



Annual report 2007

TROMSØ TELEMEDICINE LABORATORY
Centre for Research-based Innovation

Content:

1	Summary	3
2	Visions and goals.....	4
2.1	Research goals	4
2.2	Administrative goals	4
3	Research plan and strategy	5
4	Organisation.....	7
4.1	Organisation model	7
4.2	Board members	7
4.2.1	Deputy board members.....	7
4.3	Managers.....	7
4.4	Senior research staff.....	7
5	TTL partners	8
	Norwegian Centre for Telemedicine (NST), University Hospital of Northern Norway (UNN, host for TTL	8
	University of Tromsø (UiT)	8
	Helse Nord IKT	8
	IBM Norway AS	9
	Telenor Research and Innovation (R&I)	9
	Northern Research Institute (Norut)	10
	DIPS ASA.....	10
	Well Diagnostics AS	10
	Norwegian Health Net AS	10
	Collaboration between partners in TTL.....	11
6	International research partners.....	12
7	Recruitment.....	13
8	Economy	14
9	Results	15
10	Publications	16
10.1	Books or book chapters.....	16
10.2	Scientific publications in international peer reviewed journals	16
10.3	Publications in other international peer reviewed journals or conferences	16
10.4	Published papers in international conferences and professional meetings.....	17
10.5	Other publications	18



1

Summary

The creation of Tromsø Telemedicine Laboratory (TTL) as a Centre for Research-based Innovation (CRI) has joined the telemedicine research and development efforts in Tromsø, lifting the bar in terms of quality in research and innovation.

TTL is located in the premises of the host partner, the Norwegian Centre for Telemedicine (NST) which is part of the University Hospital of North Norway (UNN), in the Research Park in Breivika, Tromsø, Norway.

The TTL-partners are: NST/UNN HF (host), Telenor R&I, IBM Norway AS, DIPS ASA, Well Diagnostics AS, the Northern Research Institute Tromsø AS (Norut Tromsø), the Norwegian Health Net AS, the Northern Norway Health Authority ICT and the University of Tromsø (UiT).

The telemedicine R&I community in Tromsø numbers approximately 200 persons, including students and employees working with telemedicine in the partner companies of TTL. The activities of these partners are internationally oriented with additional collaborating partners in many countries.

The main focus of TTL is on providing research that promotes the development of technologies that enable treatment at the lowest effective level of care. TTL wants to empower the elderly and people with chronic and lifestyle related diseases to handle their own lifestyle and health, in order to unload the increasing pressure on the healthcare services in the future.

The research is based on three research areas, each with a group leader:

- Sensor-Based Systems; acquiring data and communication via mobile systems
- Extended Decision Support Systems; analysis and decision support systems turning data into information upon which decisions can be made at a lower level of care or by the patients themselves
- Computer-Supported Cooperative Work; communication systems that bind together the actors and enables secure and efficient collaboration between all levels of care and between professionals and members of the public

Many of the approximately 15 projects running in TTL feature contributions from more than one of the research groups.

Successful research and innovation results at TTL are expected to lead to new products, new services, and new processes. The results for 2007 include 9 publications in peer-review journals; one chapter in an edited book; 15 published papers in international conferences; 43 other types of presentations or publications and 44 media articles. One patent is pending and the researchers behind this patent received the TTO-Nord "Motivation Price" for the most promising new innovation at the Norwegian Science Week in Tromsø.

2007 was the start-up year and recruitment of strong PhD and Postdoc candidates has been an important effort. Many of the applicants were non-EU citizens, making the recruitment process more complicated and take longer time to complete. All planned projects for 2007 were able to recruit qualified candidates for their PhD or Postdoc positions.

Eleven PhD projects are now running as part of the TTL project portfolio. Five of these are women. In addition, there are two Postdoc projects and ten students received their Masters degree in Telemedicine at UiT through participation in projects related directly to TTL or through supervision by researchers at TTL.

Even though 2007 was a start-up year, the activity level was higher than we planned for in the proposal for TTL. With one exception (due to delayed start of some of the projects because of the recruitment process), all the partners have been involved in projects at TTL. ○

A better health care,
reducing the burden on
the health care system.

2 Visions and Goals

The Tromsø Telemedicine Laboratory's (TTL) vision is to become a world leading centre for research and innovation in the field of advanced telemedicine and eHealth systems for chronic, age, and lifestyle related diseases. The centre aims at supplying the healthcare industry with viable and sustainable technologies. These will promote global health, wellness and disease management by facilitating technological advances in the collection, processing and sharing of medical information. These technological advances will generate new products and services within telemedicine and eHealth.

2.1 Research Goals

TTL is organized into three research groups:

- Sensor-based Systems (SBS)
- Extended Decision Support (EDS)
- Computer Supported Cooperative Work (CSCW)

These groups are connected to one or more of six identified research areas:

- Health terminals for Personalized Health Care
- Health intelligence
- Computer aided diagnoses
- Workflow management
- Clinical decision support
- Integrated medical sensors

For each of these research areas, we have a number of research projects.

