

# ICT for Health and Personal Health Systems @VTT

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Business from technology

IEEE EMBS Brisbane 2008-11-28

VTT TECHNICAL RESEARCH CENTRE OF FINLAND

## ICT for Health @ VTT

Health services is one of the most potent application areas for ICT

### VTT:

- Staff ~50 (~1/3 with PhD), ~5M€/y
- In close collaboration with industry
- Areas:
  - **Medical technologies**
    - Patient monitoring
    - Medical image processing
    - Medical signal processing
    - Diagnostics
  - **Personal health systems**
    - Sports & fitness
    - Wellness, health and chronic disease management
    - Independent living
  - **eHealth services**
    - EHR, EMR, PIR
    - Telemedicine
    - Medical informatics
  - **Bio-ICT**
    - Biomedical informatics



## Some references

- Key personnel in ICT for Health
  - Dr. Ilkka Korhonen, Chief Research Scientist, docent (TUT), IEEE EMBS TC on Wearable Biomedical Sensors and Systems member
  - Mr Kari Kohtamäki, Customer Manager
  - Dr. Niilo Saranummi, Research Coordinator, research professor, past IEEE TITB Editor, etc
  - Dr. Mark van Gils, docent (HUT) - medical signal processing
  - Dr. Jyrki Lötjönen, Team Leader, docent (HUT) - medical image processing, Bio-ICT
  - Dr Jaakko Lähteenmäki, Team Leader - eHealth
  - Mr Jouni Kaartinen, Team Leader - personal health for sports and fitness
  - Dr Matej Oresic, Team Leader - Systems biology
- Strong international links
  - IEEE/ EMBS, IFMBE, EAMBES, editorial board memberships in various biomedical engineering journals, memberships in key organisations especially in Europe, membership at IEEE TC in Wearable Biomedical Systems
  - Strong history of international projects since '80s
- Strong networking
  - Health care: hospitals (University Hospitals of Tampere, Helsinki, Kuopio, Bern), other health care organisations, etc.
  - Companies: GE HealthCare, Nokia, IST Oy, Suunto Oy, BPM Group, TietoEnator, Clothing+, Firstbeat Technologies,...
- Strong links to medical and health societies and high number of publications
  - during last decade: >100 original publications in scientific journals, >100 publications in scientific conferences, several patents (incl. pending) related to BSI – mostly transferred to our customers

## IEEE EMBS Technical Committee on Wearable Biomedical Sensors and Systems



Andreas Lymberis  
Information Society Directorate  
European Commission



Paolo Bonato  
Motion Analysis Laboratory  
Harvard Medical School



Danilo De Rossi  
Interdiparimental Centre of Research  
"E. Piaggio"  
University of Pisa



Andre Dittmar  
LPM  
CNRS/INSA Lyon



Ilkka Korhonen  
Pervasive Health Technologies  
VTT



Eric McAdams  
NIBEC  
University of Ulster



Sundaresan Jayaraman  
School of Polymer, Textile & Fiber Eng.  
Georgia Institute of Technology



Y-T Zhang  
Joint Research Center for Biomedical Engineering  
The Chinese University of Hong Kong

EMBC2009 - Microsoft Internet Explorer

Address: http://www.embc09.org/

**EMBC 2009 Minneapolis**  
Engineering the Future of Biomedicine

**IEEE**  
Celebrating 125 Years of Engineering the Future

Date: September, 2-6, 2009 Venue: Hilton Minneapolis, Minnesota, USA Paper Submission Deadline: April 7, 2009

**LINKS**

- Home
- Welcome Message
- Announcement
- Invited Speakers
- Committees
- Technical Program
- Author Instruction
- Key Dates
- Registration
- Paper Submission
- Sponsors
- Exhibitions

