

**Project number 03123**

**Nordic CoE for Smart Textiles and Wearable Technology**

**NEST**

**FINAL REPORT**

April, 2005

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## Executive Summary

The traditional textile and clothing industry is losing its jobs and capacity in the Nordic countries as well as in the whole EU. The industry needs more value added products compared to the low cost imports that are flooding the market. Intelligent textiles and wearable technology is a new and exciting research and development area that cross-scientifically implants new properties into the traditional textile products, such as monitoring biosignals through textile embedded sensors, automatic thermal regulation based on phase change or shape memory materials, transfer of signals by means of fibre optics, etc.

Several research institutes in the Nordic and Baltic countries have carried out R&D projects on smart textiles and wearable technology on their own for the past eight to nine years. In 2003 it was felt that by joining forces more resources could be brought into the projects to better qualify for international funding, and NEST – Nordic Centre of Excellence for Smart Textiles and Wearable Technologies was established. The members of the CoE are SmartWearLab and Kankaanpää Unit of the Institute of Electronics of Tampere University of Technology, IFP SICOMP, Swedish School of Textiles, Danish Technological Institute, SINTEF and the Faculty of Design and Technology of Kaunas University.

NEST was granted start-up funding from the Nordic Innovation Centre. At the kick-off meeting the objectives and the principles of networking were decided. Road Show seminars were held in all the member countries for introducing NEST to industrial companies and other research institutes. The seminars were a great success with 50 to 150 participants. The seminars presented the objectives of NEST as well as highlighted the current level of international smart textile research. The members of NEST have also participated in several international conferences.

After the seminars the industrial company participants were contacted in order to find out which R&D areas they are interested in and whether they would be willing to participate in joint projects. Textile based sensors and actuators, textile embedded RFID technology, intelligent automobile interiors and military applications were identified as areas of highest common interest. A project proposal on sensors and actuators has already been filed in for EU funding. The other projects are currently under preparation.

Due to the seminars the CoE received wide media coverage throughout the Nordic and Baltic region. Articles appeared in industry magazines, newspapers and there were TV and radio interviews. The aim of NEST is to continue promoting the network by research papers and articles about future projects mainly through web page and other publications.

Despite of the successful first year, a lot of work is still needed. A database will be created around smart textile and wearable technology solutions. Web page will be updated and renewed continuously. Future communications between the members will be done through meetings and telephone conferences, which in fact were excellent and efficient ways of communicating when NEST was established. In the future NEST will contribute to Nordic well fare by encouraging SMEs and research institutes to work together in the area of smart textiles and wearable technology.

## Background

The total number of jobs lost in the EU textile and clothing industry during the past 14 years is 1.3 million, mainly due to fierce import competition in traditional product categories. The textile and clothing sector in the Nordic countries has for years suffered under severe competition from low cost imports from Eastern Europe and Asia. This has resulted in a number of closures of industrial operations or in transfer of technology and manufacturing to the low cost countries. Companies with standard products have been hit the most.



Figure 1. Accumulative jobs lost in EU textile and clothing industry

Outsourcing of textile and garment production from the Nordic countries started already 15 to 20 years ago. At the moment most of the bulk production is gone. The same development is currently taking place in Southern Europe. In conventional products, where the price is the main means of competition, a textile/garment company cannot compete with the low cost imports. But there are two areas where the low cost producing countries in the Far East are not competitive: demanding high tech products and fashion items that need to be brought quickly to the market.

Intelligent textiles and smart garments are new research and development areas that appeared in mid 90s. It was felt by the industry that by creating high tech products cross-scientifically, i.e. by combining electronics and other high tech components to the traditional textile products it would be possible to design totally new type of textiles, which are not vulnerable to low cost imports.

The researchers of SmartWearLab, one of the partners to NEST, have been involved in research and development in smart textiles for 7 to 8 years. The first project was developing a smart snowmobile suit jointly with several industrial partners, such as Reima, Clothing+, Nokia, Polar Electro and Suunto. The research team wanted to demonstrate with the prototype that smart garments can be designed and different type of wearable technology can be embedded in them. The project demonstrated to the research teams that this kind of products can only be developed by a joint effort of a team of different kind of specialists.



Snowmobile smart suit and user interface (copyright Reima and Clothing+)

Figure 2. Smart snowmobile suit and user interface

There are several research institutes in the Nordic countries that carry out R&D work in this area. In order to bring the various knowledge centres together and to exchange and enhance know how and information in this area, Nordic CoE for Smart Textiles and Wearable Technology (NEST) was set up in 2003 by the following parties:

SmartWearLab ([www.tut.fi/swl](http://www.tut.fi/swl)), Tampere University of Technology, Finland is a research laboratory, which focuses on basic and applied research in intelligent textiles and smart garments. Several R&D projects have been carried out in cooperation with textile and clothing manufacturers, electronics manufactures etc.

Kankaanpää Unit ([www.ele.tut.fi/en/index\\_en.htm](http://www.ele.tut.fi/en/index_en.htm)), Tampere University of Technology, Finland is a special laboratory, which concentrates on research on wearable technology, i.e. computerized personalized systems directly attached to textile substrates.

IFP Research AB, Sweden ([www.ifpsicomp.se](http://www.ifpsicomp.se)) is a large research institute that operates in various fields including textiles and clothing products.

