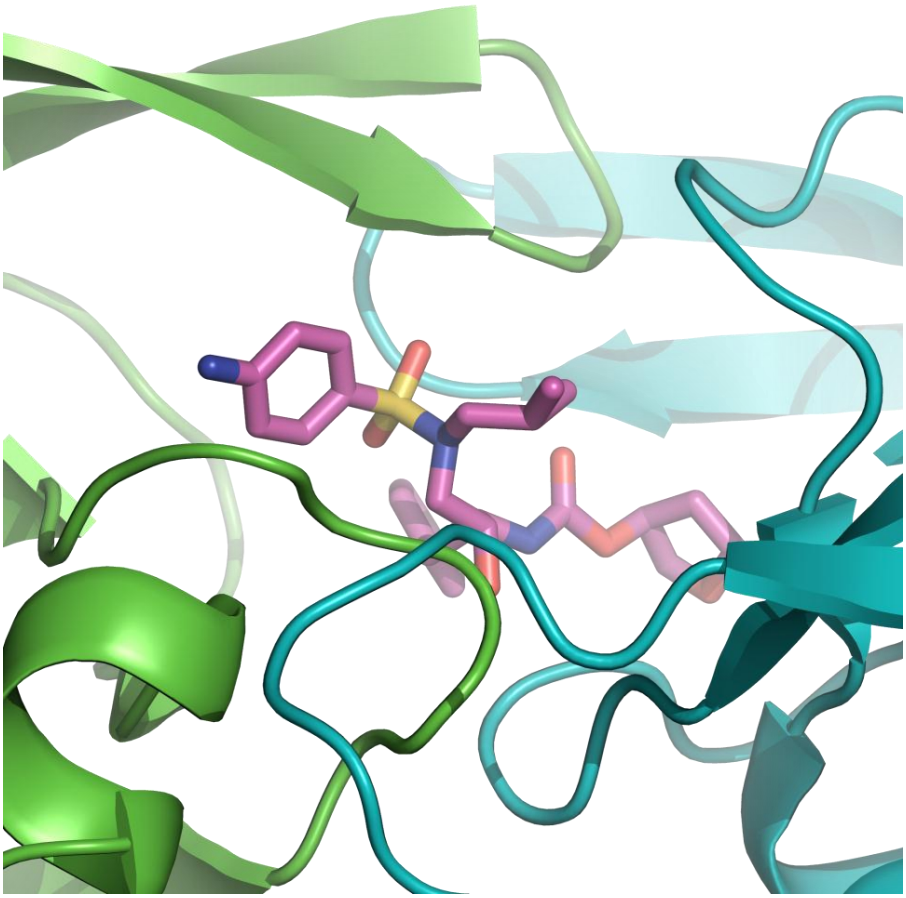
March 2011

AALTO UNIVERSITY
UNIVERSITY OF HELSINKI
STANFORD UNIVERSITY

# An Insider's View: Report on the Finnish Life Sciences Industry



Anne-Sisko Patana, Tamara Carleton, Kirsi Polvinen, Laura Kanto, Hanna Nordlund, Jussi Pihlajamaa, Pekka Berg

# Contents

# 1. Executive Summary

Bio-industry has characteristic features that distinguish it from other industries. It is strongly regulated, has longer research and development times, especially concerning the pharmaceutical sector, and has higher risks due to inherent uncertainty linked to biological processes. Bio-industry also faces challenges related to the complexity and heterogeneity of information and knowledge, since it combines many sectors (e.g. biology, medicine, biochemistry, chemistry, physics, and information technology), each of which is complex enough by itself. The ever increasing information and knowledge through basic research makes biotech industry more dependent on academia than any other industrial field. And even though the knowledge and understanding of biological processes increase on a continuous basis, the decisions in biotechnology projects still have to be made with limited experience and understanding (Pisano, 2006). All these special features set exceptional challenges to the innovation processes and innovation environment in bio- and bio-oriented industries. At the same time these sectors face the same trends and mega trends that influence other industries, like globalisation, strengthening of Asia, increasing role of customers/users, and personalisation.

This report is an insider's view to Finnish innovation environment in biotechnology, especially focusing on life sciences sector. It will bring up important aspects and concerns that actors in the field shared with us. Shortage of funding, risk aversive attitude, lack of business know-how, unsupportive entrepreneurial climate and negative public image have been shaping the business environment in the Finnish Life Sciences sector. On the other hand the strong role of Tekes, top level basic research, strong local networks, and high quality education were seen as extant strengths that are essential on the way to success.

The report contains some comparisons to San Francisco Bay Area, the strengths and challenges being quite different in these two areas. In fact, in some cases they seem to be just the opposite. Nonetheless, based on the interviews Finland still has a lot to give in biotechnology and the life sciences sector. The basic infrastructure is good, we have top level research in specific areas; hopes are high and there is a lot potential. In addition, industry has a working relationship with universities, and the whole sector is more mature, even though some challenges in local and global partnering as well as in technology transfer were recognised.

The main concern expressed by the field was funding. Without long-term financing there is a threat that several companies and innovations are sold abroad before they are even close to their full potential. Nevertheless, in the challenging funding situation alternative business models should also be considered – ways to turn the core competence into revenue before the actual product is on the market.

A foresight workshop organised as part of the study gathered together actors from the field, including policy makers, university and industry representatives. Three different topics on life sciences and biotechnology sectors arose in the group works: 1) the importance of cross-disciplinary education, 2) the importance of cross-disciplinary collaboration, and 3) personalised medicine. The workshop also showed that this kind of community consisting of different actors could be valuable and should meet on a regular basis to continue discussions on the state of the sector.

# 2. Value to You

Why should you read this report? This study provides several benefits to practitioners and researchers in the biotech field, as well as others looking for greater insight into Finnish biotech innovation. These benefits are explained below.

**Current Perceptions.** Many of the emerging trends and concerns reported in the report may not seem necessarily new or novel because they are familiar and long in the making. As an example, a lack of venture funding proved to be a common grievance among study participants. Nonetheless, a fresh capture of the industry's inside views serves as a litmus test for revealing community perceptions and concerns. How people are really feeling and what they are worrying about is useful input to policymakers, who seek the latest opinion, and also to business managers, who regularly scan for competitor issues. This report summarises the current perceptions of the Finnish industry and contrasts these perceptions to those held in the world's leading hot spot in the San Francisco Bay Area.

**Insider View.** A deeper discussion of the issues raised by the study proved fruitful in research workshops. Participants openly shared their reflections and questions, which are captured in this report. In particular, participants expressed a desire to see and hear more success stories within the Finnish biotech industry. They felt that the Bay Area and Silicon Valley, in contrast to Finland, fostered an optimistic culture that celebrated all types of success. This report brings this viewpoint to the forefront, and also aims to highlight various positive stories and examples for the Finnish market. By synthesising perspectives from those deep inside the Life Sciences industry, this report serves as a reminder of what matters to those who are building the industry's future going forward.

**A Focus on Action.** This report relies on the action research methodology. Unlike traditional academic research that often remains at the theoretical level, action research relies on professional researchers who use new knowledge to diagnose, intervene and improve existing practice in direct collaboration with practitioners. Simply put, action is at the heart of action research. The goal of this report is to motivate change and inspire smarter questions about how Finnish biotech innovation operates. An additional emphasis is on what Finnish biotech innovators can learn from other industries and regions around the world.

# 3. Introduction

The Bio-Inno project was conducted from January 2009 to December 2010. Tekes, the Finnish funding agency for technology and innovation, provided the primary funding. Based on numerous discussions in the field with companies, consultants, service providers, public sector actors, and industry patriarchs, the focus areas of the Bio-Inno project were formed as follows:

- **Industrial context.** The Changes taking place in the industry and the new business opportunities emerging from those changes.
- **Offering.** Proactive development of offerings that meet future demand of customers and are valued by them.
- **Existing and new emerging business models.** Business models that fit into the changing business environments of bio- and bio-oriented companies.
- **Innovation process.** Systematic, effective and efficient innovation processes that create a basis for repeatable success.

The current study is part of the Bio-Inno project focused on the industrial context and innovation environment of the biotech field, especially in the life sciences sector. Companies whose business relates to functional foods, drug development, diagnostics, biomaterials, and bioinformatics as well as companies specialising in medical design and technology are included in our research purview.

The study has been conducted in collaboration between Innovation Management Institute (IMI) at Aalto University's School of Sciences, Industrial Relations and Knowledge Transfer Services at University of Helsinki, and Stanford University's School of Engineering. The objective was to address the following themes:

*How is the innovation environment seen by different actors?*
*What are the current challenges and opportunities?*
*What are possible future prospects arising from the current situation?*

# 4. Research Methodology

The methodology of action research was adopted for this study. Based on pioneering work from the Massachusetts Institute of Technology (MIT) in the 1940s, action research is an active process of inquiry that addresses research problems through community interaction and reflection. Action research aims to understand underlying causes to better support the future planning of personal and organizational change.

The research goal was to understand innovation environment and changes taking place in the biotechnology sector in Finland in order to compare innovation practices, particularly cross-regional activities, between Finland and the San Francisco Bay Area. Data was gathered and compared from these two regional hot spots in biotech, and the report's research drew on three main threads of information:

- **Past Research.** A scholarly literature review of the latest studies in biotechnology, business innovation, and related topics provided the theoretical framework. A multidisciplinary stance was taken, drawing relevant studies from different fields.

- **Expert Accounts.** An in-depth series of interviews were conducted with practitioners and researchers, which offered deep perspective from within the biotech field. In total, 24 participants worked in Finland, and 9 participants worked in the Bay Area. Interviews were conducted face-to-face when possible; otherwise, interviews were by phone or email. Participants represented multiple roles in the biotech field, which spanned the following roles: university professor, researcher, policymaker, consultant, R&D director, senior executive and entrepreneur.

- **Community Input.** In the spirit of action research, a two-day workshop was conducted with representative members from the Finnish biotech community in order to gather their input on emerging insights, explore regional concerns, and identify promising opportunities for long-term success. The preliminary results of the interviews were used as a background material for discussions and future visions. The workshop was held at the Design Factory at Aalto University in May 2010.

The research questions were based on Tamara Carleton's (Stanford University) study: The Bay Area's Role in Global Innovation Networks (Carleton, 2009). Interview questions were designed to elicit open-ended responses from participants and to encourage them to provide personal stories and perspective to emerging industry trends. Questions were prepared with company representatives and organized into several categories, including Regional Changes, Global Partnerships, and Partnering across Regions. The list of interview questions can be found in the appendix.

One regional difference emerged quickly in the data collection. Within Finland, potential interview candidates were enthusiastic and available for interviews. However, Bay Area candidates were sceptical, and several declined to talk because they did not think their work was truly collaborative outside the region and thus appropriate to an international study.

Data was analysed with community input and rapid cycles of feedback, which included ongoing debriefings with IMI members. Interview transcripts provided a wealth of quotes, and the frequency of key concepts mentioned across interviews was recorded. However, the study is not quantitative but qualitative in nature, aiming to raise some critical topics for further discussions.

In many ways, this final report will not be strictly final. The hope is to continue the dialogue with participants and others in the biotech industry with the goal of using this knowledge to address and ultimately enhance current innovation practice.

# 5. Finland as an innovation environment

## 5.1 Yes, we can – some evidence from the past

OECD defines biotechnology as: "*the application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services.*" This definition covers modern but also many traditional biotechnological activities. Traditional biotechnology, using micro-organisms for the production of bread, beer and wine, has been utilised already thousands of years, while the origin of modern biotechnology is in the 1970's when DNA techniques were developed.

Finland has a long history in biotechnology as well, and we have brought several significant innovations to market. One of the most remarkable milestones in Finnish history has been the Nobel Prize in Chemistry awarded to A.I. Virtanen in 1945 for his research and inventions in agricultural and nutrition chemistry. Especially his method for preserving fresh fodder, published in 1933, was revolutionary (Virtanen, 1933). He also had a significant impact on Finnish biotech industry, since he was the head of the Valio Laboratory for almost 50 years, from 1921 until 1970. Valio was originally established in 1905 by 17 co-operative dairies under the name "Butter Export Cooperative Valio", and was one of the first companies utilising biotechnology in Finland. Currently Valio Ltd is the biggest milk processor in Finland and a world class pioneer as a developer of functional foods. It is particularly known for low-lactose and lactose free dairy products. Valio's research on enzymatic hydrolysis of lactose started in the 1970's and the first low-lactose product was on the market in 1978. (www.valio.fi)

Orion, the leading pharmaceuticals company in Finland was established in 1917, it has brought several proprietary products to market since 1980's, including e.g. entacapone -containing medicines for Parkinson's disease, levosimendan for severe heart failure, dexmetomidine for sedation of patients and toremifene for breast cancer (www.orion.fi).

Promising molecules have also been developed by smaller pharmaceutical companies. Hormos Medical's, (from 2005 subsidiary of QuatRx Pharmaceuticals) ospemifene, product candidate for treatment of postmenopausal vaginal atrophy, has completed phase III trials and is expected to be on the market in 2012. In 2010 Shionogi & Co, Japan entered into a worldwide license agreement to develop and market ospemifene. The annual sales are expected to rise to 0.7-1.5 billion euros (Turun Sanomat 2.3.2010). Fispemifene, developed as an oral treatment for testosterone deficiency and associated disorders in men, is in phase II trials. Hormos Medical has also several patents on the therapeutic usage of lignins. (http://www.quatrx.com/ and personal communication)

Biotie Therapies (founded in 1998, listed in Helsinki Stock Exchange) is in phase III trials with nalmefene for alcohol therapy. Biotie has licensed global rights to Danish pharmaceutical company Lundbeck, and depending on the outcome of the final study the product could be on the market in 2012.

