tiltakene under pkt. A som kan kostnadsvurderes som engangstiltak, selv om oppfølging over tid også her vil kreve kontinuerlig personellinnsats.

De nevnte tiltak under pkt. A anses gjennomførbare til en kostnad på NOK 40.000,-, men det må samtidig legges opp til god framtidig oppfølging av programmets nettsider.

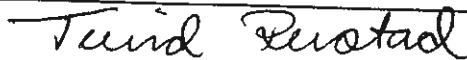
## Notat

Til: Fakultet for Naturvitenskap og teknologi

Kopi til:

Fra: Turid Rustad, Institutt for bioteknologi

Signatur:



### Nordisk master i sjømatkvalitet

Danmarks tekniske universitet (DTU) planlegger å koordinere en søknad om støtte fra Nordisk forskningsråd for å initiere en felles nordisk masterutdanning med fokus på sjømatkvalitet – tittel "Aquatic Food Production - Safety and Quality". Utlysningen spesifiserer at minst tre universiteter fra de nordiske land danner et konsortium og søker om støtte for å etablere masterutdanningen. Støtten kan bare brukes til å opprette studiet, ikke til å drive undervisningen. Det er et krav at universitetene som inngår i konsortiet i dag tilbyr en master i et beslektet område og er i stand til å tilby 20 ECTS til denne masteren.

Ulike fag/moduler vil settes sammen for å dekke hele verdikjeden og vil dekke både trygghets- og kvalitetspektet knyttet til mat fra havet. Deltagerene i konsortiet vil ha ansvaret for å organisere undervisningen, basert på eksisterende – og ved behov/ønske – nye emner. Masterutdanningen vil bli unik ved at den bygger på ekspertise fra hver enkelt partner.

Konsortiet består av Danmarks tekniske universitet DTU: (Paw Dalgaard, Michael Engelbrecht, Caroline Baron)

Sveriges lantbruksuniversitet SLU: (Anders Kiessling)

Universitetet for miljø- og biovitenskap: (Odd Ivar Lekang)

Norges Teknisk Naturvitenskapelige Universitet NTNU (Turid Rustad)

University of Iceland (Gudrun Olafsdottir)

Masteren skal være klar til å ta imot studenter studieåret 2012/2013.

Det er satt opp et utkast til innhold/struktur i masterutdanningen.

Postadresse	Org.nr. 974 767 880	Besøksadresse	Telefon	
Sem Sælands vei 6/8 7491 Trondheim	E-post: postmottak@biotech.ntnu.no <a href="http://www.biotech.ntnu.no">http://www.biotech.ntnu.no</a>	Kjemiblokk III/IV Sem Sælands vei 6/8 7034 Trondheim	+ 47 73 59 33 20 <b>Telefaks</b> + 47 73 59 12 83	Tlf: + 47

All korrespondanse som inngår i saksbehandling skal adresseres til saksbehandlende enhet ved NTNU og ikke direkte til enkeltpersoner. Ved henvendelse vennligst oppgi referanse.



Caroline P. Baron 2010

NTNU utdanner idag mastere i teknologi innenfor industriell kjemi og bioteknologi. Innenfor studieretningen i bioteknologi er det mulig å fordype seg innen næringsmiddelkjemi med fag som bla næringsmiddelkjemi og næringsmiddelteknologi (undervises ved IVT), i tillegg til basisfag i biokjemi, mikrobiologi, molekylærgenetikk, biopolymerkjemi og biokjemiteknikk. Det er også mulig å ta enkelte PhDemner som marine lipider med mer. I tillegg kommer prosjekt- og masteroppgaver innen dette feltet.

NTNU tilbyr også master i bioteknologi (real FAG). Også innen denne masteren er det mulig å spesialisere seg innen næringsmiddelfag ved å ta fagene som er beskrevet over.

NTNU utdanner også mastere i teknologi innenfor "Produktutvikling og Produksjon" og "Energi og miljø". Studenter fra begge disse studieprogrammene kan ta fordypning innen prosessering av mat. Typiske fag vil være "Varmepumpede prosesser og systemer", "Næringsmiddelteknologi" med etterfølgende fordypning innen "Industrielle prosesser-spesialisering", med fordypningsmoduler som "Varmepumpende prosesser i næringsmiddelindustrien" og "Avvanning og tørking" er sentrale tema. Det er også mulighet for å ta PhD innen prosessering av mat.

Det er også opprettet en internasjonal master (Master i marin kystutvikling/Master in marine coastal development) som har som mål å gi studentene en bred forståelse av de komplekse interaksjonene i marin sektor. Studentene kan velge tre ulike spesialiseringer: Akvakultur, fiskeri og marine ressurser og marin biologi og biokjemi. Innenfor denne masteren tilbys emner som også kan tilbys i den

foreslåtte nordiske masteren slik som Bærekraftig utnyttelse av marine ressurser, Fiskens tidlige livshistorie m fl. i tillegg til flere av emnene som er nevnt over.

Marine og maritime industrier er en av hjørnesteinene i norsk økonomi og produksjon av sjømat er en viktig del av dette. Mer enn 60 % av verdien av norsk eksport kommer fra marin sektor og Norge har også en sterk posisjon i marin forskning. Videre utvikling av marin sektor er viktig både for nasjonen og for kystsamfunnene.

Marin kystutvikling er et av NTNUs satsningsområder og er organisert i 3 hovedområder og der fiskeri og havbruk og prosessering av marine ressurser er områder som har tilknytning til den foreslåtte masteren. NTNU tar sikte på å tilby 30 ECTS til den foreslåtte masteren i tillegg til masteroppgaver.

NTNU's styrke inn mot den foreslåtte masteren er at vi har sterkt fokus på teknologi rettet mot matproduksjon, dette gjelder også undervisning og forskning innen næringsmiddelkjemi der vi har fokus på prosessinduserte endringer i råstoffer. NTNU har god infrastruktur når det gjelder undervisning og forskning knyttet til avvanning og har også god tilgang på og ekspertise på analytiske metoder som NMR, LC/MS. Innen marine lipider har SINTEF bygget opp pilotanlegg for rensing bla. NTNU har også god kontakt med industri og mange master og prosjektoppgaver utføres i samarbeide med industri og/eller SINTEF. Det er imidlertid få studenter som ønsker å spesialisere seg innenfor næringsmiddelteknologi og et slikt samarbeid vil derfor kunne styrke denne undervisningen også hos oss. Antall personer som arbeider innen prosessering av marine ressurser er relativt få ved NTNU og ved å delta i dette samarbeidet vil det gi studentene mulighet til et bredere utvalg av emner. NTNU har ikke egen sterk kompetanse innen mikrobiologi knyttet til sjømat og dette vil være noe studentene kan få anledning til å fordype seg i i den foreslåtte masteren.

Samarbeide med de institusjonene som er med i konsortiet er også av strategisk betydning for videre utvikling av undervisning og forskning på sjømat ved NTNU. Det er allerede samarbeid på forskning (EU-prosjekter, nordiske prosjekter) med flere av universitetene som er med i konsortiet og det er ønske om å videreføre og videreutvikle dette samarbeidet til også å omfatte PhD utdanning bla.

Hva slags industrier og institusjoner kan være avtagere av mastere:

Næringsmiddelindustri knyttet til sjømat slik som bla. Marine harvest, Salmar, flere bedrifter innen marine lipider slik som EPAX, Maritex, andre næringsmiddelprodusenter slik som bla Mills, TINE, Nortura, Grilstad.

Forskningsinstitusjoner: NOFIMA, SINTEF er eksempler på store forskningsinstitutter som arbeider i dette feltet

Forvaltning slik som Mattilsynet, annen offentlig forvaltning

Søknadsfrist: **15. september**

Rektor må signere brev som når Nordisk forskningsråd senest 3 uker etter søknadsfristen.

## Notat

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Til: Jon Inge Resell

Kopi til:

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Fra: Fakultet for naturvitenskap og teknologi

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### **Studieprogramporteføljen 2011-2012. Tilleggssak. Deltakelse i søknad om opprettelse av "Nordic Master of Theoretical Physics"**

Kort tid før søknadsfristen til nordisk ministerråd har Fakultet for naturvitenskap og teknologi fått forespørsel om deltakelse i en søknad om støtte til opprettelse av et nordisk masterprogram "Nordic Master of Theoretical Physics". En ikke ferdig søknad følger vedlagt. Fakultetet har i forbindelse med innsending av studieprogramporteføljesaken foreslått at NTNU deltar i foreslåtte programmet "Aquatic Food Production – Quality and Safety".

Det foreslåtte studietilbudet innen teoretisk fysikk ligger innenfor et felt det fagmiljøet ved Institutt for fysikk ved NTNU er et av Nordens sterkeste, noe som er dokumentert i Forskningsrådets evaluering av norske fysikkmiljøer gjort i 2010. Temaet er også relevant for flere av NTNU satsingsområder, blant annet Materialer. Instituttet har en rekke aktuelle emner som kan inngå i dette studietilbudet. NORDITA, det nordiske instituttet for teoretisk fysikk, vil ha en sentral rolle i det foreslåtte studietilbudet. Dette er et institutt NTNUs fagmiljøer på feltet har sterk tilknytning til gjennom møter, studieopphold for doktorstudenter og postdocer og annet. Fakultetet forventer at dette studietilbudet vil være av stor interesse for studenter som ønsker en fordypning mot teoretisk fysikk både i og utenfor Norden.

KTH i Stockholm vil være koordinator for studieprogrammet. Det gjøres oppmerksom på at det foreslåtte studietilbudet ikke er organisert innenfor Nordic 5 Tech samarbeidet. Studietilbudet er planlagt opprettet fra studieåret 2012/13.

Fakultet for naturvitenskap og teknologi har drøftet forslaget i sin ledergruppe. Dekanus og ledergruppen mener dette er et studietilbud som NTNU bør delta i, og fakultetet fremmer på denne bakgrunn forslag om at NTNU støtter at søknaden om støtte til etablering av studietilbudet "Master

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<b>Postadresse</b>	<b>Org.nr. 974 767 880</b>	<b>Besøksadresse</b>	<b>Telefon</b>	<b>Saksbehand ler</b>
7491 Trondheim	E-post: postmottak@nt.ntnu.no	Realfagbygget D1, Høgskoleringen 5	+47 73 59 41 97	Sigurd Håkon Madsen
	<a href="http://www.ntnu.no">http://www.ntnu.no</a>		<b>Telefaks</b> +47 73 59 14 10	<b>Tlf:</b> +47 73 59 60 26

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of Theoretical Physics” sendt nordisk ministerråd til fristen 15. september. Fakultetet beklager at det ikke var mulig å sende inn dette forslaget sammen med studieprogramporteføljesaken til 10. september.

Fakultetet gjør videre oppmerksom på at det ved en eventuell innvilging av søknaden vil det bli sett på muligheten for å etablere dette studietilbudet uten at antallet studieprogram ved fakultetet økes.