**31st Annual International Conference of the IEEE Engineering in Medicine and Biology Society**

**Conference Theme:**  
**Engineering the Future of Biomedicine**

**Key Dates**

January 15, 2009	Workshops / Symposia Proposal*
April 7, 2009	Four Page Paper Submission
July 1, 2009	Exhibition Booth/Table Reservation

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**VTT TECHNICAL RESEARCH CENTRE OF FINLAND**

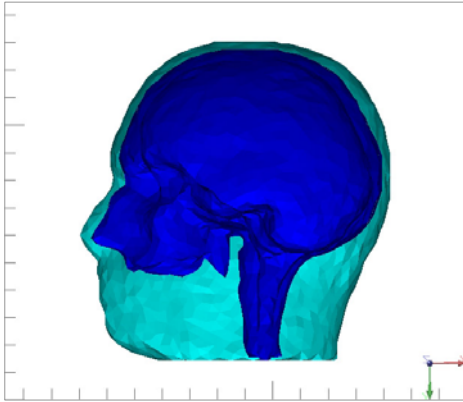
## PROCESSING AND MINING OF HUMAN DATA AT VTT

- VTT is an internationally recognised innovator and research institute partnering with industry and health service providers
- More than 30 patents and inventions - 5 transferred to international customers
- 30 - 50% international incomes
- ~5M€ annual budget - Strong growth estimates
- 85 researchers of which about 35% holds a PhD degree
  - More than 200 academic publications after 2001
  - Otto Schmitt award in 2008
  - Part of the centre of excellence in EU's Marie Curie 04-08 and Academy of Finland in 06-11

**VTT**

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## PROCESSING AND MINING OF HUMAN DATA ENABLES



- **More accurate** forecasts in human related matters (health, behaviour)
- Ability to determinate **the direction of development** (social contexts)
- Better **understanding of cause-and-effect relations**
- Unique ability **to combine excellence** in digital systems, biotechnology and telecommunications

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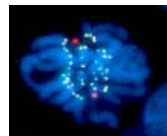
## NEW POTENTIAL HIGH GROWTH OFFERINGS

**For ICT for health**

- Medical image and signal processing
- Personal health systems
- Independent living
- eHealth
- Telemedicine
- Bio-informatics

**For diagnostics**

- Development of antibodies
- New methods
- Biosensors and detection technologies
- Technologies for point-of-care diagnostics

**For healthcare industry**

- Measurement technologies: molecular sensors, small molecule homogeneous assays
- Processing technologies: signals and image processing e.g. PAT
- Data mining, interpretation and decision support technologies e.g., combined gene copy number and gene expression analysis



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## Vivago IST: ACTIVITY RECOGNITION WITH MOVEMENT SENSORS



- An intelligent wearable social alarm system for elderly
- Enables cost efficient continuous 24/7 monitoring of wellness of the subject
- Reliable user-triggered and automatic alarms for emergency

Contacts:  
Ilkka Korhonen, Chief Research Scientist  
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## GE Healthcare: SURGICAL STRESS INDEX



- Adequate measuring of analgesia during surgery in an anesthetized patient
- Unique equipment property for customer's new product platform
- Scientific remarks
  - 3. place in Innovation 2004 competition (Finnish Innovation council 2004)
  - World wide release in AMCA2005, Switzerland

Contacts:  
Mark van Gills, Senior Research Scientist  
Tel. +358 20 722 3342

## Roche: CANCER DRUG RESEARCH



- Multidisciplinary usage of knowledge in high-throughput screening, RNA interference, cell biology and bioinformatics to conduct research studies
- Genome wide research on drug and gene interactions in living cells
- Possibility to develop novel drug combinations and biomarkers for therapy

Contacts:  
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## Bayer Schering: STUDING THE MECHANISM OF ACTION OF A NEW CANCER DRUG



- Utilizes the new gene and cell biology methods developed by VTT
- Combining scientific and technology excellence to facilitate drug development processes
- Reveals molecular signature of a novel drug in functional genome wide screens