FIT Biotech has operated since 1995 concentrating on the development of vaccines and gene transport technology. Their HIV vaccine is currently in phase II clinical trials. Fipamezole, developed by Juvantia Pharma, is an antagonist of the adrenergic alpha-2-receptor and developed for the treatment of dyskinesia in Parkinson's disease. It is currently owned by Santhera Pharmaceuticals, Switzerland, and is in phase III clinical trials.

The Finnish Red Cross Blood Service was founded in 1948 to take care of blood supply for the whole country. Scientific research became a part of the activities quite soon after the beginning. Production of interferon was one of the most noteworthy innovations developed in collaboration with the Blood Service and Professor Kari Cantell. Blood Service also has patent on the production of iron free apotransferrin. Research is still an essential part of the activities and continues in several sectors including e.g. stem cells.

Diagnostics/bioanalytics company Wallac (currently Perkin Elmer) was founded in 1950. Until 1970's Wallac was a manufacturer of devices for radioactivity measurements. In 1970's they developed the alternative immunodiagnostics method Delfia, where radioactive labels were replaced by fluorescence labels. The new product was introduced to the market in 1984 and changed Wallac into a producer of immunodiagnostic kits. (Miettinen, ) (For Matti Sintonen's Festschrift). Currently fetal, maternal and neonatal screening diagnostics are developed in Finland and sold all over the world.

Labsystems (currently Thermo Fisher Scientific) was established in 1971, it developed and successfully commercialised the world's first continuously variable micropipette, and in 1976 introduced the world's first multichannel pipette (Finnpipette). Vertical light path photometry was introduced in 1978. Pipettes made in Finland are still part of the Thermo Fisher Scientific's portfolio (www.thermofisher.com). Labsystems also developed several immunoassays; some of them are currently sold and developed further by Ani Labsystems, a Finnish diagnostics company established in 2002.

Biohit, established in 1988 is listed in NASDAQ OMX Helsinki. It is the global market leader in electronic pipettes and also has several diagnostics products, especially for screening and prevention of diseases of the gastrointestinal tract. The latest innovation in the market is Acetium®, intended to reduce the amount of acetaldehyde in low-acid or anacidic stomach. (www.biohit.com)

Finnzymes, Finnish molecular biology company, was established in 1986. Their first product DNA Polymerase DyNAzyme™ was launched in 1993. After this they have launched several new DNA polymerases as well as transposon-based products. Finnzymes was bought by ThermoFisher Scientific in 2010.

The Finnish innovation Mirena®, an intrauterine device for birth control that releases daily amounts of the levonorgestrel hormone, was introduced to the market in 1990 by Leiras (currently Bayer Schering). It has been since approved in more than 100 countries, and got FDA approval for American market in 2000. (www.bayershecingpharma.fi)

In the end of 1995 Raisio, a company founded in 1939, launched Benecol® innovation, a food ingredient lowering cholesterol levels. Benecol-products contain plant stanol ester and have been selected as one of the ten greatest discoveries in nutrition worldwide in *European Journal of Clinical Nutrition* in January 2007 (Katan et al., 2007). Currently Benecol® products are sold in 30 countries on five continents. (www.raisio.com)

The Finnish Sugar Company Cultor (currently Danisco) and Alko are among the companies that have laid the foundation for Finnish innovations in industrial enzymes. Finland is still one of the leading countries in industrial enzymes; we have strong know-how in bioprocess techniques and several other industrial biotechnology applications. One of the largest developers and manufacturers of industrial enzymes, Genencor (part of the Danisco group) also has manufacturing facilities in Finland.

One of the strong sectors in which Finland has been a forerunner is biomaterials. Biodegradable implants for fracture fixation were patented in 1986 by Pertti Törmälä and his group. Professor Törmälä has 30 years experience in the research and development of biodegradable materials in biomedical science and has over 200 patented inventions with his research group. One of the latest innovations is the world's first bioabsorbable and infection-reducing antibiotic screw used in operating theatres. It obtained the CE mark and sales permit in EU countries just in the last quarter of 2010. The company behind this innovation is Bioretec, founded by Professor Pertti Törmälä in 2003.

The innovations mentioned above are just a few examples; many other noteworthy innovations have been made in the Finnish bio sector. All those innovations are not purely biotechnological, but their development would not have been possible without extensive knowledge of biochemistry, cell and molecular biology.

## 5.2 Where are we now?

According to FIB (Finnish Bio Industries), in 2005 there were 212 firms in the Finnish bio-industry employing over 8000 people. Biotechnology in Finland is concentrated on five regions that are Helsinki, Turku, Tampere, Kuopio and Oulu. The number of biotechnology firms has grown sharply until the beginning of the millennium but after that it has stagnated (Hermans et al., 2005a).

The growth in the field of biotechnology is often compared to the traditional economic pillars of Finnish economy. We have heard optimistic speeches about new "bio-Nokias" and a lot of hope has been put on biotechnology to become the new pillar of economy alongside the traditional ones. However, Sitra (The Finnish Innovation fund) has withdrawn from the capital markets and both Sitra and Tekes are reconsidering their view on the bio industry. In addition, Finland's equity markets are under-developed (Hermans et al., 2005a) and many actors in the field state that the availability of funding forms the main obstacle for biotech's growth.

The traditional pulp and paper as well as machinery and metal industries were at the same level with biotechnology in terms of production about 50 years ago and electronics industry about 25 years ago. If biotechnology continued to grow as anticipated it would reach the production levels of the current economic pillars in 15 to 30 years (Hermans and Kulvik, 2004). Thus, we need patience in expecting results from the investments made in this industry.

Finland has internationally recognised competence in selected areas of drug development and related fields, especially connected to the problems of national health in Finland. Biotechnology is a science-based and research-intensive industry where companies often start as academic spin-offs. Many of these research-intensive and technologically high-class companies are stated to lack business competence (Hermans and Kulvik, 2004,Brännback et al., 2004), but in fact, we can already see signs of the accumulation of know-how in the bio sector and growing business competence, as the industry is becoming more mature. We are also starting to harvest fruit from the older companies that have survived so far, even though too many biotech firms have been forced to sell their innovations abroad at a too early stage. Personalisation, personal healthcare, demanding and knowledgeable customers, consciousness of environmental factors, the 'open innovation' paradigm, networked business models and the increasing role of Asia are trends shaping the biotechnology industry in Finland as well as all over the world.

## 5.3 Changes taking place

*"It is a delight to note that there are companies in Finland that are good in their own niche, they have patents and are engaged in international trade and service business. Earlier there was a sort of a bubble in the bio sector, but now we are a bit wiser and are looking for those areas of the value chain where our strengths lie and which can be profitable."*

---

*"The hype that prevailed before Sitra (Finnish National Fund for Research and Development) quashed everything was unreasonable, and in my opinion we have now come to our senses."*

---

*"The financing of applied research is quite well organised in Finland and SHOKs further emphasise that it is company-driven, but the continuity of basic research in some fields causes some concern"*

---

*"If we invest in pharmaceutical research, it doesn't mean only new performs or costs but also hi-tech jobs for highly educated people, which is exactly the direction where Finnish society should be heading, because we will never be able to compete on price. On the other hand, when jobs are created in the biotech sector, it gives rise to service companies that can be used by all. A good service company specialized on some link of the value chain, such as innovative indication models for animals, can sell services in any part of the world."*

Finnish innovation policy concerning universities has been in a whirl of change during the last few years. Especially three central changes with a major impact on the Finnish university-industry relationship have been made.

The first is the new Universities Act which came into force on the first of January 2010. The purpose of the renewal was to give universities a more autonomous position in terms of financing and overall management, even though the State still remains the main financier. The purpose of the Act was to offer universities better premises to fulfil their three central assignments 1) research 2) education and 3) societal interaction.

The second change is the establishment of the Strategic Centres for Science, Technology and Innovation (CSTI, Finnish acronym SHOK). They are new public-private partnerships and their main goal is to promote collaboration between universities, research institutes and industry and to facilitate radical innovations. The Strategic Centre for Health and Well-being launched its operations on 6th of April 2009.

The third change is the University Inventions Act which took place in January 2007. The purpose of the Act is to promote technology transfer from research to industry. The Act gives universities the possibility to acquire the rights to inventions made by their personnel. Prior to the change those rights belonged to the inventor, unless otherwise agreed. The changed legislation also granted universities the right to hold shares in companies (Tahvanainen, 2009).

The changes both in the innovation environment and in the university-industry relationships rooting on these three strategic changes were seen mostly positive from the company representatives' and policymakers' point of view, but the total effect remains to be seen in the long run. Especially the innovation services and a more positive attitude towards commerciality at the universities were greeted with satisfaction. However, some worry on strategic decisions to reduce public research funding was brought up both in academia and in the industry; especially the concern that applied research is supported at the expense of basic research was raised. The recent ETLA study concerning these changes concluded that among university researchers all three reforms have been received pessimistically. Their study was from the researcher's perspective and brought out the concern that the commercialisation of the university environment is being implemented at the cost of academic research. (Tahvanainen and Nikulainen, 2010)

The overall view of the change in the atmosphere or image of the life sciences industry was kind of a balanced, since the quantity of respondents seeing positive changes was equal to those seeing negative changes taking place. The 'hype' that prevailed earlier was seen to have faded and today's enthusiasm is based on a new reality.

The fact that several Finnish biotech companies have achieved a more mature level was noted. These companies were established several years ago, they have learned from mistakes and acquired a significant capital of business and technology know-how. Since the biotech industry is based on highly complicated, specific and often cross-disciplinary knowledge which is still emerging, the companies cannot rely only on internal knowledge development (Pisano, 1994,DeCarolis and Deeds, 1999). Both the internal accumulated knowledge and access to external knowledge through networks are important for the performance of a company (DeCarolis and Deeds, 1999). Given the time that knowledge absorption needs, the know-how increases slowly as the company gets older. A lot of this knowledge can be a tacit, acquired through personal networks and while running the business. Based on interviews, more extensive networking and co-operation among firms was observed in the Finnish biotechnology sector. They offer ways to accumulate and absorb knowledge and to convert it to competitive advantage, especially in the form of more cross-disciplinary collaboration.

Weak signals of a growing understanding among investors towards the pharmaceutical industry were observed. This kind of development would be quite positive, since a common understanding of the special features of the biotechnology field is highly important for the growth of Life Sciences industry. The sector needs investors that do not expect too fast return on investments and can see the value of a project already long before the end product. The value of the project in the proof-of-concept stage can be much higher than the value of the end product in several other fields.

The wider understanding and support to the pharmaceutical industry could create new business prospects, since investments in the drug discovery create hi-tech employment positions, which can further create e.g. global service opportunities.

## 5.4 Challenges and opportunities

*"The biggest concern is this whole bio sector in Finland, what is Finland's future role in the global bio business. Will we be an R&D repository, where will we get financing in the future, and will we be able to build partnerships with the commercialising agents."*

### 5.4.1 Funding – the main challenge in Finnish biotech industry

*"It is difficult to get financing; funding just is not available for start-up companies in Finland."*

---

*"The Aho Government, or let's say these gamblers, subjected the bio sector to severe bloodletting by publicising their views of it."*

---

*"Good projects should get enough long-term financing. We've had a mentality of giving everyone a little, which means that nobody really gets anything. There should be strict screening and substantial investment in some chosen worthy projects. This way we could gain credibility even in international financial arenas."*

---

*"Private research funding in Finland exceeds public funding. Finland should take a political stand on whether it wants to increase the share of public funding to make it a leader in public research funding, too."*

---

*"We should pinpoint first rate research areas and provide them sufficient funding to raise them to an internationally high level, instead of giving the entire bio sector meagre funding."*

#### *Current situation*

European biotech industry has long lagged behind the US, the shortage of funding being among the main causes. Even though some positive trend in the development of private equity and venture capital market in Europe has been noticed, the United States still appears to have a markedly better developed market for VC (Gruber, 2009; Hege, 2009). Regardless of the positive tendency, still only a small fraction of the obtainable capital is invested in biotech start-ups. The complexity of the sector, long development times and inherent uncertainty related to biotech industry make it more risky than any other industrial field (Gruber, 2009). Due to a poor economic situation and hard competition the venture money is currently even more difficult to get than earlier, and the investors tend to finance companies whose products are already quite close to launch. Financial constraints comprise the main challenge to a growing biotechnology sector in Europe (European Commission, Key Figures 2007).

The situation in Finland, especially in the life sciences sector, is even more difficult than in rest of Europe. Sitra's decision to withdraw funding from the life sciences industry in early-mid 2000 was a hard backlash and consequently made some other investors to reconsider their investments also. Since then the funding situation has been challenging.

Even though hard times, especially from the financial perspective, have been reported both in Europe and in the US, the life science sector still remains among the most invested-in sectors. On European level the top three industrial sectors that received the most investments in 2009 were life sciences followed by consumer goods & retail and communications (Figure I) (EVCA Research Statistics, 2010). On the contrary, the biggest private and VC

investments in Finland went to software, nanotechnology and hardware & semiconductor industry (Figure II). The biggest changes in Finland from 2008 to 2009 were a major decline in the value of mobile industry investments and a significant increase in the value of investments in nanotechnology (Cardwell et al., 2010). However, quite positively the trend seems to be changing also in Finland, since the new figures from 2010 show 53% increase in value invested in life sciences, the total sum being around 16 million euros (Technopolis Plc, Technopolis Online Annual Report, 2011).