The following short-term goals are addressed for the first 2-3 year period (2007-2009):

- Establish a secure and configurable mobile patient terminal
- Establish a secure and configurable residential eHealth/eCare gateway and platform
- Construct a demonstrator of an electronic health surveillance system based on input from sensor-based systems
- Proof of concept for a fully automated system for melanoma detection based on images from a pocket dermatoscope and a digital mobile phone camera
- Design a statistical analysis method that can detect changes in the blood glucose level caused by infectious diseases

- Establish a platform for investigating messaging systems that blend into users' home and are easy to use for the target population
- Establish work-oriented design conditions for integration of information sources from different levels of health services

The research will be published in international journals and at international conferences in telemedicine and medical informatics.

2.2 Administrative Goals

The administrative goals for 2007 were:

- Establish the Administration
- Establish the Board of Directors
- Establish the premises and infrastructure for the projects and research groups
- Recruit PhD and Postdoc candidates
- Establish the research groups
 - Sensor-Based Systems Leader
 - Decision Support Systems Leader
 - Computer-Supported Cooperative Work Leader
- Establish the projects
 - Agreement on project portfolio
 - Budgets
 - Project Managers
 - Project Members
- Strengthen Partner commitment to TTL
- Infrastructure for master students
- Establish routines for reporting
 - Reports to the Research Council of Norway
 - Reports to the Board of Directors

New technology, especially mobile terminals and wearable sensors, provide new possibilities.

3 Research Plan and Strategy

In Integrated Medical Sensors, sensors monitoring vital health parameters (e.g. INR, ECG, blood glucose) and sensors for motivational health purposes (e.g. physical activity and eating habits) will be developed and/or utilized. The sensors and sensor-based systems will use both wearable and stationary sensors. In addition, interpretation of sensor data will be addressed.

Research contribution from this area may include:

- Additional or improved sensor intelligence in medical sensors and integrate wireless technologies as part of the sensor
- New ways of designing networks of health sensors and/or new ways of utilizing promising BANs for eHealth purposes, address issues surrounding instrumentation of the home by easily deployable home networks
- Studies of access to health information in distributed databases (computer science, health informatics), development of new security mechanisms (computer science), studies of collaboration mechanisms and the implications of computer supported collaboration across institutions and levels of responsibility (CSCW, information systems), studies of mechanisms supporting interoperability (computer science, health informatics)

Health Terminals for Personalized Health Care is a growing area in the health sector. In recent years, we have experienced a shift from traditional telemedicine services towards personalized health care. The current focus of both the European Commission and others is on how to escalate the efforts on providing the patients and people generally with tools that aid them in taking care of their own health. The background is of course the elderly-boom, the population growth generally, the increase in chronic diseases due to change in lifestyle, and finally the possibilities that new technology, especially mobile terminals and wearable sensors, provide.

Research contribution from this area may include:

- Tools and procedures for improved regulation of diabetic patients
- Tools and procedures for monitoring and control of patients with chronic diseases

The Health Intelligence area focuses on disease surveillance systems and how such systems can be used for the benefit of TTL's targeted patient groups. In this research area, we will address the development of methods for detection of deviations in spatio-temporal patterns of syndromic data. We will also develop models for spreads of infectious and non-infectious diseases for the purpose of prediction.

Research contribution from this area may include:

- Detection of deviations in graph-based data that incorporates disease specific factors and time-space changes, time-space dynamical models for diseases
- Data collection system, software for spatio-temporal model production, implementation of algorithms for detection and prediction of outbreaks and computation of disease risks
- Multivariate analysis of data from different biomedical sensors
- Modeling and studies of correlations between physiology and sensor data dynamics. Correlations among different sensor data for different pathological states

Computer-aided diagnostics (CAD) systems are already widely used in practical clinical situations for tasks such as the detection of breast and lung cancer and melanoma. Most of these systems are detection systems designed to aid physicians when looking for abnormalities in diagnostic data. Others, known as differential systems, are designed to make diagnosis that is more complete, rather than just look for abnormalities.

Within the CAD research area, our focus will be on the detection of malign melanoma based on lesion images. This includes development of algorithms for image segmentation and quantification of visual lesion evaluation.

Another area that will be addressed is the correlation between pathological conditions and biometric data. This includes proof of the medical concept and development of the time series analysis algorithms for detection of deviations, blood glucose level and infections. >>

» A third area will be study of patient compliance. In this context compliance refers to: 1) The degree to which the patient follows the directions the health professional has given him or her, including medication, diet or exercise and 2) The degree to which the patient is able to follow his or her own resolve when it comes to life style related behavior.

