Biosensing Competence Centre

2007-2010

Edited by Johana Kuncová-Kallio

TAMPERE UNIVERSITY OF TECHNOLOGY
VTT
COUNCIL OF TAMPERE REGION
Leverage from the EU
European Union
European Regional Development Fund

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Executive Summary

BCC was formed to facilitate commercialization of research results in the field of biosensing.

Biosensing *is our core competence. We understand the term biosensing as the measurement of the biological characteristics and functions of living organisms.*

Key application areas:

- ***Tools for cell and tissue engineering*** *including stem cell research.*
- ***Pharma tools*** *for cell-based testing.*
- ***Diagnostics*** *molecular recognition, biosensors for rapid testing, point-of-care devices.*
- ***Well-being*** *wearable wireless monitoring, living lab testing platform.*
- ***Food and environmental monitoring*** *sensor and device development.*

Biosensing Competence Centre was formed based on a common need of professors and research leaders to accelerate the commercialization of research results in the field of biosensing. The main partners were research groups based at VTT Technical Research Centre of Finland, Tampere University of Technology and business development experts at FinnMedi Oy. During the project, other players became interested in BCC's services, most notably the University of Tampere. At the same time, the initially wide application fields of BCC were cross-evaluated with areas of regional strength and the activities were focused on the applications in cell- and tissue engineering and clinical diagnostics.

The recognized need to move beyond a network of experts to a regionally focused technology theme has driven the so called MediTech-initiative, in which BCC has played a catalyzing role. BCC has been involved in preparations of preliminary strategies for MediTech and its core units and services and will be a part of the newly forming MediTech-initiative via its members.

BCC raised funding of 1.2 MEUR. Major contributions came from the European Regional Development Fund via the Council of the Tampere Region, City of Tampere, BioneXt Tampere program and the Centre for Economic Development, Transport and the Environment.

The funding enabled acquisitions of a core biosensing infrastructure and deepened the understanding of international market and customer needs. The project resulted in a number of large national and international proposals and most importantly created a strong regional network and initiated the transformation into MediTech-initiative.

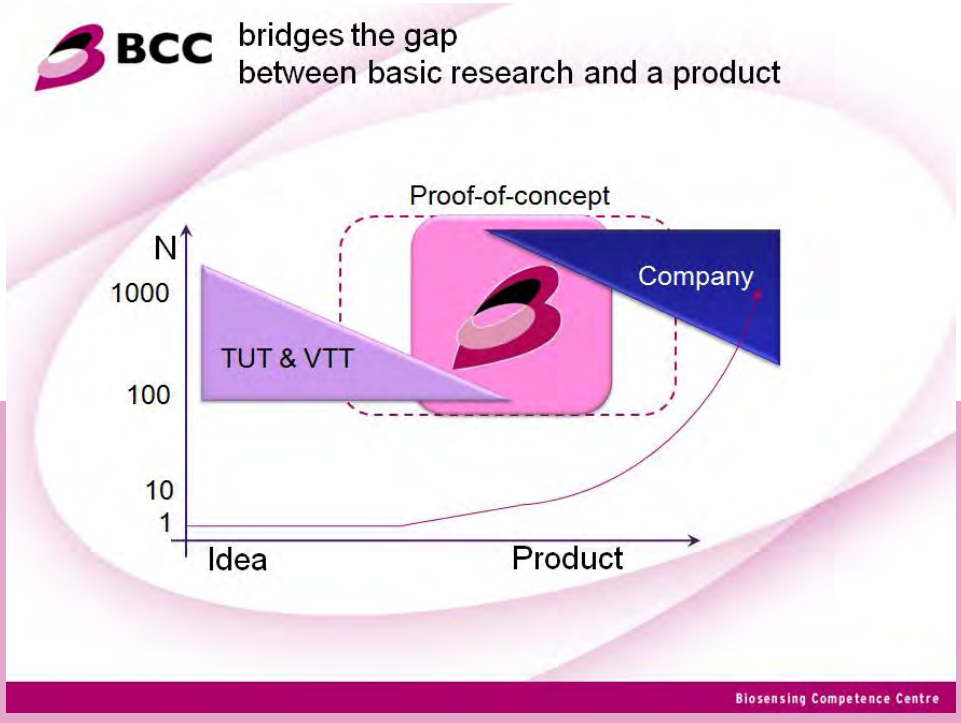
Table of Contents

1. Introduction

Biosensing Competence Centre (BCC) was formed based on a common need of several professors and research leaders **to bridge the gap between the basic research and commercialization** in the field of biosensing. Biosensing is the core know-how of BCC and is understood broadly –as the measurement of the biological characteristics and functions of living organisms.

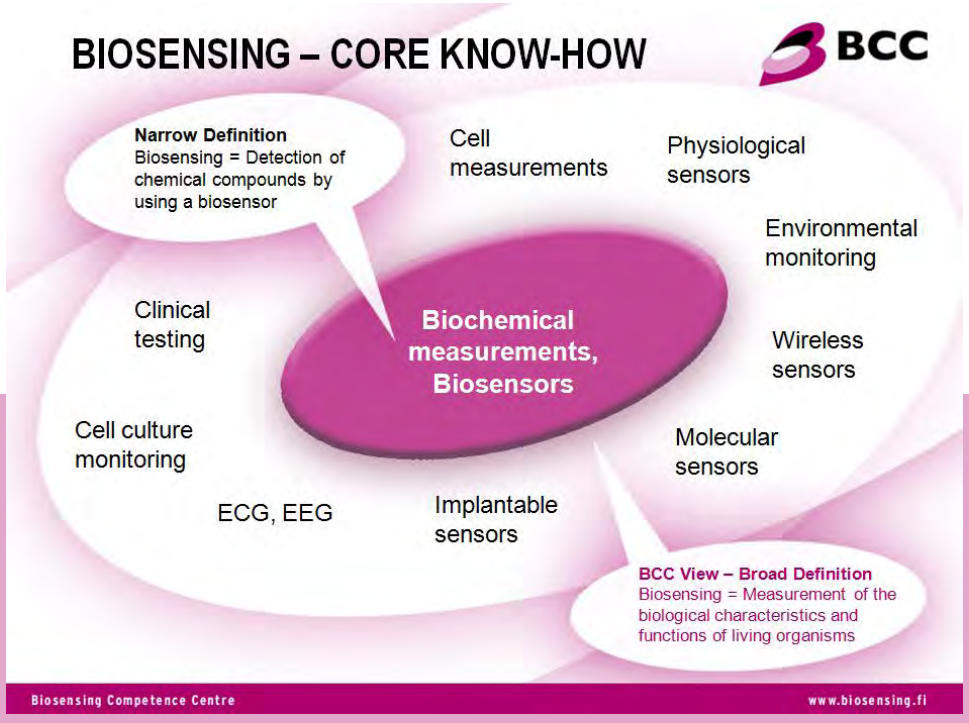
BCC raised funding of 1.2 MEUR. The major contributions came from the European Regional Development Fund through the Council of the Tampere Region, City of Tampere, BioneXt Tampere program and the Centre for Economic Development, Transport and the Environment. The overall funding and expenditure is summarized in Chapter 2. The work at BCC was organised into several projects. Each project, their goals, steering groups and the main achievements are reviewed in Sections 2.1- 2.5.

Since the preliminary discussions, the main partners were VTT Technical Research Centre of Finland, Tampere University of Technology and FinnMedi Oy. During the project, other players became interested in the services, most notably in the University of Tampere. The core groups of BCC and their competences are introduced in Chapter 3.