Understandably, the challenging situation with industrial funding emerged strongly from the Finnish interviews. The view was shared among all the different groups of participants, *i.e.* company representatives, policy makers and academia. This extremely hard situation puts new start-ups in a difficult position; companies are forced to develop new innovative business models for survival. Firms should find ways to turn their core competence into business before the actual product is on the market. Importing and distributing products, co-development of the products and services with customers already in the beginning, partnering, offering services or acquiring product licenses along with product development could offer new opportunities for achieving revenues at an earlier stage and would make the companies less dependent on financial markets from the beginning of operations. (Hermans et al., 2005a).

Yet, venture money is still needed. Finland has a good educational system and high level basic research in the life sciences field. However, without long-term financial support to companies, and patience with the investments it is quite difficult to turn those strengths into innovations and revenues. The concern that the financiers and the public sector fail to understand the special features and demands of the sector was conveyed.

In addition, especially the university representatives also expressed their concern on research funding. The basic research is the basis for research and innovations, and without a top level science we cannot expect success stories from the biotechnology field. Companies are also reported to increasingly rely on university alliances for their basic research (McMillan et al., 2000). However, some kind of focusing was also demanded. For a small country it is quite essential to pinpoint the main research areas and support them.

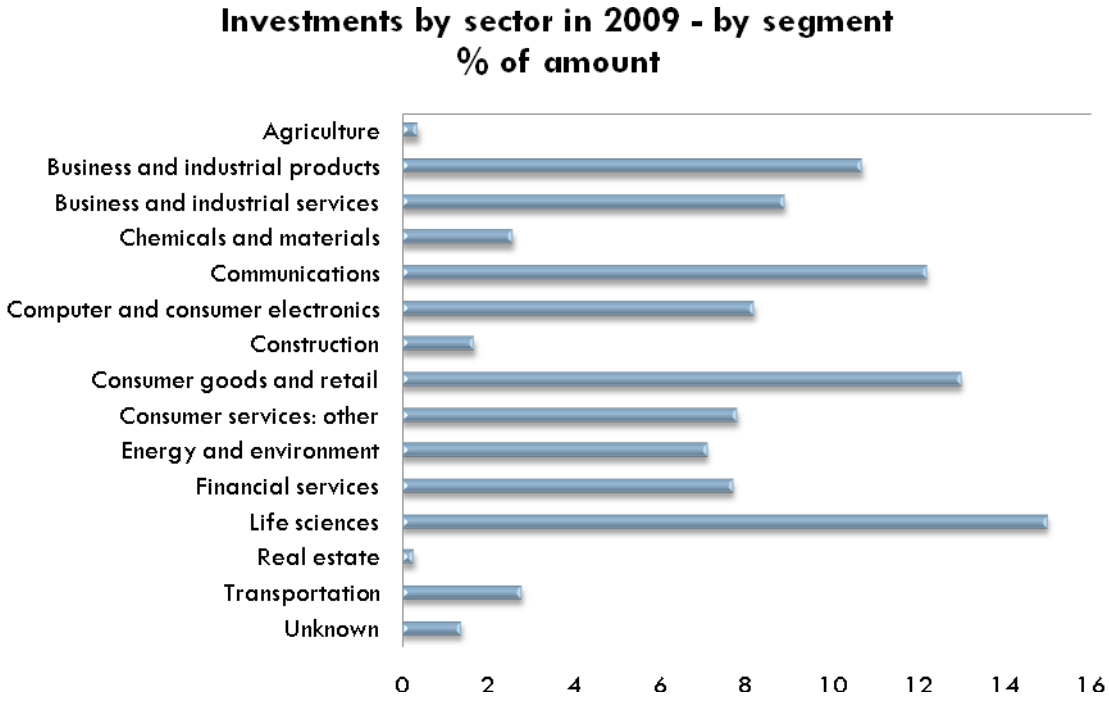



**Figure 5.1 Statistics representing 2009 annual investment activity undertaken by private equity and venture capital management companies located in Europe (source: EVCA/PEREP Analytics)**

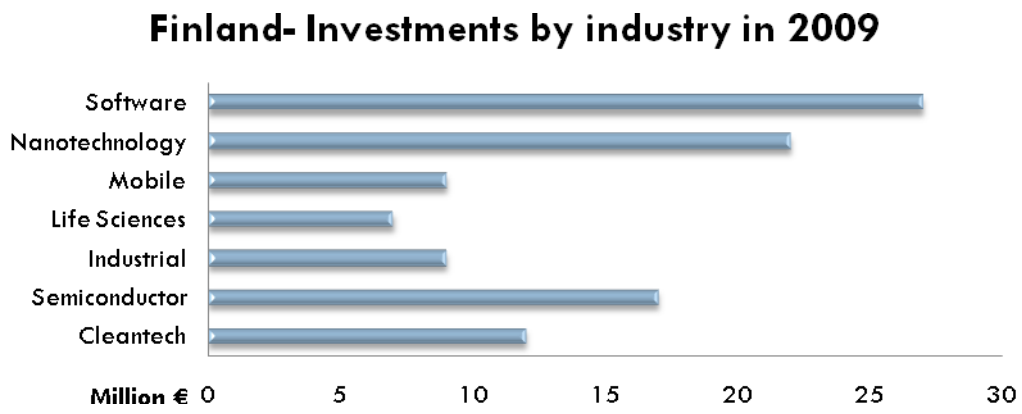



**Figure 5.2 Statistics representing 2009 annual investment activity undertaken by private equity and venture capital management companies In Finland (source: Technopolis Online Annual Report 2009)**

## *Factors affecting the availability of VC money*

***"The availability of venture capital is affected by the applicant's credibility, its employees, expertise, salaried staff and board – they all play a very big role. Finns, in fact, have a tendency to exaggerate technological aspects, which are unfortunately of surprisingly little importance. We should just remember to emphasise some other aspects as well."***

---

***"The team is often the most essential factor in the early stages. IPRs are also important, they may represent value. However, the financier may think that if the IPRs have no value, will the team be able to redirect the business into a new area while preserving the value of their operation, or are they playing just one card. For this reason the team is incredibly important."***

---

***"The availability of financing is affected, for instance, by the targeted market size and the partnerships required to enter the market."***

---

***"Are there any other business areas that could generate us some cash flow, or are we just pursuing a single innovation."***

The technology-push innovation model is often characteristic of biotech firms, since the basis of innovations is in scientific discoveries (Khilji et al., 2006). However, convincing the financiers, who often are not experts in the biotech area, needs focusing on other aspects as well. The money for even the most fascinating and promising innovations is not granted if the added value to customer is not communicated clearly enough. An exclusive focus on scientific developments may prevent incorporating market-oriented mechanisms and developing effective external linkages and collaboration (Khilji et al., 2006).

Networking and global partnering were seen to impact remarkably on the availability of venture capital. According to ETLA's (The research institute of Finnish economy) study on 2004, companies collaborating with foreign universities obtained the major part of the total equity financing (Hermans et al., 2005a). As a small country Finnish biotech companies have to go outside the country borders quite soon after the beginning. Thus early networking and partnering capabilities are crucial for companies' success.

An IPR's position and strength were brought up as important factors when applying venture capital money. However, especially among the financiers the importance of the team was raised as even more crucial for success. Commercial prospects, focus area (niche),

business idea, and reference customers were other factors mentioned as important for financiers, and so were development times, risks, regulatory barriers *etc.* In addition, cash flow from e.g. some services was mentioned to increase the possibilities for venture money.

### *How to attract global investors/companies to Finland?*

***"If people do not have faith in a company in Finland, it will not be easy to find a lead investor from abroad"***

---

***"We should all join forces, a single petitioner is useless but a bigger delegation is needed. I believe that the public sector actors should also be involved. Finland has a favourable operating environment that affects investments, so this should be a national effort."***

---

***"Somebody should make a real effort to make Finnish expertise known abroad."***

---

***"Tax benefits are extremely common tools in attracting and promoting R&D across the world."***

---

***"The decision-makers could first make economic changes in Finland, for instance, in taxation, and perhaps learn from Ireland how to attract a leading pharmaceutical company and its research and development to Finland. Practically all pharmaceutical research and development companies are leaving Finland. Funding for basic research should also be increased significantly."***

Since the situation with venture money is extremely difficult, we also asked about the means to attract global investors to Finland. The most critical issue was seen to be in the business idea, patent, concept or product, which should be unique. However, it is quite impossible or at least very hard to attract foreign investors, if the Finnish ones do not show their confidence in companies and projects. The right contacts are essential to draw investors into Finland, and without visibility it is impossible to attract the investor's attention. Finnish life sciences companies were commented to need more marketing, and the visibility of the sector should be increased. Finns were mentioned to be too modest in promoting the strong know-how we have in the biotech and life sciences sectors. As a small country we should join our forces including also public actors to promote our competence e.g. in big Bio congresses.

However, attracting some global companies to Finland is not very realistic without policymakers' support and actions. Thus, in addition to increased visibility, tax incentives and development of funding instruments were suggested, as well as development of national patent pools.

.

Taxes play a critical role when creating growth-friendly environment in which venture capitalists, business angels and companies feel comfortable in investing. Tax incentives for R&D are used in several countries, for example in 2005 70% of OECD member countries had tax incentives for R&D investments (Project:"Realisation of Young Innovative Company status, YIC, for biotech companies" supporte by European Commission., 2006). A working group of the Ministry of Employment and the Economy (MEE) has actually proposed the introduction of an R&D tax incentive scheme in Finland. The public R&D money for Finnish companies as well as tax incentives are clearly below the average of OECD countries (OECD , 2010). Tax incentives to business angels were also mentioned among the proposals.

Because of the link between the biotech and life sciences industry and university research, securing the funding for basic research was also seen highly essential for biotech's growth and success. Special know-how and top-level research have an important role when attracting foreign investors to Finland

### 5.4.2 Partnering and networking

*"The fact that everything has to be learned the hard way, through thick and thin, impedes growth. Therefore, international connections are really important as they provide shortcuts, networks of businesses and a roadmap for avoiding life's ditches"*

---

*"It is certainly worthwhile exploiting sources of information to find out who have done well, and to learn from their business models, and also use them in applying one's own knowledge, if one wants to use them as a benchmark."*

*"One pillar consists of these industrial support branches – parallel branches that may at best contribute financing, needs, business experience, and know-how. In principle, we have the potential right now; we still have global forestry companies."*

---

*"How could the expertise of the IT sector, of the people who have conducted successful international business, be transferred, for example, to the food industry in order to make new breakthroughs and conquer new markets?"*

---

*"Somebody should perhaps poke the companies that often search the same kind of contacts; maybe they could find something new in another branch or sector."*

---

*"It is a pity that we do not fully exploit the know-how that already exists in Finland, such as the forest industry, the paper industry and environmental technology."*

Global partnering and networking capacity and activity was not regarded strong enough in Finnish companies, especially when taking into consideration the size of our country. None of the new established biotech companies can stay just in the local market but have to go global right from the beginning. However, building successful global value chains and partnerships needs experience that many younger biotechnology firms are still lacking. The most important promoting factors for global partnering were funding and a need for special know-how missing from one's own organisation. A lack of resources, either people or money was the most obvious preventing factor. The group of interviewees consisting of policymakers, consultants and other experts implied that partners are sought too late, even though this view did not arise from the company or university representatives.

Because of the small size of the country partnering capabilities inside the Finland are quite limited. Research and service partners are quite easy to find, but not the commercial ones. On the other hand, if one would like to go to the global market, it is quite natural to search for a commercial partner outside the domestic borders. Several interviewees would like to see more intensive domestic partnering but the lack of information and knowledge is regarded as a preventive factor. We also do have successful international companies in other sectors. Even though biotech industry has its own peculiar features we could still learn a lot from other industries. Views that we should go out from our own sector were raised in several interviews. In fact, according to Ernst & Young Global Biotechnology Report 2010, partnering with non-traditional entrants will likely become a greater focus over time especially in the pharma sector.

Finland has strong expertise in industrial enzymes and bioprocesses, which added to the strong background in forest industry, could create new business opportunities in industrial biotechnology (Bioteknologia 2020 - hyvinvointia suomalaisille, 2009). Along with Nokia, ITC technology has also been pretty strong in Finland. This undoubtedly raises the question about actions that could facilitate domestic partnering and information sharing inside and over the sector borders.

In the life sciences industry universities are a group of partners whose importance is growing as outsourcing of R&D activities is steadily expanding. Universities are also showing interest towards more visible societal interaction and more effective utilisation of university inventions. Along with growing demand for industry-commissioned research

new mechanisms and concepts for university-industry collaboration are needed. More extensive exchange of personnel between universities and industry could facilitate more effective cooperation mechanisms and creation of mutual understanding. The new generation in universities was seen to be more positive towards closer relationships with industry, even though too tight bonds between university and university start-ups were implied to have a negative impact on the firm's performance.

### 5.4.3 Other challenges

#### *Atmosphere*

***"The greatest concern is the general mood, the appeal of the sector and the image factor. The last one should also be maintained and promoted"***

---

***"We surely could have used some positive examples; actually we have partly failed with them. For instance, Hormos is a rather valuable company, but when its backbone was breaking, it was sold to the United States. That is the problem."***

---

***"Finland has no tradition of entrepreneurship and the tax system punishes entrepreneurs rather harshly, for example, when transferring a company to a descendant. Yes, I would first revise the taxation to ensure that this country has a future; on the other hand, if we want to tax ourselves to death, that's our choice."***

The concern about the current atmosphere and the image of the sector characterise the innovation environment of the Finnish biotech sector. The extremely challenging funding situation has had a major impact on the current industrial climate. Also, the Finnish daily news, Helsingin Sanomat, was criticised for a negative attitude towards the biotechnology industry. However, we do have several successful profitable companies and several innovations that are known worldwide. We also have top level know-how and business in industrial enzymes, microbial productions, food and brewing industry and bioprocess technologies. Biotech industry, especially the life sciences sector, has not gained as much positive publicity as deserved, and in the lack of long-term financing several innovations and companies have been sold abroad.