An interesting question is how sensor data best can be integrated in sustaining appropriate self-management behaviors for those with chronic and lifestyle related diseases, with tailored feedback into a mobile tool that will support the individual in sustaining life-style changes?

Research contribution from this area may include:

- Mobile behavioral health-maintenance systems
- Validation of new or improved health services
- Improved user acceptance
- Investigation and documentation of the correspondence between physiological processes related to diseases and biometric measurements, detection of deviations in non-uniformly sampled data with different noise sources
- Clinical trial of two-dimensional image processing

Workflow management can be defined as a proactive system that manages and coordinates the flow of work between participants, according to a procedure consisting of a number of tasks.

In this research area, we will address the development of nursing plans in accordance to the needs of TTL's target patient group. Nursing plans are assumed to ensure a well-functioning communication between caregivers for chronic patients. They are also expected to ensure standardization and predictability of the care process. There are different needs for experienced/-inexperienced staff, psychiatric/somatic departments, different patient groups, different professionals, and hospital/nursing homes. This makes the tailoring of nursing plans extremely demanding.

Currently, every hospital department have their own plans (often based on the classification systems NIC and NANDA). Nursing homes have plans based on IPLOS. In addition, many chronic patients have an individual plan (a legal right).

Another research task is regional integration and reorganization practice. New IT systems and interactive services are supposed to improve collaboration between physicians in primary and secondary care. Unfortunately, establishing such systems are risky (based on partial discouraging results from implementing teledermatology, telepathology services and electronic booking systems) due to how they induce a large change in current work practice. We will do research on how work should be (re)organized and how these systems should be designed in order to establish sustainable use.

Research contribution from this area may include:

- Design input, modeling and requirements for nursing plan systems (health informatics, CSCW)
- Studies of effects and implications of nursing plan systems (CSCW)
- Integration of fragmented nursing plans into a coherent whole in order to support streamlined flow of information and processes

Clinical Decision Support Systems can be described as active knowledge systems that use two or more items of patient data to generate case-specific advice.

In TTL, we will study how to integrate information from electronic health records, computer aided diagnosis and early warning system, medical knowledge

databases and epidemiology in a medical probability platform. Different health care providers and medical departments will test the systems: general practitioners, specialists in different departments, emergency department, follow-ups in post-surgery.

Research contribution from this area may include:

- Content based text and multimedia search in electronic health records and medical knowledge data bases
- Probability modeling of medical reasoning
- Data and results visualization
- New organizational models for health providers where clinical decision support is integrated in daily routines

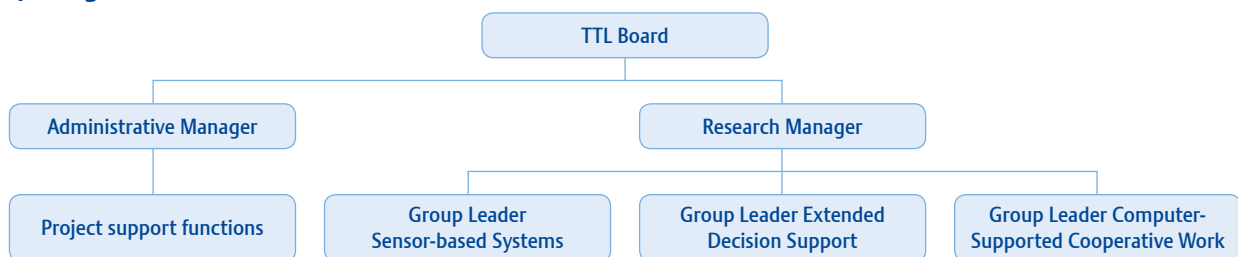
How can sensor data best be integrated in order to sustain appropriate self-management behaviors?

4 Organisation

Three research groups:

- Sensor-based Systems
- Extended Decision Support
- Computer-supported Cooperative

4.1 Organisation Model



4.2 Board Members

Lars Vorland, Chairman of the Board of TTL, Managing Director, Helse Nord RHF

Toralf Hasvold, Vice Chairman of the Board of TTL, Professor, Institute for Community Medicine, Medical Faculty, UiT
Bengt Olsen, Member of the Board of TTL, Economy and Financial Director, DIPS ASA

Morten Thorkildsen, Member of the Board of TTL, Country General Manager, IBM Norway

Ellen Brox, Member of the Board of TTL, Senior Researcher and Quality Manager, NORUT IT AS

Steinar Pedersen, Member of the Board, Head of Department, NST, UNN (on sabbatical leave from June 2007 – medio February 2008). In this period, Sture Pettersen from NST, UNN was Acting Head of Department