Högskolan i Borås, Textilhögskolan, Sweden ([www.hb.se/thb](http://www.hb.se/thb)) is a University that beside teaching carries out research and development work in smart textile applications. The University have modern fully equipped textile laboratories.

SINTEF Health Research, Norway ([www.sintef.no](http://www.sintef.no)) specializes among other things on occupational wear research and physiology issues.

Danish Technological Institute, Textile, Denmark ([www.danishtechnology.dk](http://www.danishtechnology.dk)) serves a large number of customers both domestically and abroad by helping them to implement new cross-scientific ideas into textile products.

Kaunas University of Technology, Faculty of Design and Technology, Lithuania (<http://www.ktu.lt/en/index1.html>) has wide experience and fully equipped laboratories in various fields of textile testing and research.

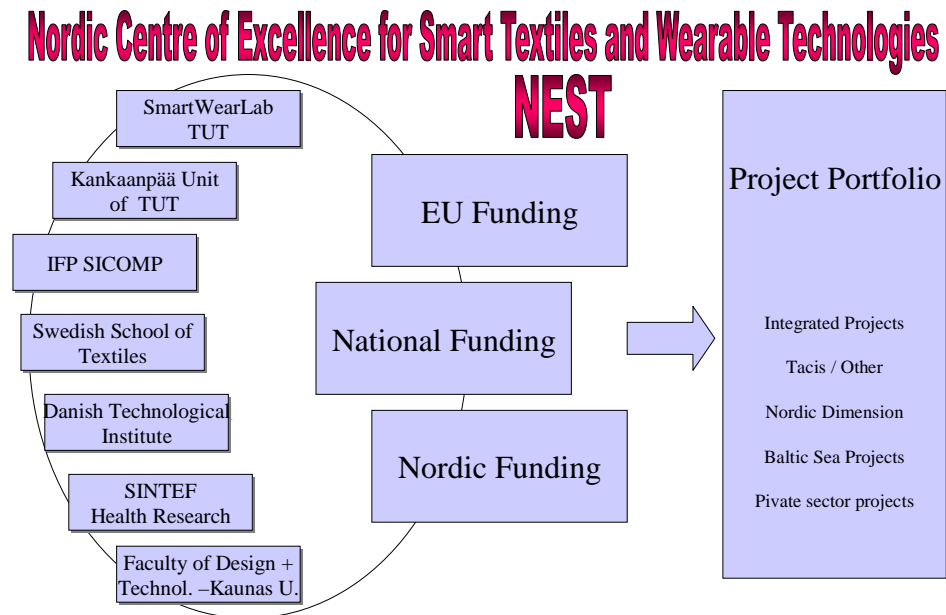


Figure 3. The objectives of NEST and its partners

## Objectives of NEST

The objective of NEST is to bring the leading smart textile and wearable technology know how of the Nordic and Baltic region under one umbrella, and to carry out research projects with internationally recognized break-through results. By combining cross-scientifically textiles, clothing physiology, electronics, communications, material science and other research resources of the member Laboratories and Institutes, joint projects with ambitious goals will be launched. The aim is also to turn NEST into an information bank on intelligent textiles and wearable technology, which will be able to contribute to general R&D work carried out by Nordic companies. NEST and its partners will gradually develop a portfolio of projects that qualify for Nordic, EU and national funding.

The objective of NEST is also to expand beyond the Nordic region and be part of larger R&D networks. Several of NEST partners are already members of such organizations as Textranet ([www.itv-denkendorf.de/texttranet](http://www.itv-denkendorf.de/texttranet)), a network of European Textile Research Institutes and AUTEX ([www.autex.org](http://www.autex.org)), a network of Textile Universities of Europe.

The European Apparel and Textile Organisation EURATEX published a survival strategy for the sector in December 2004, the “European Technology Platform for the future of textiles and clothing – A vision for 2020” ([www.euratex.org/.....](http://www.euratex.org/.....)). The objectives of the Platform have been defined as:

- Pool and coordinate research excellence across Europe, involving industry, academic world and research policy makers;
- Develop a long-term strategic vision for the future of the industry and to set-up a corresponding roadmap for a structured development from today’s situation towards the future vision;
- Significantly improve access to necessary resources and general research and innovation framework conditions.

EURATEX is doing concentrated lobbying in order to get the needs of the textile and clothing sector observed in the different research programmes, which will be published within the 7<sup>th</sup> Framework Programme.

TEXTRANET and AUTEX, the two European textile research networks, are defining the existing expertise and potentials. The strategically most important fields have been defined by TEXTRANET as:

- Innovative finishing processes including process intensification strategies;
- Innovative processes for surface and bulk modifications;
- Smart and intelligent textiles;
- Textiles for enhancing human performance;
- Barrier and functional textiles for technical applications;
- Supply chain management and mass customisation.

As can be seen from this, smart textiles and their applications are considered to form a central entity for the future of the industry.

Smart textiles and wearable technology solutions give added value to a large variety of products. Potential application areas:



- health care, e.g. patients' clothing with integrated sensors, which follow the state of the patient and give a warning signal if it gets critical. This can make home instead of hospital care possible for large numbers of patients, which is preferable both for the individuals and for the society;
- protective clothing for extreme working conditions, e.g. fire fighters, where the sensors give warning signals when the heat stress rises to dangerous levels;
- technical textiles, e.g. paper machine clothing with on-line measurement of changes in thickness and profile or filter materials which change properties due to slow contamination;
- sport and leisure wear: similar solutions as for protective clothing can be applied;
- military clothing: many application possibilities both for vital signal transfer (e.g. wounded soldiers) and for smart material solutions (ballistic protection, moisture barrier properties, etc.).