In addition to the challenging atmosphere in the whole biotech or life sciences sector, the entrepreneurial climate was also commented to be unsupportive. Taxation issues and especially the need for tax incentives were emphasised in several interviews.

#### *Commercialisation*

***"The Finnish bio sector has potential that somehow cannot be realized. The invention phase as such works but thereafter the process stalls."***

Six of the 24 Finnish respondents mentioned the commercialisation of the research results as an issue in the Finnish innovation environment. This view was shared with policymakers, other experts and university representatives, but not mentioned among company representatives. Despite the fact that patenting delays scientific publications, evidence for a growing trend in university patenting is seen in Europe, even though the patenting activity still varies a lot between countries and disciplines. Moreover, there is no longer resistance to these kinds of activities at universities, and researchers have a reasonable estimate of the additional effort that patenting requires. (Leydesdorff and Meyer, 2007)

Nonetheless, in life sciences the distance from the patent to commercial product is still pretty long and the gap between the number of commercial products and the ideas/inventions caused some concern. University licensing is also not profitable for most universities although a few of them have succeeded in attracting significant additional revenues. (Geuna and Nesta, 2006)

To recognise the commercial potential of the inventions is challenging, and to find a working model for the technology transfer from university to industry requires continuous development as well as mechanisms to develop early phase products and methods further. The licensing price for very early phase inventions remains low, and actually it is extremely difficult even to find an interested commercialisation partner. Organisations that could assure the development of the inventions further and thus facilitate more efficient exploitation of university inventions would be needed. Stuart *et al.* (Stuart et al., 2007) estimate that half of the biotechnology firms have been founded by university scientists, most of whom maintained academic positions after founding. In these kinds of companies commercialisation competence is, unfortunately, often weak. The importance of good commercialisation partners was especially highlighted in the discussions.

## Business know-how

***"We lack business skills and ambition, we cannot squeeze enough out of the company to maintain its growth potential and valuation on a level that prevents it from being sold off right away. In my opinion Finns are not greedy enough."***

---

***"It is not true that we do not have business know-how – it is available, if not in one's own company, then at least in the company next door."***

Business competence has been raised as a challenge in the Finnish biotech industry for a long time. Many research-intensive and technologically high-class companies are stated to lack business competence (Hermans and Kulvik, 2004,Brännback et al., 2004). This view was also expressed in the current interviews, but not very strongly. In fact, even an opposite view was expressed by a company representative. Several biotech professionals have actually stated that the lack of business know-how was more true in the past than present, since the industry is more mature nowadays. We also have some entrepreneurs that have established several companies and gathered a remarkable social capital of business know-how. Undoubtedly, the new university start-ups still lack business competence, and it seems that the business know-how from the other sectors is not utilised effectively. Even though the life sciences industry has some peculiar features, many challenges from the business point of view are quite universal.

## Market size and location

***"Finnish companies face a completely different situation than those on the Lund-Copenhagen axis, for instance, where the international players are automatically involved and the right questions are automatically asked and contacts found."***

Finland's distant location as well as small market was expectedly seen as a challenge. There is not much to do about our geographical location, but increasing an understanding of the global economy and the global biotechnology industry is highly essential for Finnish biotechnology firms. Even more effective partnering and networking is thus needed. The

current study did not reveal a deeper insight into the challenges faced in partnering and in internationalisation, but a deeper look into this topic would certainly be valuable.

### Attitude

*"Finnish entrepreneurs are rather jealous of their ownership and intellectual property, they do not dare share it. They do not dare license and distribute their know-how for fear of someone lying or trying to steal it. Entrepreneurship is guided by fear which is a major hindrance. If we want success stories, we must charge ahead boldly."*

---

*"I think the situation is similar to Finnish sports: if you aim to finish 33rd at the Olympics, you will never win. The lack of ambition and greed results in mediocrity."*

---

*"Is it OK if you can employ yourself and a few buddies till the end of your life? Or would it be better to employ, say, 200 or 300 persons for the next 10 years and after that have nothing to do with the company. It is a cultural thing, which alternative suits the people. Many Finns have low ambition; they are content with funding their own laboratory for the next five years with some subsidy."*

In addition to distance and cultural differences, a too cautious attitude towards IPR issues was seen as a preventive factor for global collaboration. The lack of ambition, and risk aversive attitude were perceived to hinder the growth of the bio sector in Finland. In a comparative study of biotechnology in Europe (Critical, 2005) the lack of ambition and the lack of application have been speculated to be among the obstacles to European competitiveness in biotechnology, but the most likely cause is still thought to be the lack of a suitable financial infrastructure.

Compared to many other countries and especially to the US, the goal in entrepreneurship is often quite modest. The attitude, the entrepreneurial atmosphere and the valuation of entrepreneurship were seen to be among factors preventing high-growth entrepreneurship in Finland.

### Local networks

*"In Finland, none of the established companies has assumed the leading role that was eagerly expected"*

---

*"Bigger companies have been very passive in this area, not terribly active in sustaining these bio companies or this undergrowth"*

---

*"Our strength may lie in that we are a relatively homogeneous country with potential. If we all only realised that, we could create a national strategy and a common will to promote things; yes, in a country like Finland it would be possible"*

---

*"Finland is such a small country club that people pretty much know each other. That should be a strength, at least in theory."*

As a small country we do have quite good local networks, even though some frustration that the bigger companies have not taken the leading role and supported the small start-ups came up in the interviews. Still the local networks were not regarded as strong as they could be – more potential for local collaboration was seen. This need has been recognised already, and several organisations, e.g. HealthBIO, Tekes and Science Parks have facilitated the partnering by organising networking and partnering events in the Finnish bio sector. Some activities towards more cross-disciplinary collaboration have also been

arranged, for instance “Bio meets Nano and IT” organised by BioForum Oulu in 2008. Finland's small size and strong local networks could be a strength, especially if we could create a national strategy and a common goal. Even though actors in the field are known quite well, a deeper knowledge of the other’s business is still lacking. By joining their forces smaller companies could increase their visibility, competence and offering and thus create additional value by collaboration and partnering.

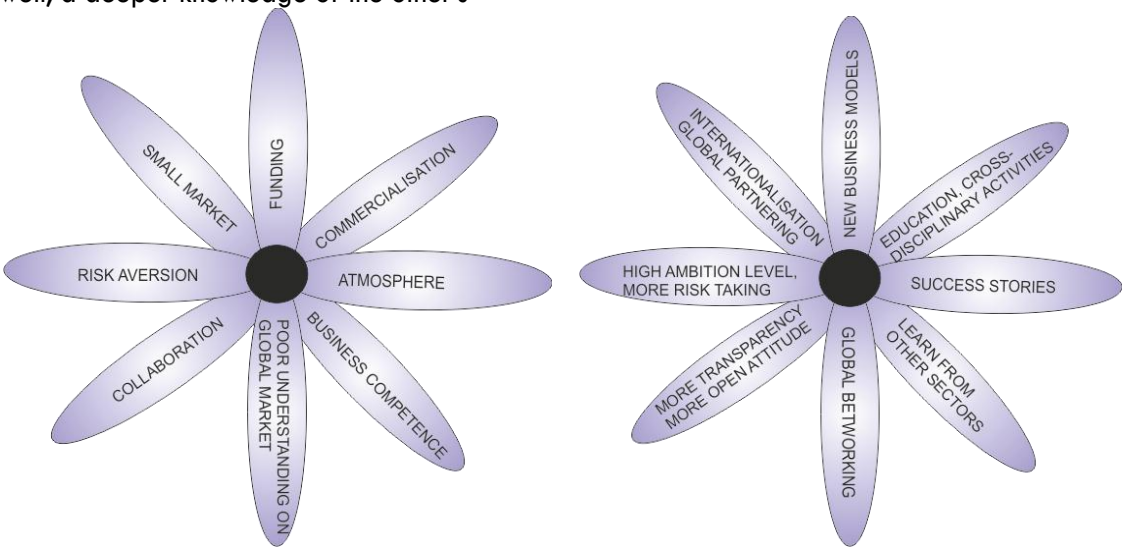



**Figure 5.3 Challenges and opportunities visualised by a foresight tool context map (more about tools in page 37)**

## 5.5 Strengths and unique capabilities

*"All indicators suggest that the clinical research in Finland is the best in the world, and we are also world leaders in biomedical expertise. In all of these engineering sciences on which Nokia is based, we are top of the world. In this light we should be an innovative country. We have a good educational system that should promote this, and a good health system that should also be able to support such further development. This foundation already exists."*

---

*"We have nothing special to give. Perhaps our stable society makes us too lazy for hard work"*

---

*"I do not find the Finnish diagnostics or pharmaceutical industries interesting as a whole; every company has to be considered individually."*

---

*"The level of basic research is good in Finland; even some untapped resources can be found there. It is clearly a strength."*

---

*"I think Finland has nothing special to give as concerns the expertise of individuals. But if there is an area where we are world leaders, or at least close to it, it is in complex things that need combining the expertise of many sectors. In Finland all technological sectors are about equally strong, and we have many kinds of top expertise."*

---

*"Clearly more service companies have emerged, and diagnostics is also a pretty strong area. Because it is so difficult in Finland to get long-term financing, for example, for the development of medicines, companies prefer areas that do not require as much initial capital."*

To be able to compete in the global market Finland should find some unique strengths and niche areas, even though it is increasingly difficult in the global biotechnology sector. Thus a few interviewees saw that Finland, as a country, has nothing special to offer, it is more a question of individuals or companies finding a good market niche or unmet needs. However, according to many interviewees Finland is still having some top research in specific areas including e.g. diagnostics, clinical, vaccine, brain, cardiovascular, cancer and diabetes research. Some special areas with industrial applications, such as food safety, functional foods, rapid tests and biomaterials were also mentioned. Finland has a good competence in clinical research and holds a high international standard, we have a long track record in clinical trials, but the number of new trials is decreasing. Initiatives to maintain a high level of competence have been made. The FinnTrials project aims to improve the international competence of Finnish clinical trials and Finpedmed (Finnish Investigators Network for Pediatric Medicines) established in 2007 wants to establish itself as a nationally and internationally reliable and state-of-the-art paediatric trial unit. (www.finpedmed.fi)

In addition, as a small country, a role as a test bed was suggested for Finland, since Finnish patients and personnel usually have a highly positive attitude towards research. Foreign companies could utilise the good patient registers, as well as the good health care system. Special competence was seen especially in cross-sectoral projects where different areas of expertise are combined. The Finnish long tradition and competence in global forest industry was mentioned as a strength even though the industrial or environmental biotechnology was actually not included in the area of this study. More systemic solutions were suggested in promoting Finnish competence. For example, the health care system and biobanks as well as the development of patent pools should be combined with the existing industry to promote the whole bio sector in Finland.

Despite strong biomedical research, diagnostics were seen to carry the biggest potential in the life sciences sector. This is mostly due to the funding situation along with the long history on diagnostics and the profitability of the sector. Drug development, functional foods, biomaterials and the service business were also mentioned as sectors to suit Finland's strengths. The service business is a growing area and certainly some additional business opportunities could be found in the selected niche areas.

## 5.6 Customer

***"Quite a few innovations come from the customer. There is no use hiding that or trying to take credit for them. In technology, in particular, the present trend is to do development work in cooperation with the customer."***

---

***"I firmly believe that the whole logic has changed. It was reflected in some of the first web start-ups that started delivering service at a relatively early stage. The customer is told that the system is not even supposed to be fully finished, and the main thing is to start interacting with the customer at an early stage. This change has been rather evident, not necessarily everywhere, but many successful companies have revised their entire operating procedure on this basis – and the benefits can be seen."***

The only way for companies to succeed in any market is through developing compelling offerings that bring added value to customers. Currently, bio industry is described as research(er)-based and technology-oriented sector where customer-orientation is not emphasised enough. Additionally, in the life sciences industry the role of the customers is ambiguous. Besides the traditional users and customers consisting of laboratory personnel, doctors, prescribers and decision makers, also KELA (The Social Insurance Institution of Finland), financiers, opinion leaders, different kinds of authorities and other influencers are customers as well. Along with increasing information the customer's role changes towards more conscious and demanding. Faster communication

methods, tough competition, quality issues and regulations set new challenges to customer interaction.

Especially, a difference between "ordinary customers" and "lead users" (Von Hippel, 1986) is made. Lilien *et al* (Lilien et al., 2002)carried out a performance assessment of the lead user concept in the idea generation of new product development and found that lead user ideas were significantly newer than ideas generated by non-lead user customers. However, Neale and Corkindale (Neale and Corkindale, 1998) state that the lead user method is a demand-driven technique for new product development and Ulwick (Ulwick, 2002) states that lead users may offer product ideas but since they are not average users their recommendations might lead the organisation to develop products that have limited appeal in the markets. Furthermore, Atuahene-Gima (Atuahene-Gima, 1995) found in his own study that market orientation contributes to the success of incremental new products but has an insignificant effect on the performance of radical new products. Finally, Atuahene-Gima (Atuahene-Gima, 1995) states that in a less turbulent environment market orientation is relatively less important than in turbulent markets while, for example, Jarowski and Kohli (Jaworski and Kohli, 1993) found that market orientation is important irrespective of the competitive intensity.

