

Smart textile research projects at SINTEF

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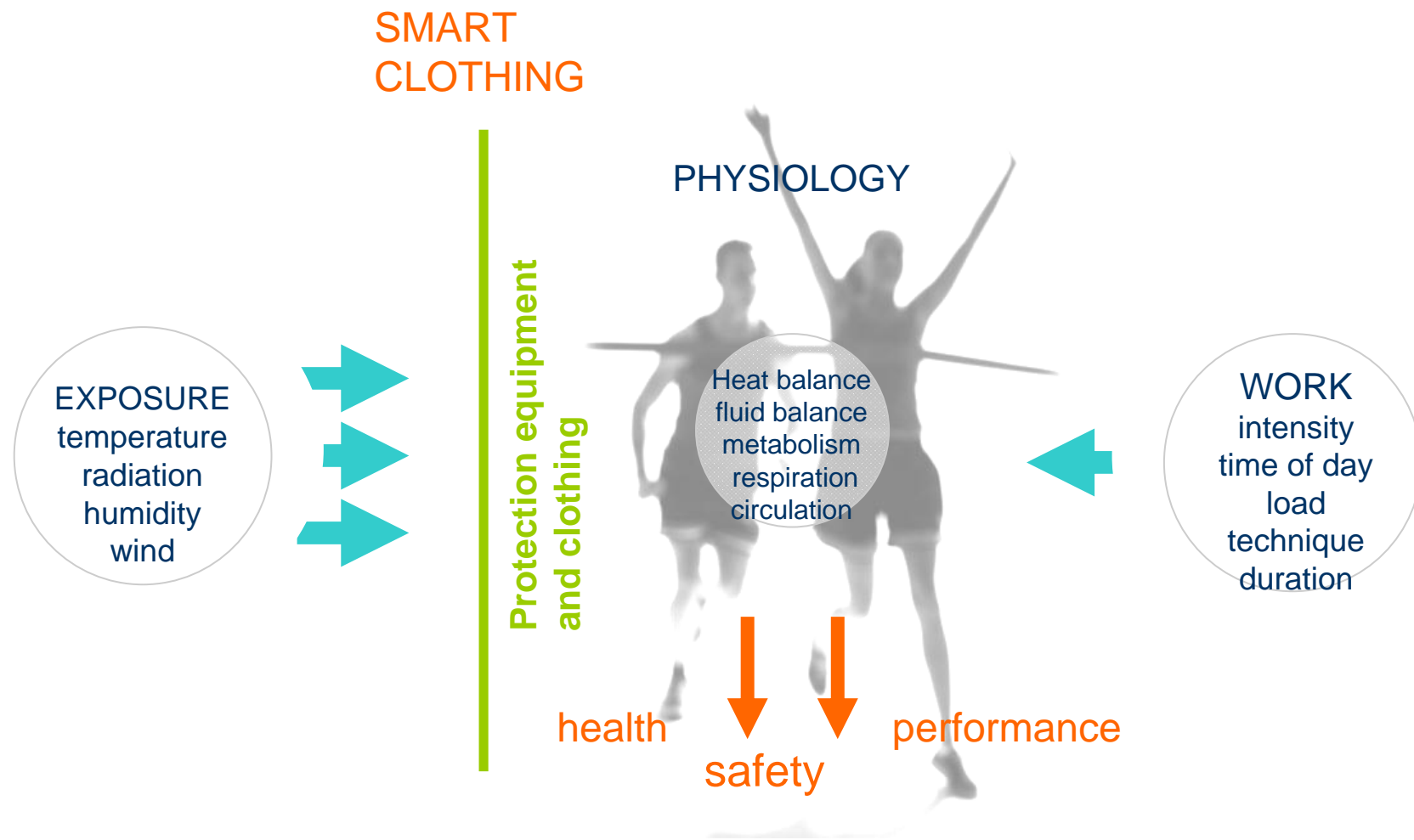


Agenda

- SmartWear in SINTEF
- National KMB project
 - ColdWear – Textiles and clothing for improved safety, performance and comfort in the High North
- EU Projects:
 - Safe@Sea – Protective clothing for Improved Safety and Performance in the Fisheries
 - Noterefiga – Novel temperature Regulation Fibres and Garments

Work physiology

Interaction between surroundings, body and work





SmartWear

Technologies for and applications of clothing textiles with added functionality and tailored properties, based on the application of multi-functional materials and/or integrated instrumentation.

physiological monitoring – **SINTEF Health Research**
temperatures, ECG, blood pressure, respiration and moisture

integrated instrumentation – **SINTEF ICT**
sensors, actuators, electronics, communication and information

functional materials – **SINTEF Material and Chemistry**
adaptive materials, protective materials, absorption and release

SmartWear main focus:
Smart cold protective clothing

2008-2012: ColdWear

Textiles and clothing for improved safety, performance, and comfort in the High North



- Research at SINTEF and NTNU
 - ✓ Financed by NRC (“KMB” project: “kompetanseprosjekt med brukermedvirkning”)
 - ✓ Supported by industry partners: StatoilHydro, Wenaas AS, Swix Sport AS and Janus AS

- KMB project – competence building by
 - Publish at least 10 papers in international refereed journals and 10 conference papers.
 - To educate 2 PhDs and supervise 10 master students
 - To provide the project partners a significant competitive advantage that will be realized by initiation of several industrial innovative spin-off projects that utilize ideas created in ColdWear.