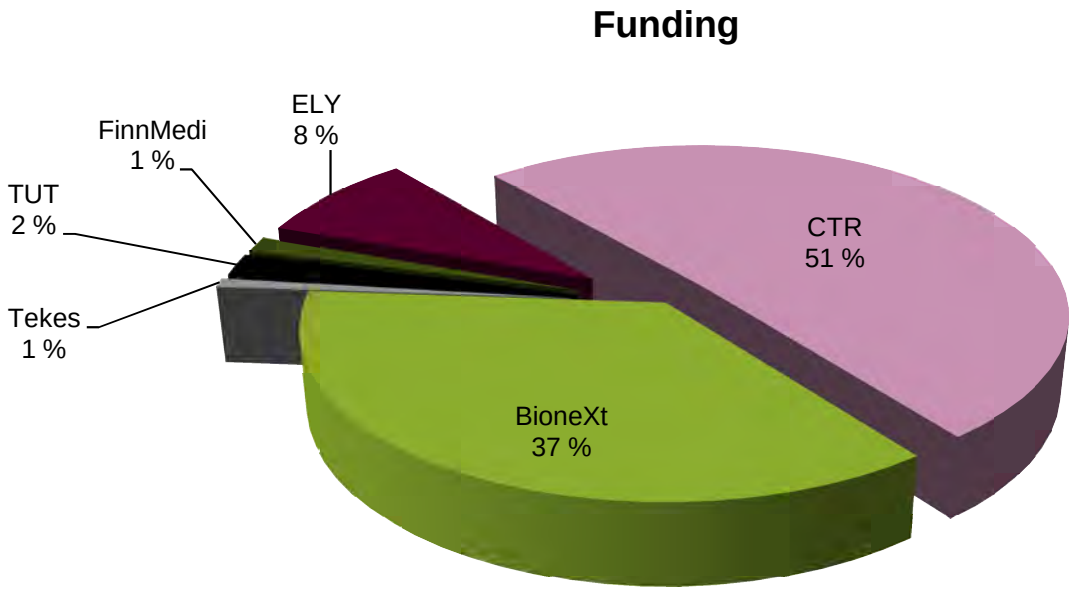
The initially wide application fields of BCC were cross-evaluated with the areas of regional strength and the activities were further focused. The reasoning for the selected key areas is described in Chapter 4.

The funding has enabled BCC to acquire a core biosensing infrastructure and provide a large range of services from funding assistance through IPR protection to internal and external networking. The infrastructure acquisitions are discussed in Chapter 5 and the services in Chapter 6. The services have enabled to deepen the understanding of international market and customer needs and have resulted in a number of large national and international proposals (Section 6.1) and most importantly to create a strong regional network and to transform it into a joint MediTech-initiative for research and commercialization. Some preliminary information on MediTech can be found in Chapter 7.

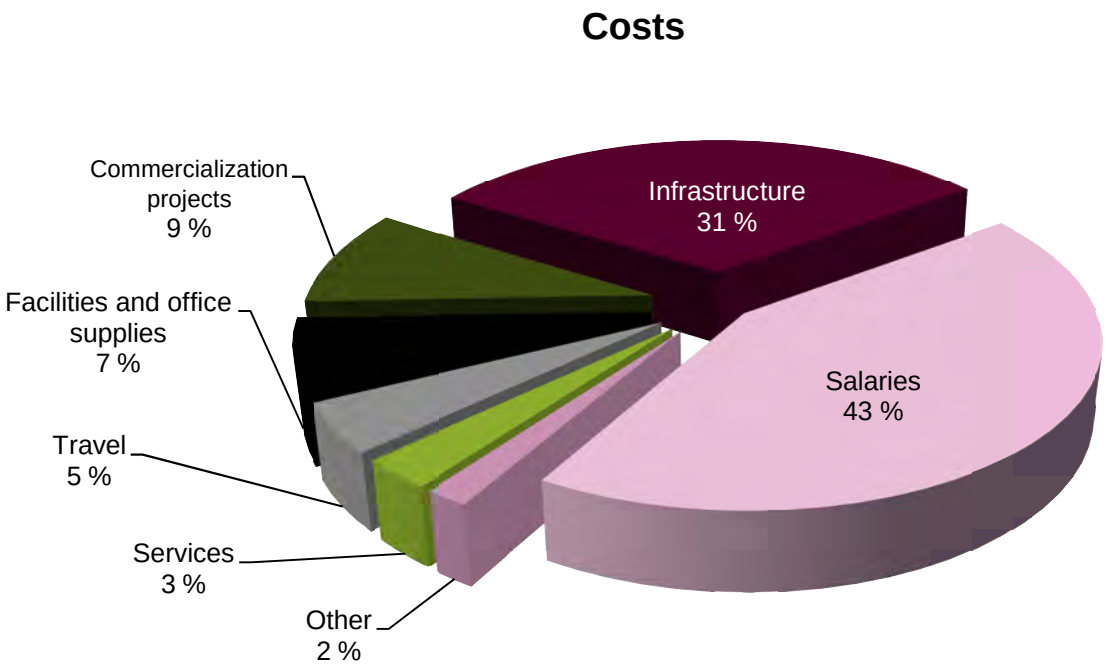


2. Summary of BCC projects

A number of meetings and projects catalyzed the regional developments towards the Biosensor Competence Centre. In the next sections, the main projects are summarized. Here, the overall funding and expenditures are presented.
The total funding volume over the span of the projects (2006-2010) was 1.2 MEUR and is presented in the graph below. We would like to thank all of the funding organizations:



The graph on this page presents the cost distribution of BCC projects (2006-2010). The main cost (43 %) is accounted to salaries, which covers the co-ordination and administration of BCC as well as business development including attaining new contacts, funding, technology protection and BCC's operational model. The second largest cost (31 %) is attributed to acquisition of devices (AFM and RIE further discussed in Chapter 5) for strengthening the biosensing research and attractiveness of BCC to industrial partners. Commercialization projects (9 %) have enabled hiring of internal experts to further develop innovations into solutions appealing to industry. Facilities and office supplies (7 %) provided room for base operations and laboratory space. Travel expenses (5 %) enabled effective face-to-face meetings with research groups and especially industrial partners in Finland, Europe and USA. Other costs and services are related mostly to production of propagation materials.

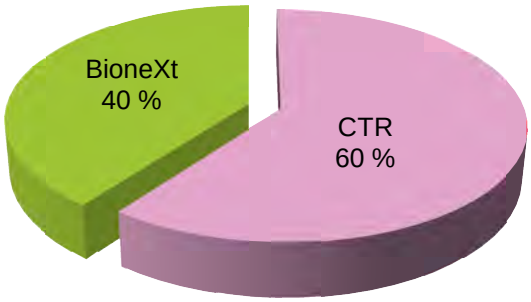


The goal of the first project was the launch of Biosensing Competence Centre.

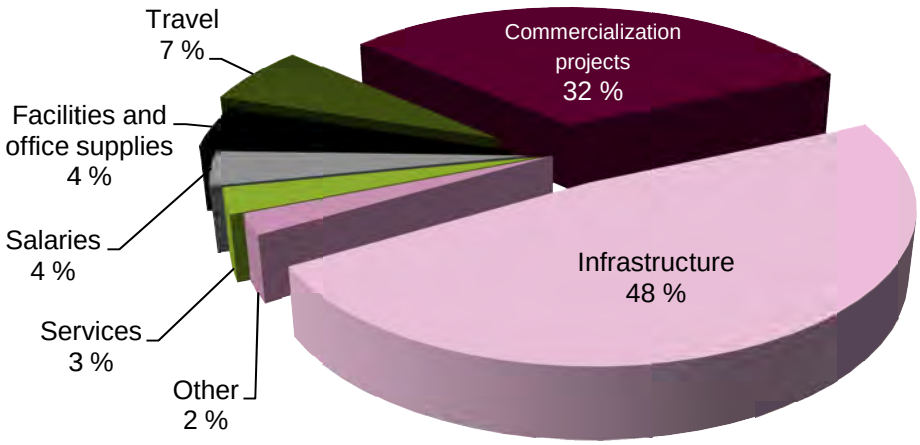
2.1. Project BCC1

Hannu Helle (in picture) was chosen to lead BCC and several experts were appointed to conduct research and analysis tasks. The marketing commenced with a brochure, a website and a leaflet as well as participation to numerous international and national events. Negotiations with tens of industrial partners were conducted. A business model was developed by Olli Öster of Pertec Oy. The regional infrastructure was strengthened by an acquisition of a reactive ion etching device and a gas station for a common use. The funding and cost structure of BCC1-project are presented in this page.

Funding



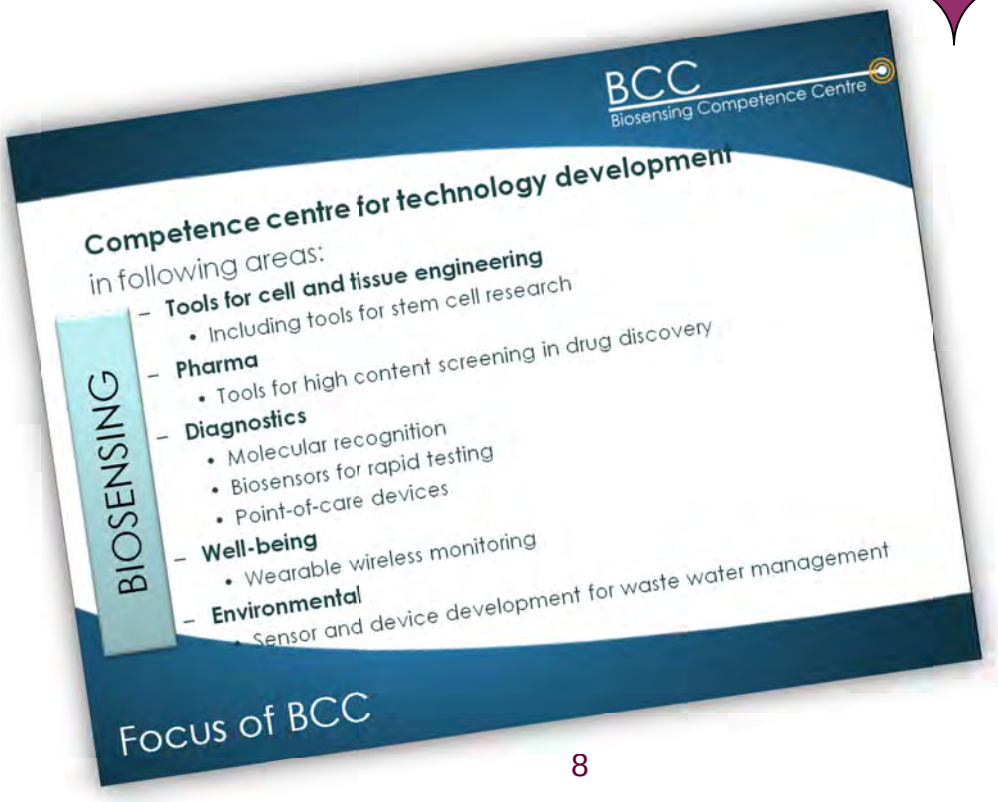
Costs



Funding partners: Council of Tampere region and BioneXt Tampere program
Funding volume: 353 140 €
Funding period: 1.8.2007 – 29.2.2008.

Steering board:
Prof. Jukka Lekkala (chair), TUT
Prof. Jari Hyttinen, TUT
Adj. prof. Kirsi Tappura, VTT
CRS Inger Vikholm-Lundin, VTT
Director Tero Välimaa, BioneXt Tampere, FinnMedi Oy
Marja-Riitta Mattila-Nurmi, Council of the Tampere Region
CSO Hans Söderlund, VTT
Res. prof. Jouko Viitanen, VTT
Prof. Matti Karp, TUT

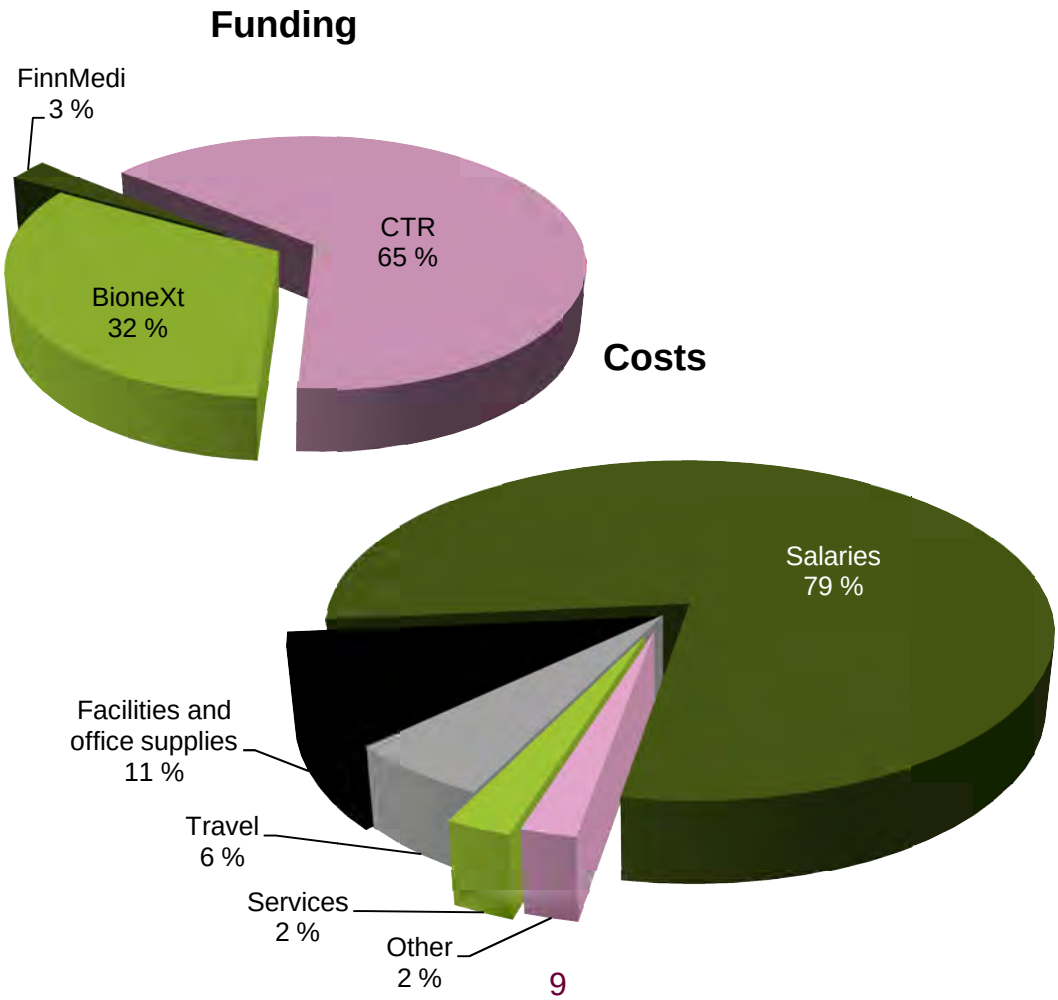
Key personnel:
M.Sc. Hannu Helle, executive director
M.Sc. Sanna Peltola, 3d-forming of sensor structures
M.Sc. Jani Pelto, Autofocusing eye based on electrochemical actuator
M.Sc. Anne Ala-Pöntiö, Generic bioluminometer
Dr.Tech. Jari Viik, Implantable cardiac sensor
B.Sc. Arjun Aryal, Implantable sensor
Teemu Ylilauri, NokiAreena – Living Lab
Carita Malkamäki, administration



The goal of the second project was strenghtening of customer relations.

2.2. Project BCC 2

Johana Kuncová-Kallio (in picture) joined BCC in 2009 as a development manager. Hannu Helle continued as an executive director. The project has generated a new set of propagation materials including new website, several technology leaflets, and information to third party databases. Throughout the project close to hundred companies were contacted, mostly in face-to-face meetings in Finland, Europe and USA. The research and commercialization funding was sought via BCC in five EU, four Tekes, two Academy of Finland and one EU regional development project proposals. More of the results can be found in Chapter 6. Generic business model based on BCC has been developed by FinnMedi Oy (available as an attachment). The funding and cost structure of BCC2-project are presented in this page.



Funding partners: Council of Tampere region, BioneXt Tampere program and FinnMedi Oy
Funding volume: 610 772 €
Funding period: 1.3.2008 – 31.12.2010

Steering board:
Prof. Jukka Lekkala (vice-chair), TUT
Prof. Jari Hyttinen, TUT
Adj. prof. Kirsi Tappura (chair), VTT
CSO Inger Vikholm-Lundin, VTT
Director Tero Välimaa, BioneXt Tampere, FinnMedi Oy
Sales Director, Reijo Itkonen, FinnMedi Oy
Tuija Rajala, Council of the Tampere Region
CSO Hans Söderlund, VTT
Res. prof. Jouko Viitanen, VTT
Prof. Matti Karp, TUT

Executive board:
COO Hannu Helle, BCC
Dr.Tech. Johana Kuncová-Kallio, BCC
Prof. Jukka Lekkala, TUT
Prof. Jari Hyttinen, TUT
Adj. prof. Kirsi Tappura, VTT
CSO Inger Vikholm-Lundin, VTT
Director Tero Välimaa, BioneXt Tampere, FinnMedi Oy
Sales Director Reijo Itkonen, FinnMedi Oy
Prof. Minna Kellomäki, TUT
Res. prof. Jouko Viitanen, VTT
Prof. Pasi Kallio, TUT
Prof. Matti Karp, TUT

Funding partners: Council of Tampere region, BioneXt Tampere program and Tampere University of Technology
Funding volume: 200 740 €
Funding period: 20.11.2008 – 28.2.2009

Steering board was not nominated.

Key personnel:
M.Sc. Hannu Helle, executive director
Carita Malkamäki, administration

The goal of the third project was strenghtening of BCC infrastructure.

2.3. Project BCC 3

During this project, BCC was strengthened by widening of the infrastructure. An evaluation of needs amongst the BCC groups was performed and an atomic force microscope (AFM) was acquired.

Funding partners: Finnish Funding Agency for Technology and Innovation – Tekes and Tampere University of Technology
Funding volume: 10 000 €
Funding period: 31.8.2006 - 31.10.2006

Experts involved in preparations
Hannu Helle, VTT
Adj. prof. Kirsi Tappura, VTT
CRS Inger Vikholm-Lundin, VTT
Director Tero Välimaa, BioneXt Tampere, FinnMedi Oy
Development Director, Reijo Itkonen, FinnMedi Oy
Rami Lehtinen, RL-Tutkimus Oy
Prof. Jukka Lekkala (chair), TUT
Prof. Jari Hyttinen, TUT
and a number of national and international experts

The goal of the first survey was to identify customer needs in biosensing.

2.4. Tuli-survey

Tampere University of Technology together with Tekes in a Tuli-programme funded a survey to assist the development of BCC. The project entitled “Biosensor Factory” focused on identification of customer needs in healthcare and other application areas. A number of national and international experts were interviewed by Rami Lehtinen / RL-Tutkimus Oy.

Funding partners: Tampere University of Technology
Funding volume: 25 000 €
Funding period: 1.1.2010 - 31.12.2010

Key personnel
Executive director, Hannu Helle, BCC
Development manager, Johana Kuncová-Kallio, BCC

The goal of the TUT funding was to strenghten core services of BCC provided to TUT groups.

2.5. TUT project

The core services offered to the BCC groups at Tampere University of Tampere (TUT) were strengthened with a funding from TUT and the Department of Automation Science and Engineering. The funding was primarily used for the preparation of new international projects, a national infrastructure call and a groundwork for launching of MediTech-initiative.

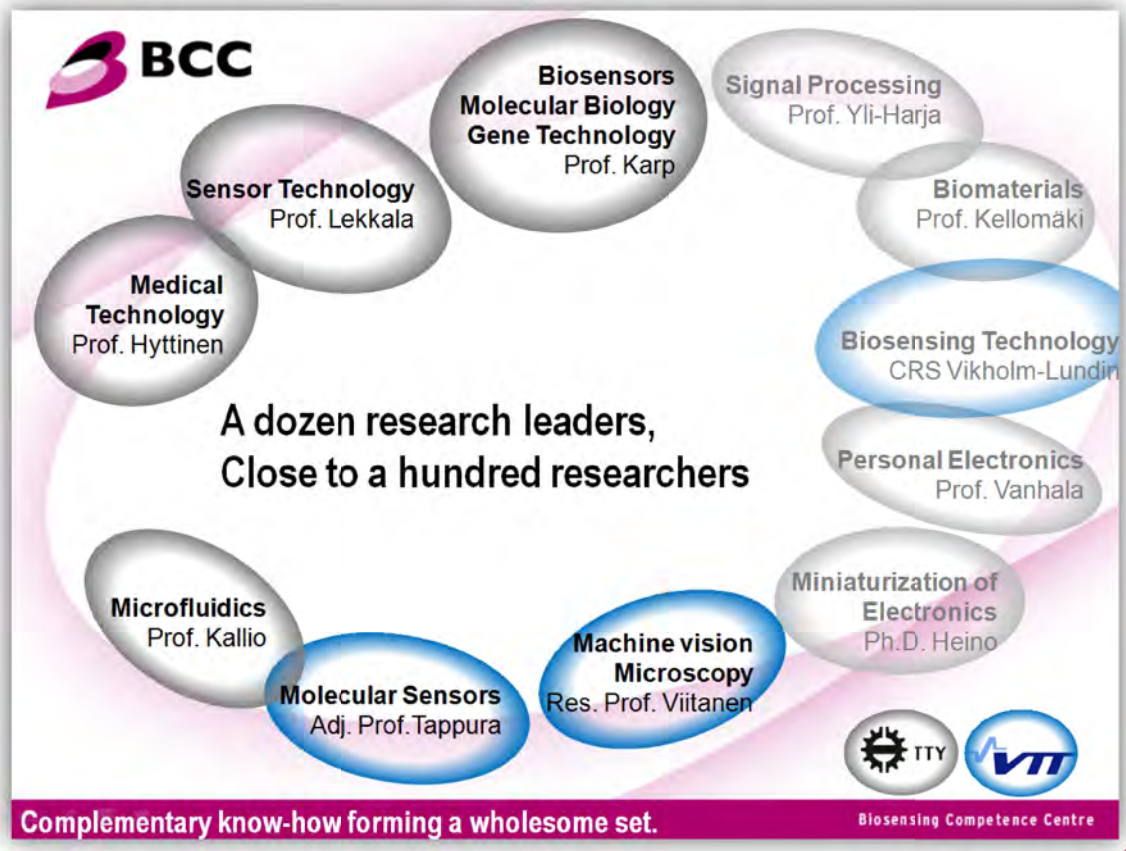
3. Core groups

The core groups of BCC together with the affiliated groups cover the biosensing technology from modeling through prototyping to small scale production. The knowhow and expertise of the groups have been further strengthened by a strong partnering with the life science academia in Tampere region. Many of the biologists also utilized the BCC services.

Several industrial clients took note of our excellent network of multidisciplinary researchers and this further increased need for deepening of the collaboration. As BCC covered in its operations primarily technology-focused research, the broadening towards life sciences and further focusing to cell- and tissue engineering on one hand and diagnostics on the other requires also new approach.

BCC actively initiated regional networking (Section 6.4), which together with the funding assistance (Section 6.1) outcomed in the upcoming initiative of MediTech. The technology core of MediTech is based on BCC and the life science core comes from the key partners of BCC.

The core groups of BCC are introduced in the next opening, while the key life science partners at the University of Tampere are introduced in the following page.



Institute for Regenerative Medicine, Regea (www.regea.fi) engages in research in cell and tissue engineering, the focal areas being stem cell research and research combining stem cells and biomaterials. Regea Tissue Bank meets the requirements of the current Finnish legislation and also EU Directives for tissue banking. It processes and supplies tissues for clinical use. The institute is led by Prof. Riitta Suuronen, MD.

The Centre of Expertise for Alternative Methods in Finland, Ficam (www.ficam.fi) is led by Adjunct Professor Tuula Heinonen, European registered toxicologist. FICAM is the knowledge center for alternative (replacement) methods in Finland and provides validation expertise on in vitro methods e.g. performs validations for ECVAM (European Centre for Validation of Alternative Methods, European Commission).

The Institute of Medical Technology, IMT (www.uta.fi/imt) is currently led by Prof. Olli Silvenoinen. The research programmes in IMT cover two broad areas, namely molecular genetics of human disease, and molecular mechanisms of immune responses and disorders. IMT is part of Biocenter Finland.

University of Tampere

- **Regea**: Institute for Regenerative Medicine
- **IMT**: Institute of Medical Technology
- **Ficam**: Finnish Centre for Alternative Methods

FinTiB: Research Tissue Bank Finland

SILK: Research, Product Development and Innovation Centre of Ophthalmology

Vactia: Vaccine, inflammation and immune disease research and product development centre

Sensor Technology
www.ase.tut.fi/sensor

Prof. Jukka Lekkala
received his M.Sc. in Electronics and D.Tech. in Biomedical Engineering from Tampere University of Technology (TUT), Finland, in 1979 and 1984, respectively. In 1985, he joined the Medical Engineering Laboratory of the Technical Research Centre of Finland (VTT). From 1993 he worked as a group manager at the VTT in Chemical Technology, Automation Technology and Information Technology research institutes. Since 2002, he has been working as a professor of Automation Technology at the Department of Automation Science and Engineering (previously Institute of Measurement and Information Technology) of the Tampere University of Technology.

Research Interests
Instrumentation, biosensors and microsensors, sensor materials and modeling

Molecular Sensors
www.vtt.fi

Adj. prof. Kirsi Tappura
received her M.Sc. and D.Sc. (Tech.) degrees in technical physics from TUT in 1990 and 1993, respectively. After employment with Nokia Research Center, in 1997 she joined VTT. Currently, she leads the Molecular Sensors team at VTT with the research concentrating on sensing methods and devices, including transducer modelling and molecular simulations.

Publications, Patents
Dr. Tappura is an Adjunct Professor in physics and has about 50 peer reviewed international scientific publications. She has also contributed to several patent applications with three patents presently in force.

Research Interests
Sensor physics, molecular sensors, transducer technology (incl. MEMS, surface-enhanced fluorescence detection, SPR), modelling of sensor devices, materials and coatings, molecular simulations, synthetic receptors.

Biomedical Engineering
www.tut.fi/bme

Prof. Jari Hyttinen
received his MSc and PhD degrees from TUT in 1986 and 1994, respectively. Currently he is the Director of the Department of Biomedical Engineering (TUT). He is former chairman and current member of the board of the Finnish Society of Medical Physics and Biomedical Engineering (affiliate of the IFMBE). He is a member of the general counsel of the European Alliance for Medical and Biological Engineering & Sciences.

Publications, Patents, Spin-offs
He is an author or co-author in more than 50 international peer reviewed journal articles, and 70 other international peer reviewed articles and about 100 other articles. He is inventor or co inventor in several patents and patent applications that are on progress. He is a co-founder of one spin-off company.

Research Interests
Bioelectric phenomena, measurement, imaging and modeling of physiological and biological systems, especially in applications in heath care and tissue engineering.

Micro- and Nanosystem Technology
www.ase.tut.fi/mst/home

Prof. Pasi Kallio
received his MSc degree in electrical engineering and a PhD degree in automation from TUT in 1994 and in 2002, respectively. He is the head of a Micro- and Nanosystems group (MST) in the Department of Automation Science and Engineering (TUT).

Awards
The MST group has been honored the Finnish Automation Award in 2009 and a regional Academic Idea Contest in 2004.

Publications, Patents, Spin-offs
Since its start in 2000, the research work has resulted in more than 50 internationally refereed articles, 10 national and international patent applications and one spin-off company.

Research Interests
Microfluidics, micro- and nanorobotics and active actuator materials, and their application in the development of automatic systems for cell and tissue engineering and point-of-care diagnostics

Embedded Industrial Solutions
www.vtt.fi

Res. Prof. Jouko Viitanen
received his PhD in Technology in 1990 from TUT, and has served as the Research professor in machine vision at VTT since 1991. He has extensive national and international experience in basic research, R&D, teaching, consulting and project management.

Publications, Patents, Spin-offs
He has over 50 publications in the areas of machine vision, computer/VLSI architecture, photogrammetry using computer vision, pattern recognition, telerobotics, manipulator control, mobile robotics, and microtechnology. He holds several patents and patent applications and co-founded a spin-off company producing image analysis systems for cell biology.

Research interests
Microscopy, photonics, cell biology, laser applications.

Biosensors and Gene Technology
www.tut.fi/keb

Prof. Matti Karp
focuses on biotechnology research in the Department of Chemistry and Bioengineering (TUT) since 2004. He is the head of Master's degree program in biotechnology and of International master's degree program in Science and Bioengineering. His scientific career started at the Department of Biochemistry, University of Turku (UTU) in the early eighties. He received his PhD degree from UTU in 1988 and has been a docent in biotechnology since 1990 at UTU.

Publications
He is an author or co-author of more than 130 referee practice publications in biosensing alone and is ranked the 5th most-cited researcher at the TUT in 2006.

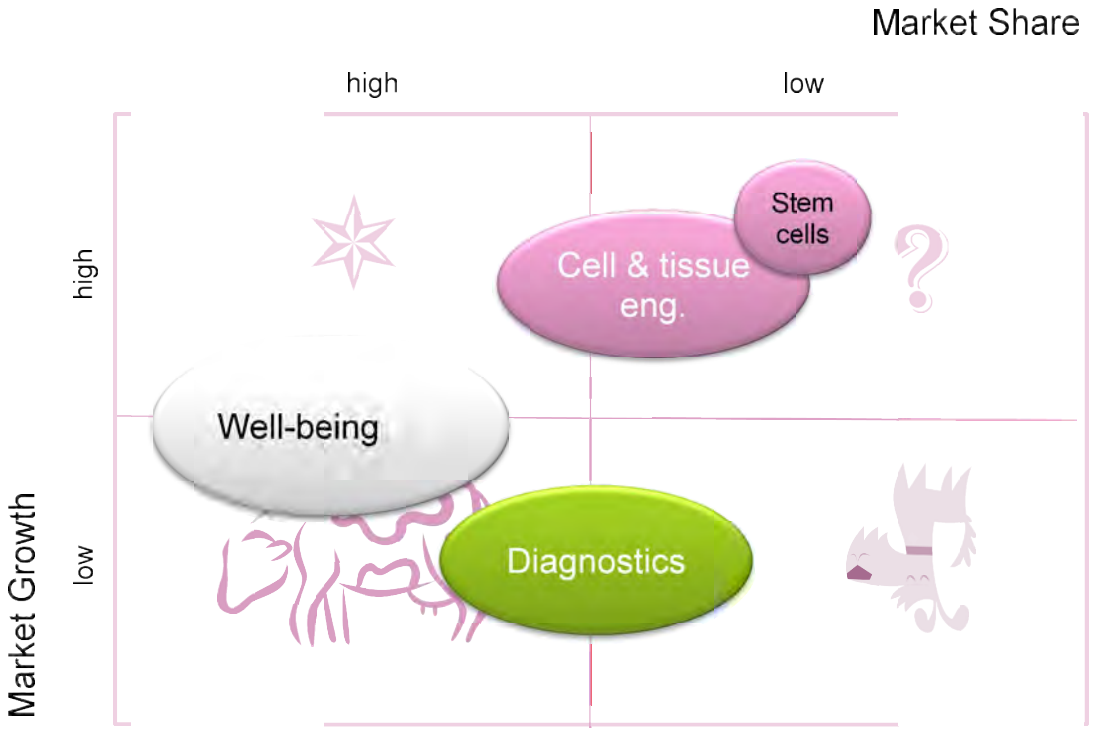
Research interests
Biotechnological applications of genetically modified microorganisms as well as diagnostic approaches utilizing molecular biotechnology tools.

4. Application Areas

At first, all application areas of biosensing were considered. The major areas of research in Tampere were identified and marketed as:

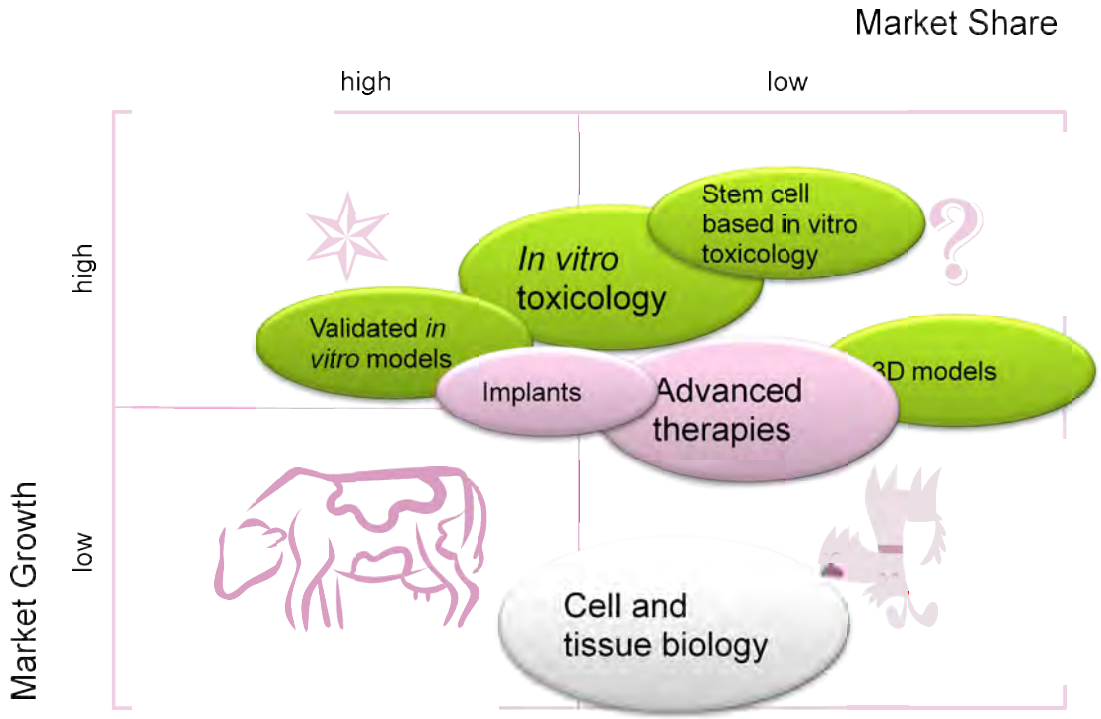
- **Tools for cell and tissue engineering incl. tools for stem cell research**
- Pharma: tools for high content screening in drug discovery
- Diagnostics: Molecular recognition, Biosensors for rapid testing, Point-of-care devices incl. microfluidics
- Well-being: Wearable wireless monitoring, Implantable wireless monitoring
- Food and environmental monitoring: Genetic engineering

An internal evaluation of the areas in the international context was performed and cell and tissue engineering distinguished clearly. Tampere has become a unique region for cell and tissue engineering. There are nationally and internationally renowned institutes such as Institute for Regenerative Medicine (Regea), Finnish Centre for Alternative Methods (Ficam), Research Tissue Bank Finland (FinTiB), Research, Product Development and Innovation Centre of Ophthalmology (SILK) and others present and coming. Abroad, such institutes would be spread around the country and co-operation among them would not be as tight as we have here.



The groups within BCC serve these institutes as a technology solution provider through a number of projects since 1994. BCC investments have enabled break-through innovations, which are expected to result in a business. Generally, this is an application area with the highest potential to become a “star,” provided that it will get sufficient support for laboratories and staff acquisitions. It is crucial to further strengthen the technology know-how and avoid this regional focus from breaking up.

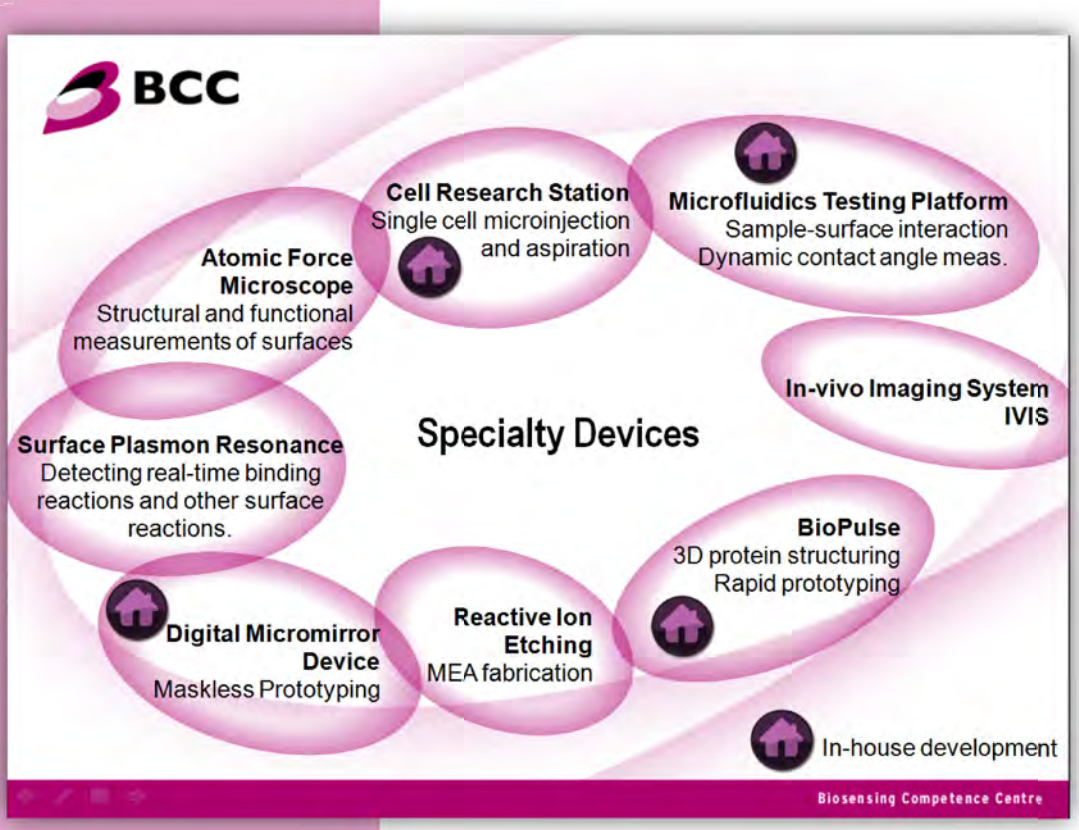
The cell and tissue engineering applications can be further broken down and roughly divided into *in vivo* applications, such as those resulting in personalized treatments, and *in vitro* applications, such as those targeting personalized diagnostics and toxicology. These markets were further evaluated based on know-how of our life science experts as well as based on strategy plans and policies of EU.



5. Infrastructure

The key parts of the biosensing infrastructure acquired within BCC were a reactive ion etching unit (Section 5.1) and an atomic force microscope (Section 5.2). They account to 31 % of the total expenditure. The future acquisitions necessary for a successful formation of MediTech were evaluated and a proposal was submitted to the Academy of Finland (Section 5.3).

A number of **specialty devices** are available within the research groups (see below). All acquisitions as well as in-house developments can be found in the list of core facilities available at www.cofa.uta.fi.



5.1. Reactive Ion Etching (RIE)

Advanced Vacuum Vision 320 Mk II RIE device was acquired together with a gas station. The device is primarily used in fabrication of microstructures, such as those used in biosensors, microactuators or microfluidics. One of the recent applications is manufacturing of microelectrode arrays (MEAs) for the use in stem cell characterization.

The RIE device is currently located within the clean-room of the Department of Automation Science and Engineering of TUT, Sähkötalo, Korkeakoulunkatu 3, Tampere. The responsible person is Tomi Ryynänen (tomi.ryynanen@tut.fi).

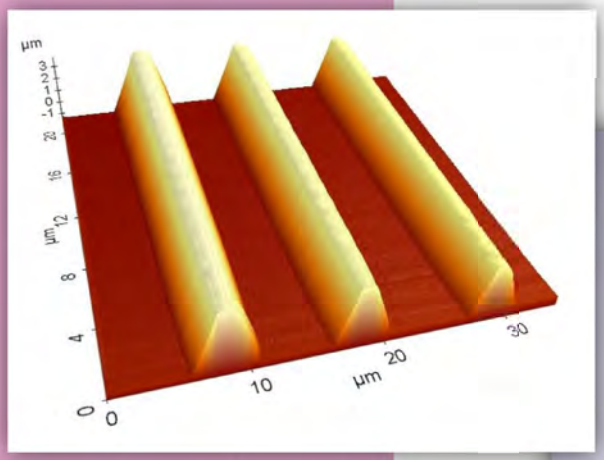
Photo of the device: Advanced Vacuum Scandinavia AB

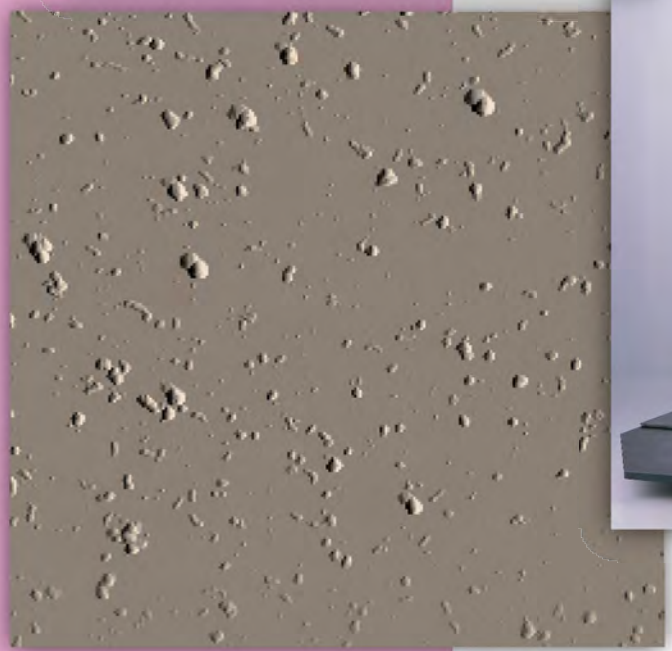
5.2. AFM

The XE-100 Complete Atomic Force Microscopy System scored the best against the needs of the BCC groups. After installation, a training and a public seminar were arranged to assist the adoption of the research tool to an active research use. The main user groups utilize it in research of novel materials and coatings as well as microstructures. There is a large user group within the life science sector interested in investigations of cells and cell-to-surface interactions. Such use requires further training and the enabled research is already incorporated in several European project proposals.

The AFM device is currently located within the biomaterial laboratories of the Department of Biomedical Engineering of TUT, Hermiankatu 12A, Tampere. The responsible person is Mika Pelto (mika.pelto@tut.fi).

Photo of the device: Park Systems Inc





5.3. Facilities

BCC has initiated and assisted the evaluation of infrastructure needs for MediTech-initiative. The preparations involved BME and ASE on the technological side and Regea and Ficam on the life science side. A wider evaluation including Institute of Medical Technology (UTA), Department of Signal Processing (TUT), Department of Chemistry and Bioengineering (KEB) and VTT is needed in order to cover all MediTech areas of research.

Currently, within forming MediTech, there is a large number of laboratories scattered around two campuses in more than six locations. The unification of the fragmented infrastructure has been identified as one of the keys to improved scientific efficiency that at the same time strengthens our ongoing collaboration and cross-fertilizes the interdisciplinary of the research. In the next paragraphs, the existing infrastructure is shortly introduced. A detailed list of local biotech instrumentation can be found in a database of core facilities (http://cofa.uta.fi/). A list of biomaterial processing and testing facilities at TUT can be found within http://www.tut.fi/bme.

TUT BME (www.tut.fi/bme). The Department of Biomedical Engineering provides laboratories and a clean-room for biomedical measurements and imaging as well as biomaterials and TE research. The current facilities include state-of-the-art processing of biomaterials, such as extrusion and melt spinning, braiding and knitting, compression molding, glass fiber spinning, freeze-drying, ultrasonic welding as well as material preparation techniques, and testing and analysis of biomaterials, such as mechanical testing (Instron 4411), thermal analysis (differential scanning calorimeter, thermogravimetric analysis), material-release analysis (UV/Vis spectrometer) and chromatography (gel permeation chromatography) as well as clinical micro CT instrumentation reaching below 80 micron resolution with objects of dm scale and Park XE-100 atomic force microscope. BME offers entire range of bioelectric instrumentation from body surface (256 channel EEG/ECG system) and bioimpedance spectroscopy to ion channel level by the the state of the art biomimetic laboratory that is build in collaboration with Regea.

Need for common infrastructure

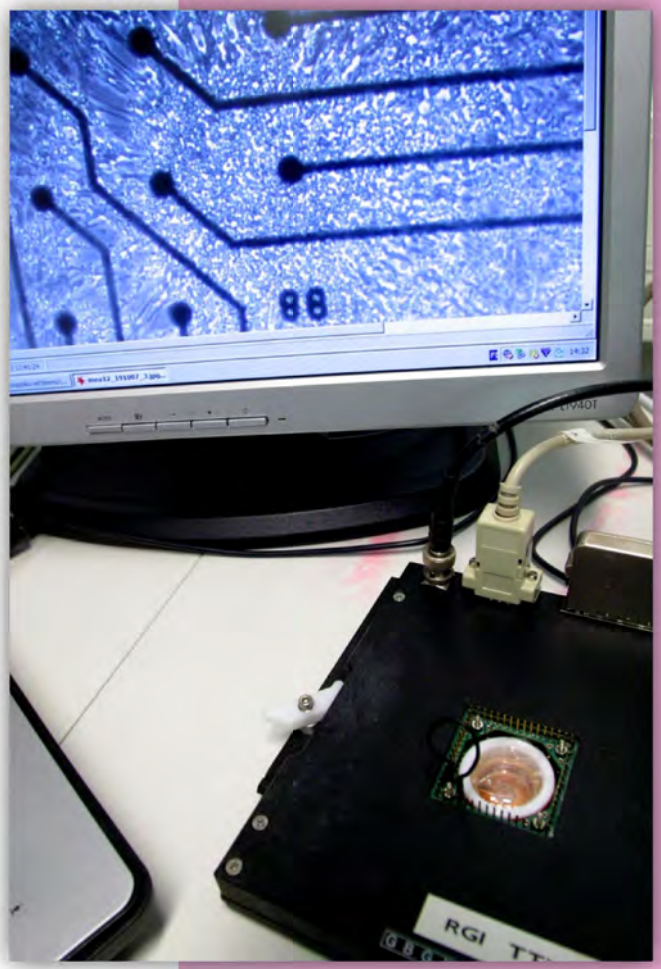
Unification of the fragmented infrastructure has been identified as one of the keys

- to improved efficiency
- to stronger multi-disciplinary collaboration as well as
- to cross-fertilization between different science fields

List of core bio facilities

http://cofa.uta.fi/

Biomaterial processing and testing facilities:
http://www.tut.fi/bme



TUT ASE (www.ase.tut.fi). The facilities of the Department of Automation Science and Engineering include infrastructure for the research and development of microsensors, biosensors, microfluidics and microrobotic systems, including a 22 m^2 clean room (class ISO7), photolithography facility with a mask aligner, an exposure device for rapid prototyping based on Digital Light Processing projector , Advanced Vacuum Vision 320 Mk II Reactive Ion Etcher (RIE) and analysis facilities with microscopes, and microprobes. A sensor testing station with commercial reference sensors and accurate computer control for adjusting pH and pO_2 is under development. For the microfluidics research, there is equipment for characterizing microchannel flows and soft lithography facilities for rapid prototyping. The instrumentation also includes a multi-plate time resolved fluorescence reader, an optical fluorescent microscope and two microrobotic stations: one for cell biology applications and another for assembling and handling microscopic mechanical, electrical and optical components.

UTA Regea (www.regea.fi). The institute has newly built cell culture and research laboratories (430 m^2), and a high class GMP facility designed for stem cell therapies with clean rooms (250 m^2). In addition to modern molecular biology equipments (PCR, qRT-PCR, sequencing, western-blotting, fluorescent microscopes etc.), state-of-the-art research equipments: Cell-IQ, a continuous cell culturing platform and a brand new state-of-the-art biomimetic laboratory that is established in collaboration with TUT/BME including multi electrode array (MEA) system, dual patch clamp and fast fluorescence imaging system, and FACSaria high performance flow cytometry cell sorter exist in Regea.

UTA Ficam (www.ficam.fi). The centre has complete cell and molecular biology facilities and technological platforms such as cell IQ imaging, fluorescent microscopy, FACS, advanced photometer/fluorometer/luminometer and PCR. FICAM has GLP-compliant (Good Laboratory Practice) and level-2 safety laboratories for validations and viral experiments, respectively. Europe has only a few similar high standard laboratories.

VTT (www.vtt.fi) The sensor research facilities of the VTT Molecular Sensors team include physics/optics and chemistry laboratories (incl. spectrum/network analyzers, proper station, surface Plasmon resonance devices, fluorescence measurement system, spectrophotometers, HPLC, HPLC/MS, etc.) as well as an electronics workshop and a small clean room (40.5 m^2 including a sputter coater, plasma CVD apparatus, ink-jet dispensing system, spin coater, etc.) for surface and device preparation.

VTT Machine vision laboratory includes equipment for microscopy image capture and analysis: Two-photon laser scanning microscope built over the Nikon ME600 body, capable for 3D two-photon polymerization or microscopy with pulse lasers in 532nm and 1064nm. Optical Cherence Tomography (OCT) setup for tissue or materials characterization. Fluorescence microscopy with cooled Diagnostic Instruments SPOT RT3 megapixel camera. Microscopy automation software based on Beckhoff EtherCAT real-time automation software and hardware. Image analysis and pattern recognition from microscopy imagery with proprietary software components.

6. Services

The scope of services provided by BCC has changed over the years. From the first survey to the last analysis of multi-institutional international expert organizations in life sciences, BCC served its groups in accordance with the goals provided by the steering group. The success was measured in a questionnaire to BCC core groups and stakeholders as well as with a BCC imago survey (stakeholders and customers) conducted within a marketing course of TUT. This chapter provides an overview of the main services.

6.1. Funding assistance

BCC has assisted both companies and core groups to find a suitable funding instrument for their co-operation. Some of the project negotiations and proposals that BCC participated in are summarized here:

EU projects:

- EU COST Open: Emerging tools and methods for in vitro characterization, quality control and safety of human stem cell derived cardiac cells and tissues; 12 partners (stem cell research and microsystems); Co-ordinator.
- HEALTH.2010.4.2.9-2: 3D-liver and barrier function-simulating cellular devices and platforms for long-term toxicity testing strategies of chemical substances (MODERET); IP; 15 partners; 10 MEUR budget; 2nd co-ordinator
- FP7-ICT-2009-5: Integrated Smart Microinstruments for Automated Cell Manipulation and Analysis (CELL-ISM); STREP; 8 partners; 2nd co-ordinator
- FP7-2010-NMP-ICT-FoF: Agile two-photon polymerisation manufacturing (A2PP); minor contribution
- EU HEALTH 2010 and IMI: Negotiations with international companies. Co-ordinator.

Tekes:

- Pharma Program: Cell Network Assays for High-Throughput Long Term Studies; 1 MEUR budget; Co-ordinator.
- Finnish National Biobank: 3 MEUR budget; 2nd co-ordinator.
- BioNavis: Co-ordinator.
- NokiAreena Living Lab: Co-ordinating the negotiations between Nokiareena Oy and research groups.
- GeBioS: Generic Biosensor System; 0.5 MEUR budget; Co-ordinator.
- New Methods for Ambulatory Multisensor Monitoring of Cardiovascular System; 0.5 MEUR budget; Co-ordinator.

European Regional Development Fund:

- 2010: MediTech development; 1 MEUR budget; 2nd co-ordinator.

The Academy of Finland:

- FIRI 2010: MediTech Infrastructure; 1,2 MEUR budget; Co-ordinator.

6.2. Technology protection

An internal event "Young Scientist' Day" was established to help to identify possible IPR. A number of innovations were identified, documented and evaluated internally.

Several of the innovations were further evaluated in terms of IPR using an external patent expert service. One of the innovations was also further evaluated with a customer-based market survey, which was conducted within a marketing course of TUT. One patent was filed and a few others are under preparations.

A new approach for evaluating innovations and proposals, based on a training by Standford Research Institute, was evaluated. Such common evaluation platform requires a mutual agreement within universities, VTT and other possible players. The actual organization of the evaluation events can be also outsourced to FinnMedi Oy, for instance, in order to ensure equality.

6.3. Industrial networking

BCC has participated in a number of national and international events. Most notably Medica, Bio International Convention, BioPartnering Europe and EU HEALTH Brokerage Day. All these events have generated a vast number of contacts, which further continued in negotiations towards co-operation or project preparations. A regional visit to San Francisco bay has been organized and also several smaller European visits to research centers and industry.

BCC has updated its image, which has received a very positive feed-back from the clients. The marketing set includes:

- Powerpoint presentations – BCC Overview, BCC Diagnostics and BCC Cell and Tissue Engineering
- Website **www.biosensing.fi**
- A4 technology leaflets: BCC Overview, BCC Diagnostics and BCC Cell and Tissue Engineering, NokiAreena Living Lab, Microfluidic Chip Characterization System
- Roll-up

The website and BCC imago were further evaluated in a survey conducted amongst stakeholders and customers (both national and international).

BCC has organized a number of events including a Tampere roadshow (in conncetion with Histola Oy and FinnMedi Oy) in Kuopio, Turku and Helsinki. Also several direct events between an industrial partner and pre-selected BCC groups took place in Tampere as well as UK and Sweden. BCC participated actively in preparations of a regional REACT event, which facilitates inter-institutional networking as well as industrial partnering.

6.4. Internal networking

BCC has organized several internal events to promote understanding of regional know-how and to foster tighter collaboration. The most important events were the BCC Lab tours, where scientists visited a number of laboratories and had an insight on ongoing research; BCC Young Scientist Day, for identification of innovations as well as for networking and BCC Visionary Day, which has brought experts from life sciences and their current research bottlenecks and BCC experts to envision technological solutions, which were further evaluated.

Other events included AFM training and seminar, REACT event or Tissue Engineering Symposium.

6.5. Early stage funding

BCC has dedicated almost 115,000 EUR for commercialization projects, which resulted in one patent and one patent application, one Tekes project and one Tekes application, one Academy of Finland application, one applicability survey and one proof-of-concept device used at UTA/Regea. Such type of funding is not available in Finland otherwise very easily.

Typically, academic research results are scanned for commercial purposes at the end of each project, while it should happen when the process starts with an idea that is first tested for commercial purposes and then funded for proof-of-concept. If we consider 3-stage development, then we can see that innovation ideas are likely to get to the first stage with TULI program of Tekes or patent funding by VTT or TUT. The bottle-neck is in the next stage – proof-of-concept, which can be to a limited extent funded by each group's overhead. The final stage – spin-off launch – is then assisted by VTT Ventures, TUT's (YritysTalli) and other programs (VentureCup).

7. Future in MediTech

In the second BCC project, a tremendous amount of effort was focused on the development of MediTech-initiative.

The goal of newly forming MediTech-initiative is to build a large and nationally unique multidisciplinary collaboration by strengthening the existing joint-projects, catalyzing novel co-operation, and enabling formation of a common strategy for development technologies and methods towards personalized therapy and diagnostics

The TUT core groups of BCC are also taking part in the preparations for MediTech-initiative joined by the partner institutions at UTA. The VTT role in MediTech will be defined after reaching a consensus between the universities. MediTech builds on the BCC know-how acquired over the funding period and further strengthens the interdisciplinarity.

List of Abbreviations

ASE	Dept of Automation Science and Engineering, TUT
BioneXt	BioneXt Tampere program
BCC	**Biosensing Competence Centre**
BME	Dept of Biomedical Engineering, TUT
COO	Chief Operating Officer
CRS	Chief Research Scientist
CSO	Chief Scientific Officer
CTR	Council of Tampere region
ELY	Centre for Economic Development, Transport and the Environment
ERDF	European Regional Development Fund
FinnMedi	FinnMedi Oy (previously Finn-Medi Research Ltd / Finn-Medi Tutkimus Oy)
SGN	Dept of Signal Processing, TUT
Tekes	Finnish Funding Agency for Technology and Innovation
TUT	Tampere University of Technology
UTA	University of Tampere
VTT	Technical Research Centre of Finland

Appendices

- BCC – focus on business model, 2008, Olli Öster
- Generic operational model, 2010, Kari Salomaa / FinnMedi Oy
- Leaflets: Diagnostics, Services, Cell and Tissue, NokiAreena, Microfluidic Chip Characterization System
- Presentations: Overview, Diagnostics, Services
- BCC Imago Analysis, 2010, Terhi Marttila, Riikka Saarenpää, Aino Vaittinen / TUT

- TULI-Biosensing Factory, 2007, Rami Lehtinen / RL-Tutkimus Oy, confidential
- Quick market view, 2009, Johana Kuncova-Kallio / BCC, confidential
- BCC Strategy, Background overview, 2009, Johana Kuncova-Kallio / BCC, confidential
- BCC Stakeholder opinions on BCC, 2009, Johana Kuncova-Kallio / BCC, confidential