Currently, empirical evidence about the relationship between market orientation and performance is inconclusive (Atuahene-Gima, 1995) because there are both studies that argue in favour of customer orientation (Cooper, 1999,Montoya-Weiss and Calantone, 1994) and others that take the opposite viewpoint. Customer orientation has been criticised for leading to incremental and trivial product development efforts: myopic R&D programs and confused business processes. (Atuahene-Gima, 1995)

The role of the customer in the company's innovation process varies depending on the industrial sector. The possibility for straight participation is quite different in the pharma industry than in instrument development. However, the open innovation paradigm is also utilised increasingly in the pharmaceutical sector. For example, in 2001 Innocentive spun out from Eli Lilly. It was the first company connecting scientists as problem solvers and the companies trying to find solutions for their problems (Munos, 2006). After this similar kind of internet based platforms for different kinds of problems have been launched (Hunter and Stephens, 2010)

Salomo et al. (Salomo et al., 2003) claim that customers may have more knowledge about their needs and better understanding about the relevant product- and service requirements than the organisation developing new concepts. Also, Cooper (1999) states that successful businesses have a "slave-like" dedication to the voice of customer. In the life sciences field many of the innovations originate from the customer, even though the customer is often not directly involved in the innovation process itself. Companies actually found it quite challenging to find ways to acquire customer input to the development process since customers and users do not express their needs and wishes as much as companies would like them to. In fact, Thomke and von Hippel (Thomke and Von Hippel, 2002) state that even if customers know what they want they are unable to communicate it either clearly or completely.

Nonetheless, a change towards increasing participation of customers was recognised. In some companies the customer is involved already from the beginning but sometimes their role is rather like a prototype tester, and a few companies said that the customer is not involved in the innovation process at all. More systematic utilisation of the customer information and gaining a deeper understanding on customer's processes could create new ideas for the development of products or services.

# 6. San Francisco Bay Area

## 6.1 As an innovation environment

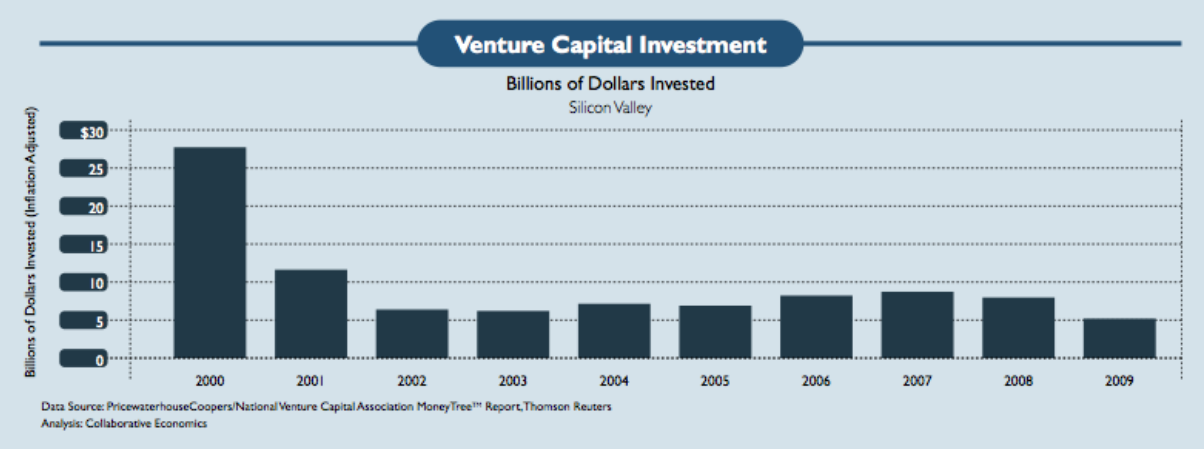
Over 50 years in the making, Silicon Valley, and the broader San Francisco Bay Area, is known for its resilience to undergo economic changes and capitalize on emerging technologies. The life sciences sector is one of many industries that has benefited from the region's array of resources. The Bay Area provides a rich ecosystem with strong universities, funding capital, and diverse foreign talent, all of which spur local entrepreneurship and innovation.

University research continues to drive significant advances in biotech and the life sciences. The Bay Area is home to four major research universities with over US$500 million in research funding: University of California at Davis, University of California at San Francisco, University of California at Berkeley, and Stanford University. For example, Stanford faculty have invented several important technologies, such as the gene chip with diverse applications in personalized medicine, and today continues to pioneer the areas of bioengineering, biomedicine, and biosciences as part of its Bio-X initiative.

Other regions look to the Bay Area's success in funding innovation, primarily the model of venture capital. In recent years, the region has typically collected one-third to 40 percent of venture dollars in the U.S., according to *Mercury News* (Harris, 2010). Figure 6.1 shows the overall distribution of venture capital since 2000. Joint Venture has found that venture capital investment has shifted away from software and semiconductors and into biotech, medical devices, and energy locally. In fact, biotech and medical devices received the greatest amount of venture investment in 2008 (Joint Venture Silicon Valley Network , 2011).

Local funding is only part of the success. Foreign-born talent plays a critical role in regional growth, and UC Berkeley professor AnnaLee Saxenian has studied the growing international mobility of entrepreneurs (Saxenian, 2006). Skilled immigrants account for one third of the Bay Area's engineering workforce and are increasingly visible as entrepreneurs and investors. Two thirds of the region's foreign-born engineers were from Asia, and in turn, Chinese and Indian immigrants accounted for 74% of the total Asian-born engineering workforce. Their global viewpoints and connections abroad further enrich the local culture and appetite for new ideas.

Beyond these obvious ingredients, an intangible and unique aspect of Silicon Valley, which permeates the broader Bay Area, is the entrepreneurial energy. Visitors sense the pioneering spirit and urgency to act immediately. Chiron Corp. cofounder Ed Penhoet described it as such, "That tireless, dedicated – sometimes manic – way of doing research, of driving relentlessly toward the goal, has been a key factor in making local companies successful. It was the model for the way of working in the nascent industry of biotech."




Modern biotechnology has its roots in the Bay Area (BayBio, Northern California's Life Science Association, 2010). In 1971, biotech

was born in the Bay Area when Cetus Corporation was founded to develop new pharmaceutical drugs and techniques. Five years later, Genentech opened its doors and is credited with launching the biotech industry. Genentech remains the largest biotech company in the region.

Breakthroughs by scientists at the University of California in San Francisco and Stanford University led to recombinant DNA, amid other discoveries. By the late 1970s, the region was leading the world in life sciences research, defining many of the new genetic engineering methods. However, there was no tradition of a pharmaceutical industry in the Bay Area, and no state subsidies existed to accelerate development. Moreover, no big programs were in place to attract or retain industry. Instead, many believe that the early biotech entrepreneurs were drawn to each other and to the optimistic climate of the region. These entrepreneurs could also follow the growth lessons of the earlier electronics industry, which had taken root in the Bay Area.

The local biotech industry continued to thrive and create new areas of research. The first agricultural biotechnology company, International Plant Research Institute, was founded here in 1986. Today, Northern California has the largest cluster of life sciences companies in the United States with over 1,300 companies and over 100,000 employees, according to trade association BayBio (BayBio, Northern California's Life Science Association, 2010). Although employment is relatively small compared to IT and service-related sectors, biotech and the life sciences are almost three time more concentrated in the Bay Area than in the rest of the U.S. This strong growth underscores the Bay Area as an innovation environment and hot spot.

# 7. Comparison of the views between Finland and San Francisco Bay Area

*"When an inventor in Silicon Valley opens his garage door to show off his latest idea, he has 50% of the world market in front of him. When an in inventor in Finland opens his garage door, he faces three feet of snow."*
*J.O. Nieminen, CEO of Nokia Mobira, 1984* (quoted in van Tulder p. 169) (van Tulder, 1988))

## 7.1 Regional Differences

### 7.1.1 Innovation environment for biotechnology

***"Some public actors, newspapers, and others may claim that the bio sector should already be referred to in the past tense, but they couldn't be more wrong. It is just due to the typical impatience that we often meet when things move much slower than desired. But they do move like a train, and their impact is already apparent in many things."*** *– Finnish interviewee*

---

***"We do a lot of research and get much research results, but there is little innovation, so the biggest concern is how to translate the former into the latter."*** *–Finnish interviewee*

---

***"In Finland we do not have the same spirit as in the USA, where numerous researchers have the primary goal of launching a product on the market or selling their start-up to a larger company. In Finland very few researchers have the same main goal. Here, it is often, possibly, considered a last resort."*** *– Finnish interviewee*

---

***"Does the Finnish legislation support entrepreneurship? I do not know. Could it be better? Entrepreneurs at least complain that it does not support entrepreneurship."*** *–Finnish interviewee*

---

***"Financing is a problem; it has been difficult to attract global capital to support these projects as the competition for capital is so tough around the world. That is probably the key factor; financing from Tekes is unfortunately not enough for global success."*** *– Finnish interviewee*

---

***"In a way, biotech is very much like the Screen Actors Guild, where you have to have been in a film to get a card, but can't get a card until you've been in a film. Similarly, you've got to have had biotech successes before you can have a thriving biotech sector; otherwise the money's not there and the employees certainly won't be."*** *– Bay Area interviewee*

In Bay Area the bio-industry is thriving with numerous successful bio-companies. The existing bio-industry, skilled employees and available funding are seen as major strengths. However, even in the U.S. it was only in 2008 that the bio industry turned a profit for the first time in its 40-year history. In Europe the net loss of biotech industry has decreased and was already quite near the break-even in 2009 (see Table 1).

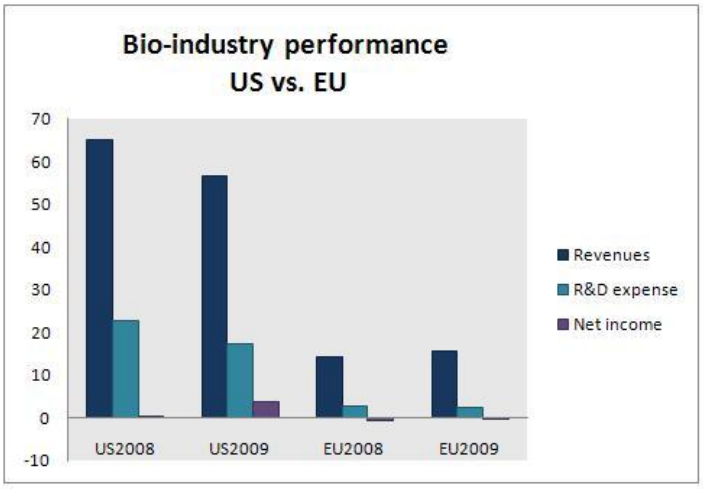



**Table 1** Comparison of performance of US and European biotech companies in 2008 and 2009. (Source Ernst&Young biotech report, Beyond borders 2010)

In Finland the Tekes (the Finnish Funding Agency for Technology and Innovation) and top-quality basic research are considered a remarkable strength. The early phase of the innovation process – ideas and research results - is seen to be working extremely well, but converting it to profitable innovations seems to be a major issue.

In Finland, the strong local networks, high-level of education and infrastructure should be harnessed even more efficiently to support the growth of the biotech industry. The public image and the atmosphere of the sector were regarded as one of the major obstacles to success, even though several noteworthy biotechnological innovations have originated in Finland. A higher ambition level, a more daring and risk-taking attitude were demanded in the Finnish interviews. Moreover, the entrepreneurial climate, legislation and taxation system were not regarded as highly supportive in Finland. Interestingly, Scientific American Worldwide has ranked Finland into the top ten countries both in 2009 and 2010 in their Global Biotechnology Reports. The ranking is based on how conductive the countries are to biotechnology innovation, one of the metrics being enterprise support. In the same comparison, US is number one (Friedman, 2009;Friedman, 2010)

A significant strength in SF Bay Area is people who have succeeded in biotech industry and the critical mass of companies and universities in the area. Several top research institutes, Stanford, Berkeley and University of California, San Francisco are located in the area and continue to nurture the biotech industry. As some success has already been attained, people are more willing to take risks. This attitude promotes the industry and creates more innovations as one interviewee from the Bay Area expressed:
***"innovation tends to beget innovation".***
However, a concern is raised that in Bay Area the financiers tend to invest in safer projects, e.g. drugs in late-stage trials and medical devices near launch that may not necessarily be the most innovative ones. The same trend is seen in Europe; in tough competition European investors are increasingly less interested in early-stage companies. Compared to the rest of Europe, the situation is even more difficult in Finland. Central actors of bio- and bio-oriented industries have implied that financing is extremely difficult to gain.

Since Finland, in contrast to Bay Area, is lacking big pharma and serial entrepreneurs in the biotech industry, the business competence and commercialisation pose challenges in the Finnish innovation environment. Good science is a prerequisite for innovations in biotech industry but not enough for success. In the Scientific American Worldwide Biotechnology report, Steven Casper, associate professor and director of the Master of Biosciences program at Keck graduate Institute in Claremont, California, comments that when *"looking at senior management in German biotechs in 2003 -2004, only 11 of 300 had any industry experience. By comparison 85 percent of senior managers in San Diego had a background in industry".* (May, 2009). Finland has no long industrial history in the development of pharmaceuticals or any other branch of industry that requires expertise needed in the biotechnology business (Hermans et al., 2005b). However, as the industry is maturing,

the business competence is also gradually accumulating.