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## NOKIA research: PERSONAL WEIGHT MANAGEMENT THROUGH WELLNESS DIARY



<http://research.nokia.com/research/projects/WellnessDiary>

### Contacts:

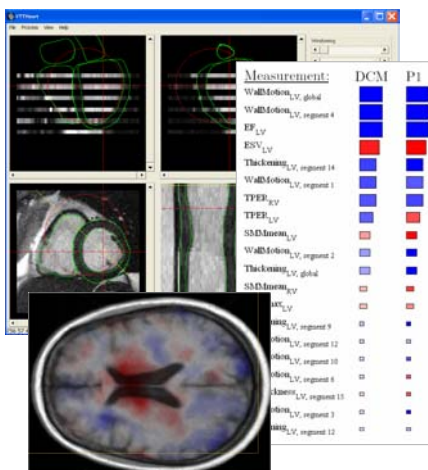
Ilkka Korhonen, Chief Research Scientist  
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- As simple as possible
- Activates user to observe his/her behaviour: Weight, exercise, stress (self-assessment), eating, steps, blood pressure, sleep, ...
- User pilot: 29 volunteers (3 drop outs), 3mths
- Based on CBT based psychological model of human behaviour, Mobile phone centric (S60 application)

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## GE Healthcare research: FROM MEDICAL IMAGES TO DIAGNOSTICS



- Automated extraction of structures from images (**image segmentation**) is a prerequisite for quantitative analysis
- **Detailed modelling of image databases** enables objective and evidence-based diagnostics as well as personalised healthcare
- Focus is in Alzheimer's disease and in cardiac diseases.

### Contacts:

Jyrki Lötjönen, Senior Research Scientist  
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## Nuadu project

## Chronic conditions

- According to the WHO, 77% of the disease burden in Europe are accounted for by disorders related with lifestyles.
- 70% of stroke and colon cancer, 80% of coronary heart disease, and 90% of type II diabetes could be prevented by maintaining healthy lifestyles [Willet, Science, 296(5568), 2002]
- Losses due to mental health problems make 3-4% of the GNP in Europe, mainly due to lost productivity (BMJ 2006)
- Sustained work-related stress is an important determinant of depressive disorders and 4th leading cause of the global disease burden, expected to rank 2nd by 2020 (WHO 2001)
- **Chronic or long-term conditions make >70% of all health care costs.**

"Its all about behaviour" - prevention & management

### Direct healthcare costs in Finland:

Cardiovascular	17%
Mental health	13%
Respiratory	11%

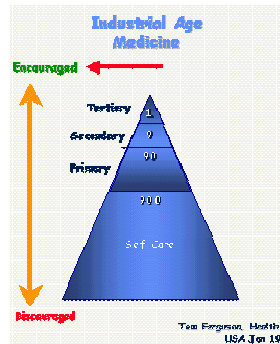
### Lost production in Finland:

Mental health	22%
Musculo-skeletal	22%



## Industrial vs. Information Age Medicine

- Optimised to treat acute cases
- Care is in the (hospital) factory
  - Provider-Centric
- Knowledge vested in provider (almost) exclusively
  - Know Everything
- Productivity = Best Practise applied consistently to everybody
  - Population Guideline



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## Psychological Theories of Behavior Change

- Transtheoretical Model (TTM)
  - Six-stage process of behavior change: pre-contemplation, contemplation, preparation, action, maintenance, termination
  - Different stages require different tools
- Cognitive-Behavioral Therapy (CBT)
  - Identifying the factors causing or maintaining problematic behaviors and making small changes
  - Self-observation + feedback => learning
- The same methods apply to any problem with a behavioral origin

Centers for Disease Control and Prevention [www.cdc.gov](http://www.cdc.gov)

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www.glasbergen.com

**“What fits your busy schedule better, exercising one hour a day or being dead 24 hours a day?”**

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Greatest opportunity for **Personal Health Systems** is in **citizen empowerment**

-  
Tools for self-care & self-management -  
**for myself by my own decision**

Thoroughly new services and provider networks should be created to enable this.