- <http://www.sintef.no/ColdWear/>

Partners and roles ColdWear



ColdWear Partner	Role of the partner in ColdWear	Competence and know-how contribution to ColdWear
SINTEF	R&D provider	Management Materials science Instrumentation and sensors Physiology and design
NTNU	R&D provider	Education Material science Physiology
Swix Sport	Industrial partner	High performance natural and synthetic fibres for sports and leisure wear
Wenaas	Industrial partner	Workwear
Janusfabrikken	Industrial partner	Wool, underwear, work wear
StatoilHydro	Industrial partner	Strong competence in user needs

ColdWear objectives

- Create the knowledge and scientific background for developing new clothing solutions that enable a significant increase in performance in the cold and safety of operations in the High North
- Two cases studied:
 - Elite athletes – cross country skiers (Swix Sport AS)
 - Oil and gas workers in the High North



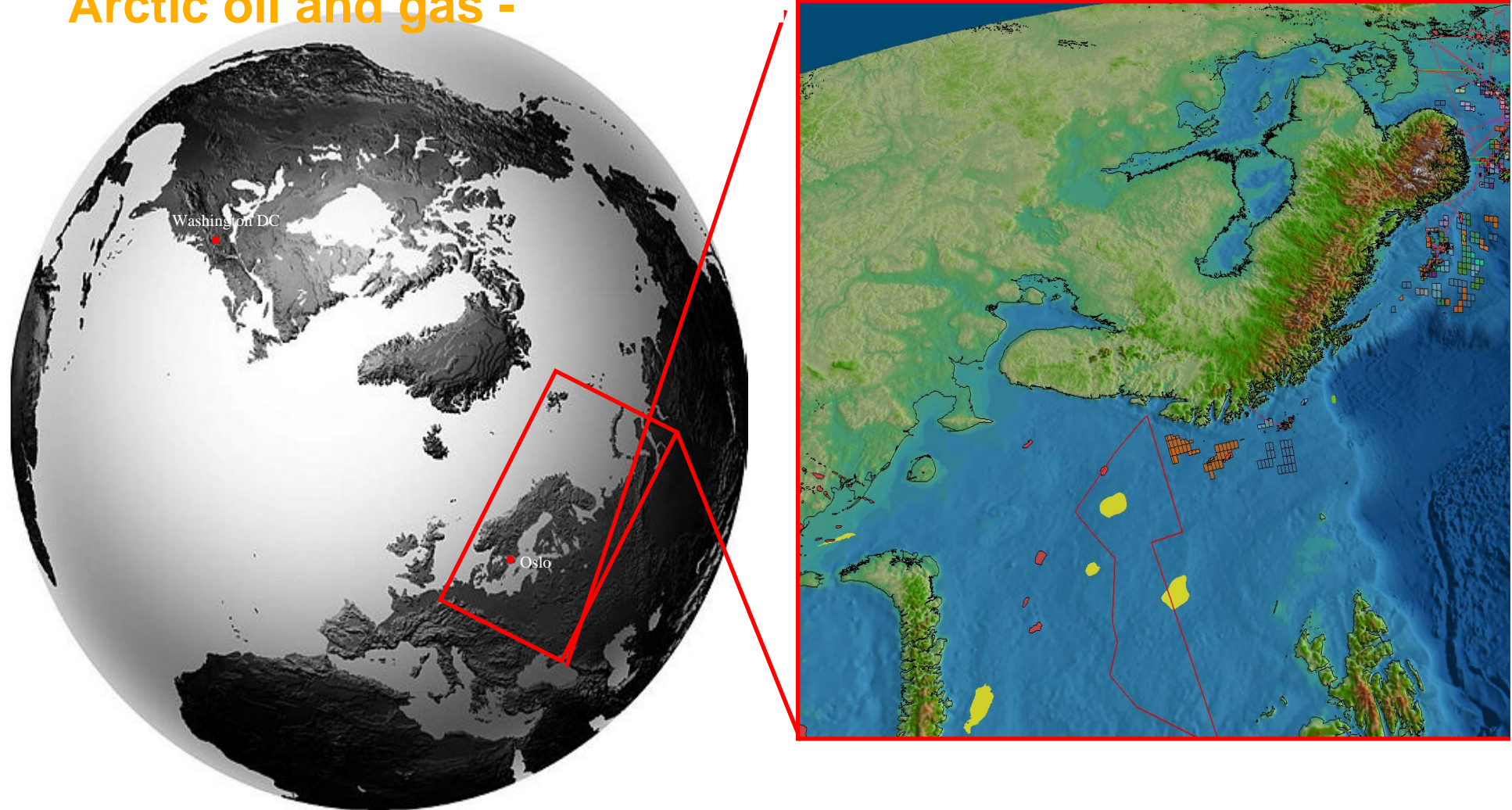
Photo: Statoil



Photo: Swix Sport AS

The High North

Arctic oil and gas -



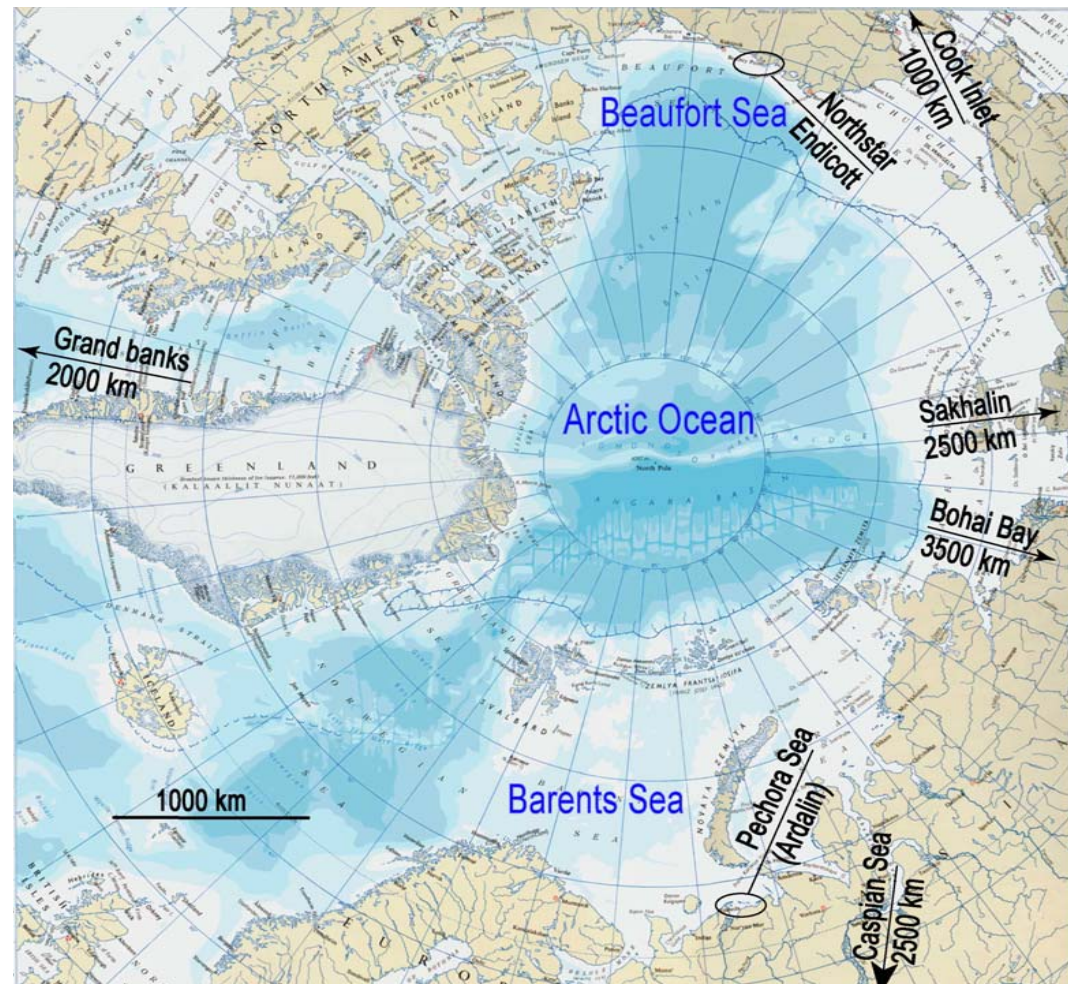
Arctic challenges

- **Climate**
 - Weather
 - Ice / icebergs
 - Icing

- **Physical Environment**
 - low air temperatures
 - poor visibility
 - polar darkness
 - snow & blowing snow
 - occasional icing

- **Remoteness**
 - Field to infrastructure
 - Field to market

- **Personnel safety/health**
- **Sustainable development**



Cold climate and personal safety and health



- The harsh (cold, wet and windy) environment in the High North is a threat to work performance, comfort and health.
- Reduced work performance and comfort represents an increased risk of human errors that may have fatal environmental and health impacts.