Med vennlig hilsen

Anne Borg /s/  
Prodekanus utdanning

# Nordic Master Program 2010

## Application

### Project information

#### Title of the Nordic Master Program

Aquatic Food Production-Safety and Quality (AQFood)

#### Project number

NMP-2010/10018

## A - Project partners

### A.1 Co-ordinating institution

#### A.1.1 Co-ordinating institution

Name of institution: DK-Technical University of Denmark

#### A.1.2 Project coordinator

Name: Baron, Caroline

Gender: Female

Title: Ph.D

Position: Senior Scientist

E-mail address: cba@aqua.dtu.dk

Correspondence Søltoft Plads, Building 221

address: DK-2800 Kgs Lyngby

Phone

(including country and area code): +45 45254919

Mobile number: +45 31159161

Fax (including country and area code): +45 45884774

Institution: DK-Technical University of Denmark

Department: National Food institute

#### A.1.3 Administrative contact person

Name: Holt, Anne Mette

Gender: Female

Position: Special Advisor

E-mail: amh@admi.dtu.dk

Address: Anker Engelundsvej 1, Building 101  
2800 Kgs Lyngby

Phone number: +45 45251017

Mobile number: +45 23674413

Fax number: +45 45870216

Institution: DK-Technical University of Denmark

Department: Study Division

#### A.1.4 Person in charge of finance on behalf of the Consortium

Name: Donovan Jensen, Jette

Gender: Female

Title: -

Position: Deputy head of division

E-mail address: jej@aqua.dtu.dk  
Correspondence Søtofts Plads, Building 221  
address: Dk-2800 Kgs Lyngby  
Phone (including country and area code): +45 45252575  
Mobile number: +45 23688291  
Fax (including country and area code): +45 45254919  
Institution: DK-Technical University of Denmark  
Department: National Food institute

#### **A.1.5 Legal representative (Rector or equivalent)**

Name: Bendsoe, Martin  
Gender: Male  
Position: Dean  
E-mail: gdekan@adm.dtu.dk  
Address: Anker Engelundsvej 1, Building 101A,  
2800 Kgs. Lyngby  
Phone number: +45 45251013  
Mobile number:  
Fax number:  
Institution: DK-Technical University of Denmark  
Department: Rektoratet

#### **A.2 Partner institutions providing Master's degrees**

##### **Partner institution**

Name of institution: NO-Norwegian University of Science and Technology  
Name of department: Department of Biotechnology  
Contact person: Rustad, Turid  
Gender: Female  
E-mail address: turid.rustad@biotech.ntnu.no  
Correspondence address: Institutt for bioteknologi, NTNU, 7491 Trondheim  
Phone (including country and area code): +47 73594066  
Fax (including country and area code):

Name of institution: IS-University of Iceland  
Name of department: Laboratory of Applied Supply Chain Systems  
Contact person: Olafsdottir, Gudrun  
Gender: Female  
E-mail address: go@hi.is  
Correspondence University of Iceland  
address: Tæknigarður, Dunhagi 5, 107 Reykjavík, Iceland  
Phone (including country and area code): +354 5255430  
Fax (including country and area code):

Name of institution: SE-Swedish University of Agricultural Sciences  
Name of department: Department of Wildlife, Fish and Environmental Studies  
Contact person: Kiessling, Anders  
Gender: Male  
E-mail address: anders.kiessling@vfm.slu.se  
Correspondence Institutionen för vilt, fisk och miljö,  
address: SLU, 901 83 Umeå  
Phone (including country and area code): +46 90-7868483  
Fax (including country and area code):

Name of institution: NO-Norwegian University of Life Sciences  
Name of department: Department of mathematical sciences and technology  
Contact person: Lekang, Odd-Ivar  
Gender: Male  
E-mail address: odd-ivar.lekang@umb.no  
Correspondence Department of mathematical science and technology  
address: P.Box 5003  
1430 Aas  
Phone (including country and area code): +47645400  
Fax (including country and area code):

### A.3 Other partners

### A.3 Other partners

## B - Content of the master programme

### B.1

#### B.1 Subject area of the master programme

##### Subject area

The master programme focuses on production of aquatic food, subsequent processing and distribution and more precisely on safety and quality aspects. As such the proposed programme is interdisciplinary as it combines aquatic production (including fisheries) with food processing and with focus on safety and quality. The proposed master is unique, being to our knowledge, the only one in the world to link pre-harvest, post-harvest, processing and distribution to general quality aspects and safety of the final product and that is solely dedicated to aquatic resources. A successful master programme will be obtained by combining the expertise of the five partners in the consortium (i.e. fisheries and aquacultures and expertise in foods processing technology and distribution as well as quality aspects and safety). The programme underpins the cause and effect relationship between the different steps along the production chain and focus on quality and safety of aquatic food until consumption.

### B.2

#### B.2.1 Description of the master programme

##### Description

Global production of aquatic resources continues to increase in order to meet market demands for healthy food and palliate to over exploitation of fish stocks. Global capture production is reasonably stable whilst aquaculture production is rising steadily by 6.5% a year on average. At the same time we have a historic shift in labour from traditional fisheries to aquaculture. At a global scale this is still 1:1, but in high technology farming, problems are related to recruitment of skilled labour in rural areas (FAO, 2009). In 2007, aquatic resource production reached more than 140 million tonnes and the Nordic countries produce approximately 7 million tonnes (FAO, 2009). Therefore, the Nordic countries, in parity with other areas with intensive aquaculture and fisheries, need to develop education in aquaculture and fisheries production to ensure safety and quality as well as enhance awareness of environment impact of the production. Considering that it is possible to tailor the product pre-harvest and affect its quality and safety, it is a prerequisite to integrate education allowing specialisation in production and processing and highlights important factors influencing the safety and quality of the products. In total 80% of the production is used for direct human consumption. European consumption of aquatic foods represents 12 million tonnes a year and is rising significantly due to consumer awareness that seafood is contributing to health and well being as well as the general promotion by public bodies for healthy diet and lifestyle. Together with the increase in aquatic food products consumption, the increase in trade volumes, the expanding market, and the diversification of the food items such as ready-to-eat and convenience food, quality and safety of aquatic foods is very much in focus. This results in a demand to educate people in this area that will be able to deliver high quality and safe products taking all aspects from the living resource to the final aquatic food product into account and to underpin strategies for sustainable resource management.

Indeed, safety and quality are major issues for aquatic food due to their highly perishable nature and this can result in severe economic losses for primary producers, processing industries, and also results in consumer rejection. In addition, aquatic food is often responsible for food-borne disease outbreak. 8-9% of all recorded food-borne outbreaks of human disease within the EU are due to aquatic food (EFSA, 2009) while in developing countries it represents approx 20% of the food-borne disease outbreaks. Moreover, bad handling practices of aquatic food can result in severe economical loss and results in a huge amount of resources wasted. Aquatic resources are limited and are valuable food items and ensuring their quality and safety with a holistic approach will not only result in a better exploitation of the available resources but also contribute to an improved sustainability and contribute to improve

the health and well being of the Nordic and European population. Combining the expertises of the different countries in their respective areas of excellence will result in educating people that will be able to address the challenges of producing nutritious, safe and healthy aquatic food for the global market in an economically and environmental sustainable way.

- **Strategically:** It is important to strengthen the link between the primary production, processing and the final food product quality and safety not only in the Nordic countries but also globally. Pre-harvest conditions and impact of processing technologies on post-harvest safety and quality is an area that needs to be further strengthened for a better optimisation of our resources, reduce down grading and waste as well as nurture a healthy food markets but also to prevent outbreaks of food-borne diseases, and reduce contamination and exposure to unhealthy chemicals.
- **The growing market:** China stands for 60% of the world aquaculture and is, together with Norway, the main aquatic food exporting country in the world. The expanding market means that products produced in one area of the globe reach the consumers in another area, which is a challenge for quality and safety standards. It is important to promote exchange of knowledge between countries for the production of high quality and safe aquatic food. An understanding of primary production conditions will support the aquatic food processing student to better understand food safety and environmental impacts of imported products arising as a consequence of production conditions.
- **International standardisation:** The code of conduct of fisheries and best practices of production and safety practices, are well established in Europe according to recommendations of international organisations (FAO/WHO, Codex Alimentarius and ISO standards). These support the global regulatory framework for food hygiene, contaminants, food technology, food import and export, and microbiology of fishery products.
- **Academically:** Most academic educations are discipline oriented, and in contrast to the usual schemes the proposed master programme is product and process oriented. In addition, the education will gather experts in the Nordic countries and will contribute to the exchange of knowledge and of good practice. Moreover, this will also result in promotion of the Nordic countries as a leader in the education of highly qualified fellows in the field of aquatic food. The education aims to be very exclusive and to generate highly specialized professionals with knowledge that will fit the demands and needs of the rapidly evolving aquatic food supply and business sector.
- **Industrially:** Another important objective of the education is that it aims at being driven by a strong industry partnership not only linking primary production to processors and distributors but also tailoring the education to the industrial and market needs. Therefore, the master programme will contribute to educating people that will match the labour market demands. The program will thus pay attention to the current emphasis of international NGO's and the retail sector to raise the profile of the environment, sustainable development and food safety in their trade agendas.

The proposed master programme involves 4 semesters of studies over 2 years and will be as much as possible web and video conference based to limit travelling of students from one country to the other. First, a field trip is planned to gather the students, to introduce the programme and to initiate contacts and exchange between students. This is considered to be an important step to build the team spirit of the group and a key to a successful and dynamic team and at the same time facilitate contacts across the two sub-programmes during the period of specialisation.

The master programme is built with a core consisting of a fundamental block of general competence courses, which is divided in 5 modules which includes: Chemistry and biochemistry (M1B), and microbiology (M2B). In addition, introduction to production (M3B) and to quality and safety (M4B) will be given as well as some basic principles of marketing, innovation, value chain requirements, logistics and economy (M5B). This will represent at total of 30 ECTS and be running for 1 semester. Subsequently, the master programme will be divided into 2 sub-programmes, one with focus on primary production of aquatic food material (Sub-programme 1) and the other with focus on aquatic foods quality and safety through processing, and distribution to the consumer (Sub-programme 2). Obligatory modules will be offered in each sub-programme together with some joint field projects. However, students will as much as possible be able to tone their master into one area or the other. The proposed modules in the different sub-programmes are given below:

#### Sub-programme (1): Production

M8A Production technologies (aquaculture/fisheries) including waste

M9A Environment and sustainable resource management

M10A Animal health, water quality and welfare

M11A Nutrition, feed technology and feed resources  
M12A Animal genetics  
M 13A Anatomy and physiology,  
M14A: Documentation/legislation  
M15A: Emerging resources and globalisation: Innovation, production & distribution

**Sub-programme (2): Food**

M16A: Processing technologies including waste  
M17A Environment and sustainable resource management  
M18A: Logistics, traceability and supply chain management  
M19A: Aquatic food quality and shelf life  
M20A: Aquatic food safety and risk management  
M21A: Documentation/legislation  
M22A: Aquatic products and human health  
M23A: Emerging resources and globalisation: Innovation, safety & quality

Students will be able to choose modules from sub-programme 1 and 2 and organise their studies in order to obtain 60 ECTS within a period of 2 semesters. If necessary summer school or intensive course will be offered between semesters in order to palliate at eventual disparity between the students background knowledge and to provide "hands on" support if needed. During the studies joint field projects will be planned as well to enhance exchanges of knowledge and discussion between the participants. Finally, a 3 week field trip in the Nordic countries involved will be done in order to have an overview of the seafood sector. As a final exam the student will deliver a master thesis (30 ECTS) based on studies carried out in collaboration with industries or branch/consumer organizations.