Hans Christian Haugli, Member of the Board of TTL, CEO Telenor R&I

Pål Myklebust, Member of the Board of TTL, CEO Well Diagnostics AS

4.2.1 Deputy Board Members

For Lars Vorland: Finn Henry Hansen, Helse Nord RHF

For Toralf Hasvold: Inger Solheim, UiT

For Bengt Olsen: Tone Jespersen, DIPS ASA

For Morten Thorkildsen: Tore Havre, Public Sector manager, IBM Norway

For Ellen Brox: Lars Vognild, NORUT IT AS

For Sture Pettersen: Eva Gjerdrum, NST

For Hans Christian Haugli: Trond Are Bjørnvold, Telenor R&I

For Pål Myklebust: Rolf Dahl, Well Diagnostics AS

4.3 Managers

Research Manager: Professor Gunnar Hartvigsen PhD, Computer Science, UiT

Administrative Manager: Sture Pettersen, NST (on leave June 2007 – through April 2008)
(Acting Administrative Manager, June 2007 – through April 2008: Per Hasvold, NST)

4.4 Senior Research Staff

In order to achieve international recognition, we need to attract well-established researchers with a solid track record in research. In addition, we must establish co-operation with excellent research groups abroad.

The core researchers in TTL are:

- Professor G.Hartvigsen, PhD (head of TTL) (UiT, NST)
- Associate prof. G.Ellingsen, PhD (group leader CSCW) (UiT, Helse Nord IKT)
- Professor F.Godtlibsen, PhD (group leader Extended Decision Support) (UiT, NST)
- Professor T.Hasvold, MD, PhD (UiT)
- Professor A.Horsch, PhD (UiT, TU Munich)
- Professor P.Hjortdal, MD, PhD (NST, UiO)
- Professor N.W.Lund, PhD (UiT)
- Associate prof. R.Karlsen, PhD (UiT, Norut)
- Associate prof. J.G.Bellika, PhD (UiT, NST)
- Associate prof. R.Wynn, MD, PhD (UiT, UNN)
- Postdoc T.Botsis, PhD (UiT)
- Postdoc J.Scholl, PhD (NST)
- Postdoc V.Hadziavdic, PhD (NST)
- Researcher M.Nidd, PhD (IBM)
- Researcher T.Sund, PhD (Telenor)
- Researcher T.Syversen, PhD (Telenor) 

The centre aims at supplying the healthcare industry with viable and sustainable technologies.

5 TTL Partners

The Norwegian Centre for Telemedicine (NST), University Hospital of Northern Norway (UNN). Host for TTL.

UNN believe that by participating in TTL new knowledge will be obtained in how to improve the quality of treatment by means of an integrated out-of-hospital data acquisition system and how to reduce work-intensive screening and follow-up of large patient groups generated from these systems.

The Norwegian Centre for Telemedicine at UNN is a research and development centre that aims to gather, produce and provide knowledge about telemedicine and eHealth, both nationally and internationally. TTL will contribute to fulfil the NST research strategy, which is "to establish NST as an internationally leading research Centre within prioritized areas of Telemedicine and eHealth". This includes increasing the number of employees with research expertise, increasing national and international research cooperation and strengthening research-based innovation. TTL will give us the opportunity to collaborate more closely with the University of Tromsø to increase the number of researchers.

NSTs goal is also to contribute to the renewal of public health services. TTL will contribute to this by laying the foundation for new industrial products in close cooperation with the consortium's industrial partners, thereby supplying the healthcare sector with products that make innovative service delivery possible.

NST expects that TTL-projects result in research based innovation for new telemedicine- and eHealth services. Potential projects will lead to new health services that use integrated medical sensors with wireless and ubiquitous communication with different health terminals. Based on current and new work- and patient flow, this information will give input to automatic or extended clinical decision support as close to the patient as possible.

The innovation dimension reflects the industrial potential of the results coming from the knowledge gained and the services developed in the projects. The research dimension reflects the ambition of NST to produce research results on a high international level.

University of Tromsø (UiT)

The research in medical informatics and telemedicine at UiT mainly focuses on (1) telemedicine systems for private homes and telecare/telehomecare systems, (2) distributed electronic health records, (3) electronic health surveillance and (4) automatic detection of malignant melanoma.

Two Faculties at UiT are involved in the TTL projects: The Faculty of Science and the Faculty of Medicine.

Most of the projects are done in cooperation with, or closely connected to, the Norwegian Centre for Telemedicine, University Hospital of North Norway.

At the Department of Computer Science, the focus is on the construction of medical & telemedicine systems from a computer science perspective.

In addition to bachelor, master's and PhD degrees in computer science and statistics, the UiT offers a two year international master's degree in telemedicine and ehealth.

We believe that TTL will strengthen the research in telemedicine at UiT as well as the relationship to industrial partners. Through extended international cooperation in TTL, UiT will be able to establish strong international connections to leading research groups in telemedicine and medical informatics.

Through a unique cooperation with industrial partners, we expect that research ideas and projects that origin from UiT to a larger degree will find their way to new industrial innovations and products.