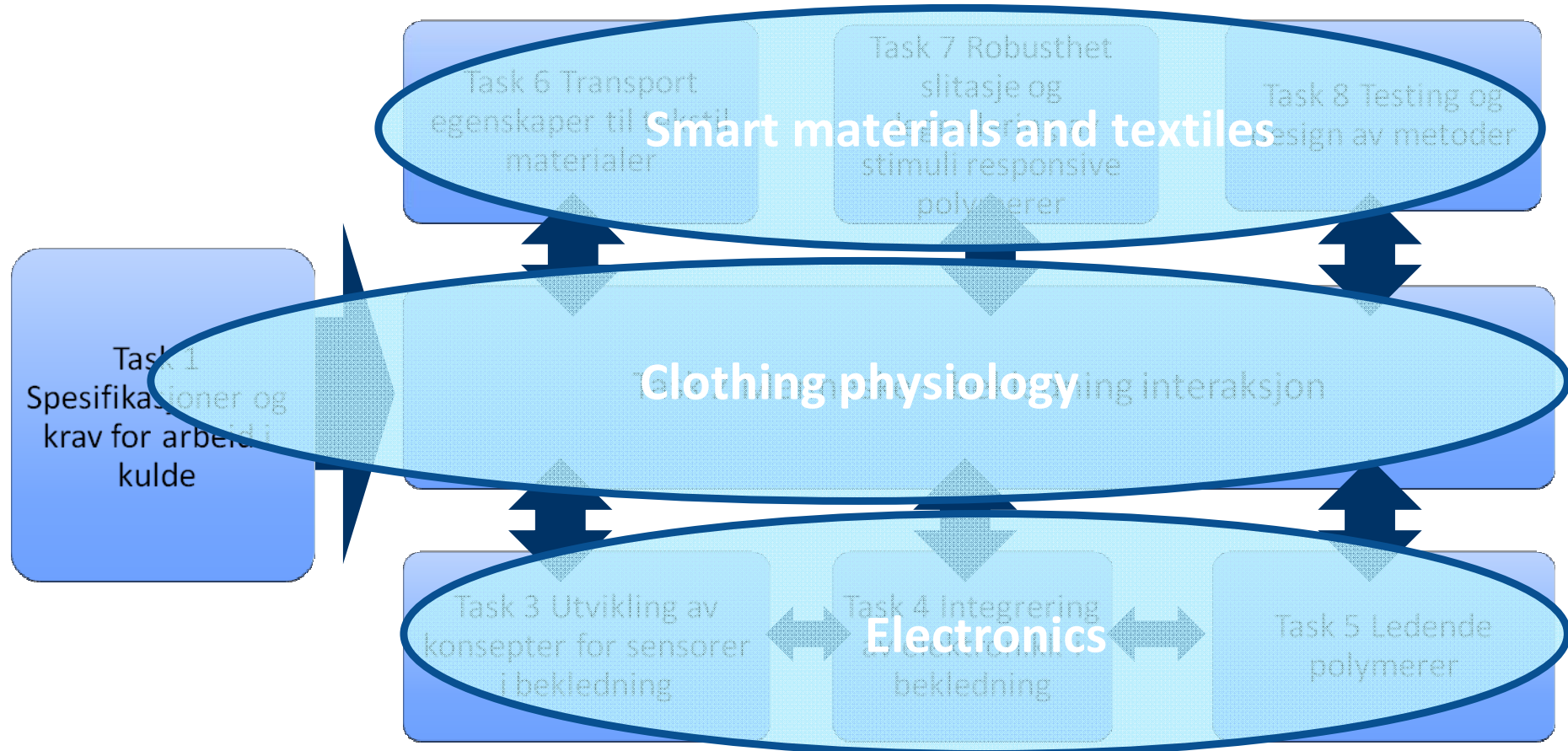
Main knowledge building areas in ColdWear



- How the interaction between environmental exposure, clothing, work load, and physiological regulatory system affect the worker (task 1, task 2)
- How to develop and integrate sensors in clothing that improve user safety without reducing comfort and work performance (task 3, task 4)
- How comfort and work performance can be improved by the use of stimuli-responsive materials that adapt properties to environmental changes (task 5, task 6, task 7, task 8)
- How to develop materials that provide a significant increase in performance because they add functionality that cooperates with the body's own regulatory mechanisms to provide optimal function (task 8, task 6)