## Start-up

In order to organize the CoE in an efficient way NEST applied for start-up funding from Nordic Innovation Centre. The funding was to cover start-up procedures, web page design, and a Road-Show seminar that would introduce NEST and its objectives in all the participating countries. The ultimate goal was to create projects where industrial companies from various Nordic countries and the Baltic area could jointly with the NEST partners carry out research and development in the area of smart textiles and wearable technology.

The core members of NEST are research institutes without direct commercial ties to companies or industry. The partners were found by search of all possible research institutes in the Nordic countries and Lithuania, which somehow are connected to textile research. Once the partners were found the most efficient networking method for connecting the CoE to the industry was decided to be a set of Road Show seminars, that were organized in each member country.

As mentioned already, traditional textile and garment manufacturing has widely been relocated to lower cost areas from the Nordic countries. The only positive future that can be seen for the Nordic textile and clothing industry is to concentrate in high-tech, value adding products and concepts. The objective of NEST is to be a research and development vehicle that will contribute to these industries through research and development, and in this way help each Nordic country to preserve jobs and companies in this industry and on long run also create new businesses for high-tech applications.

## Milestones

Once the Consortium agreement was signed between the parties NiCe was approached for start-up funding, which was granted for a period of one year (01.03.2004-28.02.2005). It was felt between the parties that in order to get to know each other and to understand the strong points of each participant, a kick-off meeting had to be organized. In this meeting the goals and activities for NEST were decided.

The Consortium felt also that the existence and objectives of NEST should be introduced to the industrial partners throughout the Nordic countries and Lithuania. The best way to do this was to organize Road Show seminars that went around all the member countries, starting from Denmark and ending in Norway. At these seminar NEST and its targets were presented, and high-level presentations were held on what the international level of intelligent textile and wearable technology research currently is. The seminars were half-a-day events with presentations, a coffee break and time for discussion and questions at the end.

After each seminar the host member contacted all the participants to find out what are the most interesting areas for future projects. In order to guarantee the interests of the industry, the Seminars were organized in cooperation with national associations of textile and clothing industry. This was important as one of the aims of NEST is to be a platform of high tech knowledge for the textile and clothing industry and on long run to improve the competitiveness of the whole cluster.

Three key presentations were the same in each country, followed by local presentation of various topics of interest. The key presentations were the following:

Objectives of NEST and presentation of NEST members – Professor Heikki Mattila, SmartWearLab of Tampere University of Technology  
<http://www.tut.fi/units/ms/teva/swl/RoadShowFIN.pdf>

Overview of Intelligent Textiles and Their Development – Professor Roshan Shishoo, ShishooConsulting  
<http://www.tut.fi/units/ms/teva/swl/shishoo.pdf>

Overview of Smart Clothing and Wearable Technology – Professor Jukka Vanhala, Electronics Department of Tampere University of Technology  
[http://www.tut.fi/units/ms/teva/swl/NEST\\_Finland.pdf](http://www.tut.fi/units/ms/teva/swl/NEST_Finland.pdf)

The presentations can be downloaded at  
<http://www.tut.fi/units/ms/teva/swl/nestroadshow.htm>



Figure 4. NEST Road Show seminar at Kaunas, Lithuania

The Road Show seminars proved to be very successful in terms of participation and media coverage. Each seminar had an audience between 50 and 150, both from industry and from research institutes. (See programs in Annex). Before each seminar and during the seminars NEST was promoted through various types of media (trade magazines, daily news papers and even TV).

The members of NEST participated also in international scientific conferences and presented research papers in:

- 'New Generations of Wearable Systems for eHealth – Towards revolution of Citizens' health and life style, Pisa, 11-14 December, 2003
- 'New Technology and Smart Textiles for Industry and Fashion', London December 1-2, 2004
- 'Smart Fabrics 2005', Barcelona 7-9 February, 2005

A NEST web site ([nest.hb.se](http://nest.hb.se)) was created during the project. Through this web site the future projects will be presented together with scientific and popular papers to be written on the projects. Also access to the knowledge database will be available through the web site once the future projects produce such information.

Due to limited funds it has not been possible to organize meeting between the partners, beside the kick-of meeting and the Road Show seminars. But several telephone conferences held during the year turned out to be a very practical and efficient way to discuss the targets and activities of NEST. In the future two meetings will also be organized during two international smart textile conferences:

06-09.06, 2005 Avantex/Techtextil, Frankfurt Germany  
<http://avantex.messefrankfurt.com/global/en/home.html>

and

19-20.09.2005 Ambience 05, Tampere Finland  
<http://ambi05.suvisoft.com/>

Date	Activity	Location
11-14.12.2003	Pisa conference	Italy
23.03.2004	Kick-off meeting in	Borås
11.05.2004	Road Show seminar in Herning	Denmark
17.05.2004	Road Show seminar in Gothenburg	Sweden
18.05.2004	Road Show seminar in Kaunas	Lithuania
09.06.2004	Road Show seminar in Tampere	Finland
19.08.2004	Road Show seminar in Aalesund	Norway
1-2.12.2004	London conference	UK
07-09.02.2005	Smart Fabrics 2005 conference in Barcelona	Spain
06-09.06.2005	Avantex/Techtextil symposium	Germany
19-20.09.2005	Ambience 05	Finland