Non exhaustive list of industrial partners contacted for support to the proposed master programme: field trips, practical placement, and advisory board is given below:

HB Grandi (IS), Brim Seafood (IS), Skagerak Pelagic A/S (DK), Biomar A/S (DK), Rabbekfisk A/S (DK), Musholm (DK), NOFIMA (NO), SINTEF (NO).Abba Seafood A/S (SE), Fram Food A/S (IS) Lykkeberg A/S (DK), Saeby Fisk Industry (DK), Skagerak Salmon A/S (DK), Royal Greenland Seafood A/S (DK), Hyttels salmon (DK), MATIS (IS).

## **B.2.2 Summary**

### **Summary**

The general objective of the master programme "Aquatic Food Production-Safety and Quality" (AQFood) is to deliver a unique education in aquatic food production and processing in order to support a continuous and prosperous growth of Nordic fisheries, aquaculture and fish processing industries aiming at delivering safe and high quality products. Link between the primary production, the processing and distribution steps to the consumers in term of quality and safety. The product will be followed using a holistic approach and focus on methods to monitor technologies to maintain quality and safety aspects of these healthy food items throughout the entire production and food supply chain. Norway and Iceland are the main producers of aquatic food in the Nordic countries whilst Denmark and Sweden have well established aquatic food processing industries. In addition the different Nordic countries involved are leaders in their respective area in the academic world and have different and complementary expertise in the different themes. Combining the expertises of the different countries in their respective areas of excellence will result in educating people that will be able to address the challenges of producing nutritious, safe and healthy aquatic food for the global market in an economically and environmentally sustainable way.

## **B.3 Contribution of each partner**

### **B.3.1 Contribution of each partner**

#### **Contribution**

SLU: SLU has academic strength in sustainable food production and management of natural resources. The department of Aquaculture was established in 1985 and is now integrated with management of wild populations and environmental studies (VFM) at SLU. SLU offers MSc in management of fish and wildlife population and aquaculture and fish behaviour and they will be able to deliver teaching in aquaculture, including production, health, welfare, environment and food science. SLU will significantly contribute to

sub-programme 1 and has been identified as the obvious coordinator of this sub-programme, however this will be confirmed at a later stage.

UMB: UMB offers a MSc in Aquaculture, and is the department in Norway with the highest number of Aquaculture MSc awarded degrees. The speciality of UMB is production technology, fish nutrition and fish breeding. In addition to competence in relevant coldwater species, UMB also perform work, including a breeding program, on tilapia which would be important in general for the internationalisation of the programme. UMB will significantly contribute to sub-programme 1.

Both UMB and SLU are part of the NOVA University Network, and they will represent the network, which is a platform for efficient and innovative Nordic cooperation. Both UMB and SLU are involved in the joint education programme in Nordic Aquaculture and Fresh water management platform and they will with their expertises significantly contribute to the sub-programme 1.

NTNU: NTNU educates masters in technology with different profiles and the relevant faculties and departments contribute to give the students a good knowledge in engineering and technology. Marine and Maritime research is one of NTNU's six thematic interdisciplinary strategic areas. In addition, NTNU Centre of Fisheries and Aquaculture (SeaLab) provides a common arena and building blocks for research groups with focus on aquaculture, fisheries and the processing of marine resources and a common node for workshops and projects with SINTEF (an independent research organisation). NTNU at present deliver a master in Technology with a specialisation in Food Science and a master in Marine Coastal Development and will with their expertise significantly contribute to the core teaching and both sub-programmes 1 and 2.

DTU: DTU offers MSC programmes both in Food Technology and in Aquatic Science and Technology. These programmes will be able to provide teaching for the proposed master programme. DTU has internationally recognized research platforms for fish technology, quality and safety that generate understanding of food during processing and distribution. Areas of expertise where DTU will be able to deliver courses include biological quality, pre-harvest impact on post harvest quality, sensory evaluation, shelf-life and spoilage reactions including oxidative modification and microbial changes, hygiene and prediction of safety together with optimisation of processing. DTU will significantly contribute to the core teaching and to the sub-programme 2 and has been identified as the obvious leader of sub-programme 2, however this will be confirmed at a later stage.

Uol: The recently established ASCS (Applied Supply Chain Systems) research group ([www.ascs.is](http://www.ascs.is)) within the School of Engineering and Natural Sciences, focuses on interdisciplinary applied science in the area of aquatic foods and supply chain management for enhanced safety, quality and transparency of products in the value chain. Uol will be able to deliver courses dealing with logistics and supply chain management, real time monitoring devices for quality, safety and traceability and evaluation of environmental impacts by Life Cycle Analysis (CLA) and carbon footprint for the whole fish supply chain, focusing on the production and transport of fish as an area where research activities are growing. They will significantly contribute to sub programme 2.

### **B.3.2 Application and admission procedures**

#### **Application and admission**

Application: A central application procedures will be coordinated by DTU. Each application will be handled through a local contact point at each core partner to underline that the student is registered at the partner university as a full member of that university. The application procedure will be integrated in the national application system to make it visible. Both Sweden and Norway are now using a central application system with BSc, MSc and free courses at all higher education institutions. However, each partner will advertise and promote the HEI with a common deadline for final admission. All HEI in the consortium will provide support to applicants/students both during the application procedure and throughout the MSc. via a national contact point. Support will be provided via email and telephone and during the start up face an online application form will be filled out by the applicant. The student will provide information regarding their mobility track and their study plan as part of their application. Depending on the HEI application origin, their proposed study plan and motivation, and their mobility track the student will be affiliated to one university in particular, which normally is the applicants university but may change due to specially expressed interest by the applicant (see below).



**Admission:** The students will be admitted in the first instance to HEI where they submit their application and refer to the legislation of that country for admission. However, common criteria for admission procedure will be pre-defined in the consortium and an admission panel will be in place to address the disparity between the different HEI admission criteria. In all HEI in the consortium, there are strict rules against discriminations and equal opportunities will be given to all applicants irrespective of disabilities, religious belief, sex and race.

**Tuition fee:** EU/EEA citizens are not required to pay tuition fees to enrol in master programmes in any Nordic countries as their tuition fees are financed by the government. This includes the following countries: Denmark, Sweden, Norway and Iceland (the consortium countries) as well as Belgium, Finland, France, Greece, Netherlands, Ireland, Italy, Luxembourg, Portugal, Spain, UK, Germany, Austria, Cypress, Estonia, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia, Czech Republic, Hungary, Bulgaria, Romania and Liechtenstein. All other countries are defined as non-EU/EEA countries, and as of August 1st 2006, their citizens will have to pay a tuition fees to HEI in Denmark and Sweden while there is no tuition fee in Iceland and Norway. The tuition fee in DK for students enrolled in a DTU study programme is DKK 102,500 (EUR 13,500) per academic year. The tuition fee in Sweden (SLU) as of 2011 is still awaiting a final decision. Affiliation of non-EU students to one of the 5 HEI involved in the consortium will be discussed within the consortium but it is expected that students will be under the national regulation of the country where they have submitted their application.

### **B.3.3 Joint study programmes and relation to national legislation**

#### **Study programmes and relations**

Not all countries in the consortium are presently able to issue a joint degree, however the consortium is aiming at a joint degree and will work to achieve the joint degree. In case this is not manageable in the first years a degrees will be awarded according to a double degree framework. The consortium will, depending on the university of origin, the mobility track, the study plan as well as the physical location of the master thesis project work, agree on where the joint degree should be issued. It is anticipated that a 60 ECTS model will be the basis for the joint diploma agreement with 60 ECTS qualifying the 2 Universities delivering the joint degree. Rules will be established in agreement with legislations in the different countries before the master is launched and reevaluated every year as legislation evolve in order to aim at a joint diploma. The content and the type of layout of the diploma and eventually diploma supplement(s) will be agreed upon at least one semester before the first cohort of students are expected to complete the programme.

### **B.3.4 PhD requirement**

#### **PhD requirement**

All participating HEI provide a third cycle degrees within closely related subjects and the successful students, providing that they have completed their master education with success and that PhD position are available, will have the possibility to be enrolled as Ph.D. students in the different HEI.

### **B.3.5 Number of ECTS (Study credits)**

#### **Number of ECTS**

120 ECTS

All participating HEI will be able to deliver a minimum of 20 ECTS each to the proposed master programme.

### **B. 3.6 Language**

#### **Language**

All courses will be taught in English and the final master thesis/dissertation will also be written in English. Students are expected to have a level in English sufficient to follow the different course and applicants needs to submit TOEFL or IELTS scores.

For admission all applicants should submit IELTS or TOEFL test results score reports which will be sent directly to HEI where they will be enrolled from the test centres.

The requirements are different for the different partners in the consortium and the scored will be compared and agreed upon but will most likely depend on which HEI the applicant is affiliated to.

Only the following applicants are exempted: 1) Applicants who earned their B.Sc.-degree in a country in the European Union or in one of the following countries: Australia, Bahamas, Canada, Guyana, Iceland, Jamaica, Norway, New Zealand, Switzerland, Trinidad and Tobago, or the United States of America. 2) Applicants who are currently completing or have previously completed at least six months of English taught studies in a university of a Nordic country applying to a minimum of 20 ECTS credit points.

## **B.4 Nordic added value**

### **B.4.1 Academic quality**

#### **Academic quality**

##### **Academic quality**

To date no master programme relates the primary production to the final aquatic product quality, safety, distribution. In that respect the proposed master programme is unique as it links the production and distribution parameters to quality and safety parameters of the final food products using the expertise from the different HEI in the Nordic countries. This allows for synergy and combination of expertise. Several master programmes exist in the Nordic countries dealing with aquaculture (SLU, UMB) but they do not address quality and safety of the final aquatic product as food. In addition masters in Food Science/Technology, Biotechnologies and Engineering exist at NTNU, UoI and DTU but they do not focus on aquatic food chains.

DTU: DTU includes several divisions that will contribute to the proposed master programme. Particularly, the newly established Division of Industrial Food Research (includes the former Department of Seafood Research originally started in 1931) is an internationally recognized research platform for fish technology, quality and safety that generates understanding of food during processing and distribution. Areas of expertise include aquatic food quality and safety together with optimisation of processing. Other divisions are also expected to contribute to the proposed master programme for example: Division Microbiology and Risk Assessment. Research based teaching will e.g. be provided by associate professor Michael Engelbrecht (Aquatic production quality) and Senior Scientist Paw Dalgaard (Aquatic and predictive food microbiology).

SLU: Has since 25 years included all relevant faculties and departments related to sustainable food production and management of natural resources. The department of Aquaculture was established 1985 and is now integrated with management of wild populations and environmental studies (VFM) at SLU. SLU initiated at the beginning of 2010 establishment of a cross faculty national centre of excellence in aquaculture, including production, health, welfare, environment and food science. This 5 year initiative is supported by economic means from SLU's internal budget with the intent that this will be a permanent part of SLU's portfolio. The proposed Nordic MSc fits perfectly in to this work and has obviously the support of the university as well as the Swedish aquaculture industry.