### 7.1.2 Finland's appeal

***"I have heard some good things about the basic research and tissue engineering work being done in Scandinavia."*** *– Bay Area interviewee*

---

***"What they tend to do best is work in a focused area, and they tend to do that pretty well… not necessarily the whole thing"*** *– Bay Area interviewee*

---

***"What could be appealing about medical product collaborations in the Scandinavia region is their well-managed and well documented healthcare delivery system."*** *– Bay Area interviewee*

---

***"The biggest barriers to success with U.S. life science companies are slower than expected patient accrual into clinical trials, and/or excessively complex clinical trial requirements put forward by the FDA. If a Scandinavian partner could help overcome one or more of these, there would be value in the collaboration."*** *– Bay Area interviewee*

---

***"It is often said that Finland has excellent parish registries and collections of samples, and combining them produces added value. You could try to make better use of the Scandinavian public health care system, for example, by cross-checking databases. This, however, requires some big decisions from the legislators (e.g. laws on bio-banks)."*** *– Finnish interviewee*

---

***The biggest disadvantage of clinical development in Scandinavia, of course, is the relative genetic homogeneity of their populations – few Asians, Africans, Southern Europeans, or South Americans."*** *- Bay Area interviewee*

Despite the challenges Finland has some unique strengths. First, the technological, internationally recognised competence creates a fruitful platform for the development of the industry. Also, the small domestic market can be used as a test market and the global aspect is self-evident for companies right from the outset. Basic research and focusing on narrow specific areas have been Finland's strengths and could keep us in competition. The same view was shared in Bay Area's comments.

Additionally, the single reimbursement system combined with a complete patient register increase the potential of clinical studies. The need for this kind of collaboration was clearly noticed in Bay Area. The good health care system with access to patient samples could offer new business opportunities since one of the obstacles to biotech growth in Bay Area was ***"access to clinical samples, with full treatment and outcome history"***, the fragmentation of the US health care system being a problem. Distinct and often competing entities are responsible for the financing and delivery of health care, each of these units often having its own objectives, capabilities and obligations (Cebul et al., 2008). Therefore from the Bay Area perspective the Scandinavian health care system is seen as added value in collaboration projects, and the Scandinavian social security number identification system offers a way to map the samples with patient data. However, decentralised provision of health care services by local authorities in Finland causes some problems, since several different kind of patient record systems are in use and they do not always communicate with each other. In addition, genetic homogeneity and the small size of the population may also be a disadvantage.

The potential of the Scandinavian health care system is also recognised in Finland, the law on establishing a bio-bank for blood and tissue samples in Finland is under preparation and should have originally come into effect at the start of 2010. Ministry of Social Affairs and Health aims to get the law passed by the start of 2012. Once established, the Finnish bio-bank should have an advantage compared to

many other countries, because the samples are coordinated with health and lifestyle data about the donors. (Finnish Government, Ministry of Social Affairs and Health 29.12.2010, Yle News 30.8.2010).

Further, Finland has committed 5 million euros to support a national Biomedinfra-project. The project aims to link the country's biobanking, bioinformatics, and translational research resources, and will also connect to a much larger EU effort to integrate resources in these areas. Biomedinfra will develop a biobanking infrastructure for epidemiological, biomedical, and clinical research; create high-performance computing infrastructure to facilitate next-generation biomedical data analysis; and build a translational research infrastructure aimed at using biobank data to advance diagnostics and personalised medicine. The country hopes that the infrastructure will improve healthcare in Finland, provide opportunities for international collaboration and research services, and help to integrate its research infrastructure with the EU's efforts. (http://www.genomeweb.com/informatics/finland-invests-67m-connect-biobanking-bioinformatics-and-translational-research)

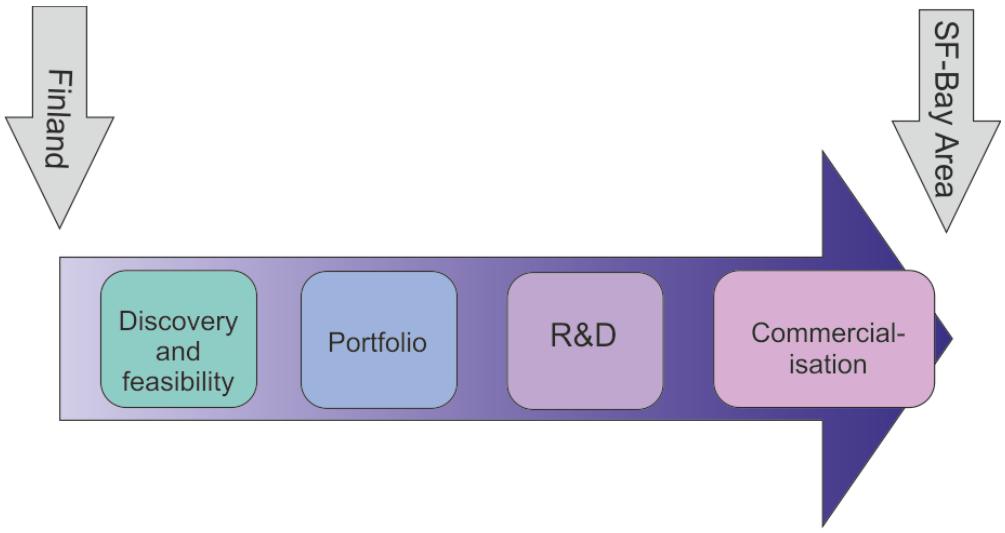



**Figure 7.1** Position of Finland's and SF-Bay Area's Strengths in innovation process

### 7.1.3 Global Views

#### *USA*

***"No comparison – the U.S. wins hands-down, for now."*** *–BayArea interviewee*

---

***"Well, the promotion of these bio sectors is pretty much in the hands of the USA and it is because of their money and expertise. Others are sort of lagging behind."*** *– Finnish interviewee*

---

***"In the USA you will receive 10-fold, or maybe even 100-fold funding, compared with Finland at the same stage of a project, since the domestic market from which the investor expects a return is bigger."*** *-Finnish inteviewee*

The origin of the modern biotechnology industry is in the US, and it is still a forerunner both in biotechnological research and industry. When asking to compare the bio areas around the world, the leading position of the U.S. in biotechnology was quite evident.

The functional relationship between university and industry has affected industrial success, and the advantage based on the size of the local market and available funding are also undisputed. In the US some investors are specialised in the bio industry and are thus more familiar with the peculiarity of the sector.

## Europe

***"Europe does have venture capital and capitalists and whatnot, but much less than the USA. Financing has been the major factor behind the success of the bio sector in the USA."*** *- Finnish interviewee*

---

***"Europe in general has a hard time in biotech because you don't really find the clusters of qualified employees and the risk capital is a lot harder to get. Denmark's got some antibody companies, France has some genomics companies, Germany has a few interesting and innovative companies (all struggling), there are some protein manufacturing companies in the Netherlands, and there's basically nothing left in the UK, Spain or Italy."*** *- Bay Area interviewee*

---

***"In agriculture Europe is lagging behind because of the strict attitudes to all GMO products."*** *– Finnish interviewee*

---

***"The problem with Europe has been the legislation, everything is so strictly regulated. As such, it is good that people are protected and the control is strict, but, especially in the green biotech, it has been an obstacle to development."-*** *Finnish interviewee*

Even though biotechnological research is regarded quite strong in Europe, in business and commercialisation Europe clearly lags behind US. A lot of directives and regulations have been enacted on EU level, but Europe is still quite fragmented; all EU countries having their own legislation, taxation, research and education systems. In addition, filing a patent in Europe is complicated and expensive as there is no Europe-wide community patent. The European legislation and dogmatism in refusing GMOs were also seen as slowing factors for business development.

## India and China

**Common**

***"China and India are still a "Wild West", which means that anything goes and the benefits of the traditional Nordic comforts are absent."*** *– Finnish interviewee*

---

***"In China and India, biotechnology is part of society's growth strategy; it has been seen as an opportunity for society. It has mainly given rise to service operations, but real innovation or even ideas are still relatively rare. New service operations are emerging, and if they create the know-how, pharmaceutical industry will probably also arise sooner or later."*** *- Finnish interviewee*

---

***"In China and India the production and service business work."*** *- Finnish interviewee*

**China:**

***"Intellectual property is difficult to protect; labour and manufacturing are inexpensive; product quality (and delivery of care) is much less regulated."-*** *Bay Area interviewee*

---

***"They don't have a culture of innovation and relatively few Mainland Chinese that I've met understand how to direct a novel, innovative research program…"*** *- Bay Area interviewee*

---

***"The Chinese copy everything. On the other hand, they also concentrate heavily on basic research."*** *– Finnish interviewee*

---

***"The Far East, South Korea and Singapore are becoming really competitive with original inventions, and the same will soon apply to China. In this sense, the competition will intensify and the differences will begin to even out."*** *– Finnish interviewee*

*"There is a lot of talk about China, it is a big growth market and some day it will be the place to make big money. Trade terms and reliability are still a problem."* Finnish interviewee

***India:***

*"The Indians have focused on ROW (rest-of-the-world) vaccines and generics, at which they're incredibly good… But that's not biotech, that's executing lower-margin businesses extremely well."* –Bay Area interviewee

---

*"In India agreements are observed better than in China. The Indian have marketed cheap and competent labour"* – Finnish interviewee

Both China and India are emerging economies and will undoubtedly play an increasing role in shaping the global biotechnology industry and market. Both countries are supposed to sustain an 8 to 9 % economic growth over the next few years (Bawa et al., 2010). The market potential of Asia is huge and biotechnology production has already been moved to Asia on a large scale. In both of these countries research is considered stronger than earlier and especially China has made big investments in the bio sector. In particular the service business and the know-how acquired in running the business can facilitate further development of the pharmaceutical industry in these countries.

India is regarded to have some advantages over China in contract agreements and communication. As a former colony of Britain its legislation resembles the British one, and the terms of contracts are respected more than in China. Moreover, communication is easier, since English is widely spoken. In India, the population is growing and the number of trained technologists and scientists is remarkable. The cost of production of generic drugs has in some cases been less than 1% of their cost in the US. India has large human biodiversity and a large number of naïve patients of various diseases. This makes India as attracting country for clinical trials and clinical research.(Bhargava and Suresh, 2009).

China's biotechnology industry is not a mature one, but during the 11th 5-year plan (2006-2010) China's government has focused on launching several biotechnology projects to address the critical challenges from the fields of health, food, energy and environmental issues. Bio-pharmaceuticals are one of the top priorities in the medium-to-long-term plan for the development of Science and Technology (2006–2020). (Wang et al., 2009).

## Finland

*"In Finland we probably have a comparable starting point, with the exception of funding, but there is still a lot to do in the field of networking. American and Indian bio sector companies can rely on their own national networking, which gives them a solid foundation. If a Finnish company wants to get networked, we must go abroad because only international networking counts; national networking is not very useful."* – Finnish interviewee

---

*"The Swedes are much better in marketing their accomplishments than Finns. Sweden has a strong pharmaceutical industry basis. When the pharmaceutical industry was run down, the employees moved to bio sector companies, which meant that the biotech companies received people with experience from international business, while in Finland the companies have been established by researchers. Sweden has many factors that give it an advantage over Finland."* Finnish interviewee

Finland's position in the bio industry was seen comparable to Europe, except for the shortage of funding. The need for funding was regarded as the most severe problem by the companies already in 2003 (Luukkonen, 2005) and the situation has not changed a lot since then. Moreover, the Finnish local market size is small and thus the ability to build global networks

right from the beginning plays a more important role in Finland than in many other countries.

In contrast to several other countries (e.g. Sweden) Finland has never developed industry in the pharmaceutical field, which sets us in poorer position as we lack skilled employees and relevant business know-how. The shortage of experienced work force was also compared to that in Denmark, since we do have good clinical and biomedical research, but have not been able to create a thriving industry for these fields. Furthermore, the academy-industry relationship is an important enabler for a successful biotechnological industry, and was considered closer and more functional especially in the US, but also in Denmark's Medicon Valley.

## 7.2 University-industry relationship

The relationship between public research institutions and the biotechnology industry is quite exceptional compared to all the other industries. In fact, the emergence of the biotechnology industry has been totally dependent on university research. (Dalpé, 2003). The life sciences sector also differs from other industries in that the university-industry relationships continue from the early stages of technology development until the time after the commercialisation of discoveries (Powell et al., 2007)

In many industrialised countries a reduction in direct research funding during the 1990s has promoted the university industry collaboration. Universities have searched new sources of funding and have adopted new approaches to develop industrial collaboration. On the other hand, in the BioPharma sector the increased technological costs and higher regulatory demands have forced companies to search for alternative R&D models to be able to enhance the innovation capability and to get new products to the market faster (Kleyn et al., 2007). Thus the innovation paradigm is shifting from closed to open innovation (Chesbrough, 2003).

### 7.2.1 U.S.

***Most academic institutions are instituting policies that make the industry-academia relationship more tricky."***

---

***"The role of the university continues to be the engine which nurtures the basic research upon which innovative new products can be created. This research function has potentially gotten stronger with increased investment by government and private parties."***

---

***"I think there is a much greater emphasis on translational research, and bringing new technology from the bench-top to a patient's bedside."***

The US university system has a long history in conducting research that has a major impact on technological development and industrial performance (Owen-Smith et al., 2002). The growing commercialisation of academic research has its roots in the technology transfer offices created by American universities and in the Bayh-Dole Act 1980 - legislation allowing commercial use of university research. Since 1980 patents assigned to US research universities have increased over 800%. (Powell et al., 2007). Several other initiatives to promote university-industry relationship were also made in the 1980s (Poyago-Theotoky et al., 2002). It has been stated that in the US the relationship between university scientists and industry is closer than anywhere else, which is regarded as one of the reasons why US is a leading country in the biotechnology industry (Dalpé, 2003). Nonetheless, some critical comments on

the academic partners in university-industry relationships were raised in interviews.