Helse Nord IKT

The state of reason for the Northern Norway Regional Health Authority to participate in TTL is summarized in the report "Decentralization of specialist health service" approved by the board in august 2005:

- The concept of equality to healthcare services leads to the conclusion that Helse Nord must adjust so that a larger part of the population gets access to such services closer to their home, when this is professionally justifiable and economically possible >>

- The population emphasizes closeness to and confidence in health services
- Demographic development (more elderly) and changes in illness panorama (more people with chronic diseases and need for complex services) increase the importance of closeness to the services which are produced
- The professional premises are present, among others as a consequence of services increasingly given policlinic or as day-treatment
- The medical methods become more simple, among others as a consequence of standardized treatment records
- Helse Nord has good infrastructural premises through a decentralized institutional structure, a well developed health net and great potential for telemedicine services
- Helse Nord has the highest expenses of patient travelling
- Decentralizing suits the geography of Northern Norway

TTL will meet our need to explore different ways to utilize the total resources in a more efficient way and bring the healthcare system closer to the patients. The clinicians will gain simpler and more uniformed access to information of his or her patient through a patient-centric architecture, and not through an application-centric architecture as today. This will improve the workflow, cooperation and follow-up of patients outside the hospitals.

TTL and Helse Nord IKT will do research on dynamically updated, cross institutional, patient-centric, multi-modal information systems. An important aspect is to include the patient as a source of information. The innovations will prepare the ground for new products like ICT supported evidence based medicine systems on an individual and epidemiological scale.

IBM Norway AS

Your vision is our focus

IBM wants to bring together healthcare insight, best practices, innovation and leading edge IT technology to tackle your most difficult issues.

Why IBM?

Global reach. Thought leadership. Hard-hitting solutions. At IBM, our teams of consultants apply innovative thinking, practical tools, services and high powered technology to unearth business value, define a plan of action and solve your healthcare and life science issues.

Healthcare is in crisis. While this is not news for many countries, we believe what is now different is that the current paths of many healthcare systems around the world will become unsustainable by 2015. Healthcare systems that fail to transform will likely “hit the wall” and require immediate and major forced restructuring – a “lose-lose” scenario for all stakeholders.

There is a more positive scenario – a “win-win” – but it is one that will require new levels of accountability, tough decisions and hard work on the part of all stakeholders.

- Develop a shared vision and a comprehensive, long-term plan.

- Build and sustain a case for change.
- Develop a set of principles to guide transformation.
- Provide universal coverage.
- Fully leverage the capabilities of information technology.
- Balance collaborative innovation with proven global best practices.

Our vision is that from a control centre at a hospital, we have a full overview of patient’s conditions without being physically present. Or that the information can be sent to a wireless unit in the doctor’s pocket. Decisions can be made in real time about the welfare of people.

One of the most exciting healthcare initiatives is found in Tromsø Telemedicine Laboratory. Here, we have launched a project that may have a massive impact on society.

“We have completed a survey of software for assisting diabetics in self-management, identified the most desirable attributes, and proposed improvements and useful configurations for these systems. We have created a prototype implementation of this proposal, and implemented it on WebSphere Portal Server, reading glucose data from a DB2 database. The DB2 database also stores user preferences so the patient view on the data is formatted individually. When the patient logs into the Portal Server instance, the preferences are read and the data is displayed. If the patient wants to experiment with the presentation, this is made as simple as possible, and the new preferences may be stored with a single button press. The implementation is also capable of exporting a display in JPEG form for later use in stand-alone LCD displays at the patient’s home, but this will require integration with the TTL system to become useful”, says Morten Thorkildsen, IBM Norway.

Telenor Research and Innovation (R&I)

Telenor Research and Innovation (R&I) is one of Norway’s largest research organisations within ICT and usage. The department contributes to the long-term global competitive strength of Telenor, by facilitating innovation and providing input to strategic development. R&I collaborates extensively with industrial partners and academia both nationally and internationally.

R&I is a competence resource centre for Telenor, offering expertise and advice, and challenging management on existing strategies and mindsets. Based on R&I’s own activities and on external cooperation, R&I offers world class research in defined areas. The work comprises business models, user studies and future communication networks as well as new service concepts and applications in various markets. The activities include experimentation, testing and demonstration facilities.

R&I is an innovation hub for Telenor and external partners. On the basis of R&I research competence and commercialisation skills, Telenor is able to realise new options in a variety of ways, alone or in collaboration with third parties. This enables great flexibility and agile management of new initiatives. >>

» "R&I has a strong focus on innovation. We were the initiator of telemedicine in Tromsø and have for many years been an active partner in the development of this field. As TTL targets innovative solutions to health care challenges, it is natural for us to participate in the consortium", says Hans Christian Haugli, Senior Vice President and Head of Telenor Research and Innovation.