Table 1. Main milestones of the project

Several activities have also taken place in different NEST member countries:

### Norway

After the press release about NEST in April in Norway, there was wide interest in the media towards the project. The Norwegian Research council also heard of the project and invited SINTEF to participate in one of their foresight seminars: Materials 2020  
[http://www.forskningsradet.no/forport/application?origin=menu.jsp&event=bea.portal.framework.internal.refresh&pageid=ForesightOgDialog&lang=no\\_NO&lastpageid=ForesightOgDialog&childId=1084178468725&childName=For/For/Akt/Nano&childAssetType=GenerellArtikkel&col](http://www.forskningsradet.no/forport/application?origin=menu.jsp&event=bea.portal.framework.internal.refresh&pageid=ForesightOgDialog&lang=no_NO&lastpageid=ForesightOgDialog&childId=1084178468725&childName=For/For/Akt/Nano&childAssetType=GenerellArtikkel&col)

- May , presentation of all the foresight seminars in Oslo, SINTEF are invited to panel debate about SmartWear, possibilities in the health care sector.
- NANOMAT conference 3-4 June, invited by the Norwegian Research Council to talk about; "Smart Wear, new possibilities for Norwegian textile industry".
- [http://program.forskningsradet.no/nanomat/Konferanse\\_2005/NANOMAT-Birkeland%20conference%202005.pdf](http://program.forskningsradet.no/nanomat/Konferanse_2005/NANOMAT-Birkeland%20conference%202005.pdf)

The press release about NEST in April 2004 resulted in publicity in; NRK P1, P2, P4, Aftenposten, Adresseavisa and local newspapers and net papers.

January/February 2005:

NRK Radio, Kveldsåpent, 20 minute interview

NRK TV, Forbrukerinspektørene, about Nanotechnology and smart clothing

<http://www.forskningsradet.no/forport/application?childAssetType=GenerellArtikkel&lang=no&childId=1106676924781&pageid=ForesightOgDialog>

SINTEF has visited Swix Sport AS, Helly Hansen and Norrøna Sport AS, and has had telephone meetings with textile industry in Norway; Mosjøen Veveri AS, Norsk Fiberpels AS. So far, SINTEF has one concrete project with Norrøna Sport AS, (400' NOK).

Smart Wear is a strategic target area in SINTEF. SINTEF Health Research together with SINTEF ICT, SINTEF Materials and Chemistry have established a group that aim at generating ideas and projects together with the industry. Two work shops will be arranged together with industry in May 2005.

SINTEF has prepared the following projects during NEST:

Norwegian Research Council STORFORSK- program (not accepted)

NANOMAT program (decision in June)

SINTEF will also together with industry apply for a SIP (strategic institute program) in June.

### Lithuania

In Lithuania NEST was instrumental in launching a smart material research program. The following events have taken place at Kaunas University in 2004 - 2005:

<b>18<sup>th</sup> May, 2004</b>	Road –show seminar, organized at Kaunas University of Technology, Faculty of Design and Technologies (Studentu str. 56, Kaunas). The aim of seminar was to present NEST ( <i>Nordic Centre of Excellence for Smart Textiles and Wearable Technology</i> ) to Lithuanian Apparel and Textile Industry Association (LATIA), Lithuanian clothing and textile enterprises, textile research institutions and other organisations with an interest in the development of smart textiles and wearable technology in Lithuania.
<b>14<sup>th</sup> January 2005</b>	<p><i>Center of Safe Interaction Between People and Techniques</i> was opened at Kaunas University of Technology (<a href="http://www.ktu.lt">www.ktu.lt</a>) under the rule No. A-17 of University's Rector. The background to create the Center was the recommendations of Lithuanian Confederation of Industrialists, Ministry of Social Security and Labour, Commission of Safety and Health, and the ideas which were raised during the road-show seminar of NEST in Kaunas.</p> <p>The goal of Center is to expand the area of people safety by using new technologies and materials and through multidisciplinary approach of practical and experimental research to minimize the risk of accidents in most dangerous workplaces in Lithuania. Besides that, the activities of Center will allow to widen scientific and education base of the University, helping to qualify the graduates with new, multidisciplinary and modern knowledge.</p>

<b>6<sup>th</sup> April 2005</b>	<p>Project <i>The Study of Interactive Clothing and Wearable Technologies Application for People Safety Insurance</i>, sponsored by Ministry of Social Security and Labour of Lithuania. Project terms - 6<sup>th</sup> April 2005 – 30<sup>th</sup> September 2005.</p> <p>The aim of Project is:</p> <ul style="list-style-type: none"><li>• to survey the possibilities of application of interactive clothing, wearable warning systems and personal protective devices for accident prevention and people health at workplaces;</li><li>• to specify the main professions and jobs in Lithuania for which the creation and production of wearable warning systems and personal protective devices is the most reasonable.</li></ul>
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### Denmark

Danish Technological Institute established a knowledge platform in Denmark regarding intelligent textiles based on textile magazines, conference papers and supplier information. All the seminar participants were visited in order to identify further activities in the field. So-called idea generation workshop "New Smart Textiles" were offered to interested textile and clothing companies.

Furthermore, network group(s) of interested companies on "Intelligent Textiles" were set up included 3-4 meetings per year with speeches from external parties together with company visits and a newsletter. DTI also participated in an application for Danish Innovation Consortium on embedded sensors, where the textile field is one of several activities.

## Future projects

After the Road show seminars each NEST member contacted the companies that participated in the seminar in order to find out research and project ideas. Several telephone meetings were held during autumn 2004 for defining the project ideas. The following project topics were agreed for further preparation:

**(A) Textile sensors and actuators** – this project has already been prepared and the application was filed into an EU funded IP-SME program in March, 2005. SINTEF is the project leader for this project. The project is as follows:

NMP Integrating and strengthening the European Research Area  
Nanotechnology and nanosciences, knowledge based multifunctional  
materials, new production processes and devices

FP6-2004-NMP-NI-4

3.4.4.4 Multifunctional technical textiles for construction, medical  
applications and protective clothing - IP dedicated to SME's

Integrated Project

**SENSORS AND ACTUATORS IN FIBRES AND TEXTILE STRUCTURES**

Next generation of smart clothing for work, sport and leisure in cold climate

Acronym: COLDWEAR

The overall objective of the project is to develop technology for a new generation of protective clothing against the extreme conditions of cold and cold/wet environments through the implementation of sensors and actuators in fibers and textile structures. The developed “smart” solutions will be integrated into demonstrators and tested to optimize the regulation of the wearer’s heat content and contribute to their protection, comfort and safety.

- Sensors in the textiles able to detect conditions (both in the environment and on the person) that bring along increased risk.
- Actuators to;
  - prevent accidents by sending out a warning signal when hazardous conditions have been detected and;
  - react by providing a change in structure that protects the wearer

As stated in the recently published “European Technology Platform for the future of textiles and clothing”, the future of the European textiles and clothing sector will increasingly depend on the industry’s ability to relentlessly innovate in its products and to focus its business operations on the constantly evolving needs of its customers. SMEs, the majority of textile and clothing manufacturers in Europe, generally do not have own resources to perform highly specialized product development projects, but rely on the services of research institutes and universities.

An international consortium was established for this project with participants from different EU countries:



### CONSORTIUM

Participant no.	Participant organization name	Participant organization short name
1 (coordinator)	SINTEF Prof. Randi Eidsmo Reinertsen	SINTEF (RTD)
2 (leader)	Norrøna Sport AS, Norway Managing Director Jørgen Jørgensen	Norrøna Sport (SME)
3	Helly Hansen ASA, WorkWear, Norway Vegard Berg	HH (SME)
4	Mosjøen Veveri, Norway Managing Director Torgeir Markhus	Mosjøen Veveri (SME)
5	Norsk Fiberpels AS, Norway Managing Director Svein Ove Martinsen	Norsk Fiberpels (SME)
6	Dale AS, Norway Managing Director Jan Cleveland	Dale AS (SME)
7	L.Michael Oy, Finland Managing Director Lorenz Michael	Michael Oy (SME)
8	Nokian Jalkineet, Finland Tuire Erkkilä	NOKIAN (SME)
9	Swix Sport AS, Norway Erik Stensrud	Swix Sport (SME)
10	SmartWearLab, Tampere University of Technology, Finland Dr Harriet Meinander	SWL (RTD)
11	Institute of electronics, Tampere University of Technology, Finland Prof. Jukka Vanhala	TUT (RTD)
12	IFP Research AB, Sweden Pernilla Walkenström	IFP (RTD)
13	Shishoo Consulting AB, Sweden Prof. Roshan Shishoo	SHI (RTD)

Smart textiles and clothing, which use either interactive materials or integrated sensors and IC technologies, offer a totally new and added-value dimension to products. In protective clothing for work and leisure activities, smart solutions can substantially increase the protective, comfort and safety properties, thus have an impact on the work and leisure of the European citizen, and the competitive ability of European manufacturers.

Due to the climate in the Nordic countries in combination with the long coastlines, a culture of functional clothing for cold and cold/wet environments has developed. As a result, many Nordic companies have specialized in protective clothing against cold and wet for both outdoor winter work and sport wear, and follow the requirements of the respective EN-standards. However throughout Europe there is a need for such protection in a number of situations including, as an example, artificially cooled cold stores.

A multidisciplinary consortium with representatives from different types of companies in the supply chain and different technology expertise is necessary to successfully develop smart protective clothing in defined conditions. Knowledge of textile and component materials, sensor technologies, ICT, and thermal physiology can then be applied to industrially producible products, which can be marketed worldwide.





**(B) RFID technology in textile substrates** – a project for embedding a transponder and an antenna in yarns, which can be woven into textile fabrics. Project is currently under preparation with SWL as the project leader.

RFID technology has made it possible to identify products from a certain distance by reading the data stored on a microchip. Data reading is done with a special reading device that creates a magnetic field around the tag, like between the gates at the store entrances that prevent stealing. A hangtag or a label attached to garments may be a smart label, which contains information regarding the size, color and style number, all of them necessary for identifying the product. This information is normally displayed also in a written form both for consumers and the retailer to read. Smart labels enable product identification without actually pointing the reading device at something like a bar code. This is time saving in production, distribution and at the retail store.

Other ways of attaching microchips to textiles is by coating the chip and antenna to the textile or by weaving them directly into the textile structure. Conductive yarn connected to the microchip could be inserted into woven textiles as weft yarn at certain intervals. The yarn would be used as an antenna since with UHF-technology the antenna does not have to be a coil. Producing yarn that contains the conductive fiber plus the chip, for example as a core, is a challenge. Further challenges will be how to weave it into the structure and how to make it durable enough for dyeing, finishing and industrial washing.

Garments or home textiles containing such chips could be used by for example laundries that lease work wear or institutional textiles. When the textiles are returned back for washing they can be identified by the chip and returned back to the correct user. Piracy is a serious problem also in the fashion trade. Many multi-national brands fight continuously against trademark copying. RFID based smart tracking technology can be used for protection against stealing or copying, since it can be hidden into the product. Controlling of deliveries, handling of returns and customer identification are other areas where the technology can be used.

**(C) Smart automobile interiors** – a project idea that focuses on intelligent solutions in truck and car cabins. A meeting will be organized with the main Nordic technology players in this area in order to define targets for this project. IFP has the leading role in this project.

A large part of truck and car interior is made of fabrics and textile fibres, which can hide as well as contain electro-conductive fibres for signal transferring. Optical fibres could be used for illumination. It is possible to weave fabric of optical fibres and use it as light source. In this way the textile part of the cabin ceiling would light up. Air bags are good examples of textile safety devices in cars. Textiles could be used for other type of safety use, for example for shock absorbing.



**(D) Military applications** – targets and activities within this project will be prepared jointly with the defence forces of Norway, Denmark, Sweden, Finland and Lithuania. Once the targets are defined the leader for this project will be decided.

Despite of national security issues the Nordic military forces already cooperate in research and development, and NEST could be a new Nordic network for enhancing such cooperation.

## Conclusion

NEST has proven to be very successful in bringing together research and product development know how within the Nordic region. Setting up the CoE and networking its members was supported by Nordic Innovation Centre. This made it possible for the various members to meet and agree about strategic targets for the CoE. As described above, NEST is actively preparing R&D projects that involve industrial partners in various Nordic and Baltic countries.

During the first 'kick-off' year a wide media coverage was achieved in all countries. As result NEST is now well known by the industrial companies as well as by various research centres in the whole EU area. The textile and clothing industry associations in the Nordic countries have also shown interest towards NEST – in fact most of the Road Show seminars were supported by them.

Of course, NEST is not ready. Beside launching projects more effort will be needed in order to establish a high quality knowledge bank on smart textiles and garments. This database will serve both industry and research. High level publicity and promotion will also be maintained. The aim is to write scientific and popular papers of the future projects. The current web site will also be renewed and up-dated continuously.

As described above NEST has resulted in new initiatives in the participating Universities and research centres, for example in Lithuania, Norway and Finland. These will contribute to the domestic research and industry and will encourage SMEs to participate in national and international research and development in the area of smart textiles and wearable technology.



norden

Nordic Innovation Centre

## **ANNEX – Seminar programs**

## **NEST (Nordic Centre of Excellence for Smart Textiles and Wearable Technology)**

Teknologisk Institut, Tekstil, inviterer i samarbejde med Dansk Textil & Beklædning til seminar:

### **Præsentation af NEST til danske virksomheder, myndigheder og andre interessenter med interesse for udviklingen af "smart textiles" og "wearable technology"**

Dato: 11. maj 2004, 9.30 - 14.30  
Sted: DTB, Birk Centerpark 38, 7400 Herning

#### **PROGRAM**

9.30 - 10.00	Registrering og kaffe
10.00 - 10.15	Velkomst ved underdirektør Aage K. Feddersen, DTB
10.15 - 10.50	Om NEST projektet og dets deltagere ved professor Heikki Mattila, Tampere University of Technology, SmartWearLab og sektionsleder John Hansen, Teknologisk Institut, Tekstil
10.50 - 11.20	Overview of intelligent textiles and their development ved professor Roshan Shishoo, Shishoo Consulting AB
11.20 - 11.50	Overview of smart clothing and wearable technology ved professor Jukka Vanhala, Tampere University of Technology
11.50 - 12.00	Spørgsmål og svar
12.00 - 13.00	Frokost
13.00 - 14.00	Status på intelligente produkter - hvor langt er vi i Danmark? Ved chefkonsulent Bent Bilstrup, Teknologisk Institut, IT-udvikling
14.00 - 14.30	Opsamling på seminaret samt drøftelse af behovet for udvikling

#### **Praktiske oplysninger**

**NEST** (Nordic Centre of Excellence for Smart Textiles and Wearable Technology) er et samarbejdsprojekt mellem nordiske tekstil- og beklædningsinstitutioner, der beskæftiger sig med udviklingen af intelligente produkter. Projektet støttes af Nordic Innovation Centre (tidligere Nordisk Industrifond).

Teknologisk Institut, Tekstil, er den danske repræsentant i NEST og indbyder derfor, i samarbejde med Dansk Textil & Beklædning, til dette seminar om NEST projektet.

Seminaret henvender sig til virksomheder inden for tekstil og beklædning med interesse for udvikling af intelligente produkter, "smart textiles" og "wearable technology".

Seminaret vil blive gennemført på dansk, dog forventes de svenske og finske indlæg at foregå på engelsk.

**Tid**

Tirsdag den 11. maj 2004, kl. 9.30 - 14.30

**Sted**

Dansk Textil & Beklædning  
Birk Centerpark 38  
7400 Herning

**Tilmelding**

Teknologisk Institut, Tekstil  
Anne-Lise Christensen, tlf. 7220 2121 eller  
e-mail: [anne.lise.christensen@teknologisk.dk](mailto:anne.lise.christensen@teknologisk.dk)

**Forbehold**

Teknologisk Institut tager forbehold for eventuelle ændringer i program, tid og sted.

**Yderligere oplysninger**

John Hansen tlf. 7220 2123 eller  
Anne-Lise Christensen tlf. 7220 2121

## NEST Nordic Centre of Excellence for Smart Textiles and Wearable Technology

IFP Research har tillsammans med Högskolan I Borås glädjen att bjuda in till seminariet:

### "Smart Textiles and Wearable Technology"

*Textil- och konfektionsindustrierna i Norden och resten av Europa står inför stora utmaningar. Utflyttningen av produktionen till låglöneländer har dramatiskt minskat antalet anställda i branschen. Ljuset i tunneln är emellertid de företag som satsat på tekniskt avancerade produkter med ett högt marknadsvärde och av god kvalitet. Intelligent textilier och smarta beklädnader ger ytterligare en dimension till de produkter vi nu och i framtiden kommer att konkurrera med.*

*Seminariet är startpunkten i ett samnordiskt projekt, NEST, med deltagande från industri, forskningsinstitut, universitet och högskolor, och som skall utmynna i ett antal utvecklingsprojekt som i första hand skall öka den nordiska industrins konkurrenskraft och attraktionsvärde på en alltmer global marknad.*

**Datum:** 17 maj 2004, tid 09.30 – 15.30

**Plats:** Konferensrum VINGA, IFP Research, Argongatan 30, Mölndal

**Moderator:** meddelas senare

**Öppningsanförande:** Ronald Pedersen VD IFP Research AB

<b>09.40 – 10.30*</b>	<b>Objective of NEST and presentation of NEST members.</b> Professor Heikki Mattila, Tampere University of Technology, SmartwearLab
<b>10.30 – 11.00</b>	<b>kaffe</b>
<b>11.00 – 11.30</b>	<b>Overview of Intelligent Textiles and their Development.</b> Professor Roshan Shishoo, ShishooConsulting, Gothenburg
<b>11.30 – 12.00*</b>	<b>Overview of Smart Clothing and Wearable Technology.</b> Professor Jukka Vanhala Tampere University of Technology
<b>12.00 – 12.20</b>	<b>Var står den svenska tekoindustrin idag.</b> Sven Cele, VD TEKOindustrierna
<b>12.20 – 13.20</b>	<b>Lunch</b>
<b>13.20 – 13.40</b>	<b>Fokus på funktion.</b> Maria Larsson FMV
<b>13.40 – 14.00</b>	<b>Industrirepresentant</b> meddelas senare
<b>14.00 – 14.20</b>	<b>paus</b>
<b>14.20 – 15.30</b>	<b>Paneldiskussion och Sammanfattning av dagen.</b>



## NORDIC CENTRE OF EXCELLENCE FOR SMART TEXTILES AND WEARABLE TECHNOLOGY

**18<sup>th</sup> of May, 2004 (Tuesday)**

**Kaunas University of Technology,  
Faculty of Design and Technologies,  
Studentu str. 56, room 335**

### Aim of seminar

To present NEST (*Nordic Centre of Excellence for Smart Textiles and Wearable Technology*) to Lithuanian Apparel and Textile Industry Association (LATIA), Lithuanian clothing and textile enterprises, textile research institutions and other organisations with an interest in the development of smart textiles and wearable technology

### Seminar language – English

### Seminar programme

9 <sup>00</sup> -9 <sup>30</sup>	Registration
9 <sup>30</sup> -9 <sup>40</sup>	Opening - <b>dr. Sigitas Stanys</b> ( <i>Dean of Faculty of Design and Technologies, Kaunas University of Technology</i> )
9 <sup>40</sup> -10 <sup>00</sup>	NEST: Objective, Organisation and Members – <b>prof. Heikki Mattila, D.Sc.(Tech)</b> ( <i>Head of SmartWearLab, Tampere University of Technology, Finland</i> )
10 <sup>00</sup> -10 <sup>30</sup>	The Overview of Clothing and Textile Industry in Lithuania – <b>Dalia Mančauskienė</b> ( <i>Marketing Director; Lithuanian Apparel and Textile Industry Association - LATIA</i> ) Presentation of AUDIMAS AB – <b>Mindaugas Balaišis</b> ( <i>Manager of Distribution network expansion; Audimas AB</i> )
10 <sup>30</sup> -11 <sup>00</sup>	Overview of Textile Development in Lithuanian Research Institutions – <b>dr. Aušra Abraitienė</b> ( <i>Director General of Lithuanian Textile Institute</i> )
11 <sup>00</sup> -11 <sup>30</sup>	Coffee break
11 <sup>30</sup> -12 <sup>00</sup>	Overview of Intelligent Textiles and their Development- <b>prof. Roshan L. Shishoo Dr.(Tech)</b> ( <i>Director of Shishoo Consulting AB, Sweden</i> )
12 <sup>00</sup> -12 <sup>30</sup>	Smart Clothing and Wearable Technology– <b>prof. Jukka Jaakko Vanhala D.Sc.(Tech)</b> ( <i>Institute of Electronics, Tampere University of Technology, Finland</i> )
12 <sup>30</sup> -13 <sup>00</sup>	Textiles and Clothing Research at KTU, Faculty of Design and Technologies – <b>dr. Virginija Jankauskaitė, dr. Eugenija Strazdienė</b> ( <i>Faculty of Design and Technologies, Kaunas University of Technology</i> )
13 <sup>00</sup> -13 <sup>30</sup>	Discussions and conclusions concerning project development
13 <sup>30</sup> –	The end of seminar