UMB: This University was the first in Norway to offer a MSc in Aquaculture (1972), and is the department in Norway with the highest number of Aquaculture MSc awarded degrees. The speciality of UMB is production technology, fish nutrition and fish breeding. UMB was also the origin of "Akvaforsk" (now a part of Nofima Marine and Nofima Food) which is one of the underlying reasons for the close connection between the aquaculture MSc at UMB and the Norwegian aquaculture industry. In addition to competence in relevant coldwater species, UMB also perform work, including a breeding program, on tilapia. Because of this UMB receives many aquaculture MSc students from China, other South East countries and Africa. The present application supports the request of the Norwegian aquaculture industry to increase recruitment of students with the intent to join Nordic industries.

NTNU: specializes in technology and natural sciences and has educated masters in technology for 100 years. More than half the degrees awarded are within technology and natural science. University of Trondheim was founded 1968, based on the Norwegian Institute of Technology and Norwegian Teachers College. NTNU has a close cooperation with SINTEF, one of the largest independent research organisations. Both masters in technology in Chemical engineering and biotechnology with a study profile of Biotechnology and masters in natural science in biotechnology can specialize in food science. Masters in technology in mechanical engineering can specialize in food processing. Marine coastal development is a two-year international multidisciplinary master of science programme. It is especially designed to give the students a broad understanding of the complex interactions in the marine sector.

UoI: The recently established ASCS (Applied Supply Chain Systems) research group ([www.ascs.is](http://www.ascs.is)) within the School of Engineering and Natural Sciences, focuses on interdisciplinary applied science in the area of aquatic foods and supply chain management for enhanced safety, quality and transparency of products in the value chain. The priority is on the integration of food science, engineering, and natural sciences with active industrial and private company collaboration. Implementation of Information and Communication Technologies (ICT) in the value chain, including real time monitoring devices for quality, safety and traceability and evaluation of environmental impacts by LCA and carbon footprint for the whole fish supply chain, focusing on the transport of fish as an area where research activities are growing. Collaboration with the Environment and Natural Resources Interdisciplinary masters program at the UoI and programs within the School of Engineering and Natural Sciences in addition to the Faculty of Food Science and Nutrition and Matis Icelandic Food Research, the University of Akureyri and Holar University College will ensure a dynamic environment for the masters programme and further the recruiting of international students from the United Nations University - Fisheries Training Programme in Iceland.

The different universities involved have complementary expertise in related fields and the proposed master programme will link the two areas and will enhance significantly the academic quality as it will be dedicated and focussed on aquatic foods quality and safety.

#### **B.4.2 Contribution to excellence and competitiveness**

##### **Contribution**

The proposed master programme will contribute to excellence and competitiveness via:

- 1) Unique education: The master programme proposed is unique as it gathers excellence and expertise from each Nordic country involved in the consortium and it delivers an exclusive education within the field of aquatic foods.
- 2) Excellence: Complementary strength of the Nordic partners involved, each bringing their area of excellence will result in a master of exceptional quality with synergy and effect based on this unique combination.
- 3) Teaching model: The Nordic teaching model is well recognised as being very successful. Tendency to move from the individualised teaching toward the teaching of individuals will prevail. The education will also take starting point in individual choices where students are entrepreneurs and make individual choice for their own education. Integrated learning system using modern technologies will contribute to develop lifelong learners. This will contribute to the education of independent and competitively individuals to the labour market that will be able to adapt and embrace changes in our fast changing world.
- 4) Interaction with industries: Strong links between the master programme and the Nordic aquatic food industries i.e. producers, processors, retailers will be provided through field trip, research project, consultancy, sponsor etc... This will result in an education closely linked to the needs of the market that will be able to fulfil the demands of this fast growing sector.

#### **B.5 Quality assurance**

##### **B.5.1 Measures to assure the quality of the master programme**

###### **Measures to assure the quality of the master programme**

Measures to assure the quality of the master programme:

- 1) Quality of teaching: On completion of each module an evaluation will be in place and this will be reviewed by internal evaluation panels (including both student, university pedagogic). This will ensure that the delivered teaching match the requirements of the core partners universities as well as the industry. It is important that we deliver educated individuals that have a profile necessary for the labour market. In addition, feedback from students will be encouraged as being part of the policy of the different HEI engaged in the consortium to deliver excellence and to match expectation with delivery and this will result in a high quality of teaching. In term of learning methods, bloom's taxonomy moving toward the

highest order of the taxonomy will be a goal in itself with "analyse, evaluate and create" as the way of learning will be engaged.

2) Accreditation: Accreditation is done in accordance with the rules and procedures of the participating universities and their national legislation. The standards and guidelines for quality assurance in the European higher education area, central to the Bologna process have been fully embraced by the consortium as well as the international network of quality assurance agencies in higher education (INQAHE).

3) External International Advisory Board: An external international advisory board consisting of academics and industrial partners external to the master programme will be established for the development part. During the running phase of the programme, the board will consist of industries involved and supporting the programme in order for them to be able to address specific issues related to the quality of the education delivered in relation to expectations and demand of the market.

## **B.5.2 Connection to research**

### **Connection to research**

Connections to research in the proposed programme are evident as all teachers are involved in their professional career not only in teaching but also in research. It is a goal in itself that the master programme has to be well connected to ongoing research activities so that the latest findings will be incorporated in the teaching element provided in the master. The concept of research driven education will be put in practice. This will also allow future players in the aquatic food industries to relate to research in a much more accessible way. For example in the aquaculture and fisheries (production/Sub-programme 1) new elements and findings related to improvement of feeding regime/nutrient resources and quality/environmental impact using modelling, including LCA, and knowledge of the latest technical innovations to support the development of practical and science based tools to foster sustainable trade of aquatic products. Other examples are implementation of welfare –health and economic consequences of its violation. Also genetic resources are a rapidly moving field requiring close connections to the latest research. Related to aquatic food products (Sub-programme 2) mathematical predictive microbiology models and computer software, as recently developed by DTU, will be used for teaching with the assessment and management of quality and safety including product development, shelf-life prediction and consumer exposure. Other areas with close links between recent research and teaching include human health and functional food for example. This connection between current research findings and the future actors in the sectors will benefit dissemination, exploitation and will result in valorisation of university based research by the aquatic food sector. In addition the master thesis will be linked to ongoing research at the HEI partners and at industry/research institutes.

## **B.5.3 Evaluation of the master programme**

### **Evaluation of the master programme**

The master programme will be evaluated based on constructive feedback from the student and teachers and this will be done for every module. In addition at the end of each module and at the end of each year the programme will be evaluated based on student tests and results according to expectations, which will have been determined using Bloom's taxonomy and intended learning outcome (ILO). Results of the evaluation will be used to further improve the teaching delivered as well as the teaching methods and to reach a high quality master programme. Evaluation scheme and questionnaires will be elaborated and defined by the consortium before launching of the master to ensure that evaluations are identical in the different HEI. The industrial partners will, as part of the advisory board, also be able to evaluate the master and an evaluation sheets will be also issued and filled out by the industries after completion of the master thesis work. Feedback from our industrial advisory board will be taken into consideration as the master programme aims at serving the seafood industries sectors by delivering highly qualified workers.

Evaluation in term of enrolment will be done according to a goal of a minimum of 15 students in the first enrolment year and 30 student in total (15 + 15) in the second running year. However, the master aims at attracting international students and this number is expected to grow also due to the intended international recognition of excellence for the proposed master programme.

## **B.6 Innovation**

### **B.6.1 Innovative aspects regarding the content of the master programme**

#### **Regarding content**

The proposed programme is innovative as it is exclusively focussed on aquatic foods. Most master programmes today are discipline oriented or combine several disciplines in an innovative way. The proposed master is unique as it encompasses all elements, from the primary production to the retail, which are necessary to deliver safe and healthy aquatic food of premium quality. The master is dedicated to aquatic food and no comparable master programme exists in the Nordic countries, within the EU or to the best of our knowledge world wide.

### **B.6.2 Innovative aspects regarding the teaching methods of the master programme**

#### **Regarding teaching methods**

Teaching provided at the blackboard in plenum will be minimised as much as possible in the master programme as this has been proved to not always be the most efficient method in educating students. Therefore, a variety of teaching methods will be employed. The teacher and student will be both engaged in the teaching in innovative and interactive ways. Modern technologies, including video link, online course, e-learning, interactive teaching elements, podcasting, facebook group, online forum, will be integrated in the teaching methods provided in the master programme. Some HEI in the consortium already have e-learning elements in their teaching activities and this will allow us to be able to reorganise existing courses in new ways. This will result in a dynamic up to date education and this will be done in collaboration with for example the NOVA Pedicnet at Nordic level and with the already established pedagogic and IT departments of each member university. For example in DK the Learning Lab at DTU is an internal consultancy unit aiming at inspiring and supporting DTU teachers, students and management to continuously improve the quality of the teaching and learning at DTU. Through their activities they support innovative education practices focused on student learning and integrating technological tools in teaching and learning.

## **B.7 Dissemination**

### **B.7.1.Examples of good practice**

#### **Good practice**

Traditionally primary aquatic production and seafood processing has been two separate worlds with their own set of quality indicators. However, it has long been recognised that some farmers produce prime quality while others do not. It is recognised, in economic terms, with the major aquaculture farming industries being big enough to afford an internal quality control, using among other criteria number of returns from processors and retailers as indicators. The sustainable management of fishery resources the impact of harvesting, manufacturing and global transport on the environment, are factors that are gaining increasing attention and eco-labelling schemes are being introduced in trade. This calls for attention of better transparency in the chain and benchmarking of the environmental impact by development of valid indicators for monitoring i.e. LCA. In aquaculture a very gross criteria of quality of products such as total fat content, pigmentation and outer shape of the fish are applied as on line quality criteria, whereas monitoring of temperature and evaluation of freshness, color, odor and texture attributes and defects such as gaping, are applied in trade of aquatic products. In general processors, retailers and chefs express a general awareness of importance of production conditions, signified by using brand names of specific producers or/and in house brand names tied to production conditions. However, this is often based on personal insights and personal initiatives. No education exists at present to bridge this gap. One outcome of this education is to provide students with the tools to integrate and thereby formulate good practises in quality and safety control systems covering the complete value chain of aquatic food.

Another example of good practice is that this education aims at establishing a strong collaboration with the aquatic food sector/industries in the Nordic countries. An understanding between the education and the aquatic food labour market will be vital. This will be a measurable output via joint project with the seafood industries and considered to be the key to success. By establishing a strong industrial support the proposed master programme will be able to bring out to the labour market highly skilled and valuable students.

## **B.7.2 Dissemination and exploitation of results**

### **Dissemination and exploitation of results**

Several available media will be used to disseminate the results. A blog will be provided as well as an interactive (web) home page will be the core of the master programme. In addition industry and branch associations in the different countries will be vehicles for dissemination of research results and further exploitation of knowledge. A folder dedicated to the master programme will be available this will be a starting point for dissemination of good practice. In addition, presentation of the successful master projects in collaboration with our industrial partners will be done through popular magazines dedicated to fisheries, aquaculture and foods.