Northern Research Institute (Norut)

Northern Research Institute (Norut) is a national research corporation, situated in Northern Norway. Norut does research within technology and the social sciences, and we do contract research for industry, commerce and public administration.

The corporation focuses especially on the Barents region and has 110 employees. The corporation consists of the following companies: Norut Tromsø, Norut Alta – Áltá and Norut Narvik.

Norut Tromsø is a partner in TTL. Norut Tromsø has top competence in the following areas:

- Information technology
- Earth observation
- Culture and society
- Industry and innovation

"Participating in TTL gives Norut the chance to be part of a leading research environment with international recognition," says research leader Lars Kristian Vognild at Norut Tromsø. "Norut has done research within telemedicine and ehealth since the beginning of the 1990s and has for a number of years built up a strong competence in net-centric computing."

"The cooperation within TTL gives us a unique possibility to develop new technology and services, in order to help a rapidly growing number of chronically ill in our society. We have already worked together with a few of the TTL partners for some years. With TTL however, we have further possibilities to build long-term relations with strong research communities and create new and innovative technology and services", Vognild says.

DIPS ASA

DIPS want to be a leading eHealth Company. To be able to do this we need to be in the forefront when developing the new version of our "Care Plan system". Through this consortium DIPS gets the unique opportunity to work closely together with researchers and the university hospital (UNN) in creating a new "Care Plan system" for the future. The research project will also detect better ways of using classification in the hospitals, making them more efficient and enabling better communication within and between hospitals, as well as in the home care sector. This will be the benefit all hospitals using DIPS Care plan, including all hospitals in Helse Nord. If the use of standard classification is "rolled out" in the home care sector and primary healthcare sector this will possibly benefit both NST and Well.

Without the consortium DIPS could not afford to go through with such a project.

Developing a new "Care Plan system" based on standard classification is necessary to penetrate the foreign market for DIPS. This innovation gives us great potential to establish DIPS abroad. In addition this will strengthen DIPS position in Norway.

Well Diagnostics AS

Well Diagnostics is a leading supplier of products and services, that provides the health sector with secure communication and interaction. Well Diagnostics is a preferred integration partner for suppliers of core systems in the Norwegian and Nordic health market. We are the largest supplier of software for secure interaction between hospitals, GPs offices and public institutions in Norway.

Well Diagnostics has 16 employees, is rapidly growing, is financially solid and runs with a profit. The company's main office is in Tromsø. There is also a branch office in Oslo.

"Well is a small company in a hectic industry, and we have to focus on what our customers need right here and right now. By joining the TTL, we have established a solid "research department" that gives us a better insight into the needs and possibilities of the future. This will enable us to produce better solutions for the future", says R&D manager Yngve Nyheim.

Norwegian Health Net AS

TTL is expected to develop new telemedicine services, based on new technologies, and offered in residential and mobile surroundings where such services are not presently available.

It is NHN's ambition that the current national health network should be extended and adapted to incorporate these new service aspects. Project participation will provide an opportunity for NHN to become more proactive with respect to evaluation and introduction of new service elements into the health network.

Demographic changes and patient empowerment is projected to change many aspects of today's health services. Some of these changes concern the way services are delivered, the environment services are delivered in and the communication technologies involved in the service deliveries.

The TTL projects have the potential to serve as an "early warning system" for NHN, providing indications of development trends and maturing services and technologies. This will contribute to NHN's ability to adapt its service portfolio to match the changes in requirements from the organizations connected to the national health network. »

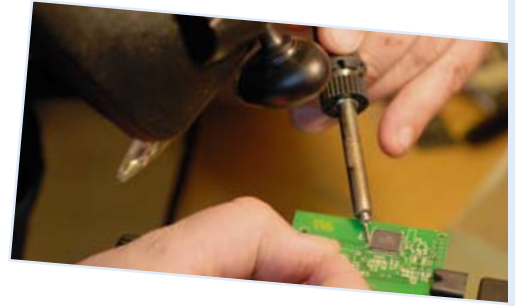
» Collaboration between Partners in TTL

The most important instrument for collaboration in TTL has been participation in the research projects. Several of the partners have one or more PhD or Post Doc projects working on research related to fundamental problems or to the development of new products, services, or processes for the partner.

All partners are participating in one or more projects, although the level of involvement varies from technical support to actual research contributions.

An important element in the consortium agreement between the partners was to regulate the ownership of intellectual property. The current structure allows a high degree of openness and collaboration between the partners, while maintaining a high level of protection of the rights to the contributions of the partner.