Moreover, the patent legislation allowing a one year grace period may give some advantage to the US over the European patent law. A few countries, including the USA and Japan, allow a period, usually 12 months, during which the inventor is allowed to file a patent application after publishing his or her invention e.g. in a scientific publication. The European system denies such rights; publishing the invention is an obstacle for novelty. Consequently, in the US the patent's extension abroad also increases the publication delay considerably (Franzoni and Scellato, 2010). According to Franzoni and Scellato (2010) nearly one third of academic inventors in the US actually use the grace period exception. Since publication productivity is crucial in an academic career there is some controversy between early disclosures of inventions at conferences or in scientific papers and patent filing.

In the Bay Area industry the universities' role in basic research was seen highly central. McMillan and co. (2000) state that the biotechnology industry relies on basic public science more than the pharmaceutical industry does. The public science is seen critical to US industry and the public funding nurturing basic research is strategically important to US economy. (McMillan et al., 2000). Basic science is the basis and the key component of academic science and increasingly seen as complementary to applied science (Lee, 1996). On the other hand, the recognition of the importance of translational research in universities is also growing. The opportunities that the research achievements offer in several fields, including genomics and proteomics, should be converted into real applications and practices in clinics (Zerhouni, 2007).

### 7.2.2 Europe

In Europe more attention has been paid to university-industry relationships and technology transfer since late 1980's (Owen-Smith et al., 2002). Many countries are adopting Bayh-Dole inspired legislations and developing technology transfer offices (Valentin and Jensen, 2007). However, it seems that compared to the US Europe is still more basic research and less commercialisation oriented (Ryan and Phillips, 2002). In addition, the blurring boundaries between basic and applied research and huge competition for research funding facilitate greater mixing of disciplines in the US (Owen-Smith et al., 2002,Galambos and Sturchio, 1998). The research infrastructures also have some major differences between the US and Europe, the European system being more centralised in terms of financing, and thus also more hierarchically controlled. This probably also plays an important role in the formation of university-industry relationships in the European region (Owen-Smith et al., 2002).

### 7.2.3 Finland

***"The new university legislation forces universities to view themselves increasingly as profit centres, which is both good and bad. That makes it necessary to evaluate how universities interact with society. This should, however, not be taken too far. I am worried that universities might become mere extensions of the research and development units of companies. It is also important to do research that only serves the production of information."*** *- Finnish interviewee*

---

***"Research is like facing a mountain without knowing what's behind. Such research has its own place and is just what universities should do. The business world, for its part, brings realism into the picture and teaches scientists to assess things on a more realistic basis."*** *-Finnish interviewee*

---

***"If only universities assumed a stronger role in the networking and not regard it as necessary evil. Got to get enterprises involved in university projects because it is the only way to get financing from Tekes (Finnish funding agency)"*** *- Finnish interviewee*

*"This is how it should go: an enterprise should knock on the door of a professor and say: 'Please research this thing for us, so we can seek European funding for it." -Finnish interviewee*

---

*"In Finland and elsewhere, all universities have their own IP offices, and it is a good thing. But it is a quite different thing what kind of expertise there is. It varies, but in my opinion they are not very good at commercializing things. Whether in Finland or in the USA, it seems that things are ranked on the basis of the number of patents created. The business drive and understanding is missing."- Finnish interviewee*

---

*The cooperation between universities and enterprises would benefit from more sensible pricing of the services that universities produce for enterprises. At the moment, they are overpriced due to the rather high administrative costs. That is why companies rather buy services from abroad than from a nearby university, even if that would be offer a natural way of launching cooperation" – Finnish interviewee*

During the last few years three major changes with an influence on university-industry relationships have been made in the Finnish innovation policy. New university legislation, new act on university inventions and the establishment of the Strategic Centre for Health and Well-being emerged in the Finnish interviews. Their impact on the promotion of university-industry relationships was clearly recognised. A changed atmosphere in the universities and a more positive attitude towards commercialisation and industrial collaboration was mentioned in several interviews. However, many of the interviewees emphasised the role of the university in basic research. Consequently, if universities are more dependent on industrial funding, some concern on the continuation of basic research was perceived. A concern that a closer university-industry partnership may shift the focus from basic research towards applied research has also been raised in other countries. Interestingly, several studies suggest that these partnerships have not had a negative effect on the quantity and quality of basic research (Geuna and Nesta, 2006,Poyago-Theotoky et al., 2002,Zucker and Darby, 1996,Louis et al., 2001)

Many of the Finnish respondents expected universities to take a more active role in networking and collaboration. Research projects between a university and industry are mostly university driven and do not always meet the firms' needs. Companies would like to get help for scientific and technological problems. This kind of collaboration was seen highly essential for the development of the US biotech industry in the late 1970's when the researchers in the pharmaceutical companies did not have the required knowledge of molecular biology and genetics. Hence they needed direct interaction with university scientists and had to rely completely on university research. Without such a close interaction and trust the emergence of the modern biotechnology in the US would not have been possible (Dalpé, 2003).

Even in collaboration research projects between a university and industry it looks like the entire potential is not utilised. Tekes projects facilitate collaboration and offer new possibilities for networking and gaining important knowledge from the field, but especially the university partner is often seen reluctant to true cooperation.

The development of the technology transfer offices or innovation services in Finland is still under way. Their role in promoting the commercialisation of university inventions is seen quite crucial, and an even more professional role in this respect was expected. However, the study of licensing activities in the US implied that a big share of the leads for potential licensing came from the scientists themselves (Jansen and Dillon, 1999). This indicates that alongside with commercialisation services, technology transfer offices should also facilitate network formation and create some other support mechanisms with researchers (Tupasela, 2000).

One inhibiting factor to university-industry collaboration in Finland was seen in the huge overhead costs of universities conducting to a situation where the pricing of the services provided by the university exceeds those from external service providers. If universities would like to promote industrial collaboration, lowering the prices of the university services could be one option. Interestingly, the same issue was also raised in Bay Area:
*"The universities themselves put up barriers, including extremely high overhead that they charge."*

## 7.3 Partnering across regions

Compared to many other industry sectors collaboration and partnering plays extremely important role in the biotech industry. Besides the relationships to public research organisations, small biotech companies are often dependent on their industrial counterparts in financing their research and commercialising their research results. On the other hand, established pharmaceutical companies expand their R&D and drug development pipeline by collaborating with small biotechnology companies (Farag, 2009). The changing landscape of the industry features increasingly the ideas of open innovation (Chesbrough, 2003). Partnering or outsourcing to access novel technology opens new opportunities to firms and can be a major driver for structural change in industry (James, 1994,Teece, 1986).

There is also indication that learning and innovation takes place through interactive, iterative and networked approaches and that those kind of valuable collaborations are often cross-regional (Clifton et al., 2010). The study of SME's in the UK showed that more innovative and faster growing companies tend to use more cross-regional networks (Cooke et al., 2005).

According to Scientific American Worldwide 2010 *"In year 2010 the European investors are less interested in early-stage companies and more attracted to those having products, some revenue and collaborations or partnerships in place with other firms and institutions. Companies will have to become consolidators of early-stage products and build partnering engines to be successful"*, Helmut M. Schühsler, Managing partner of TVM Capital in Munich predicts (Agres, 2010). Thus strategic partnering, networking and collaboration are seen increasingly important in building industrial value in the global biotechnology market.

### 7.3.1 How are the partners selected?

***"Whoever can do work of the needed quality the most cheaply."*** – *Bay Area interviewee*

---

***"We have explored opportunities that would have required cross-regional collaboration, but found them to be logistically problematic for companies in our [smaller] size range."*** *- Bay Area interviewee*

---

***"Partnerships where each party contributes his unique expertise to the whole, work best."*** *- Finnish interviewee*

---

***"It is only possible to maintain a few operative and active cooperation partners that play a key role"*** *- Finnish interviewee*

---

***"I don't think any company is doing systematic work in that area. Finding a suitable person interested in your organisation is, at least to some extent, sheer luck. Cooperation is usually launched more or less accidentally."*** *- Finnish interviewee*

---

***"You start with the people you know and then gradually expand to random contacts. "*** *- Finnish interviewee*

---

***"In a perfect world, we want our partners to be the ultimate customer for the product. Our major partners are our customers."*** *- Bay Area interviewee*

---

**"It should be based on the customer, on understanding his needs in different areas, because customers' needs may vary."** – *Finnish interviewee*

Due to a huge local market the need for global partnering is not that compelling in Bay Area companies in contrast to their Finnish counterparts, in which going global is not an opportunity but a necessity for survival and success. With several clusters of biotech industry, the Bay Area region also offers more opportunities for local partnering than Finland.

In Bay Area cost, speed, quality and logistics were raised as important aspects in partnering, while in Finland strategic interest, mutual benefit and complementary know-how were mentioned as selection criteria for cooperation. However, the number of partners should be limited especially in small biotech companies which do not have resources for extensive partnership management. Networking depends largely on organisational capacity, and Dalpé (2003) states that an organisation can afford only limited number of networks since absorption capacity limits the assimilation and application of new knowledge (Cohen and Levinthal, 1990). Deeds and Hill (1996) actually suggest that after certain threshold there are decreasing returns from networking.

In order to minimise the time needed to build the functional partnership, the search for potential collaborators is quite often started from personal networks and then gradually expanded. The role of personal networks and trust was thus seen very important in the Finnish interviews. According to the network theory relations between actors are based on trust built by personal interactions (Powell, 1990). Long relationships are regarded highly important since the same values and norms are shared when actors come to know each other (Deeds and Hill, 1999).

Some bigger companies are doing systematic work on partnering, but small biotechnology companies do not have resources for that, so the role of coincidence in partnering was expressed in the Finnish interviews. Nonetheless, rational planning and systematic work do not necessarily give advantage over personal informal links. Actually, according to Parhankangas and Hawk (2003), personal contacts are seen to play a considerable role in helping firms to form new connections including first customers. The role of luck and coincidences arising from personal networks has particular importance in the novel technologies (Parhankangas and Hawk, 2003).

In business the ultimate focus in partnering should be in producing added value to the customer, and the answers from both regions reflected also that perspective.

### 7.3.2 Timing

***"The venture funded companies I have worked with since [the mid-1990s] are typically told to stay focused on building their own product dominance in the U.S. market before exploring any OUS relationships.*** *– Bay Area interviewee*

---

***"Partners must be sought at an early stage, even before they are needed, because when you need them, it is good that they already know you. At that stage, it is too late to make oneself known around the world."*** *– Finnish interviewee*

---

***"Companies should continually keep in touch with potential partners on a wide scale, even when they are not needed. It is good to discuss your issues with other researchers and actors and not be too careful about IPR. However, it is one thing to know something and a different thing to do something."*** *– Finnish interviewee*

---

***"Enterprises that join a research effort, want to get involved already at the planning stage. But people usually turn to them at the last instance, telling them that we have this thing underway and asking them for a little funding."*** *– Finnish interviewee*

---

***"Even universities used to seek them only when they started applying for funding"*** *–Finnish interviewee*

According to the study, there is no specific time point in the innovation process when the partners are selected. The partnering takes place in every stage of the process depending on the company's needs. In Bay Area manufacturing, clinical trials and distribution phase are typically the ones where partnering takes place. However, with the huge local market capacity US companies can stay much longer in the domestic market. This can offer some advantage over Finland in giving them a longer screening period concerning possible partners. Actually, relatively many Finnish interviewees would like to see partnering already at the earlier stages and were concerned for the fairly late timing of collaboration. Companies also showed an interest towards earlier stage cooperation with universities. A too cautious attitude in IPR issues was considered to be one of the limiting factors to early partnering.

### 7.3.3 Challenges

***"Nothing can replace personal interaction. People always work with and for people. Of course, personal interaction is the more difficult, the farther away the partner is. Based on my own experience I think that no serious cooperation should be attempted before meeting the partner personally and discussing things over a meal and a few beers to get things somewhat calibrated. Establishing cooperation is always difficult but then the exchange of information and contents will be easier."*** *– Finnish interviewee*

---

***Language, time-zone, different legal environments, multiple currencies, etc. all add make partnering cross-regionally trickier than working within the U.S."*** *- Bay Area interviewee*

---

***"It's much easier to get things done when the lab is a mile away rather than 1000 miles away."*** *- Bay Area interviewee*

---

***"The European summer vacation schedule is usually a pain in the ass when the plant shuts down for 2-3 weeks in the middle of July /August."*** *- Bay Area interviewee*

Cross-regional partnering can be quite fundamental to a small biotech company, but finding a valuable partner and building confidential collaboration also sets various challenges. Current technological development with internet, conference calls, web conferences, *etc.* has lowered the barriers to international communication and collaboration, but building the relationship still takes time and needs resources and travelling. Building the trust and confidence between the parties was regarded as one of the major challenges. Maintaining the established partnership was not seen very demanding but creating new ones always requires face to face contacts. Language, cultural differences and misunderstandings caused by them were seen as a major challenge in Finland, but were also mentioned in Bay Area.

Distance always sets its own challenges, but interestingly from the US perspective the European summer vacation was seen as a major obstacle when coordinating meetings and trying to contact people.

## 7.4 Trends

***"The really revolutionary uses of biotechnology are increasingly going to not be biomedical, but industrial. With a price on carbon, biofuels will have enough investment stability that the world will increasingly get off oil – if Brazil can do it, the Europeans and we can do it, too. Once the refineries have gone, I'd look to see the chemical manufacturing plants go as well, replaced by vats of smartly engineered bugs."*** *–Bay Area interviewee*

---

***"Personalised medicine, diagnostics, nutrition and ageing of the population"*** *– Finnish interviewee*

The aging of population at an accelerating rate in developed countries is one of the most distinctive demographic events of the twenty-first century. It will have a profound effect economically, politically and socially. (United Nations Department of economical and Social affairs population division, 2002). In the more developed countries, people over 65 already make up to 15% of the population, but the number will further increase to 26% by 2050. Society faces new challenges with the increasing prevalence of aging diseases and rising medical cost. From the perspective of biotechnology it also offers new business opportunities when the developed countries have to focus more on preventive health care.