Overview of the ColdWear project



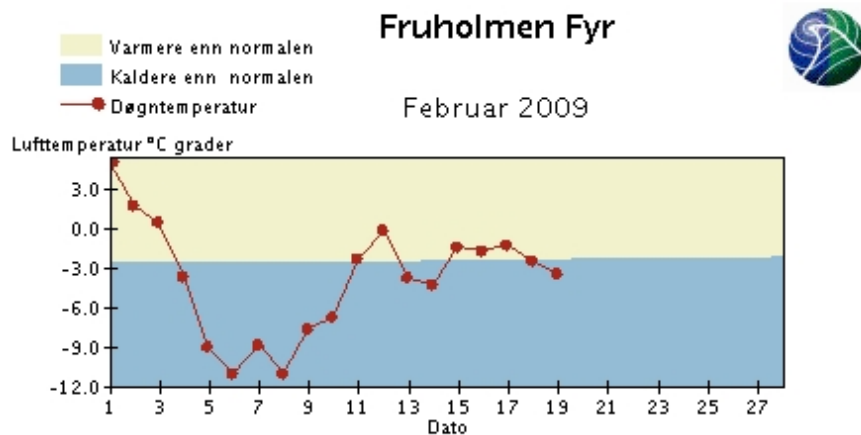
Climatic challenges at Melkøya, Hammerfest



www.statoilhydro.com

- Snøhvit field is the worlds northernmost installation for LNG export, gas is transported in a 143 km long subsea pipeline

- Polar storms are not uncommon in january/february

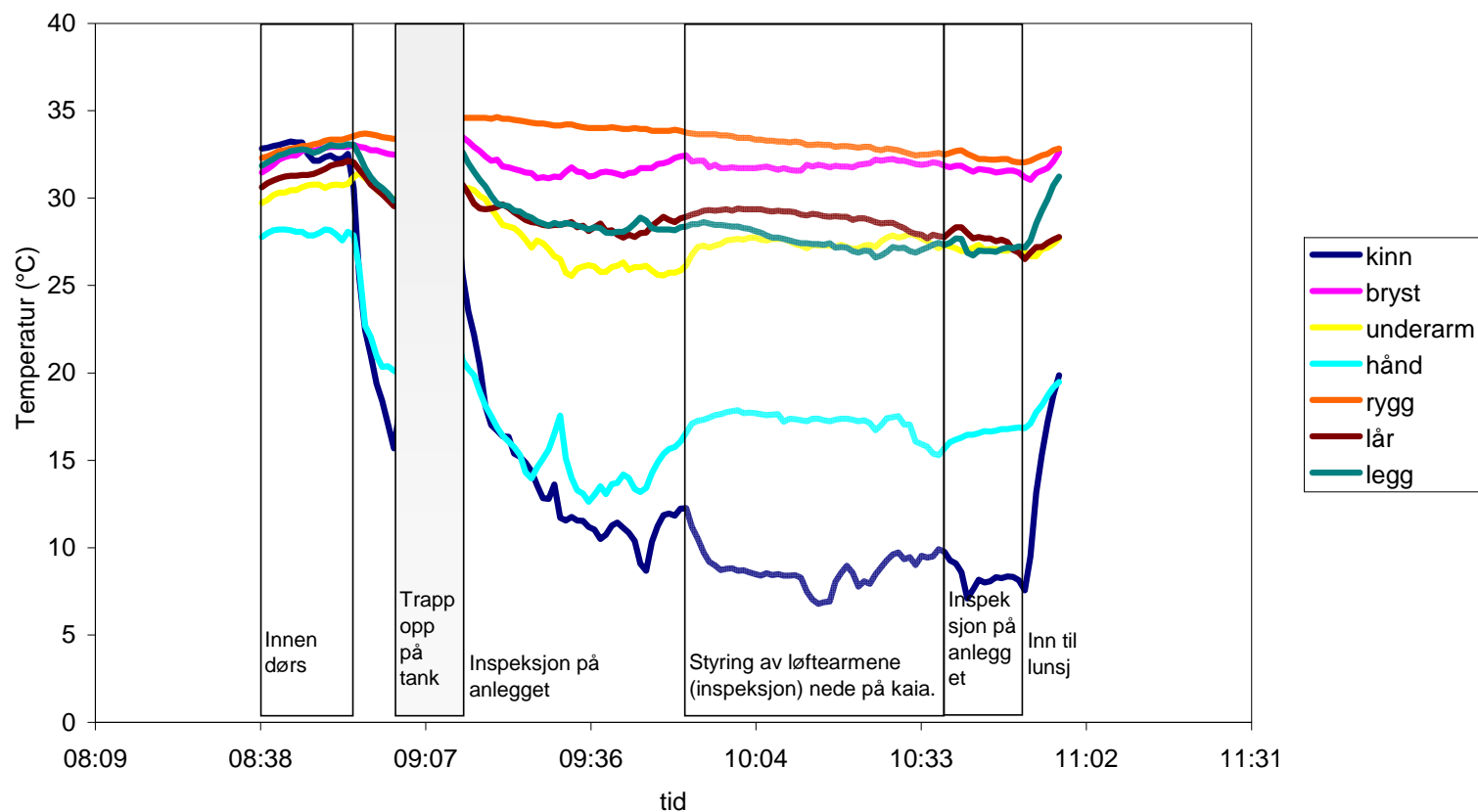


Observations – LNG Melkøya



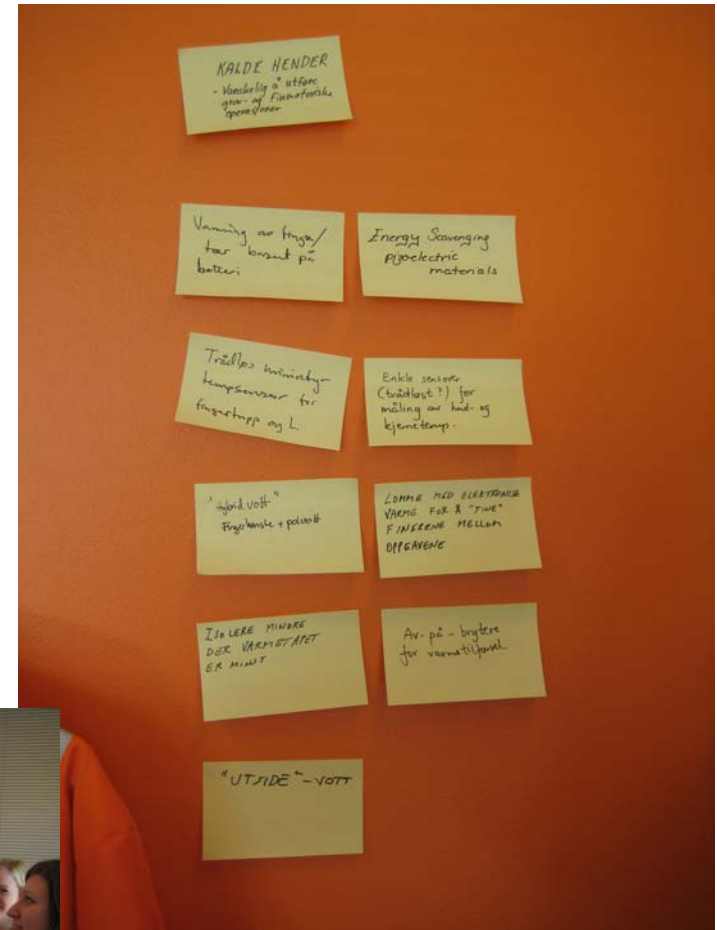
Temperatures subject 3 - operator

6 feb Melkøya, Forsøksperson 3, operatør



Internal Workshops

- Work shop I 12 desember 2008,
 - Etablering av et tverrfaglig **SmartWear Team** for utvikling å gjennomføring av **ColdWear**
 - Bevisstgjøring av roller og ansvarsområder
- Work Shop II, 26 mars 2009
Presentasjoner av resultater fra task I og II
 - Relevante problemstillinger fra task 1-2 til task 3-8
 - Ide generering – brukers utfordringer - forslag til løsninger
 - Fremme tverrfaglig samarbeid
 - Relevans og sluttbrukerfokus i prosjektet



D2.7A Masterthesis industrial design Hege Torsvik

Design of work clothing for oil and gas industry workers



Integrated communication device



Notes on the arm



Great movement



Great movement



Ventilation possibilities



Ventilation possibilities



Alarm



Tightenings for a better fit



Tightenings for a better fit

Safe@Sea

Protective clothing for improved safety and performance in the fisheries

Collaborative Project Targeted at SMEs

Work programme topics addressed: FP7-NMP-2008-SME-2

NMP-2008-4.0-9 Reducing the risk of injury in complex systems
through advanced personal protective equipment

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Partners

Beneficiary	Beneficiary name	Beneficiary short name	Country
Number 1 (Coordinator)	SINTEF (RTD)	SINTEF	Norway
2 (Leader)	Helly Hansen Pro WorkWear	HH	Norway
3	Ohmatex (SME)	OHM	Denmark
4	Tampere University of Technology (RTD)	TUT	Finland
6	Swerea IVF (RTD)	IVF	Sweden
7	Sisyfos AS (SME)	SIS	Norway
8	CENTEXBEL (RTD)	CEN	Belgium
9	B.Huhta (SME)	B.Hu	Finland
10	Leia (RTD)	LEIA	Spain
11	Grado Zero Espace (SME)	GZE	Italy
12	International Safety Products (SME)	ISP	UK
13	International Maritime Health Organization	IMHA	Belgium
14	FOV Fabrics AB	FOV	Sweden