In addition, TTL has staged research seminars and workshops on specific topics, and partners are generally invited when any partner has visiting lecturers or other arrangements that may be of interest. ○



6

International Research Partners

International partners include:

- Prof. Klaus Kuhn, Technical University of Munich, Germany
- Prof. Alexander Horsch, Technical University of Munich, Germany
- Prof. Ole Hejlesen, Aalborg University, Denmark
- Prof. Lasse Holmström, Department of Mathematics and Statistics, University of Oulo, Finland
- Prof. Probal Chaudhuri, Indian Statistical Institute, Calcutta, India
- Prof. James Stephen Marron, University of North Carolina at Chapel Hill, Chapel Hill, USA
- Associate Prof. George Demiris, University of Washington, Seattle, USA
- Associate professor Jesper Simonsen, Computer Science, Roskilde University, Denmark
- Associate professor Henrik Linderöth, Umeå School of Business, Umeå University, Sweden
- Garth McKay, Oregon Research Institute, USA
- Dr. Lisa Feldman Barrett, Department of Psychology, Boston College USA
- Dr. Jörg Polzehl, Weierstrass Institut für Angewandte Mathematik und Statistik, Berlin, Germany
- PhD Signe Vikkelsø, Copenhagen Business School, Denmark
- Post.doc Brit Ross Winthereik, Technical University of Denmark
- PhD Roland Bal, Erasmus University of Rotterdam, Holland
- PhD Mark Hartswood, School of informatics, University of Edinburgh, UK
- James D. Ralston, The Center for Health Studies Group Health Cooperative
- Jim Tufano, University of Washington, Seattle, WA, USA ○



7 Recruitment

Recruitment advertisements were posted in national and international journals as well as campaigns targeted at seminars and conferences attended by master and PhD students.

It was expected that the recruitment could be a difficult hurdle for TTL, as the general availability of students interested in becoming a PhD candidate is low within the fields of research in TTL.

An additional goal for the recruitment process was to recruit women to ensure an equal gender distribution. The current situation is that we have eleven PhD projects, and female students hold five of these.

PhD students:

Monika Alise Johansen, NST

Eli Larsen, NST

Liv Karen Johannesen, Well Diagnostics

Naoe Tatara, NST

Klaske van Vurden, UiT

Terje Solvoll, NST

Eirik Årsand, NST

Kevin Thon, NST

Bert-Ivar Olsen, UiT

Luis Fernandez Luque, Norut IT

Kristoffer Røed, UiT

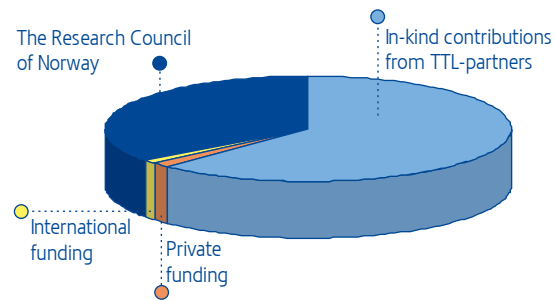
Postdocs:

Dr. Jeremiah Scholl, NST

Dr. Taxiachos Botsis, UiT

8 Economy

The planned activity level had budgeted with a total cost of approximately NOK 21.151.000, with an in-kind contribution of 58%. Although the recruitment process delayed many projects, the activity level was kept high by building the activities of TTL on existing projects among the partners of TTL. The increased in-kind contribution resulted in the total activity of 2007 far exceeding the original plans for the first year.



1. Actual Costs 2007

1.1. Personnel cost	80 %	21 117 695
1.2. External R&I Services (Norwegian universities or institutes)	0 %	0
1.3. Equipment	4 %	910 301
1.4. Other costs	16 %	4 167 455
Total actual costs	100 %	26 195 451

2. Actual Funding 2007

2.1. In-kind contributions	62 %	16 316 846
2.2. Other Public funding		0
2.3. Private funding	1 %	310 165
2.4. International funding	1 %	291 900
2.5. Research Council of Norway funding	36 %	9 276 540
Total actual funding	100 %	26 195 451

All costs in Norwegian Kroner (NOK).



9 Results

The goals defined in the Research Plan for 2007 (as submitted to the Board of Directors in January 2007) were:

Recruit 14 PhD candidates and 6 Postdocs. Publish 1 draft for book and 19 scientific papers in international and peer-reviewed journals and conference proceedings.

Some of the proposed projects were not started in 2007 and some have been postponed for a later startup (2008 or 2009), and the recruitment process took longer than initially planned.