## **B.8 Target groups and recruitment of students**

### **B.8.1 Target groups and marketing within the Nordic region**

#### **Within the Nordic region**

Students with bachelor degrees in engineering or life science are the target groups and this is a strength of the proposed master programme as it combines elements of life science and technological aspect in a unique way. The master programme is expected to meet the demand of the Nordic labour market for highly specialised and qualified people with both technological and life science qualifications. Recruitment of students will be performed using marketing strategies and publicity. The programme will be announced at several national, Nordic and International meetings, workshops, conferences and seminars. The program will also be included in the EU aquaculture education student portal of Aqua-Tnet, making it easily found by any student searching the net for education in Aquaculture or Aquatic food. All HEI in the consortium will be involved in the recruitment at the Nordic level and the intent is that a link will be included at each members own home page under key words as aquaculture, fish farming, aquatic food, seafood, quality, safety, etc under the search function. A market analysis in order to recruit new students will be performed using the DTU Match (DTU own market analysis performers) who will evaluate and propose strategies to reach out for new students. The master programme will be advertised using paper based material such as flyers and magazines but also using new technologies such as web-based (web pages, emails) and online mass diffusion medias (youtube, linkedin, facebook etc..). In addition the Nordic HEI web pages will be use to advertise the programme as it will also be recognised byt the national HEI involved.

### **B.8.2 Target groups and marketing outside the Nordic region**

#### **Outside the Nordic region**

Strategies similar to those used in the Nordic regions will be used in order to market and advertise the master programme at the European and international levels (see B8.1).

With the uniqueness of the programme and the growing market for aquatic resources it is expected that the programme will attract international fellows. Diffusion outside the Nordic region will take place by dissemination of the information via existing cooperation programmes and associated research institutions like Aqua-Tnet. Also several existing international research activities will be used as support such as the SeafoodPlus European platform, EATIP (European Aquaculture Technology and Innovation Platform) etc., who will play a key role in diffusion and advertising the Nordic master programme. The popular DTU international workshops on predictive microbiology/seafood safety and quality will also used to advertise the education e.g. by including information on the software homepage (<http://sssp.dtuaqua.dk>). In addition, existing European portals will be used for advertising such as for example [www.masterportal.eu](http://www.masterportal.eu) and [www.study-in-europe.org](http://www.study-in-europe.org) and international portals such as for example [www.sarnissa.org](http://www.sarnissa.org)

## **B.9 Sustainability**

### **B.9.1 Sustainability of the master programme**

#### **Sustainability**

It is expected that the master programme will be sustainable due to the strong partners involved in the consortium, the dynamic of the proposed programme and the strong industrial back up of the programme. Existing courses at the participating HEI will form a solid basis for this new master programme. By new combinations and redesign of courses it will be possible to run the proposed master programme at reasonable costs and at the same time with a high probability of being successful.

In this way the programme is expected to be sustainable. In fact, staff in permanent positions within the consortium combine all the necessary expertise and will supplement and support each other in a sustainable way in order to avoid unnecessary expenses.

## **B.9.2 Financing**

### **Financing**

Implementation will be financed by the present funding and will be supported by the consortium HEI partners administrative entities. With respect to the teaching staff, at HEI, staffs are dedicated to teaching and education, this is part of the HEI employment and education system and therefore the programme will be able to run smoothly. In addition, elements of courses from existing master programmes in the HEI will be part of the new master and will be reorganised and implemented for a web based learning keeping the cost for travelling of students and staff down. The programme is also strongly linked to the aquatic food industry and they will support studies and activities e.g. in relation field trips and these projects. Physical mobility is expected to use already existing forms of financing like NordPlus and NOVA course support for example.

## **C - Development period of the master programme**

### **C.1 Description of the development period**

#### **C.1.1 Goals and achievements during the development period**

##### **Goals and achievements**

In order to ensure that the goals are reached, the consortium will meet every 6 months. Tasks with deadline will be assigned to each HEI members, tasks will be related to the general organisation, management and implementation of the programme. A status report will be issued after each meeting to make sure that tasks and issues have been dealt with accordingly and unambiguously. This will allow a smooth development period. The goals to achieve during the development period are classified as:

- 1) To propose a unique education: It is important for the master programme to be recognised as a unique education in the Nordic countries and also internationally. Nordic countries have a very long history and tradition for production of aquatic resources and deliver high quality products. Standards of quality are recognised worldwide and it will be the consortium ultimate goals to be able to deliver a unique and successful education that will disseminate the knowledge and that will be able to attract Nordic and international fellows. This is considered to be necessary for educating professionals with the potential to develop the aquatic food sector successfully, to grasp opportunities and to achieve the goals of delivering safe and healthy aquatic food for the expanding market.
- 2) To implement a unique Nordic teaching model: As previously mentioned the goal of the master programme is also to further develop and implement the Nordic teaching model. Indeed, this model is proven to be successful and takes its origin in the individualisation of the education. All available material and technology will be used and implemented as much as possible in order to deliver a unique teaching experience. New ways of teaching, linking technology and engineering to life science will be explored.
- 3) To integrate the education with industrial needs: The education will be very strongly linked to industrial needs and will be therefore driven by a constant dialogue between the teachers and the industries in order to stimulate the learning process and integration of student in the labour market. Close interaction between the master programme and the industries will be part of the master programme by field trip, project and master thesis.
- 4) To facilitate harmonisation of higher education system: a smooth implementation of all administrative tasks related to for example diploma, ECTS, and national regulations for example. In addition as for the Bologna process make mobility and transfer from one Nordic country to the other one easy as well as in general the European higher education system making them competitive and attractive. The consortium has the advantage that the partners form the NOVA aquaculture education platform already has confronted and also in part solved a number of these issues facilitating progress in this area.

5) To attract international students: One of the goal of the master programme is to attract international students. Due to the fact that the teaching language will be English, and that a lot of the courses will be e-learning or web-based this will give the programme extra flexibility and allow to attract international fellows. The programme will be able to meet the market demand for delivering highly educating and trained international fellows with knowledge of the Nordic and European aquatic sector.

### **C.1.2 Main activities during the development period**

#### **Main activities**

In order to ensure a continued activity and on time delivery of tasks a main secretariat will be installed at DTU, coordinating sub secretariats at each HEI core partner. It is expected that SLU will be in charge of coordinating sub-programme 1 whilst DTU will be in charge of coordinating sub-programme 2. For each sub-programme a coordinator will be identified and agreed upon. As soon as the evaluation will be released the consortium will meet for a 2 days kick off meeting at DTU in December or January with a clear agenda and written record in order to track and file decisions. A consortium agreement will be signed between all partners. The following points will then be addressed:

- 1) Determination of working groups according to the different expertises for each of the proposed modules but under the sub-programme coordinators (after agreement).
- 2) Determination of content in details of the different modules based on existing courses at the different HEI and participation of the different HEI in the modules. It is evident that the HEI profile will predetermine their implication in the different modules. However, to make sure that no ambiguity arises discussion and decision in plenum with vote if necessary will take place. It will be aimed that a unique education is proposed in the programme with identification of the best possible lecturer and modules. It is aiming at minimizing the opening of new courses but to base as much as possible the teaching experience on already available courses. Guest lecturer as well as industrial lecturer will also be identified to eventually palliate at missing expertise however, this will be kept to a strict minimum.
- 3) Status of materials and set up available at the different HEI including e-learning and set up for promoting distance education. The aim is as much as possible to deliver a web based and e-learning education and careful investigation of available video materials and resources will need to be performed. Preparation of the material necessary for video and computer based systems for implementations and for a successful delivery of such teaching based methods will be an important part of the debate.
- 4) Identification of industrial partners that responded positively to support the proposed education and as a core driver for fields trips and placement of student for master thesis. Determination of their involvement and request for the education integrated learning content. Identification of international industries advisory board with respect to the preparation of the programme content, evaluation and objectives.
- 5) Define the learning objectives for each module based on industrial and market demand as well as preparation of feedback and evaluation forms.
- 6) Advertising and marketing of the current master programme will be done by preparation of folder and posters for dissemination in order to recruit student at the different Nordic countries but also internationally. Overview and identification of the dissemination channels. In addition a survey will be performed in order to reach out for new students.
- 7) Design the of homepage as well as content as well as link to HEIs and to national as well as international web sites. This will include preparation of on line application and evaluation sheets and forms.
- 8) Define the criteria for admission and evaluation of students and affiliation to respective institution based on the student profile and study plan. Establishment of deadline for admission and procedure in details as well as follow the development of the tuition fee in relation to the different national legislations.
- 9) Clarify the nature of the degree delivered with respect to joint diploma or double diploma but aiming at obtaining a joint diploma for all HEI involved for 2014 which will be the first graduating year.
- 10) Reporting will be done on a regular basis and a report will be issued every 6 months by all HEIs institutions involved in order to follow the progress of the preparation phase. This will be necessary in order to ensure progress but also identify shortcomings which will require immediate attention in order to result in a smooth implementation phase.
- 11) Budget will be dealt with as well with expectation of expenses and overview of economy and fund available for full transparency. Again for expenses decisions will be taken in plenum with possibilities to vote.



12). Meeting the frequency of meeting will be very 6 months with several video conferences and telephone meeting on regular basis.

### **C.1.3 Institutional and national anchorage**

#### **Institutional and national anchorage**

The anchorage of the proposed master in all HEI within the consortium is strong due reliance on course elements from existing educations. In addition, each partner will have responsibilities for at least one full module related to their key expertise and have the option to collaborate on other modules. In this way all partners are have responsibility and basis to deliver their best. National anchorage will also be improved by the fact that industries from the different countries will actively take part of master programme. Students will be mainly affiliated to one university depending on their study plan, their field trip and their master thesis and this will contribute to national anchorage.

In addition, the proposed master programme will be recognised by all HEI involved and part of the proposed master education in the same way as other national master programme.

### **C.1.4 Monitoring and evaluation during the development period**

#### **Monitoring and evaluation**

Progress will be evaluated internally and externally. Internal advisors at each HEI in the consortium will take care of following the progress of the master programme development and monitor is successful development. A diagram with tasks and milestones including date for completion will be issued as this will allow checking for a smooth progression of the developing phase. After each meeting a minutes will be written and distributed to all partners in order to assess progress and it will also be the responsibility of the faculty staff responsible for education and teaching at each HEI to support and advise the consortium during the development phase. In addition, an international external advisory board will be created and this board will follow and monitor the development phase of the master programme. During the running phase supporting industries will play the role of the evaluation board in order to follow the master programme delivering of teaching in accordance with the labour market after implementation and during its running period. This is expected to be free consultancy from the involved industries.

## **C.2 Partnership**

### **C.2.1 Previous collaboration**

#### **Previous collaboration**

SLU and UMB in this Nordic MSc have a long and documented history of collaboration within education, and then in particular in aquaculture. Already 5 years ago the partners initiated a network under the umbrella of the NOVA virtual university network (<http://www.nova-university.org/networks/aqua/> ). The primary aim of the network was to formulate a joint Nordic Aquaculture and Fisheries education platform, with the ultimate goal of a joint Nordic Master in aquaculture based on internet teaching, and joint field and laboratory courses. The involved universities formulated a joint intent in the form of a signed document, formalizing the goal of a joint MSc in Aquaculture. This experience will be very valuable for the proposed master programme and some of the teaching will take its origin in the NOVA network. .