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## Personal Health Systems

New wearable devices  
- easy, affordable, accurate



Advanced analysis tools  
and psychophysiological models  
- from data to information and feedback

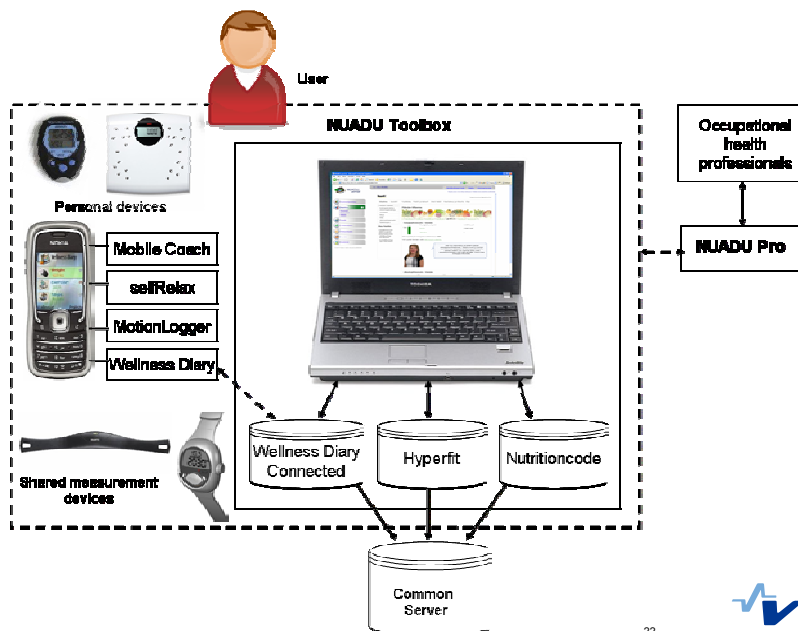


Computing and connectivity  
- pervasive



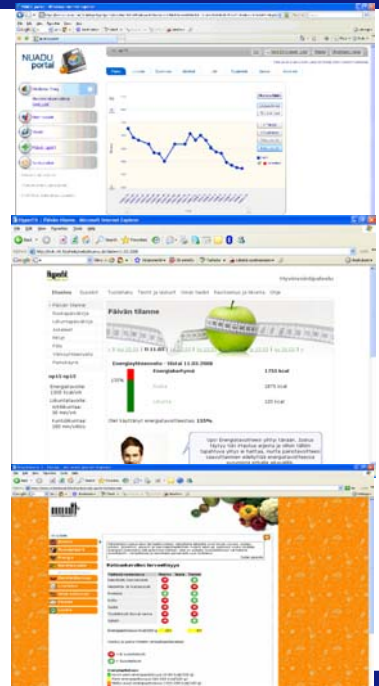
- + New service models
- + New delivery and business models
- + New peer and social networks

*Easy, available, affordable, efficient,  
personalised, trusted, standard-based,  
interoperable, citizen-driven*



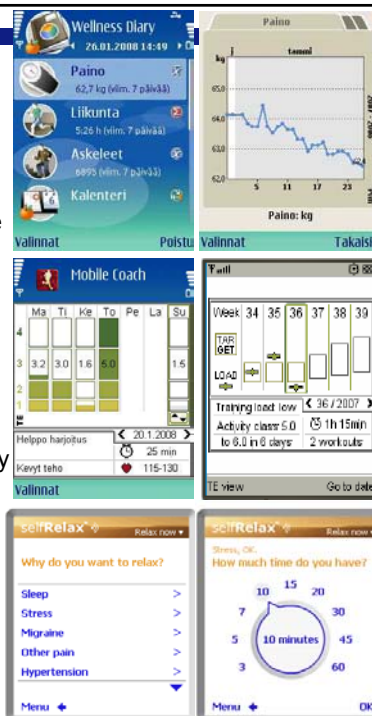
## Nuadu Portal

- Integration of internet based wellness services
  - Independent services from different providers under single sign-on
- Basic services provided by the portal framework:
  - Service orchestration
  - User account management
  - Health libraries
  - Teleconsultation (messages to health professional)
- Services:
  - Wellness Diary Connected: self-observations
  - Hyperfit: detailed nutrition and exercise diary
  - Nutritioncode: reward card based automatic nutrition monitoring