Reported results for 2007:

Phd projects:.....	11
Postdoc projects:.....	4
Books or book chapters (chapter in edited book):.....	1
Scientific publications in international peer reviewed journals:.....	9
Publications in other international peer reviewed journals or conferences:	15
Published papers in international conferences and professional meetings:	6
Other publications:.....	14
TTL references in the media (approximately):.....	90
Patents pending:.....	1
Research or innovation rewards:	1

Publications

10.1 Books or book chapters

Olsen, B.I., Lund, N.W., Bellika, J.G., Årsand, E., Hasvold, P., Ellingsen, G., Horsch, A., Hartvigsen, G.
Documents in Medicine: from Paper Documents to Quality-Healthcare? In: Skare, R., Lund, N.W., Vårheim, A. (Eds.), A Document (Re)turn. Frankfurt am Main: Peter Lang, pp. 95-116. (ISBN-13: 978-3-631-56294-9)

10.2 Scientific publications in international peer reviewed journals

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Infrastructural arrangement for integrated care
– implementing an electronic nursing plan in a psychogeriatric ward, *International Journal of Integrated Care* 2007 Apr–Jun; 7: e13. ISSN 1568-4156, PMID=1894674

Ellingsen, G., Monteiro, E. and Munkvold, G. (2007):
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Seamless integration: Standardisation across Multiple Local Settings, *Journal of Computer Supported Cooperative Work*, Vol. 15, No. 5-6, pp. 443-466

Bellika, J.G., Hasvold, T., Hartvigsen, G.
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Botsis, T., Bellika, J.G., Hartvigsen, G.
Disease surveillance for sensitive populations. *Advances in Disease Surveillance* 2007;4: p. 148

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Blood glucose levels as a sensor for the early detection of infection in type-1 diabetics. *Advances in Disease Surveillance* 2007;4: p. 147

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10.3 Publications in other international peer reviewed journals or conferences

Hartvigsen G, (2006) Challenges in Telemedicine and eHealth: Lessons learned from 20 years with Telemedicine in Tromsø. *Proceedings 4th Scandinavian Conference on Health Informatics Aalborg University, August 24 - 25, 2006*, pp. 34-36. ISBN 87- 986264-7-7

Granberg, O., Bellika, J.G., Årsand, E., Hartvigsen, G. Automatic Infection Detection System for *Proceedings of Medinfo 2007, 20-24 August 2007, Brisbane, Australia*. Amsterdam: IOS Press 2007. ISBN 978-1-58603-774-1. pp. 566-570

Scholl, J., Hasvold, P., Henriksen E, Ellingsen, G. (2007):
Managing communication availability and interruptions: A Study of Mobile Communication in an Oncology Department, *Pervasive 2007, May 13-16, 2007 in Toronto, Pervasive Computing, Volume 4480/2007*, pp. 234-250, ISBN 978-3-540-72036-2

Skattør, B., Berntzen, L., Engvik, T., Hasvold, P. (2007):
A Framework for Mobile Services Supporting Mobile Non-Office Workers. *Proceedings Human-Computer Interaction. HCI Applications and Services, 12th International Conference, HCI International 2007, Beijing, China, July 22-27, 2007, Proceedings (Part IV)*, Springer, pp. 742-751

Munkvold, G., Ellingsen, G. and Koksvik, H. (2006):
Formalising work – reallocating redundancy. *CSCW 2006 : Conference on Computer Supported Cooperative Work : 20th anniversary conference proceedings, November 4-8, 2006* ACM Press, pp. 59-68, ISBN 1595932496 >>

➤ Munkvold, G. and Ellingsen, G. (2007): Common Information Spaces along the illness trajectories of chronic patients, ECSCW 2007, Springer London., pp. 291-310, ISBN 978-1-84800-030-8

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Botsis, T., Solvoll, T., Scholl, J., Hasvold, P., Hartvigsen, G. Context-aware systems for mobile communication in healthcare – A user oriented approach. The 7th WSEAS International Conference on APPLIED INFORMATICS AND COMMUNICATIONS (AIC'07), (Vouliagmeni Beach, Athens, Greece, August 24-26, 2007). World Scientific and Engineering Academy and Society 2007. ISBN 978-960-8457-96-6. pp. 69-74

Baardsgaard, A., Hartvigsen, G.
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Johannessen, T., Hartvigsen, G.
The mobile solution for blood donor, registration and identification for the National Blood Transfusion Service, Tanzania. Proceedings of 5th Scandinavian Conference on Health Informatics (SHI 2007) (Kalmar, Sweden, 1-3. October 2007). eHälsöinstitutet, Kalmar Science Park, Kalmar, pp. 39-40. (ISBN 978-91-633-1111-6)

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Divine, D., Pohzehl, J. and Godtlibsen, F.:
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Bayesian modelling and Significant features exploration in wavelet power spectra. Geophysical Research Abstracts, Vol. 9, 01600, 2007, SRef-ID: 1607-7962/gra/EGU2007-A-A01600, European Geosciences Union 2007

10.4 Published papers in international conferences and professional meetings

Munkvold, G. and Ellingsen, G. (2006):
Interconnecting Practices in Health Care through Infrastructural Arrangements, International workshop on Infrastructures for Health Care: Connecting practices across institutional and professional boundaries, Copenhagen 19-20 June 2006

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Tromsø Telemedicine Laboratory is:

