

**Biomedical Development in Western Sweden 2005 - 2007**  
Report to VINNOVA  
December 15 2007

## **Summary of Important Results and Milestones**

Biomedical Development in Western Sweden, BMV, is a ten year development process started in February 2005. Processes and projects have been started during these first three years in accordance with the approved plan, and the following milestones have been reached:

- three of the collaborative projects within the field of biomaterials and cell therapy have produced results that have been published in peer-reviewed journals and presented at scientific conferences
- one international scientific conference has been organized within the field of biomaterials and regenerative medicine
- a total of 17 innovation projects within the area of cardiovascular and metabolic sciences have received support from BMV and were able to leverage this support into a total of 26 MSEK in additional grants and investments from national and international funding agencies and investors
- 23 students graduated from the first International Masters Program dedicated to business development within the area of biomedicine and a third group of students were admitted to the program in the autumn of 2007
- the incubator at Sahlgrenska Science Park has expanded and presently 6 companies and > 20 projects are supported
- the science park at Sahlgrenska Science Park has expanded to the level where additional space was constructed in 2007
- profiling activities and participation at 9 national and international conventions and exhibitions
- close to 1000 persons have participated in 13 seminars to build networks in the region
- the follow-up research program has contributed with one chapter in a book about the development of the VINNVÄXT program

In addition the BMV process has contributed to making key decision makers in the Göteborg region aware of the importance of biomedicine to the regional development, spurring increased attention and new programs both in collaboration among various actors and within their respective organizations. Furthermore the experimental nature of the process has enabled testing of an approach for support to early validation and verification that has inspired other programs in the region. An indirect effect is visible in the improved entrepreneurial climate, as is evidenced by the increased proportion of bioscience projects in the portfolios of the schools of entrepreneurship and in the activities of early stage start up companies, and also in the increased interest in spinning out projects from established companies.

## **Introduction and Background**

Biomedical Development in Western Sweden, BMV, is a process to develop cooperation among national and regional actors, aiming to improve and strengthen the foundations for sustainable growth in the region within the field of biomedicine, by turning world class academic research into innovations in industry and health care.

The BMV process has four focal areas:

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- strengthen the commercial outcome from research and development in the Göteborg region's two profile areas; biomaterials and cell therapy and cardiovascular and metabolic science
- educate and train future leaders for advanced business creation within the biomedical field
- strengthen and improve infrastructure for commercialization within the biomedical field
- attract highly qualified and competent individuals and capital to biomedicine in the Göteborg region

Principals for BMV are AstraZeneca, Business Region Göteborg, Chalmers University of Technology, DOXA AB, Göteborg University, Innovationsbron Väst, Mölnlycke Health Care, Nobel Biocare and Region Västra Götaland. Financial and operational support is received from VINNOVA through the VINNVÄXT program.

As a service to non-Swedish readers a list and description of abbreviations and names of organizations are collected in Appendix 1.

The strategic concept for BMV is to create structure and develop tools, platforms and processes to bring world class academic research into innovations in industry and to implementation in health care. Actors from academia, industry, the public sector and health care work jointly in a Triple Helix set up to effectively improve the processes in the innovation system.

An additional aim of the process is to focus attention on the biomedical field in the region, and to inspire different actors, companies and organizations to collaborate to strengthen the field.

Some of the actions are of a general nature. They are intended to change working procedures and to be useful for innovation support throughout the whole biomedical field. Others are intended to strengthen and develop innovation support with a focus on the two areas in the region where there are established fields of strengths both industrially and academically, biomaterials/cell therapy and cardiovascular/metabolic science, respectively. Since the industrial structure and the historical evolution of the two fields are different, BMV is testing different approaches. The aim is to have learning processes within the innovation system that will be useful across the various sub fields of biomedicine and the biomedical industry, as well as for other regions. To enable the dissemination of these experiences there is a subproject for interactive research on the BMV process and the innovation system.

The vision of BMV is that the Göteborg region in the year 2015 shall be perceived as one of Europe's most innovative and expanding regions for industrial development and evidence based application of new knowledge and innovations in the field of biomedicine. There shall be transparent and measurable effects on employment in industry and on the quality of health care. These effects shall be manifested through significant new investments, collaborative projects and grants from new national and international partners.

BMV is operationally divided into a number of sub processes:

- 1. Develop and strengthen need driven research and development within two areas of international strength:**

Biomaterials and Cell Therapy (IBCT)

Improve the links between industry and academia by creating a new inter-disciplinary institute for biomaterials and cell therapy

Cardiovascular and Metabolic Science (CVM)

Develop and improve mechanisms to bring academic research into commercial innovations

**2. Attract qualified and competent persons and investment capital to the region**

Increased internal and external communication, marketing and net working through the sub process Communication and Visibility

**3. Increase the availability of trained leaders for advanced business creation for biomedicine**

Develop and establish "Göteborg International Bioscience Business School" (GIBBS)

**4. Strengthen and develop the infra structure for commercialization within the field of biomedicine**

Establish an incubator for biomedicine

**5. Develop a process for efficient learning within the innovation system**

Initiate interactive research on the BMV process and the innovation system

## **Aim and Objectives**

The overall aim of the BMV process is to create conditions for sustainable growth in the field of biomedicine in the region, based on internationally competitive research and industry

For the first period the goals were expressed as the following descriptive indicators.

We expect that the first projects in GIBBS have reached a stage where they attract significant VC investments, and that CVM and IBCT have contributed to development of ideas and strategic tools for development within the cardiovascular/metabolic field and the field of biomaterials, respectively.

The flow of non-Swedish students has increased.

The large established companies find it easier to attract internationally competitive specialists, and their researchers participate on a regular basis in research projects at the universities, hence increasing the access to specialized networks and improving mobility between industry and academia. Additional pharma projects, based on ideas from researchers in the region, have consequently been started at AstraZeneca. Spin out projects have led to a number of new companies.

The incubator activities have identified and cultivated around 10 projects which have resulted in new companies started at Sahlgrenska Science Park.

Access to seed capital is sufficient for projects with good potential..

The region is recognized nationally and internationally as very dynamic and growing strongly.

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Within the universities a concentration has taken place resulting in an increased amount of research funds from national and international programs,

Methods and processes for cardiovascular diseases have been coordinated, reducing costs for the regional health care system.

### **Results Achieved in the Area of Biomaterials and Cell Therapy**

An institute for research in the area of biomaterials and cell therapy (IBCT) is under development. IBCT has strong connections with the comprehensive research efforts in the Göteborg region, e.g. at the Sahlgrenska Academy at Göteborg University, Chalmers University of Technology and other actors regarding biomaterials and regenerative medicine, and associated technologies.

During the period 2005-2007 the institute has focussed on the first of its two main tasks, i.e. to initiate and run internationally competitive research projects in the area of biomaterials and cell therapy. The four projects have been directed towards innovative methods for analysis and characterization of new biomaterials, and evaluation of biological and clinical functionalities.

Due to constraints in resources, IBCT has not emphasised the second main task during these three years, i.e. to be the node in a comprehensive network comprised of competences in the areas of biology, engineering and other critical areas. The network as a whole is intended to have a profile adapted to the needs of small and medium size enterprises (SMEs), active in the area of biomaterials and cell therapy.

#### *Research Projects*

During the period 2005-2007, four research projects (“Alpha”, “Beta”, “Gamma” and “Delta”) have been initiated and developed in collaboration with larger companies and SMEs. Projects Alpha and Beta are devoted to the development of analytical methods of profound importance for the understanding of the complicated interaction mechanisms between artificial material and living tissue. To be more specific, project Alpha supports and helps develop understanding of the extremely complicated healing processes taking place when an implant is inserted into living tissue. In project Beta a method has been developed, giving extremely detailed pictures of the interface zone between implant and tissue when the implant has been in place for a time exceeding the healing period. The knowledge of the interaction between tissue and artificial material, which can be achieved with these methods, are of profound importance for basic research as well as for implant companies like e.g. Nobel Biocare.

The scientific results have been published in peer reviewed journals and presented at a number of conferences. In addition, one PhD student has graduated during the period, and one PhD student will graduate in spring 2008.

Already during this initial three year period, a considerable interest has been demonstrated from several companies to investigate the basic interaction mechanisms of their products with the pertinent surrounding tissue, using the methods developed in the Alpha and Beta research projects. This interest represents a considerable source of future income for IBCT, which already has resulted in performed and payed tasks and a number of ongoing quotation processes.

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Project Gamma is of a somewhat different nature, where the potential of a recently developed CO<sub>2</sub> sensor is investigated for indications outside its original intended use. The project will be finalized during 2008.

Project Delta represents an effort to develop *in vitro* models for the study of interactions between soft tissue and medical devices, initially to be used in the study of healing processes for chronic wounds and for the study of the interaction between soft tissue (skin) and implants.

The research area in this project is less mature than those for projects Alpha and Beta, and thus represents a profound scientific challenge. However, the commercial impact is tremendous, keeping in mind a number of severe clinical complications associated with soft tissue medical devices (e.g. soft tissue penetrating connections). Achievements within this project are thus expected to have a considerable importance for IBCT, also on a commercial level.

### *Offer to Small and Medium Size Enterprises*

As mentioned above, IBCT has during the period 2005-2007 not been able to put resources into the second main task, i.e. to be the node in a comprehensive network comprised of competences in important areas like e.g. biology and engineering.

However, the need for a resource corresponding to this second task has been confirmed in an investigation among medical device SMEs in the Göteborg region. The limited financial capacity of these SMEs makes it necessary to find solutions where their needs for support are handled in cost effective ways.

#### **Defined targets 2005- 2007**

Establish IBCT operationally and as a brand name for biomaterials in the region

Establish a research program in cooperation with industrial partners to rejuvenate the regional support to biomaterials industry

Organize and conduct a number a research projects in collaboration with industrial and academic partners

Establish an attractive commercial offer from IBCT to established industry both inside and outside the region

Create an attractive offer to SMEs

Participate in and organize international scientific and industrial conferences

#### **Achieved:**

IBCT has been in operation as a project since mid 2005. A review of suitable legal structure will be reported to the BMV board Q1 2008.

A research program was established with three core projects; Alpha, Beta and Gamma.

Alpha and Beta have delivered both scientific output and methods that are being offered to industry, and early adopters have placed orders

Alpha and Beta have delivered both scientific output and methods that are being offered to industry, and early adopters have placed orders

A study has been performed but resource constraints have led to postponed implementation

One international conference was held in Göteborg 2006, and several papers and abstracts have been given

### **Results Achieved in the Area of Cardiovascular and Metabolic Science**

The overriding target for BMV, and thus for CVM, is to create and strengthen competitiveness and business opportunities for existing and new companies and to develop methods and quality in the regional health care system. This shall be achieved by catalyzing and supporting collaboration among the various parties, and through increased visibility of current projects and already existing competences in the region. In order to achieve these aims and to identify

opportunities in the cardiovascular and metabolic field a steering group of senior researchers and business executives was formed in early 2005.

The first outcome of this work was creation of a widened understanding of what activities are ongoing in different parts of the region within the CVM field. The second outcome was the identification of the most crucial gaps within the innovation system; knowledge and competence in the fields of business, project management, and regulatory affairs, followed by the lack of funding for project verification. This latter element has since been addressed by the establishment of special programs from several of the actors in the system. As a consequence CVM has adopted an industrial type of project management process with focus on commercial verification of scientific results to complement these programs. This process is built on the following criteria:

- Agreed business model and commercial value of the product,
- Detailed project plan clearly identifying value increasing steps
- Agreed project contract on how to reach the next value step
- Financial support to perform necessary activities

In order to test the ideas CVM issued a call for proposals in June 2005 for projects with research funding in place, and where the potential of commercial interest would be tested. Eight projects applied and six projects were selected for management and financial support after evaluation by a separate panel composed of individuals with scientific and business/financial competence and recruited outside the region. The steering group and project management of CVM acted as management and competence support while most projects delivered according to expectations, as specified in the individual contracts established for each one of them. The CVM project office had continuous interaction with the projects and made quarterly progress reviews as a basis for decisions on continued support, since the grant contracts had milestone achievements as conditions for payments. For some projects the discussions and reviews were intense and sometimes difficult, and tough decisions were made in some cases concerning both content and strategy and also on management and manning issues.

Some important achievements were receipt of significant financial support from VINNOVA and grants from the EU, winning prizes in international competition for business plans, and filing of patents. The commercial targets were more difficult to reach than the purely financial or technical.

Based on the good experiences from 2005/06 a new call was announced in June 2006. 11 applications were received and 6 projects were selected for support (3 new and 3 from the previous year). Based on the earlier experiences more focus was put on the initial strategic analysis and planning together with the companies, and also to secure that world class competence would be available to the projects when necessary. The achievements were similar to the previous round. Several of the projects have also been able to successfully apply for further verification grants, either from Innovationsbron or from VINNOVA.

In June 2007 a new call was issued for 2008, which resulted in four applications of good quality.

Based on the realization that many projects need technological as well as biological and medical competences, and that currently there is a lack of arenas where these interact, a discussion was initiated in late 2006 on how to increase output of commercial projects from Sahlgrenska Academy, the Sahlgrenska University Hospital and Chalmers. A seminar on this

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topic was held in March of 2007, with a total of 80 attendees. A demand for closer collaboration between academia and the health care system was expressed, especially the need for innovations in order to increase efficiency. A taskforce is now working on activities for 2008 to support collaboration and projects at the Sahlgrenska University Hospital involving researchers from the medical and technical fields.

The Sahlgrenska Center of Cardiovascular and Metabolic Research, CMR, was set up at Sahlgrenska Academy in late 2005 with support from The Swedish Foundation for Strategic Research, SSF. It includes twelve research groups with a total of almost 100 persons focusing on highly competitive research projects in this area. In order to increase awareness and strengthen opportunities for commercialization, the board of the center and CVM initiated a thorough commercial evaluation during 2007. The evaluation identified five projects with an interesting potential of which 3 have been or presently are supported by the CVM network.

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### Defined targets 2005- 2007

Initiate and support projects with commercial potential with at least 2 different parties from different organizations.

Move at least 10 projects in the value chain

Charting of regional resources and opportunities within the CVM segment

Increased collaboration between different organizations, companies, universities in the region

Common vision and process for how to increase the output of products and services from research.

Collaboration with the Center for Cardiovascular and Metabolic Research

### Achieved:

17 projects have been managed and supported during the three years and 12 of them have reached their targets.

Partly performed. Within Sahlgrenska University access has been given and a good understanding has been reached. Within Chalmers and VGR there is still work to be done.

Several activities have been performed and it is much easier now to discuss and arrange collaborative activities related the CVM segment. Furthermore the steering group has a good overview of strategic work and ongoing activities which make it easier to initiate collaborations.

Within BMV and the CVM steering group there is acceptance of the model developed within CVM. However work still has to be done to fully anchor the process on the board level for BMV and the universities

Commercial evaluation of all potential projects done with former senior researchers from AstraZeneca. End product report to the CRM board recommending actions in 5 projects of which 3 are supported today from CVM.

## Results Achieved in the Area of Education for Entrepreneurship and Business Creation

Göteborg International Bioscience Business School, GIBBS is today established as a master level education program, designed to develop entrepreneurial individuals capable of leading development of tomorrow's innovations in the bioscience and biomedical areas. It is managed by the Centre of Intellectual Property Studies (CIP), a joint center between Chalmers, the Sahlgrenska Academy and the School of Business, Economics and Law, both at Göteborg University.

The students in the program interact with academia and industry to transform promising ideas into innovations with potential for becoming successful commercial ventures. The integrated and experience-based business education, coined 'education based pre-incubation', challenges the students to test their boundaries and exceed their potential, while in the process building innovative companies of the future.

The program emphasizes bioscience based entrepreneurship and business creation, by combining real-life innovation projects, teamwork across different educations, and interplay with various actors in the innovation system and the regional knowledge based industry.

### *Educational and Academic Results*

The program has achieved national and international recognition as a unique environment and teaching tool for advanced entrepreneurial learning and as model for development of innovations and knowledge creation within the health care area. The Swedish National

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Agency for Higher Education has placed the program among the nine in the forefront of masters programs available in the Swedish universities.

	GIBBS06	GIBBS07
Students entered/admitted	12/15	11/15
Master exams	12	11
Business plans	5	5
Technical reports	5	4
Market analysis	5	5
Publications	1	2
Patent applications	3	2
Approved grants	>14MSEK	2.5 MSEK
Grants in process (participation)	8M€	4 MSEK

15 students were admitted the first year and 12 of them received their master degrees at the end of 2006. A new group of 11 students will graduate in December 2007 out of 15 admitted. 10 students entered for the autumn semester 2007.

One reason for the lower number of students entering 2007 is the the adoption in Swedish universities of the so-called Bologna process. Together with the improved job-market and the not so well understood changes in the curriculums a reduction in applications to all master programs was seen in Sweden this year. However, with the positive media around GIBBS we expect the applications in spring 2008 will increase, including the number of international applicants.

Some of the courses are given by the Sahlgrenska Academy at Göteborg University and there will also be a special track starting in 2008 for students from Göteborg University in addition to the already available Chalmers track. There will therefore be around 20 students, and 6 to 10 projects to be pre-incubated starting in 2009.

The future management of GIBBS is planned to be set up as cooperation between the two universities under one management, with faculties from the two universities working closely together, and with common rules for admittance and examination.

### *Pre-incubation*

A high number of project ideas are necessary in order to have enough projects to be pre-incubated into a potential enterprise during the students' project year. To date approximately 50 bioscience projects have been evaluated and 25 of them have been admitted for further processing into GIBBS and the sister programme Chalmers School of Entrepreneurship.

The origin of these projects are i.a. the health care system in Western Sweden, the University Hospital in Linköping, the universities in Göteborg and Oslo, Chalmers, pharmaceutical industry in the UK as well as local entrepreneurs in the region. The outcome of the preincubation seems to be independent of the origin of the projects, but a university relation increases the potential for verification and further grants.

In total the GIBBS projects have recieved about 18 MSEK in support for further evaluation and verification of projects. The contribution from BMV is still essential but has been reduced significantly in relative terms. The contribution from the universities and the fund structures

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have increased. The contributions *in kind* from the network of industrialists around the school are also important.

<b>Defined targets 2005- 2007</b>	<b>Achieved:</b>
Define the long term structure for the school as a cooperation between GU and Chalmers	The master program has been adapted to the two year Bologna principle, combining faculty from Chalmers and GU. From spring 2008 students may apply through Chalmers (bioscience), and GU/Sahlgrenska Academy (biomedicine)
Recruit a school director	
Develop an internationally accepted curriculum with international and national lecturers	An international curriculum with national and some international teachers has been developed. The search for teachers with further international experience will be continued
Extend the recruitment of students from other countries and universities and achieve an improved gender distribution.	More students from outside the Nordic countries apply and are admitted. The relationship with Swedish embassies and CSN has to be improved to avoid late drop outs.
Recruit more bioprojects	More than 50 projects have been evaluated
Develop the principles and the funding to support the projects	Support from NUTEK, Innovationsbron and VINNOVA has been received

### **Results Achieved in the Area of Science Park and Incubator – Sahlgrenska Science Park**

BMV's activities in the area of science park and incubator are conducted through Sahlgrenska Science Park, SSP. SSP works on behalf of Business Region Göteborg, Region Västra Götaland and Göteborg University. The mission is to facilitate commercialisation of research-based innovations originating from the healthcare sector, academia and industry, by supporting the development of business projects within the pharmaceutical and medical device industries as well as services applicable to these industries.

Sahlgrenska Science Park functions as an incubator, business park and meeting place for research and industry within the life science area. Extensive cooperation is ongoing with other actors within the innovation system in Göteborg, such as GU Holding (with joint financing from VINNOVA's VINNKUBATOR program) and Chalmers Innovation.

Incubator activities cover the earliest phases of development, forming the foundation for the projects' commercial advancement, focusing on business counselling to early projects and to prepare them for industrialisation and financing. Two positions as business advisors are connected to the incubator, one established in late 2004 and the other during 2007.

The business park provides necessary office and conference facilities for research based companies with medical applications in the region. Companies operating here are close to Sahlgrenska University hospital as well as to the academic world, and have access to the park's services, contacts and networks.

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During the period 2005 – 2007 the business park has expanded, housing 5 companies or organisations at the start of the period and a total of 30 at the end of the period. During the period five companies have left the business park for other locations. To meet the increased demand for space the park was expanded with additionally 500 m<sup>2</sup> during the spring of 2007. These were fully let within a month of completion.

The Biotech Center (owned by the city of Göteborg) provides established research-based companies with state of the art office and laboratory facilities. The Biotech Center opened in 2004, and covers a total of 16,000 m<sup>2</sup>. SSP plans to open a “laboratory hotel” in early 2008 in the Center, essentially providing space for a “wet incubator”.

### **Defined targets 2005 – 2007:**

A minimum deal flow of 130 ideas

Pre-incubation of at least 48 projects

### **Achieved:**

96 ideas have been presented to Sahlgrenska Science Park, out of which 26 ideas came from women

45 of the ideas were pre-incubated, 4 together with GU Holding, and 7 were given pre-incubator loans from Sahlgrenska Science Park

7 new companies entered the incubator. 3 of these were funded through SSP. 6 companies were accumulated in the incubator at the end of the period, with 0 alumnis

Sahlgrenska Science Park also aims to extend collaboration with other actors within the innovation system , with development of the project in focus. This is mainly done through:

- Continued development and integration of incubator processes
- Developing projects together with CVM (pre-incubation) and GIBBS (pre-incubation and incubation)
- Funding projects/companies jointly with GU Holding, Innovationsbron et al.
- Working with licensing of ideas and projects

In addition SSP works to build networks and provide arenas for interaction, mainly through Park Annual, an annual gathering of more than 200 people from start up companies, financiers, researchers, service providers, consultants etc within the region.

### **Results Achieved in the Area of Communication and Visibility**

The mission for the sub process Communication and Visibility is to make the region known, in Sweden and abroad as a dynamic and attractive region, conducting biomedical research, commercialisation and educational activities of the highest international standard, with the purpose of attracting both expertise and capital into the region.

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Objectives for the period have been

- to increase knowledge and create a positive attitude towards the position and importance of biomedical development within the Göteborg region, with particular emphasis on the areas of biomaterial/cell therapy and cardiovascular/metabolic diseases
- to attract new actors to the region
- to measure target fulfilment

### Defined targets 2005- 2007

Increase knowledge and create a positive attitude towards the position and importance of biomedical development within the Göteborg Region, with particular emphasis on the areas of biomaterial/cell therapy and cardiovascular/metabolic diseases

Attract new actors to the region

Measure target fulfilment

### Achieved:

Brand name – development of logotype, communication policy and manual, annual communication plans, registering of brand name, participated in communication training programs by VINNOVA and their associates.

Marketing – development of profiling material, e.g. brochures, posters, advertisements, articles, presentation material, participated at exhibitions and seminars in Sweden, Europe, China and USA, development and maintenance of web page

Seminars – organized 13 seminars and 1 international conference with a total of 945 participants

Networking – organized activities together with SwedenBIO, Swedish Trade Council, VINNOVA, EU Brussels, Regional EU Info Centre, Swedish Association of Scientists, Swedish Industrial and Chemical Employers Association, SP Technical Research Institute of Sweden, Göteborg University, Chalmers University of Technology and a number of local companies. Contacts with media and cluster organizations. Development and maintenance of data base.

Initial awareness survey was performed during second half of 2006 with a result of 3,8 on a scale of 1-5 , with 5 representing the highest level of awareness

## Results Achieved in the Area of Interactive Research on the Innovation System

In order to continuously learn about the dynamics of the regional innovation system 'interactive research' is carried out. Its aim is to describe and analyse the development of the regional (sectoral) innovation system, and thereby to increase the understanding of the mechanisms through which such systems evolve over time – and consequently how such processes can be supported through various policy initiatives.

First, in order to understand the dynamics of the very initiation process of the BMV programme, the motives and views of regional actors were analysed. In this the researchers have taken the role of "story teller" or "reporter", as defined by VINNOVA, and recorded the history of the BMV process. Second, the main focus of the research project is 'the core processes' (or functions) in the regional innovation system and how these develop over time,

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for example, as a result of activities carried out within the frame of the BMV process. In particular, one 'core process' analysed is the process by which knowledge flows and interaction takes place among actors in the innovation system. In practice, this has involved mapping of the firms and the university-based research groups, as well as analysis of their views about the system dynamics and their behaviour as regards collaboration and commercialisation.

Specific goals for the interactive research were expressed in the initial action plan, but these goals have continuously been updated in a dialogue between the researchers and the process management. The intention is that the outcome of the research project should be useful from a practical point of view – both in the context of the BMV process and for other actors (e.g. VINNOVA or others who run or plan to start similar regional development processes). The research should thus produce results – as specified below – which the regional actors and VINNOVA perceive to be useful to the BMV process. The results should be presented to the process management as well as to the larger audience in the region, for example, in the form of strategic discussions, reports, or workshops. In addition the outcome should also contribute to the academic literature (within the discipline of policy-related innovation studies). The latter intention is important for the integrity and quality of the research performed. Accordingly, the objective is that by the end of 2008 the project should have attained the goals as specified by the table below.

### Defined targets

Analysis of the initiation process of the BMV program. To be reported at international conferences and in a scientific publication.

Analysis of the biomedical firms in Western Sweden and their views about the system dynamics and their behaviour as regards collaboration and commercialisation by a survey and interviews.

Reports/publications:

- Report about core processes in the biomedical innovation system in Western Sweden
- Journal article about core processes in innovation systems

Two seminars based on the company survey:

- One for the process management
- One for a broader audience

Analysis of the biomedical researchers in Western

### Achieved by end of 2007

Analysis of the initial phase of the BMV process reported in a book chapter, in Swedish, has been published in the book "Regional power of growth in a global economy: the Swedish VINNVÄXT programme" edited by Laestadius et al.

An English version of this book chapter has been presented at three international conferences, and will be submitted for journal review.

Effects: a) recording history, b) diffusion of the 'BMV story' and brand name, c) scientific output

A survey on biomedical firms in Western Sweden was carried out in 2006. A comprehensive report, also including some results from an interview study of selected firms, was completed in 2007 and will be published in RIDE's report series. A shorter version, in the form of a book chapter or journal article, may be written in 2008.

Results from the survey have been presented to the BMV process management group on two occasions, including a workshop in August 2007. These discussions included issues of strategic interest to BMV.

Effects: a) mapping of the firms, b) enlarged understanding of the dynamics of the innovation system and the role of BMV, c) highlighting of strategic issues, d) scientific output.

A survey on biomedical researchers in Western

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Sweden and their views about the system dynamics and their behaviour as regards collaboration and commercialisation by a survey.

Sweden was carried out in 2007. The results will be analysed and reported in 2008.

Effects: a) mapping of the researchers, b) enlarged understanding of the dynamics of the innovation system and the role of BMV, c) scientific output

Continuous contribution to the strategic discussions within BMV.

This was intensified in 2007 and will be further highlighted in 2008.

There are three sets of experiences from the first period. First, the understanding gained from the analysis of firms and university-based research groups proves valuable for strategic discussion on the dynamics of the innovation system and the role of BMV.

Second, the research performed in this initial period has had the character of an initial investment in terms of mapping of actors, construction of surveys and interview guides, and substantial data collection. This chosen research strategy and the related methodology is rather time-consuming and results in long lead-times. Such investment was necessary in order to gain a 'base line understanding' of the innovation system. The 'investment' will surely pay off in terms of facilitated future data collection (e.g. surveys) and analysis.

Third, the time-consuming research strategy has given limited opportunities for real-time feedback to the ongoing BMV process and strategic discussions. Therefore, in the next period (from mid-2008 and on) the research will be linked closer to activities carried out in the BMV process and more short-term outcomes will be prioritised. This will likely increase the benefits of the project as perceived by the regional actors involved in BMV.

### Research Strategy

The aim of BMV is to improve the processes used in utilization of research. Therefore direct support to research is not a major element in the strategy, with the exception of the field of biomaterials and cell therapy. In this field BMV puts emphasis on creating new tools for strategic development of products and services as a means to support the long term competitiveness of the region's industry. However, the industrial thinking in management of projects in IBCT and CVM, and in preincubation by CVM, and the education based preincubation of GIBBS have led to direct effects in research groups involved, chiefly by inspiring them to become more targeted and milestone driven. The incubator activities by SSP also have focused more projects to deliver to targets of commercialization.

The strategies in BMV have been focused towards the verification of ideas and validation of early ideas. The processes however have led to participation in grant applications for research groups. Several of these have been successful in spite of the short period since start. It is our view from these situations that focused preincubation and targeted utilization of research already at this stage has improved the outcome of the grant applications and thus proven the benefits of early process support.

In the field of biomaterials the aim of BMV requires direct involvement in performance of research, through development of cutting edge methods for analysis of interaction of materials and cells in hard and soft tissue. The approach has been to combine state-of-the-art competence and methods from the fields of cell and molecular biology (projects Alpha and Delta), or material physics (project Beta), with leading competence in experimental biology, morphological analysis and clinical experience. The core objectives in the projects have been

developed in intensive discussions between researchers, clinicians and companies as intended users of the methods to be developed. The result is an interdisciplinary approach with a rapid translation of methods to end users, in a way that is very complementary to the traditional mode of operation.

The project year at GIBBS starts with an evaluation of the commercial and research potential of the projects. The need for additional data and clinical documentation necessary to increase the value of the project is a core part of this analysis, which in several cases has led to applications to e.g VINNOVA's verification programs or to Almi funding for generation of such data for knowledge protection etc.

Several of the GIBBS project have received such funding directed towards applied verification research, for instance a project around veterinary medication, and a project around microencapsulation of biocides for improved waterbased paint .

### **Business and Strategic Results and Effects in Participating Companies**

In connection with the projects supported by CVM, GIBBS and SSP a number of companies have been created, with details presented in appendix 2.

The first group of CVM-supported projects has until Q1 2007 received a total of 25 MSEK in grants and investments from other sources, including research grants from the EU and VC investments. Some examples are:

- DuoCort: Received financial support from VINNOVA in the amount of 8MSEK
- Civo Bioscreening: Received prize for outstanding business plan in international competition; company was formed and patent filed
- Cellartis: Filed patent based on research performed in the stem cell project
- Midorion: Received EU grant, at the level of 5MSEK
- BioPix: Company formed and first external clients outside academia

The second group has achieved the following so far:

- GraftCraft: Application of 2 patents, creation of company and ready for proof of principle study in first project. Second application under development
- Arterion: Focus on indication strategy work and QA of production; company created; 9 MSEK in funding from VINNOVA
- BioPix: (in second year of support) has managed to move business model from only license fees to a mix of licensing, application development and joint venture with other company to secure full service provider status.
- Anti-Resistin: Managed to take Antibody project from idea to proof of principle study in mice during 2 years

Several projects have generated new knowledge as foundation for new patent applications. One of these is one of the first CVM projects, conducted jointly between AstraZeneca, the start up company Cellartis and researchers at GU. This project has helped spark a rejuvenation of the research program within the cardiovascular and metabolic area at AstraZeneca and is

expected to also strengthen the product portfolio of Cellartis. The project is now ready for final verification.

Two of the major companies in the region are strategically refocussing their R&D portfolios. As a result of interaction between these companies and BMV discussions have been initiated regarding possible formation of one or more spinout company to be set up in the region. Final answers are not available but important knowledge is being created on how to support such processes.

From the first student group at GIBBS, GIBBS06, three companies have been established, of which two in Göteborg and one in Oslo. An additional incorporation is underway. A total of more than 12 MSEK have been approved as grants to these companies or their university groups.

In GIBBS07 six projects have been pursued, and four of these will be finally evaluated and potentially incorporated in 2008. Two more bioscience projects will likely be incorporated by CSE.

SSP has developed a few companies that have shown success already. Two examples are Aidera AB and Pharmsurgics AB.

Aidera's business concept is to market IT-based business support to medical service providers. The first product is a system for the transmission of glucose values and data from insulin pump, enabling distance monitoring of diabetes patients. The information is available to nursing staff, via a website ([www.diasend.com](http://www.diasend.com)), as well as to the individual patient. The results are more secure patient monitoring and more effective patient visits. The Diasend system has reached status as "preferred" choice within hospital care in Region Skåne. It is also sold in selected European countries. SSP has provided seed funding and has a position on the board.

PharmaSurgics develops and commercialises a novel treatment for the prevention of harmful scarring (adhesions) after abdominal and back surgery. The core technology constitutes a patented compound with highly beneficial anti-inflammatory and anti-microbial effects that promotes the healing process. PharmaSurgics focuses primarily on two indications: adhesion prevention after flexor tendon and abdominal surgery. The flexor tendon indication provides strong advantages for establishing clinical proof of concept since the clinical outcome is easily evaluated. Abdominal surgery represents the largest market potential for anti-adhesion products. The company is private held, owned by its founder and three investors.

## **Scientific and Technical Results**

### *IBCT*

Within IBCT the Alpha and Beta projects have delivered advanced methods and procedures for analysis of interaction of medical devices with the surrounding tissue. One patent application has been filed based on the results from Alpha and the first commercial order for such analysis has been performed from Beta during 2007. A number of international companies are in discussion with IBCT for new orders. According to the companies involved the methods are expected to provide important new knowledge on which significant IP and product development can be built.

## Biomedical development of Western Sweden

In the projects three recently graduated PhD's have participated. One PhD thesis was defended in 2007 and another thesis will be presented in 2008 as a direct result of the IBCT projects. A third doctoral student plays a central role in project Delta, where her work is organized as an "industry doctor agreement" between one company and a department at GU.

The total number of publications in international peer reviewed journals has reached 8 of which 4 are published and 4 submitted and in the review process. IBCT has presented findings at conferences with a total of 25 abstracts and has in addition made 59 presentations at conferences, in academic settings and at companies. Some of these are listed here:

"Biointerfaces - Quo Vadis?", Göteborg, Sweden, 2006, the first international conference organized by BMV

European Society for Biomaterials Sorrento, Italy 2005, and Nantes, France 2006

Gordon Conference on Biointerfaces, Switzerland, 2006

"Nanotec Forum 2006", Stockholm, Sweden

Medicintekniska dagarna, Uppsala 2006, Örebro, both in Sweden, 2006

Swedish Dental Association, Göteborg, Sweden, 2007

### *GIBBS*

By the end of 2007 23 master theses have been delivered and opposed to in a semi public setting, in the form of 8 business plans and technical reports. Besides being judged on their potential commercial role they are also being judged in an academic setting.

The science around the projects has led to a number of publications by the idea providers, in all at least six papers published abstracts presented. Several patent applications have been filed during these two years with active projects.

One important factor for analysis of the commercial potential of a project is the patent landscape. There are few such studies published. During his GIBBS studies one such study was performed by a GIBBS student, which was published in *Nature* (K. Bergman & G.D. Graff, "The global stem cell patent landscape: implications for efficient technology transfer and commercial development". *Nature Biotechnology*, vol. **25**, issue 4, p. 419-424 (2007)).

One project originating in GIBBS has progressed into a project for developing a support structure and system in the field of Chemical Biology in the form of an international network mobilizing resources and competences in a number of universities and companies in Europe and the US. The work in Göteborg is being organized in conjunction with groups in Norway, through MedCoast Scandinavia. The formation of a consortium for application to European 7<sup>th</sup> Framework Program, FP7, is ongoing at the time of writing.

### **Added Value from the Program– Regional Leadership, Improved Capacity for Joint Action**

The BMV process has contributed to making key decision makers in the region aware of the importance of biomedicine to the regional development, spurring increased attention and new programs both in collaboration among various actors and within their respective organizations. There were already at the outset several arenas where the various actors met but during the period that BMV has been active a lot more attention has been devoted to the strengthening of the biomedical field and a number of steps have been taken. Some examples are given below.

One is the establishment and growth of the incubator for biomedicine at SSP. It receives “seed financing” through the BMV funding, but the major funding is now coming from other sources, chiefly VGR, Business Region Göteborg and Innovationsbron. It works closely with the holding companies of GU and Chalmers.

Göteborg University and Chalmers have applied for and have jointly received funding from the Key Actor Program at VINNOVA. One feature of their joint plan is to emulate elements from CVM into a larger scale roll out.

VGR has moved to emphasize the significance of healthcare as a driving force for innovation and growth, using the possibility to integrate its responsibilities for healthcare provision and for regional development. A Healthcare Innovation Program has been launched aiming to create improved conditions for R&D collaboration with industry and to further develop the infrastructure for its own R&D and clinical research, as well as optimizing healthcare quality and delivery. The program encourages innovation creation and diffusion in the VGR healthcare organization. To support this, a policy on intellectual asset management has been developed. The most recent Regional Growth Program (RTP) also supports the role of healthcare as a driving force for growth.

Within VINNOVA’s program for national program for need-driven basic scientific research, named VINN Excellence, there are two centers selected with similar aims as regards materials for life science applications, BIOMATCELL at Göteborg University and SuMo (Supramolecular Biomaterials: Structure Dynamics and Properties), at Chalmers. Although with different starting points and focus they share an interest in biomaterials. BMV has provided a platform for a joint application to VINNOVA for a Graduate Research School in biomaterials. In addition to fostering a new generation of researchers a key feature of the plan is to support mobility between academia and industry and between international and regional groups.

Another effect is visible in the improved entrepreneurial climate, as is evidenced by the increased number of spin out projects from established companies as well of early stage start up companies, and the intensified dialogue of these and the leaders of the Public Helix.

### **Gender and Equality**

The focus of the BMV process is development of products, processes and services for improved health and wellbeing, with results that shall be beneficial for patients regardless of gender, ethnicity or the like.

Balance between men and women within the sub processes is one of the overall objectives for BMV. In this context “balance” is defined as a minimum of 40 % of the individuals in any given group shall be men and likewise at least 40 % shall be women. Based on a philosophy of non-hierarchical structures with a large degree of autonomy for individuals and groups in the system we have strived to achieve this balance. As a supporting strategy we have also strived to put emphasis on women and on younger people in all public material and presentations. However, BMV only controls the projects operated by it and so the impact will be seen only indirectly and over time on the total system.

In total the process has involved around 150 persons each of the years 2006 and 2007, 55 of whom are women. The board of BMV includes two women and seven men, and the process advisory committee comprises 16 individuals, of which ten are men and six are women. The leaders for the various sub processes are six, of whom two are women and four are men. The assistant process leader is a woman. The proportion of women has been rather stable, rising from 30 % in the year 2005 to 39 % in 2006 but is back down to 31 % in 2007. The most significant difference from the previous year involves shifts in both the total number, and the proportion of men and women, among the idea providers and supporters *in kind* to GIBBS.

Of the 40 students admitted thusfar in GIBBS 11 are women, i.e 28%, although the number varies between the years. In presentations of the school there is an emphasis on the high number of women in the areas of biomedicine and natural sciences. Recruitment efforts are focused on attracting an increased number of female applicants.

### **Organizational Aspects**

The organization for BMV was chosen based on experiences in the region from other cluster initiatives involving the same organizations as principals. BMV is set up as a consortium with the principals having signed a multiparty cooperation agreement among them. In addition each of them has also signed a bilateral agreement with BRG, Business Region Göteborg, for the financial support it will provide to the process. BRG acts as the main contractor to VINNOVA, with responsibility for the administrative support to the process. BRG is the contracting party to all sub suppliers to the various projects and act as the custodian of the funding from VINNOVA and the principals, and as the provider of liquid funds as needed to bridge gaps in the financial flows. All principals have the right to appoint a representative to the board of BMV. These representatives have all been at the level of the head of the relevant institution, or a person directly reporting on this level, with the Managing Director of Business Region Göteborg holding the position of chairman. The board has adopted bylaws guiding the way decisions are to be made. The board regularly meets four times per year to review progress and 1-2 times per year to discuss strategic matters and plans.

The day to day management of BMV lies in the hands of a process leader supported by a management team. This team includes the assistant process leader and the leaders of the sub processes.

In order to provide a forum for discussions of strategic and policy related issues before proposals are made to the board a process advisory committee has been formed. This group consists of individuals from the principals who are closely involved with their senior management on matters covered by BMV and of the member of the management team. This committee has met 5-8 times per year.

Two of the sub-processes, GIBBS and the incubator, have in essence been “out-sourced” to existing organizations to operate. GIBBS is attached to Center for Intellectual Property Studies, a joint center between Chalmers and Göteborg University. The reason for this choice is the long standing and successful experience of Chalmers in education and training of entrepreneurs, which BMV wants to build on and augment. BMV has exercised its governance of GIBBS through a yearly contract specifying what the financial support from BMV should be used for. The director of GIBBS is a member of the management team of BMV, and other members of that team also have been involved in GIBBS projects, thus ensuring a high involvement and insight.

The incubator was similarly placed in the hands of the pre-existing science park for biomedicine, Sahlgrenska Science Park (SSP). SSP has an ownership structure that overlaps BMV on the public and academic side, with a significant overlap of board members. The general manager of SSP is also a member of the BMV management team. Together these links have ensured the necessary insight and involvement for BMV.

IBCT has as its aim to set up a new institute and has thus not been integrated into any existing structure. It has been operated as an independent project while it establishes enough customer volume to prove the viability of the concept of a new institute. It is managed by a project leader and a scientific director reporting to a steering group, which in turn reports to the board of BMV. The chairman of the steering group is one of the industrial representatives on the main board.

CVM has likewise operated as project with a project leader and a steering group reporting to the board of BMV. The chairman of the steering group is a senior executive from one of the industrial principals, with his immediate superior being the company's representative on the main board.

The Communication and Visibility process has been conducted directly by BMV, headed by the assistant process leader

The interactive research is conducted by two researchers associated with the Institute of Management of Innovation and Technology, IMIT.

The membership of the board and the steering groups as well as of the individual project groups have undergone a rather low number of changes in membership during the three years, stemming from the fact that people shift jobs, that requirements for competence in a group varies etc. Although the management of these situations has taken their time we do not see that this has presented any particular challenges that are different from normal operations in a complex environment such as ours.

### **Follow Up of Key Indicators for Performance and Results**

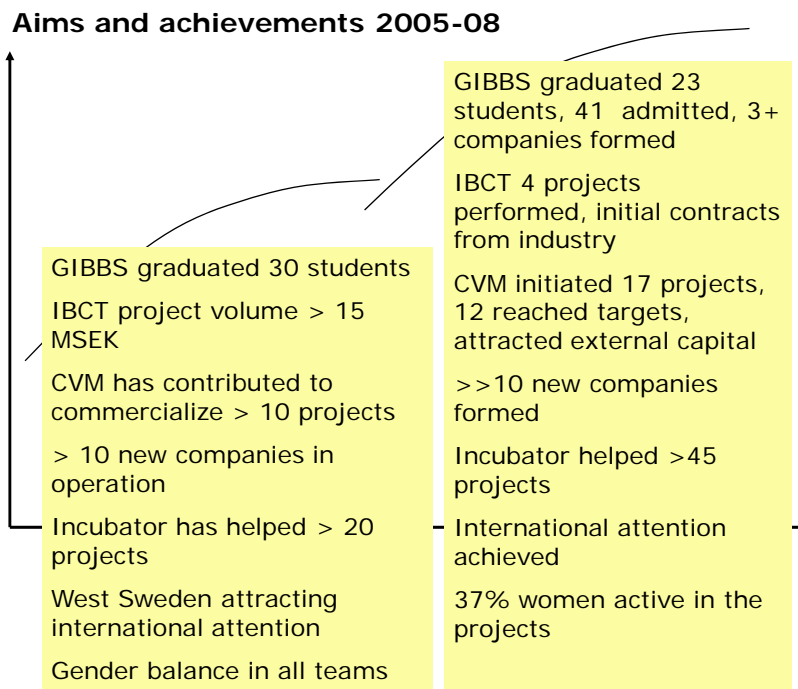
The overall long term objectives for BMV have been complemented with targets with a shorter time horizon. They have been set by the board as a form of "owners' directives" for the sub processes. For the first period, from 2005 until mid 2008, the following should be achieved:

- GIBBS shall have graduated 30 students
- IBCT shall have a demand-driven project volume of 15 MSEK
- CVM shall have supported the transfer of at least 10 projects from academia to commercial environment
- The incubator shall have helped at least 20 projects to become commercial ventures
- Western Sweden is recognized internationally in the field of biomedicine
- BMV has an even distribution of men and women in all active groups in the process

For each year the Plan of Action has specified targets and objectives for each sub process and the yearly reports follow up on these.

## Biomedical development of Western Sweden

At the aggregate level the BMV process will fulfil most of the targets set for the middle of 2008 as is graphically described in the following picture:



GIBBS has admitted 41 students and will reach its target based on the number of students in the class starting in the autumn of 2007, in addition to the two classes graduated in 2006 and 2007. As a technical matter the third class will not graduate until 2009, due to the conversion from three to four semesters for master programs in Swedish universities initiated this year.

IBCT has established two main methods and is well on its way to build a third in collaboration with several groups of companies. These have been presented at scientific meetings and in articles in peer-reviewed journals. In spite of this, IBCT will not reach its stated target of a demand driven volume of 15 MSEK, due to the long lead times involved in commercialising services. The volume for 2007 is forecasted to reach ca 7,6 MSEK.

CVM will surpass its targets as will the incubator at SSP. Likewise the target for > 10 new companies and the target about international awareness and on gender balance is met.

### National and International Position

Regional, national and international networks are essential to be able to build and develop a competitive biomedical innovation system. Region Västra Götaland and the Göteborg region have collaborative agreements with a number of regions including the states of North Carolina and Michigan in the USA and the city of Shanghai in China. For these regions as well as for the Swedish side biomedicine has a high priority. Within the Göteborg-Oslo Initiative a member organisation for collaboration has been formed; MedCoast Scandinavia. Focus areas for search of collaborative partners have primarily been the biomaterial and cell therapy area as well as the metabolic area. BMV has thus been able to capitalize on already established platforms when developing our network internationally

### *USA*

In North Carolina contacts have been established with North Carolina University (NCU) at Chapel Hill, and Wake Forest University in Winston Salem. At NCU discussions are ongoing about joint projects within the dental implant area. NCU was ranked as number one amongst dental schools world wide 2006, while the Faculty of Odontology at Göteborg University was ranked number two.

Wake Forest is building one of the strongest institutes in USA for regenerative medicine with special focus on artificial organs. Definition of joint projects is ongoing between researchers in our region and their counterparts at Wake Forest. Apart from projects exchange of staff and students are on the agenda. Also companies in the regions have been visited and collaborative opportunities explored.

At University of Michigan discussions are ongoing regarding functionality and development of limb prosthesis and development of bioactive conductive polymers, including a Swedish company and the US Department of Defence. Another collaborative initiative is being explored around chemical biology (screening of compounds for new pharmacological effects) where Ann Arbor has built up a centre for such activities and is interested to collaborate with Göteborg in this field. At NorthWestern University in Chicago discussions are ongoing with one of USAs leading groups in biomaterial development. Apart from collaborating in projects the director of the group has accepted to be a member of the advisory board of BIOMATCELL.

Negotiations are ongoing with two of the world's largest biomaterial companies regarding collaboration projects to be performed by IBCT in Göteborg.

### *China*

Several collaborative projects are in start up process between Shanghai and actors in the Göteborg region. One area of mutual interest is the stem cell field. With the Institute of Health Science at Shanghai Jiao Tong University projects regarding differentiation of cardiac as well as cartilage cells are starting. Apart from the projects also exchange of post-docs is planned. Together with the company Cellartis, the Institute will start research and development for production of embryonic stem cells for the Chinese market.

Within the field of biomaterials collaborations are planned also together with Jiao Tong University (the Institute of Bioengineering) to develop new implants.

Negotiations are ongoing between a Chinese biomaterial company and a Göteborg based company to form a joint venture for development and marketing on the Chinese market.

### *Norway - MedCoast Scandinavia*

MedCoast Scandinavia is a non-profit member organisation that aims to further strengthen and develop the biomedical sector in the Göteborg-Oslo Region. It acts as a catalyst for collaboration between scientists, businesses and the public sector.

Within the scope of BMV, MedCoast has been able to drive collaborations in the cardiovascular area, biomaterials for sensors, collaboration for early innovation, besides increasing the collaboration between the health care systems and smaller innovative companies.

MedCoast has also been the driver for transfer of knowledge and experience from Göteborg for education based preincubation to universities in Norway, where the University of Tromsø has decided to include a similar master education, focusing on marine life business creation.

## Biomedical development of Western Sweden

### *Other*

The BMV initiative has on several occasions been presented internationally and received great interest. Examples of this are lectures at seminars held in Shanghai (China), at the universities of North Carolina, Michigan, and Stanford (USA) and in Chennai, Bangalore, and Mumbai (India).

In 2006 IBCT arranged an international conference – Biointerfaces Quo Vadis – with participating researchers from USA, Europe and China.

The Director General of Health from the EU Commission directorate on R&D visited Göteborg in January 2007 to study the cooperative biomedical environment and also met with the regional political leadership.

The Göteborg Region participates in Invest in Sweden Agency's life science program together with the regions of Stockholm/Uppsala and Skåne.

GIBBS has appeared in several newspaper articles and in radio interviews and talk shows. Considerable interest has been created, due to these publications. Both the school and the project have also been presented both nationally and internationally at meetings in Sweden, Denmark, Finland, Norway, France, at the EU commission, India and China.

The school and the process of education based pre-incubation have been discussed at several occasions at visits or visits to the school by groups from VINNOVA, Innovationsbron, The Norwegian Research Council, University of Tromsø and a group from British Midland universities.