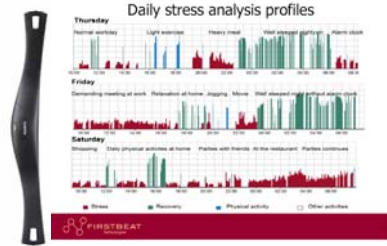
## Mobile Applications

- Stand-alone applications installed in the mobile phone
- Intended for free, fast and easy daily usage independent of location and time
- Applications:
  - Wellness Diary: self-observations & feedback, possibility to synchronize with Wellness Diary Connected
  - Mobile Coach: training coach, which automatically creates a training program and updates it according to performed exercises
  - selfRelax: relaxation assistant based on personalized relaxation sessions listened on the mobile phone



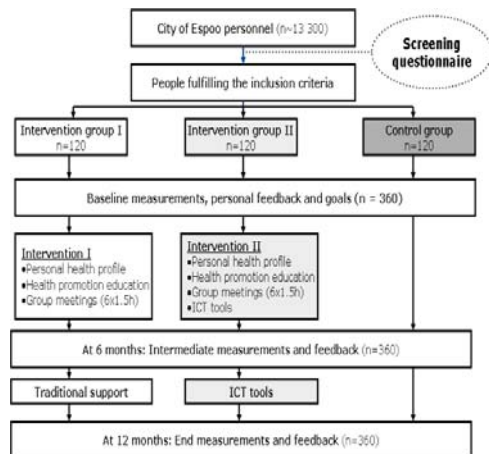
## Measurement Instruments

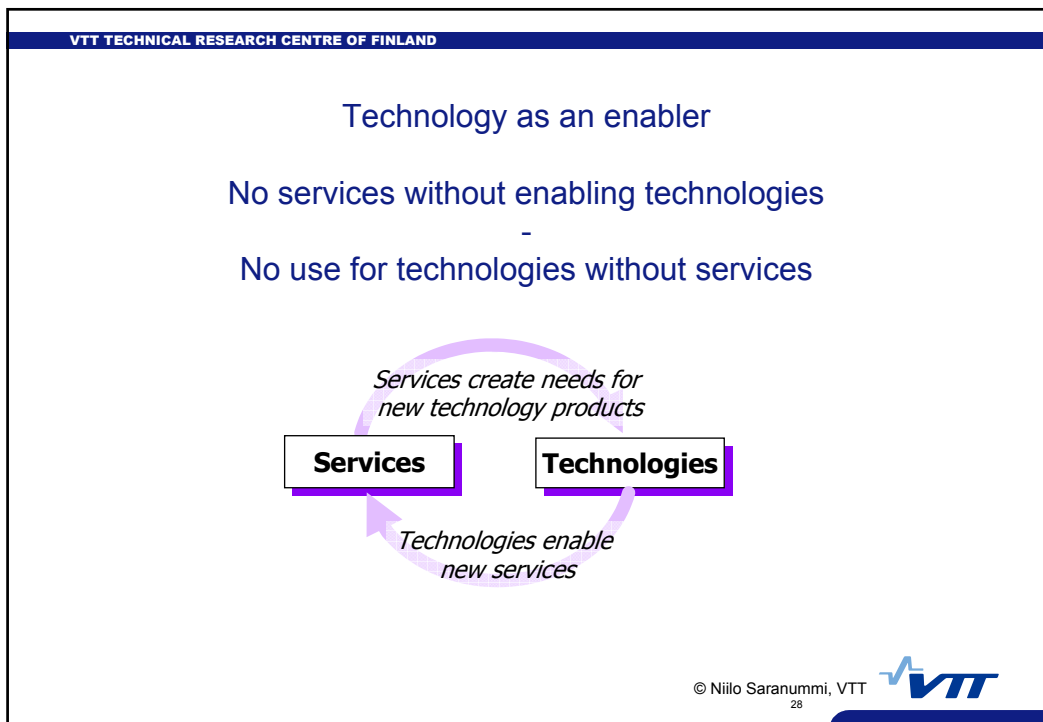
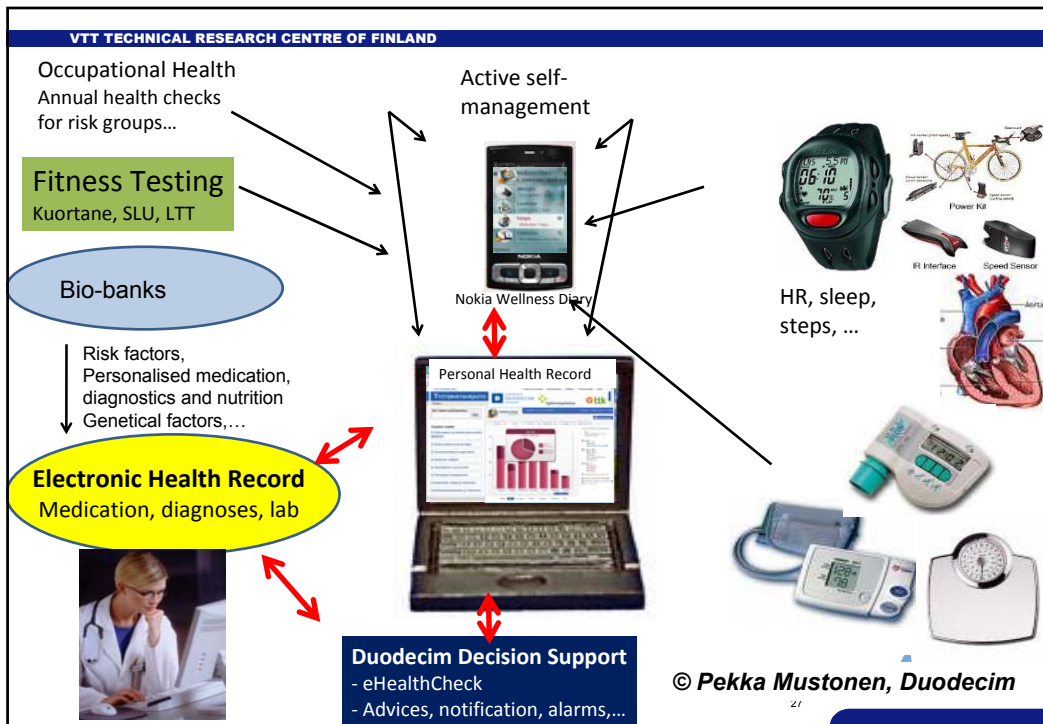
- Advanced measurements for more detailed information
- Intended for intermittent usage, e.g., one week at a time
- The data are analyzed by a health professional, who posts a feedback report to the user to be viewed in the portal
- Measurement instruments and analyses:
  - Suunto Memory Belt and Firstbeat Pro analysis:
    - Continuous HRV measurement
    - Analysis of stress and recovery
  - IST Vivago Personal Wellness Manager
    - Wrist actigraphy
    - Analysis of sleep



## Study design

- One-year randomized controlled trial
- Hypotheses:
  - ICT tools will improve the effects of the group intervention for a significant subgroup
  - This group may include those who would not benefit from traditional intervention







Nuadu Finland  
Partners



Business from technology