Background

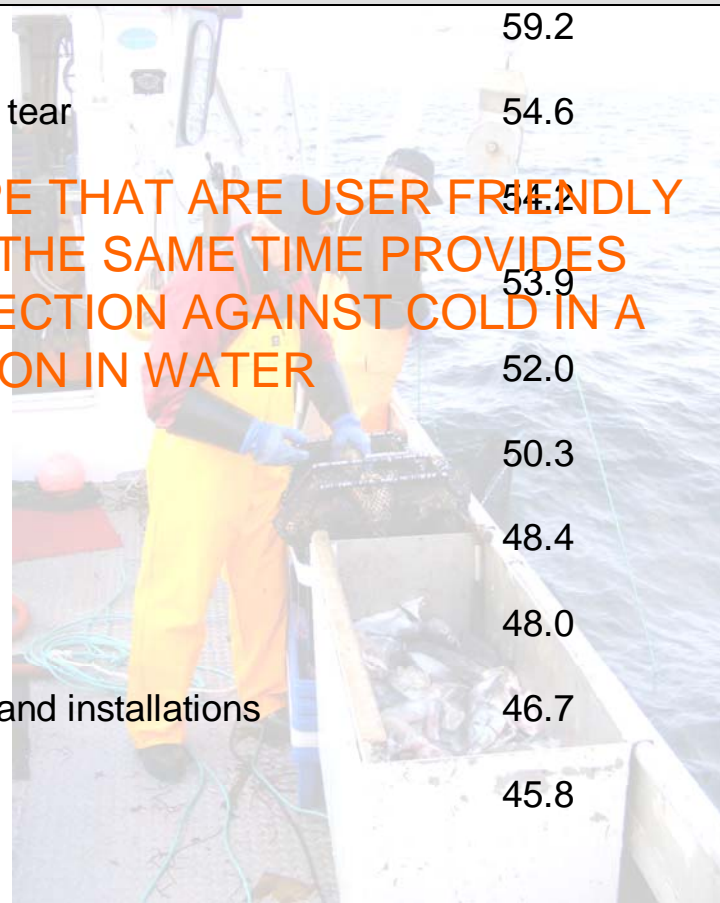
- 28.5 million people are engaged in capture fishing worldwide
- Fishing is among the most dangerous of all professions with as many as 24,000 fishermen around the world killed every year ⁽¹⁾
- Improved safety at Sea is a major concern to national authorities, international organizations and nongovernmental organizations
- Efforts have been put in safety education and training of fishermen, improved vessel design, construction and working conditions aboard and improvements in **personal protective equipment (ppe)**

[1] European Agency for Safety and Health at Work,
http://osha.europa.eu/good_practice/sector/fisheries/

[2] <http://www.cdc.gov/niosh/> National Institute for Occupational Safety and Health (USA) NIOSH
Publication No. 2006-114: Proceedings, Second International Fishing Industry Safety and Health
Conference, April 2006

Fishermens requirements (1)

User requirement	% of total (n=306)
1 Water-proof	59.2
2 Reinforced on parts especially exposed to wear and tear	54.6
3 Maintains the body warm overboard and drowning and consequences are often fatal	54.2
4 Provides freedom of movement	53.9
5 Ensures good visibility	52.0
6 Buoyancy aid while working on deck in spite of being exposed to a significant risk of falling overhead (4) by fishing hooks	50.3
7 Ventilates water vapour and sweat	48.4
8 Feels light when wearing	48.0
9 Reduces risk of getting caught in fishing equipment and installations	46.7
10 Integrated buoyancy aid	45.8



THIS EMPHASIZES THE NEED FOR PPE THAT ARE USER FRIENDLY IN A WORKING SITUATION AND AT THE SAME TIME PROVIDES SUFFICIENT BUOYANCY AND PROTECTION AGAINST COLD IN A EMERGENCY SITUATION IN WATER

[1] Geving IH et al. (2006). Safer work clothing for fishermen. Internat Marit Health. Vol 57, 94-102.

Today's fisherman clothing

Highly traditional design

- Few details
- Loose fit
- PVC coated
- Resistant to fish oil, petroleum, concrete, chemicals and mildew
- Tough wear and tear

Flotation suits available are too warm and bulky to work in and are not preferred by the fishermen

Lifejackets are seldom used because they are too warm and bulky



Objectives



The **main objective** of Safe@Sea is to develop a new generation of advanced **personal protective clothing for the fishing industry** that will lead to a **significant increase in safety without reducing work performance**.