NTNU, DTU and UoI, in have successfully collaborated in EU funded Concerted Actions and Integrated Research project SeafoodPlus under different EU framework programmes. This has resulted in a number of highly relevant research projects and scientific efforts. This previous collaboration will strengthen the current research programme as the partners have understood cultural differences and build up a network that will be very valuable for the current master programme and will contribute to a smooth implementation of the teaching activities .

Emails, telephone meetings, as well as face to face meeting will take place in order to prepare the current master programme application. For example a meeting in October 2010 during a seafood technology conference (WEFTA, Izmir October 2010) is planned and some of the HEI representatives (NTUN, DTU and UoI) in the consortium will be able to discuss further the organisation of particular sub-programme 2 of the master programme. Subsequently several meetings will take place on bilateral basis and when given the opportunities.

## C.2.2 Division of work between the partners

### Division of work between the partners

The core of programme and the central coordination will be located at DTU where Caroline Baron will be responsible for making sure the programme is running smoothly, according to deadline, according to agreements, and budget. In addition, 2 coordinators, one for each sub-programme activities will be nominated. They will link each sub-programme and coordinate teaching activities in the sub programme but also between sub-programmes. It is anticipated that based on their expertise SLU will lead sub-programme 1 and DTU sub-programme 2. Each partners in the consortium has a very strong profile in respective areas and this will be the base for assignment of responsibilities. The general frame of the master content and assignment of responsibilities in respective area is clear, however, the tasks and assignment between the partners have not been yet fully determined in details as the overview of the existing possibilities will be fully explored during the kick off meeting.

## C.2.13 Division of funds

### Division of funds

The funds will be divided in a way that will ensure maximal commitment of the HEI involves. Each HEI will receive an initial 10% to cover their working hours, except for the master programme coordinator that that will receive 20%. The remaining 40% will be administered through the coordinator and made available to all partners throughout the development phase of the master. Criteria for administration will include travel expenses, cost implemented for organisation of meetings, webpage preparation, marketing of the education, e-learning set up including funding of the external international industrial advisory board during the preparation phase of the master and unforeseen cost and expenses. In this way it will be possible for involved partners to obtain more funding depending on their involvement and commitment to the master programme and will be administered during the course of the implementation phases according to performance, productivities and negotiations. However, the cost will always be budgeted and discussed and decided by committee before any expenses are allocated.

## C.3 Work programme

	Activity	Start year	Start date	End year	End date
1	Kick-off Meeting	2010	15/12/10		
2	Consortium agreement	2011	01/01/11		
3	Determination of working group and sub-programme responsibilities	2011	01/01/11		
4	Determination of curriculum content	2011	01/01/11	2011	31/12/11
5	Determination of set up and needs for teaching activities	2011	01/01/11	2012	30/06/12
6	Identification of industrial partners	2011	01/01/11	2012	31/12/11
7	Definition and determination of teaching objectives	2011	01/01/11		31/12/11
8	Advertising and marketing	2011	30/06/11		
9	Design of homepage and web content	2011	30/06/11	2012	30/06/12
10	Determination of criteria for admission & Evaluation of students	2011	01/01/11	2012	01/01/12
11	Degree and Diploma according to legislation	2012	01/01/12	2015	01/01/15

12	Reporting every 6 months (status report + final report)	2011		2012	
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## C.4 Budget

### C.4.1 Budget

	2010 (DKK)	2011 (DKK)	2012 (DKK)	Sum
<b>Development of study programmes/courses</b>				
Salaries / fees /employers' fees / general expenses	0	400 000	0	400 000
Travels	25 000	125 000	25 000	175 000
Costs for seminars, workshops, etc	25 000	50 000	25 000	100 000
Purchase of products and services	0	25 000	0	25 000
<b>SUM - Development of study programmes/courses</b>	<b>50 000</b>	<b>600 000</b>	<b>50 000</b>	<b>700 000</b>
<b>Dissemination</b>				
Dissemination of results, including printing costs	0	50 000	0	50 000
<b>SUM - Dissemination</b>	<b>0</b>	<b>50 000</b>	<b>0</b>	<b>50 000</b>
<b>Project management</b>				
Salaries, coordinating institution	25 000	150 000	25 000	200 000
Evaluation	0	0	25 000	25 000
Other costs	0	25 000	0	25 000
<b>SUM - Project management</b>	<b>25 000</b>	<b>175 000</b>	<b>50 000</b>	<b>250 000</b>
<b>SUM - Total</b>	<b>75 000</b>	<b>825 000</b>	<b>100 000</b>	<b>1 000 000</b>

#### Comments to the budget

The frequency of bilateral and consortium meeting are based on estimation, why all cost except for salaries to core members will be administered by the coordinator. Thus the coordinator will cover expenses eligible in the planning phase of the Master Programme.

### C.4.2 Detailed financial plan

	Title	2010 (DKK)	2011 (DKK)	2012 (DKK)	Sum
1	Salaries for non-coordinators through the whole period		400000		400000
2	Core group/advisory board kick off meeting DTU	50000			50000
3	At least three core group meeting (in 2011/2012)		125000	50000	175000
4	Bilateral meetings between HEI's as well as with industry		125000		125000
5	Dissemination (homepage, flyers, report)		500000		50000
6	Salaries coordinator	25000	150000	25000	200000

#### Comments to the financial plan

The level of specification in the financial plan reflects the fact that place and time for bilateral meetings will be planned at the first meeting at DTU in December 2010 or January 2011.

## **Nordic Master Program 2010**

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### **Application**

#### **Project information**

##### **Title of the Nordic Master Program**

Nordic Master of Theoretical Physics

##### **Project number**

NMP-2010/10260

### **A - Project partners**

#### **A.1 Co-ordinating institution**

##### **A.1.1 Co-ordinating institution**

Name of institution: SE-KTH (Kungliga Tekniska Högskola) - Royal Institute of Technology in Stockholm

##### **A.1.2 Project coordinator**

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Department: NORDITA, the Nordic Institute for Theoretical Physics

##### **A.1.3 Administrative contact person**

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#### **A.1.4 Person in charge of finance on behalf of the Consortium**

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#### **A.1.5 Legal representative (Rector or equivalent)**

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Mobile number:  
Fax number:  
Institution: SE-KTH (Kungliga Tekniska Högskola) - Royal Institute of Technology in Stockholm  
Department: Central Administration

#### **A.2 Partner institutions providing Master's degrees**

##### **Partner institution**

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### **A.3 Other partners**

### **A.3 Other partners**

## **B - Content of the master programme**

### **B.1**

#### **B.1 Subject area of the master programme**

##### **Subject area**

The proposed master program is in general theoretical physics and encompasses several more specialized areas including astrophysics, condensed matter physics, high-energy physics, gravitation, space physics, and atmospheric physics. Student research projects will be in diverse sub-fields of theoretical physics but the program will also contain some core courses, specifically designed for this program, that will be common for students in different areas.

### **B.2**

#### **B.2.1 Description of the master programme**

##### **Description**

The main objective of the Nordic Master of Theoretical Physics (NMTP) program, is to create a strong Nordic "brand name" that attracts talented students to Nordic universities and provides them with excellent training and research experience in preparation for further study at the PhD level or direct entry into knowledge based industries. This is especially important in the face of increasing international competition for the best physics students from leading institutes in the US and Europe and from high-profile masters programs such as the Perimeter Scholars International program at the Perimeter Institute in Canada or the Master in Mathematical Physics at Hamburg University in Germany. The creation and promotion of a successful brand name requires attention to quality at all stages, ranging from the entrance requirements for new students, to setting high standards for courses that are offered, to the evaluation of the research carried out by students accepted into the program.

Theoretical physics is a central area of basic research within all the Nordic countries and worldwide. Besides its intrinsic interest as a human endeavor, it is intimately connected to numerous fields of more applied research, and an important training ground for the mathematically sophisticated workforce required in many areas of today's economy. A strong Nordic master program in theoretical physics serves to attract talented students to Nordic universities, both from within the Nordic countries and also from outside the region.

The NMTP program aims to coordinate and strengthen the masters programs in physics at the participating universities through increased student mobility and by creating a critical mass for



sustaining advanced courses that are not viable at each institution separately. It builds on and extends existing programs rather than creating a new program from scratch. This is possible because many of the courses that one wants to have in the program, especially the more introductory ones, already exist at the participating universities. The NMTP program will add the following features:

1) A joint application procedure: The program will use a paperless web-based system, already developed at Nordita to handle post-doctoral and junior faculty appointments, allowing for relatively easy screening of applicants by an international evaluation panel. The program will require applicants to take a well-established standardized test (GRE physics test). The test scores must be used with care but they are especially useful for international applications where there is often no first hand knowledge of the bachelors program that has been completed. Applicants to the NMTP program select to apply for admission at one or more of the participating universities at the same time. The application to the NMTP program will be forwarded to the universities in question and admission into the NMTP program is contingent on admission into a home university within the NMTP consortium.

2) Approval of courses: A selection of existing courses at the participating universities will be included in the NMTP curriculum. This gives students an overview of courses that are on offer at the participating universities and are certified by the consortium to meet the standards of the NMTP program. Students can then select courses at different participating universities without restrictions. The overall study plan of a given student should of course not include overlapping courses and must be approved by the NMTP board and at the home university.

3) New advanced courses: The core of the NMTP program will be a number of new courses at an advanced masters level specifically developed for the program. The precise number and detailed content of these courses will be decided by the NMTP board during the development phase of the project. Each student will be required to select at least 15 ECTS units from the core NMTP courses as part of their masters degree. The new courses will be given by leading scientists in the field and will draw on current research wherever possible. They will be given in a hybrid format with short periods (one or two weeks) of intensive classroom teaching separated by longer periods of internet based distance learning. This allows students at different participating universities to attend the courses together. An important practical aspect is that Nordita can provide housing free of charge to visiting students during the classroom periods of courses taught in Stockholm and can invite prominent scientists for extended visits to prepare and give lectures to NMTP students.

4) An emphasis on original research: All NMTP students will carry out substantial research projects (40 to 60 ECTS units) that must involve original work and should be at a level that qualifies for publication in international physics journals.

5) Enhanced quality measures: Entry into the program is decided by the NMTP board based on a joint evaluation procedure. The proposed research project of a student is submitted for approval by the NMTP board within six months of enrollment in the program. Courses at the participating universities that become part of the NMTP program are certified by the NMTP board. The masters thesis is examined and given a grade by an expert from outside the home university of the student.

## **B.2.2 Summary**

### **Summary**

Theoretical physics is a central area of basic research which, besides its intrinsic interest as a

human endeavor, is intimately connected to numerous fields of applied research. The main objective of the Nordic Master of Theoretical Physics (NMTP) program, is to create a strong Nordic "brand name" that attracts talented students to Nordic universities. This is especially important in the face of increasing international competition for the best physics students from leading institutes in the US and Europe. Nordita – the Nordic Institute of Theoretical Physics – which is a world known Nordic center of theoretical physics, will coordinate the program, that will support and complement the national masters programs. The main elements is a strict admission procedure, a careful selection of courses, masters projects of high quality involving original research, grading using external examiners and a set of advanced master courses based on both web-based distance studies and shorter periods of intense teaching where students from different Nordic universities meet and study together.

## **B.3 Contribution of each partner**

### **B.3.1 Contribution of each partner**

#### **Contribution**

Nordita, the Nordic Institute for Theoretical Physics, has a long tradition as a training center for young researchers at the PhD and post-doctoral level, and of pursuing front-line basic research in theoretical physics and facilitating cooperation among Nordic scientists. With its existing network of contacts in the Nordic and international scientific community, Nordita is in an ideal position to bring NMTP students into contact with leading researchers and excellent educators in theoretical physics at an advanced level. Nordita has the facilities to organize core courses developed for the NMTP program and can provide housing free of charge to NMTP students during the anticipated one or two week teaching periods.

The Niels Bohr Institute at Copenhagen University offers a wide range of high quality master's level courses in theoretical physics, including advanced courses in selected topics relevant to forefront research. The institute is known for its research based education and the typical master's project is based on original work. There are strong theoretical groups in high energy physics, condensed matter, cosmology, astrophysics, complex systems, and quantum information.

University of Southern Denmark

The University of Helsinki offers MSc and PhD degrees in theoretical physics, and it is the leading theoretical physics education and research center in Finland. It has established theoretical physics research groups in particle physics, cosmology, space physics, condensed matter physics, aerosol physics and atmospheric science.

The University of Iceland is the leading higher education institution in Iceland and offers masters and PhD degrees in physics. The university has established research groups in condensed matter theory, cosmology, high energy theory, and mathematical physics.

NTNU

At Fysikum, which is the Physics department of Stockholm University, there are established research groups in condensed matter theory, astroparticle physics, cosmology, string theory, and mathematical physics. The existing masters program in theoretical physics offers advanced courses in quantum field theory, cosmology, general relativity and quantum information.

The department of theoretical physics at the Royal Institute of Technology has research groups in condensed matter theory, statistical physics, mathematical physics, theoretical particle

physics and in biological physics and computational structural biology. The department is involved in masters programs in engineering physics with specializations in theoretical physics and in biological physics.

### **B.3.2 Application and admission procedures**

#### **Application and admission**

The program will have a joint web-based application procedure using the "Job Application Manager" system that has been developed at Nordita. This allows a paperless evaluation procedure carried out by multiple reviewers through a web interface. Students will be required to submit scores from the standardized Graduate Record Examination (GRE) advanced test in physics, which is administered by the Educational Testing Service in the US.

Admission into the Nordic program is in three stages:

- 1) Admission into a masters program at a home institute: The application into the Nordic program is automatically also an application to one or more of the master programs at the participating universities and the first stage is to be accepted into one of these local master programs.
- 2) Approval of program of study: Students submit a proposed program of study including a list of courses and a preliminary outline of the research project for approval by the NMTP steering committee.
- 3) Approval of research project: Within 6 months of starting their studies, students submit a more detailed description of the research project for approval by an evaluation panel.

### **B.3.3 Joint study programmes and relation to national legislation**

#### **Study programmes and relations**

Students who complete a Nordic Master in Theoretical Physics will receive an M.Sc. degree (or equivalent) at their home university along with a certificate from the consortium. Since every student taking part in the joint program will be registered for masters study at one of the participating universities in a Nordic country the studies will be subject to the national legislation of that country. While the certificate from the NMTP consortium is sufficient in order to identify participants in the joint program it is preferable for the purpose of creating a strong brand name that the masters degree at the home institution is specifically designated as a Nordic Master in Theoretical Physics. This designation will be pursued at each participating university during the development phase of the program.

The subset of masters level courses at the participating universities that become part of this program have already been certified at the national level. They will also have to be approved by the program steering committee. The core courses that will be specifically developed for this joint program will be submitted to the faculties of each of the participating universities to be included as optional courses in their masters curriculum.

### **B.3.4 PhD requirement**

#### **PhD requirement**

All the universities participating in the program offer doctoral studies and are certified at the national level to issue PhD degrees in physics. We anticipate that, due to the international character of the program and stringent quality controls, the graduates of the Nordic Master in Theoretical Physics program will be successful in securing places in PhD programs in the Nordic region and elsewhere.

### **B.3.5 Number of ECTS (Study credits)**

#### **Number of ECTS**

The NMTP program will be 120 ECTS units corresponding to two years of full-time studies. This includes a research project of 40 - 60 ECTS units and a minimum of 15 ECTS units from the courses specifically developed for the joint program. The remaining ECTS units will come from master level courses offered at the participating universities that have been selected for inclusion in the NMTP program. Students will be free to combine courses from the different participating universities but individual programs of study have to be approved by the NMTP steering board.

### **B. 3.6 Language**

#### **Language**

All courses in the master program will be given in English.

### **B.4 Nordic added value**

#### **B.4.1 Academic quality**

##### **Academic quality**

The NMTP program is very much focused on added value through academic quality and cooperation. Specific aspects include:

- 1) Exposing students to a very broad range of research topics: A physics bachelor has a good background in both theoretical and experimental physics, but is usually not yet prepared for doing independent front-line research. A master program in theoretical physics should provide the advanced tools necessary for doing this in several sub-fields, but also allow for focusing towards a particular area of interest, such as high energy physics or condensed matter physics. While the groups at the participating Nordic universities clearly can provide high quality courses, and supervision in specialized areas, they are typically too small to comprehensively cover even the most central areas of modern theoretical physics. The NMTP program, coordinated by Nordita, will address the critical size issue and expose students to a wide range of current research, both through advanced courses and by direct contact with leading researchers.
- 2) Common screening and grading of Master thesis: To ensure high-quality course work and research by NMTP students, study plans and masters research projects have to be endorsed by a joint Nordic committee, and the master thesis will be graded by an external examiner.
- 3) Formation of inter-Nordic coordination and collaboration: The research and study environment is essential for the quality of the education. Increased contacts between students at different Universities, who share common interests, will boost their enthusiasm for physics, spawn collaborations and long-standing partnerships over national borders, and vouch for high quality learning and research.

#### **B.4.2 Contribution to excellence and competitiveness**

##### **Contribution**

Because of the strict quality demands on course and thesis work, we are confident that a Nordic master in theoretical physics soon will be considered as a mark of excellence, thus allowing the participating students to successfully compete for PhD positions at the very best institutions in the world. This is, however, but a link in a positive feedback loop, where some of these students

will return to junior faculty positions at Nordic universities, where they in turn will be in excellent positions to train the next generation of masters and PhD students.

Recruiting very good non-Nordic students can be challenging, both due to language barriers and because the competition for these students is strong. The NMTP program will increase the competitiveness of the participating masters programs in this respect. This will improve the reputation of Nordic graduate physics education as a whole and may thus even benefit programs in the Nordic countries that do not participate in the NMTP program.

## **B.5 Quality assurance**

### **B.5.1 Measures to assure the quality of the master programme**

#### **Measures to assure the quality of the master programme**

1) Admission procedure: Admission to the NMTP program will be granted by a Nordic committee of theoretical physicists and will be contingent on acceptance in at least one national program. The number of students in the NMTP program will be limited, and while the detailed criteria for the selection of the students is to be worked out during the development phase, it will certainly include documented strong background in both mathematics and physics. Students will also be requested to submit scores from a standardized test developed and administered in the United States.

2) Endorsement of individual courses: Not all courses in the existing masters programs at the participating universities are necessarily suitable as NMTP courses and the NMTP board will produce a list of endorsed courses.

3) Endorsement of master thesis projects: The master thesis projects in the NMTP program are to be presented to a Nordic committee, and only projects with a substantial element of independent research will be accepted.

4) Grading of the master theses: A close to final draft of the thesis is to be submitted to the NMTP board in advance of the final examination. The board will decide if it is of high enough quality to be defended as an NMTP thesis, and a representative of the board will be present at the defense. A grade for the thesis research will be decided based on the recommendation of the representative present at the defense.

### **B.5.2 Connection to research**

#### **Connection to research**

The connection to front-line research is among the foremost objectives of the NMTP program, and it is guaranteed in several ways.

1) Participating departments: Only university departments with strong and active research groups in theoretical physics are included as partners in the program. This ensures that the students will have access to an active research environment, and qualified supervisors.

2) Selection of thesis subjects: The strict demand on the thesis subjects, as described in B.5.1, which excludes the possibility to write a thesis solely based on literature study.

3) Direct contact with researchers in different fields: Through the advanced courses designed for this program, the students will get in direct and close contact with leading researchers in fields different from their specialty, contacts that they might not be able to make at their home

institutes.

### **B.5.3 Evaluation of the master programme**

#### **Evaluation of the master programme**

The evaluation of the program will be at two levels.

1) Evaluation at course level: The courses in the national masters programs will be evaluated according to the rules of the country at hand, and the NMTP board will analyze the results. If necessary, the committee can with time decide to remove a given course from the list of endorsed courses. The special NMTP courses will be evaluated separately according to a common procedure to be decided upon during development phase. They will also be submitted for certification at each of the participating universities.

2) Evaluation at program level: All students finishing the program will be asked to fill out an evaluation form that will focus on questions regarding the general structure of the program. The results will be analyzed by the NMTP board and reported back to Nordita and the persons responsible for the national masters programs. The program as a whole is to be evaluated at intervals of a few years by external expert committees. The first evaluation will take place towards the end of the development period before full implementation of the program and will focus on the development process itself.

### **B.6 Innovation**

#### **B.6.1 Innovative aspects regarding the content of the master programme**

##### **Regarding content**

The ambition of the NMTP program is to cover many of the most exciting areas of modern theoretical physics and encourage students to explore advanced topics beyond the confines of a single specialty. It should be stressed that the program will offer a richer set of courses and research opportunities than any single master program at the participating departments. The strong emphasis on quality controls, which is designed to enhance the international standing of the NMTP program and its students, is another innovative aspect.

#### **B.6.2 Innovative aspects regarding the teaching methods of the master programme**

##### **Regarding teaching methods**

The new advanced courses are planned to be hybrids between traditional class-room teaching and distance learning. There will be one or two short and intense periods of lectures and problem solving classes where all students are physically present, and a more extended period of distance instruction using web-based technology. In most cases the traditional teaching will take place at Nordita but other locations within the consortium can also host teaching periods. This is in particular anticipated when there is a strong concentration of expertise in a particular research area at a participating university. During the distance-teaching period, students at the different universities will be encouraged to form both traditional and net-based study groups. When possible, there will also be a local instructor assigned to the various courses who can assist the study groups on an ad hoc basis.

### **B.7 Dissemination**

#### **B.7.1.Examples of good practice**

### **Good practice**

The primary output of the NMTP program will be its graduates, i.e. students who have gained solid background knowledge of physics that encompasses more than one specialized area and have received high-level research training. These students will be well equipped for further study at the PhD level or for work in industries requiring sophisticated mathematical and modeling skills.