TAMPERE UNIVERSITY OF TECHNOLOGY

## NEST Road Show Seminar 9.6.2004 Tampere, Finland

Welcome to the Road Show seminar of the NEST Project in Finland, to hear about and to discuss today's and tomorrow's intelligent textiles and wearable technology.

The Nordic Innovation Centre (NICe) has allocated start-up funding for the textile network NEST (Nordic Centre of Excellence for Smart Textiles and Wearable Technology). The Road Show Seminar will be held at Tampere University of Technology (Korkeakoulunkatu 1, Hervanta, Tampere - Tietotalo) on Wednesday, the 9th of May 2004 at 9.00 – 15.00.

### Programme:

- |       |                                                                                                                                                                                                                                                |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9.00  | Coffee                                                                                                                                                                                                                                         |
| 10:00 | Opening, Veli-Matti Kankaanpää, Association of Textile and Clothing Industry                                                                                                                                                                   |
| 10:10 | Current situation and the future of the Finnish textile and clothing industry, Veli-Matti Kankaanpää, Association of Textile and Clothing Industry                                                                                             |
| 10:30 | Introduction of NEST and its partners and the objectives of NEST, Heikki Mattila, Tampere University of Technology, SmartWearLab                                                                                                               |
| 11:00 | Visions on smart clothing, Jasmin Julin-Aro, Rukka / L-Fashion Group Oy                                                                                                                                                                        |
| 11:20 | Lunch                                                                                                                                                                                                                                          |
| 12:30 | Intelligent textile materials, Roshan Shishoo, IFP, Sweden                                                                                                                                                                                     |
| 13:00 | Wearable technology, Jukka Vanhala, TUT institute of electronics                                                                                                                                                                               |
| 13:30 | Current projects and new project ideas:<br>CLAN (Clothing Area Network), Markku Honkala, SWL<br>Experiences in commercializing wearable technology, Akseli Reho, Clothing+ Oy<br>Mekaniks - You Are the Message, Antti Westerberg, Mekaniks Oy |
| 14:00 | Closing                                                                                                                                                                                                                                        |



SINTEF Helse er den norske representant i NEST og har sammen med Teko Forum gleden av å invitere til seminaret:

### Smart Textiles and Wearable Technology

Seminaret avholdes i forbindelse med Teko Forums møte i Ålesund 18-19 august.

**Tekstil- og konfeksjonsindustri i Norden og resten av Europa står overfor store utfordringer. Utflyttingen av produksjon til lavkostland har dramatisk redusert antallet ansatte i bransjen. Et lyspunkt er imidlertid de foretak som har satsset på teknisk avanserte produkter med en høy markedsverdi og god kvalitet. Intelligente tekstiler og smarte bekledninger gir ytterligere en dimensjon til produkter vi nå og i fremtiden kommer til å konkurrere med.**

NEST (Nordic Centre of Excellence for Smart Textiles and Wearable Technology) er et nordisk samarbeidsprosjekt med deltagere fra industri, forskningsinstitutt, universitet og høyskoler. Målsetningen for NEST er å etablere forsknings- og utviklingsprosjekt som skal øke den nordiske industriens konkurransevne og attraksjonsverdi i global sammenheng. Prosjektet støttes av Nordisk InnovationsCenter (tidligere Nordisk Industrifond).

**Dato:** 19. august 2004, tid 1315 – 1600

**Sted:** Comfort Hotell Bryggen, Ålesund

**Organisator:** Hilde Færevik, SINTEF Helse

<b>1315 – 1415</b>	Introduksjon, <b>Hilde Færevik SINTEF</b> *Objective of NEST and presentation of NEST members <b>Professor Heikki Mattila, Tampere University of Technology, SmartwearLab</b>
<b>1415 – 1445</b>	*Overview of Intelligent Textiles and their Development <b>Professor Roshan Shishoo, ShishooConsulting, Gothenburg</b>
<b>1445 - 1500</b>	<b>kaffe</b>
<b>1500 – 1530*</b>	*Overview of Smart Clothing and Wearable Technology <b>Professor Jukka Vanhala, Tampere University of Technology</b>
<b>1530-1600</b>	Status over intelligente tekstiler, hvor er vi i Norge i dag, og hvor går vi? Diskusjon om behovet for utvikling <b>Diskusjon; Hilde Færevik</b>

*\*Foredragene vil bli holdt på engelsk*

**Påmelding:**

SINTEF Helse

v/ Hilde Færevik, tlf. 73592355 eller

e-mail: [hilde.ferevik@sintef.no](mailto:hilde.ferevik@sintef.no)