Scientific and technological objectives:

- Development of some new specialty and **high-performance materials**,
 - **tear strength and resistance to penetration of sharp objects**
 - coated materials with improved **scratch and wear resistance** as well as **stain/dirt repellence**
 - **self repair functions**
- Integrate **lightweight and flexible solutions for buoyancy**
- Integrate **sensors** into protective outer garments to detect fall overboard
- Integrate shock absorber materials for **head protection**
- Develop **ergonomic design** solutions with high degree of user acceptance
- Develop new **total clothing concepts** based on the fabrics and design solutions selected
- **Validate the materials and design solutions** for developed outerwear, gloves and head protection
- Develop an **optimised strategy for the engineering and industrialisation process**

Buoyancy aids

Flotation suit – traditional rainwear - lifejacket



ICT safety solutions (Ohmatex ApS)

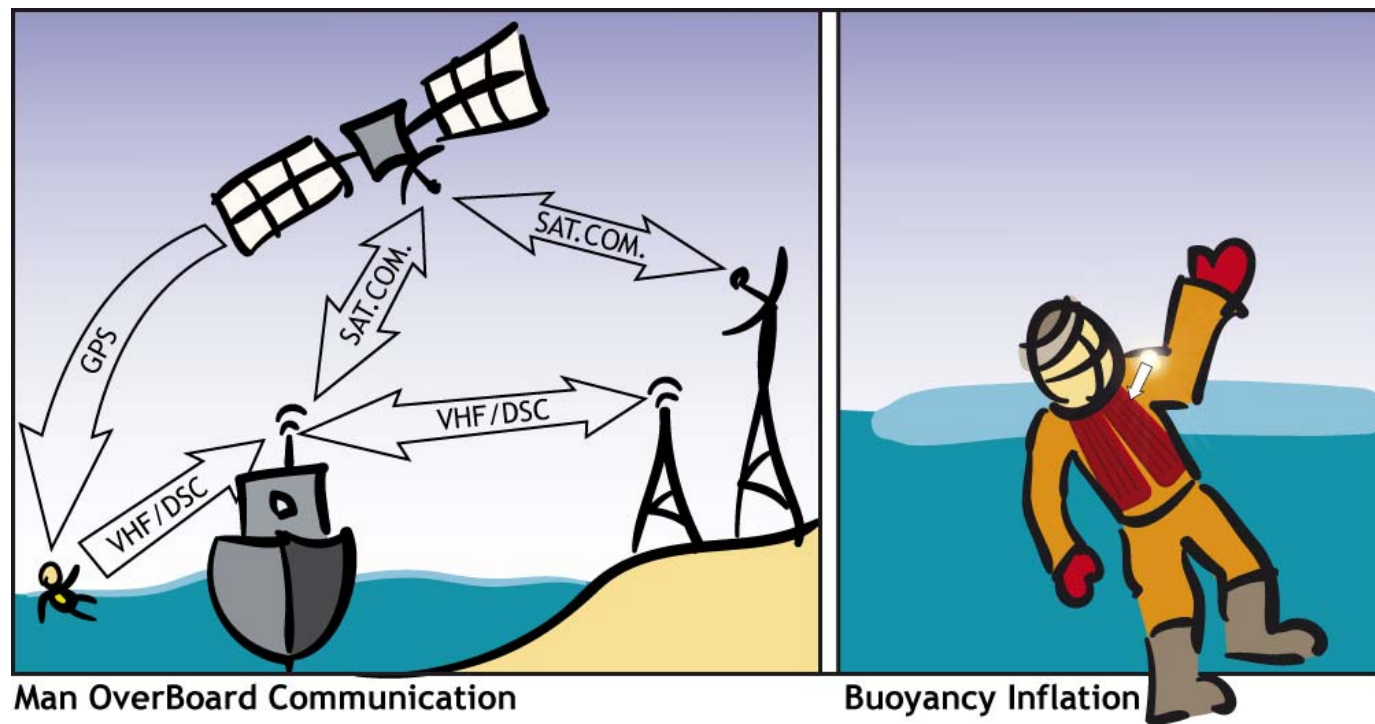
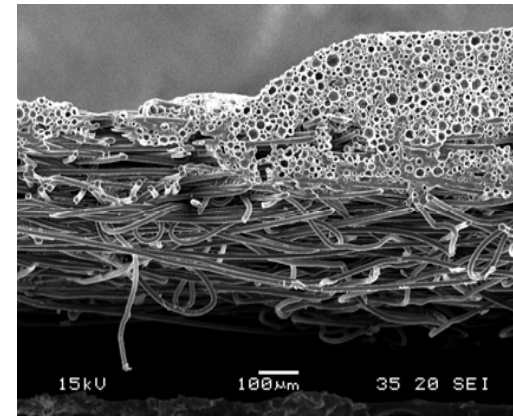


Figure by Torben Schaltz,
Ohmatex ApS

- The objective of the project is to develop novel temperature regulating fibers and innovative textile products for thermal management, selected by the SME segment of the textile industry in Europe.
- The temperature regulating effect is achieved by novel methods of incorporating large amounts of phase changing materials (PCM) in textile fibers.
- Latent heat larger than 60 J/g
- Sufficient strength
- Design and development of new garments
- 4 years
- 15 partnere from Europa
- SME and FoU partners



Scanning electron microscope (SEM) picture PCM,
Photo; SINTEF Materials and Chemistry



SINTEF

**Technology
for a better
society**

**Thank you
for your
attention!**