Examples of good practice include the emphasis on original research by NMTP students and rigorous evaluation and grading by external examiners of all masters projects within the program.

The program will introduce a course model, which combines intense lecturing over short periods with internet based remote studies, enabling NMTP students at different universities to take advanced courses together. The course model can be adapted to other settings and other fields of study besides theoretical physics (similar models may in fact exist already in other fields without our knowledge) and its successful implementation will help promote student mobility in the Nordic countries.

## **B.7.2 Dissemination and exploitation of results**

### **Dissemination and exploitation of results**

The salient features of the NMTP program will be described on the program home page (to be constructed during the development period) and will therefore be publicly available. The implementation and promotion of the program will no doubt be noted by Nordic colleagues and more universities may wish to join. The program structure is to be kept open in order to facilitate expansion during the implementation phase so that a maximum number of qualified students in the Nordic region can benefit from participating.

The masters theses that are produced as part of the program will be collected into a publicly available web archive. Depending on how copyright issues are resolved, some course material developed for the program may also be released through the internet.

## **B.8 Target groups and recruitment of students**

### **B.8.1 Target groups and marketing within the Nordic region**

#### **Within the Nordic region**

The target group within the Nordic countries consists of promising and highly motivated students with bachelor degrees in theoretical physics and related subjects. This is the same target group that the participating universities would like to attract to their existing masters programs and one of the motivations for creating the NMTP program is to have increased visibility among this group of strong Nordic students and be able to offer a more competitive masters program.

### **B.8.2 Target groups and marketing outside the Nordic region**

#### **Outside the Nordic region**

The target group outside the Nordic region is similar to the Nordic one, i.e. promising students with bachelor degrees from universities worldwide. Successful recruitment from this group requires more aggressive outreach than within the Nordic countries. In the long run the international success of the program rests on establishing and maintaining NMTP as a high-quality brand name within the physics community. This will take time and will only be

achieved by paying careful attention to quality in all aspects of the program on a continuing basis.

The launch of the NMTP program will be widely advertised through available internet channels and by conventional advertising in international science journals and by distributing printed fliers. The program homepage is a crucial link in the promotion of the program and sufficient resources have to be put into its development and maintenance.

The level of the physics training obtained at different universities can vary enormously and the background knowledge and skills of applicants from far corners of the globe can be difficult to discern from their university transcripts alone. To help identify talented international students we plan to require applicants to the NMTP program to take the GRE physics test, which is widely used by universities in the United States and its use is becoming more common in Europe as well.

## **B.9 Sustainability**

### **B.9.1 Sustainability of the master programme**

#### **Sustainability**

All the partners in the consortium have physics master programs in place that are already sustained. The NMTP program will extend and strengthen the theoretical physics part of these master programs as described above. The added value that comes from running joint advanced level courses and the various quality measures built into the NMTP program will enrich the student experience at the partner universities and enhance their career prospects. This will in turn serve to attract strong students to these master programs.

By ensuring that the NMTP program conforms to local rules and requirements in each country and making the additional administrative procedures associated with the program as smooth and efficient as possible, partner universities will be motivated to stay within the program and others will be interested in joining.

### **B.9.2 Financing**

#### **Financing**

The partner universities will remain responsible for funding and running their individual master programs. Additional funding is needed to organize and implement the additional features that are involved in the NMTP program, including the joint application procedure, the new NMTP courses, external evaluation of master theses and public lectures, meetings of the NMTP board, etc. The primary source of funding for these activities will be income generated at the Royal Institute of Technology and/or Stockholm University when students (including visiting students from partner universities) complete NMTP courses held at Nordita, which is jointly hosted by these two universities in Stockholm. At a conservative estimate, 10 to 15 students will participate in 15 ECTS units of NMTP courses run at Nordita each year. These student numbers are enough to finance one or two meetings of the NMTP board per year and provide adequate administrative support for program activities at Nordita. Direct administrative costs at the partner universities, beyond those incurred in operating their own master programs, should be minimal and is likely to be offset by an increase in student numbers once the NMTP program has been launched and promoted internationally. The partner universities have different policies when it comes to tuition charges for master students in their own programs and these will remain in place for NMTP students. We do not, however, plan to charge any extra tuition for participation in the NMTP program.



Living expenses for master students will remain the responsibility of participating universities and the students themselves. We do not anticipate providing student grants within the NMTP program but extended visits by NMTP students to partner institutes may be eligible for funding from international programs such as Erasmus Mundus. Nordita can provide housing for lecturers and up to 30 students free of charge in Stockholm during teaching periods in the new NMTP courses.

## **C - Development period of the master programme**

### **C.1 Description of the development period**

#### **C.1.1 Goals and achievements during the development period**

##### **Goals and achievements**

The overall goal is to have a fully developed framework for the NMTP program in place and to have the first NMTP students begin their studies no later than Fall 2012. This entails a number of steps.

- 1) **Steering committee and work plan:** The first step is to set up the NMTP board and agree on a time plan for the development period. This has already been achieved in that the contact persons at the participating universities will make up the first NMTP board and this proposal includes a work program.
- 2) **Legal status and financing:** The legal status of the NMTP program at each participating university in relation to existing master programs needs to be established at a relatively early stage and a detailed financing model addressing long-term implementation of the program needs to be developed.
- 3) **Curriculum development:** On the one hand, the NMTP board will select courses from the existing curriculum at the participating universities to be included as NMTP courses, and on the other hand the board will decide on the new courses that are to be developed specifically for the NMTP program. The necessary IT infrastructure for distance teaching and evaluation of student performance needs to be in place by the end of the development period.
- 4) **Application procedure:** A procedure for handling student applications needs to be agreed to and checked against conflicts with local procedures at the participating universities. The on-line Job Application Manager system at Nordita needs to be extended to handle also NMTP applications.
- 5) **Home page and advertising:** Having a well-designed and functional home page is crucial for reaching out to potential students and later on for the successful implementation of the program. The design and content of an NMTP home page is a major goal of the development period. Advertisements of the NMTP, both web-based and in print journals, also need to be designed and distributed in good time before the program is launched.

#### **C.1.2 Main activities during the development period**

##### **Main activities**

- 1) **Steering committee meetings:** In order to make progress towards the goals outlined in C.1.1. above, the NMTP board will meet regularly during the development period, with the first meeting taking place at Nordita in Stockholm in January 2011. Subsequent meetings will take

place at each of the participating universities outside Stockholm in turn during 2011 and early 2012.

2) Contact with university administrations and faculty: The contact person at each participating university will consult with their university leadership on how to fit the NMTP program into existing administrative structures or set up new ones if needed. The contact person is also responsible for keeping the physics faculty at their home university informed and involved in the development of the NMTP program. These tasks are on-going throughout the development phase.

3) IT design: An NMTP logo and the basic layout of a home page for the program will be commissioned by the consortium early in the development period. Other IT tasks include an upgrade of the application software at Nordita and a secure web interface for handling teacher/student interactions during distance teaching in NMTP courses.

4) Administrative support: A temporary, part-time, position of NMTP administrator will be at Nordita during the development period to facilitate the work of the NMTP board.

### **C.1.3 Institutional and national anchorage**

#### **Institutional and national anchorage**

The NMTP board will consist of one member from each participating institution during the development phase. This ensures that all partners in the consortium take part in the development work and are able to influence the final outcome. As mentioned in C.1.2 above, the NMTP board members will report regularly to the physics faculty and the administration at their home university.

The NMTP program itself will be firmly anchored at the universities participating in the consortium as it will be partly based on courses that already exist at these universities. NMTP students will be enrolled at a participating university. Their studies will be subject to local rules and regulations and their masters research projects will in most cases be directly supervised by a local faculty member.

The NMTP board members are contact persons at the national level in addition to representing their home institutes in the consortium. They will inform other departments in their home countries with high quality research in theoretical physics about progress in developing the NMTP program, and make clear that it will be open for more partners to join once it is in the implementation phase.

### **C.1.4 Monitoring and evaluation during the development period**

#### **Monitoring and evaluation**

The NMTP board is scheduled to meet at least six times during 2011 and early 2012 and will at each time evaluate the progress on the 5 points listed under C.1.1 above. Progress reports based on these self-evaluations are to be sent to the physics faculties at the participating universities. We also anticipate having external evaluations carried out every few years once the NMTP program has been launched. The first of these could be at the end of the development period, in time to be included with the final report to SIU.

## **C.2 Partnership**

### **C.2.1 Previous collaboration**

### **Previous collaboration**

Nordic collaboration in theoretical physics has a long history where Nordita has played an important role and has served as a hub bringing together Nordic and international scientists in a variety of research related activities. Many of the professors in theoretical physics at Nordic universities, including all the contact persons, have spent time at Nordita, either as post-doctoral fellows, faculty members, or as guest researchers, and basically all Nordic theoretical physicists have attended Nordita conferences and workshops. There have been several discussions in the Nordita Board about launching educational programs for graduate students and the need for creating critical mass for courses at the advanced master and PhD levels. The present proposal is to a large extent a result of those discussions. It only concerns masters study but once the NMTP program has been launched and successfully run for some years, we are interested in developing a parallel program for course work at the PhD level.

The primary means of communication in the actual preparation of the proposal has been e-mail but there have also been conference telephone calls and face to face meetings at Nordita and at the Niels Bohr Institute in Copenhagen with contact persons from participating universities.

### **C.2.2 Division of work between the partners**

#### **Division of work between the partners**

Nordita is in a unique position to facilitate and support a joint master program of the type described here. It is a Nordic research institute with an extensive network of contacts within the Nordic and international physics communities. It will carry the main responsibility for organizing the development of the NMTP program, including developing the IT tools needed for admission and distance teaching, coordinating the work of the NMTP board, and handling the program finances. Nordita will also play a central role in the implementation of the program by providing teaching facilities for the new NMTP courses, providing housing for students and lecturers in Stockholm during intensive teaching periods, organizing regular meetings of the NMTP board, processing student applications, and handling the program finances.

Faculty members at the partner universities bring expertise and experience in teaching and supervising master students. The NMTP curriculum will consist of courses that are selected from existing master programs at the participating universities and there will also be a number of new courses at an advanced master level, covering different areas of theoretical physics. The new courses will be designed by teams of experts from the participating universities with the exact division of labor and designation of team members to be decided by the NMTP board early in the development phase.

### **C.2.13 Division of funds**

#### **Division of funds**

## **C.3 Work programme**

## C.4 Budget

### C.4.1 Budget

	2010 (DKK)	2011 (DKK)	2012 (DKK)	Sum
<b>Development of study programmes/courses</b>				
Salaries / fees /employers' fees / general expenses	0	0	0	0
Travels	0	0	0	0
Costs for seminars, workshops, etc	0	0	0	0
Purchase of products and services	0	0	0	0
<b>SUM - Development of study programmes/courses</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Dissemination</b>				
Dissemination of results, including printing costs	0	0	0	0
<b>SUM - Dissemination</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>Project management</b>				
Salaries, coordinating institution	0	0	0	0
Evaluation	0	0	0	0
Other costs	0	0	0	0
<b>SUM - Project management</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
<b>SUM - Total</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

### Comments to the budget

### C.4.2 Detailed financial plan

### Comments to the financial plan