One of the hot topics in the current world is personalised medicine or even widely viewed personalised health care, also including lifestyle and nutritional facts. When individual genetic information becomes more easily accessible and affordable, diseases or elevated risks of certain diseases can be detected at earlier stages, thus enabling more effective treatment. Shifting the focus in medicine from reactive to preventive will also reduce the cost of healthcare, which is seen inevitable with an aging population. The concern for the cost effectiveness of healthcare was particularly evident when discussing with people from the Bay Area. Research will also increase our understanding on how different genetic traits influence the personal response to available therapeutics, thus enabling the grouping of people into subpopulations. The discovery of biomarkers (i.e., protein and RNA molecules associated with genes and diseases) for susceptibility to disease, presence of disease or differential response to treatment is of key importance. The potential for savings is not limited to preventive health care but the expensive treatments can also be targeted only to those individuals that benefit from the treatment.

Pharmacological industry is facing huge challenges when the development costs of the new molecules increase and the product revenues decline due to patent expirations. Traditionally, innovations have been developed in big pharmaceutical companies, and SMEs have had a minor role in the innovation activity. However, the costs of development and risks of investment increase significantly due to new technologies, higher regulative pressures, and the need to present new products at an increased speed (Kleyn & Kitney & Atun 2007). Thus, a growing number of biopharmaceutical companies may adopt new and more effective business models for accessing international markets. This includes e.g. strategic alliances with diagnostic companies and increasing outsourcing of discovery research, clinical trials and manufacturing. During the last five years licensing deals between biotechnology and top-20 pharmaceutical companies have increased by 30 % compared to the previous five-year period (Mayhew, 2010).

The growing importance of the generics is also shaping the pharmaceutical industry. Generics have an increasing share of the world pharmaceutical market, being over 50 % of all prescriptions in several countries, including the US. Since prescription drugs form more than 15 % of the national health care costs in the US, there is an increasing pressure to the use of generic substitutions in order to reduce costs. Furthermore, despite the increasing importance of generics, the fastest growing area for prescription drug expenditures is biologicals (Hoffman et al., 2009). Therapeutic proteins are seen as a future trend and it is noted that in 2007 the biotechnology industry got over 68 % of its total sales from biological drugs (Pharma outlook 2018).

In the diagnostics field the need for point-of-care diagnostics (POC) is widely recognised,

even though the financial support to diagnostic technology development has not been as extensive as in drug discovery or vaccine development. The importance of point-of-care diagnostics is especially critical in the developing countries, where infectious diseases are a major cause of death and the money available for the development of health care is minimal. However, developing accurate and affordable diagnostics is also important in the developed world as the pressure for reducing health care costs with the aging population is increasing (Yager et al., 2008)

Despite the fact that our study mostly dealt with the red biotechnology field applied to medical processes, the growing importance of environmental aspects and bio energy was brought up both in Finland and the Bay Area. The concern on carbon dioxide emissions and environmental sustainability are getting ever growing attention in discussions in the biotechnology field, which has traditionally focused more on the medical or red biotechnology sector. Industrial biotechnology (white biotechnology) is widely considered the third wave of biotechnology, the first wave being related to medicine and the second to agriculture (Tang and Zhao, 2009).

# 8.Foresight

## 8.1 Foresight methods

Long-range foresight is about understanding the situation today, seeking future opportunities, and intelligently creating innovations. It echoes what management guru Peter Drucker described as the one trait he found in successful entrepreneurs, namely a commitment to approach innovation as a "systematic practice."

William Cockayne and Tamara Carleton have developed a proprietary set of foresight tools as a systematic practice, using Stanford University as a test bed. Their tools are used to help develop and train leaders in long-range innovation. Working with multiple partners from industry, academia and government, Cockayne and Carleton conduct research and identify leading practices in foresight across all phases of the innovation lifecycle.

Foresight is a type of strategy, requiring an intentional plan of action. Unlike strategy, however, foresight is not defined by a specific aim or goal. Foresight requires seeing that alternate options are available, since there are different ways to get to the future. With foresight, a policymaker or innovator will see the world anew in terms of potentials and possibilities. Part of foresight is learning how to look ahead and compare the likelihood of different opportunities. When coupled with hindsight, a person now has an understanding of history and can wisely apply the lessons of the past toward future activities.

Foresight really comes from asking better questions about today. Many answers can then be gained when looking back in time, at other countries, across generations, and to different cultures. The world is rich with examples from which data can be found. Instead of vapid hand-waving, foresight can be developed that is grounded in real data and real stories. The Stanford Foresight framework is what provided the practical model for this study.

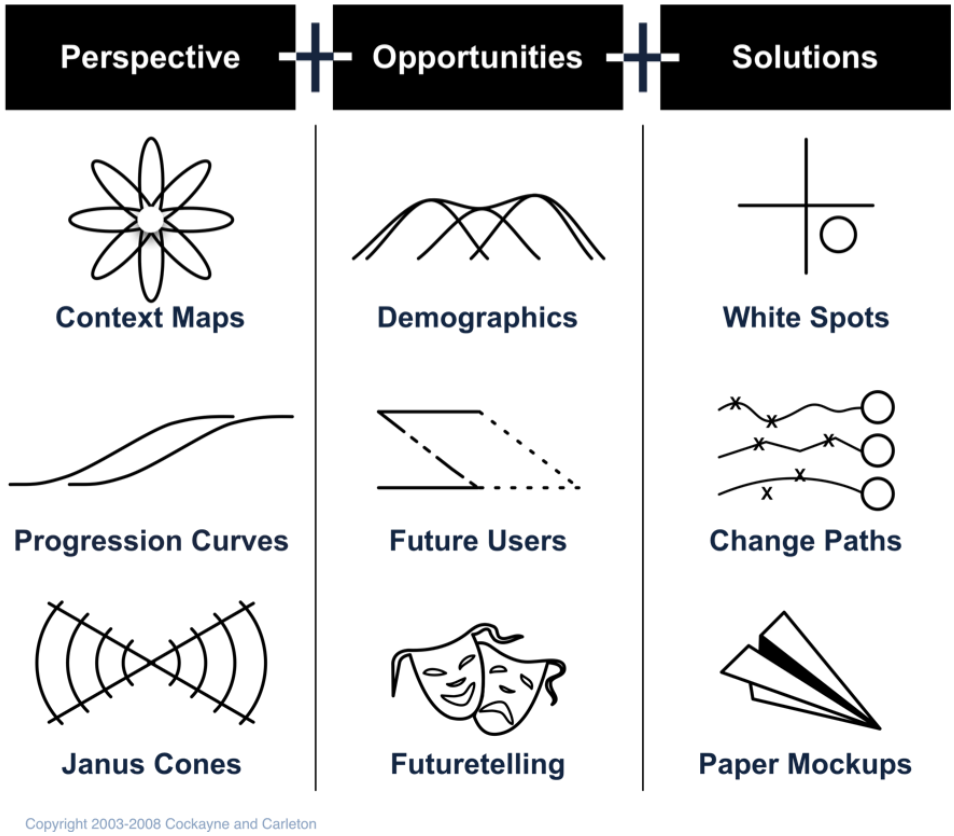
Taking a long-term view of innovation, this model guides leaders through the steps required to prepare confidently for the future. The process can be understood as three overlapping phases: Perspectives to Opportunities to Solutions. Each phase recognizes a distinct set of activities within the broader lifecycle of long-range innovation, although the phases tend to overlap in real life. Often, the start of the process has the highest ambiguity for participants. Each phase is progressively more hands-on and concrete, taking participants on a gradual journey from open-ended investigation to practical convergence.

The first phase of Perspective focuses on developing a historical perspective about an area of interest relevant to the future a person wants to live in. You must look back first in order to look forward. Perspective is critical to establish upfront, and yet, how often do leaders take the time to see the big picture? The big picture is an abstract concept, encouraging the mind to see an invisible complex web of multiple variables and their relationships. The foresight tools help to capture the big picture, and when comes down to finding future opportunities, having perspective is the first advantage.

Three Foresight tools develop perspective:

- **Context Mapping** is a mapping technique for capturing emergent conversation themes in complex problems to show integrated context.
- **Progression Curves** are a graphical representation that explains the progression of changes in terms of technological, social, and related filters.

- **Janus Cones** is a foresight tool for looking backwards and forwards in time to identify the timing of historical events and how timing affects potential future events.
- **Futuretelling** are short and dramatic performances that illustrate a particular user need as a scene from the future. This is active storytelling at its best.




Knowing where you are – and how you got there – is essential for making good decisions on where to go or what to do next. The second phase, Opportunity, helps leaders to develop an ability to see growth opportunities that exist today and extend into the future. A focus on opportunity further brings the long-term view into focus and supporting the investments and actions required today to begin the path to tomorrow. In other words, today's opportunities become tomorrow's innovations.

Three Foresight tools find opportunity:

- **Demographics** is a research method to identify and track population changes within a specific group over time in order to understand impending changes on the workforce, life stages, future markets, and other variables.
- **Future Users** explores the potential future of a chosen demographic through the comparative analysis of personas and similar groups over time.

The third phase, Solution, seeks to define the questions that exist along different paths to innovation. Innovative solutions are specific to an industry, customers, organization, and individual skills. A delicate process of emergence unfolds during the earliest stages, as different sets of individuals and concept threads come together, separate, recombine, fade away, and advance forward ultimately into one innovation solution.

Three tools prototype possible solutions:

- **White Spots** are a strategic tool for studying the future opportunity space defined by two salient issues. Opportunities can be discovered in the 'white spots', or empty areas.
- **Change Paths** are a set of data-driven narratives exploring different paths and key decision points toward possible future innovations.

- **Paper Mockups** in three-dimensions (3D) are an advanced design method to prototype and communicate a new concept using paper and inexpensive materials.
  A specific iteration is the Dark Horse Prototype.

Together, these Foresight tools provided the framework to guide and provoke discussion among the workshop participants. When leaders look to the future with open eyes, they can begin to see the opportunities that are coming.

## 8.2 Foresight workshop

A two-day Foresight workshop was arranged in Espoo, Finland on 18th - 19th of May 2010. The participants represented different roles in the life sciences field and consisted of academic researchers, company representatives, policymakers, other experts and students.

In the workshop we practiced the Foresight tools in teams starting from perspective, going through opportunities and ending with solutions including a Dark Horse prototype. Before practical exercises preliminary results of the survey were presented as a starting point. During the session particularly three main themes arose in the team works, namely education, multidisciplinarity and personalised medicine.

Fig 8.1Intensive Team work in a Foresight workshop

Finnish education has been ranked high, and especially the Finnish success in PISA surveys has received attention from all over the world. The educational policy has aimed at equity in education. Student performance is largely unrelated to the schools, and teachers are highly qualified professionals. (Niemi, 2009). High-quality education lays the foundation for building a high level of expertise and world-class innovations. However, in our workshop a concern on decreasing arts and sports classes, as well as low diversity in education/ career path was raised. Innovative solutions usually require an unconventional approach and a lack of diversity prevents cultivation of creativity and innovativeness. Finnish Aalto University established in 2009 represents this kind of holistic approach to innovation. It is a merger of three established universities: University of Technology, Helsinki School of Economics and University of Arts and Design. The university manifests the government's conviction that innovation will come from cross-disciplinary efforts. (Kao, 2009). However, the bio sciences, especially the life sciences field are not strongly represented in Aalto University.

These bio specific disciplines are more concentrated on the other universities, of which the University of Helsinki is the most well-known. Actually, the need for closer collaboration between bio sciences and technical universities has been raised in discussions.

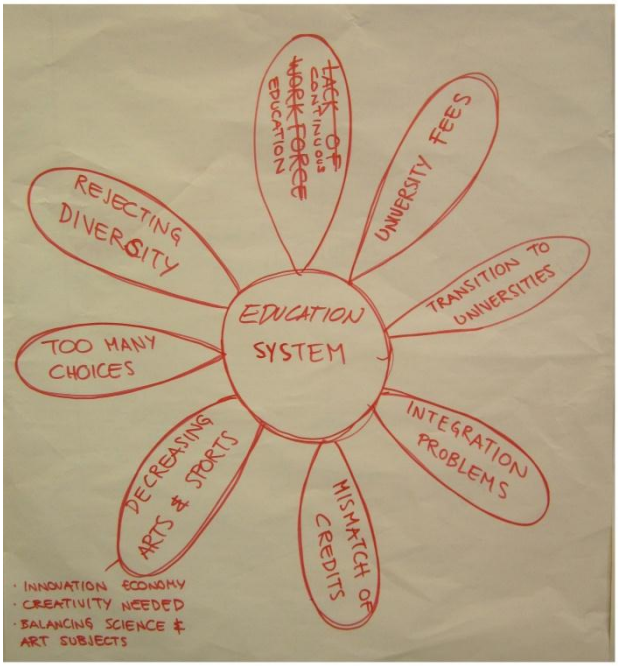



Fig 8.2 Practical example of a context map dealing with the current education system

Fig 8.3 Prototype of more diversified education paths leading to the same goal

The increase of multidisciplinarity in the biotechnology industry was another main theme handled in the groups. As Finland is well-known for Nokia's mobile technology and ICT solutions, and we do have competence in diagnostics, environmental technologies and functional foods, the idea of combining expertise from diverse fields was suggested. Adapting known technologies to new areas could open new business opportunities especially in the sector of personal well-being.

A similar theme was discussed in the third group but from a different perspective. The uniform health care system, health registers, mobile technology, IT know-how, diagnostics industry and technology oriented society could be utilised in global competition on expanding the area of personalised medicine and personalised health care.

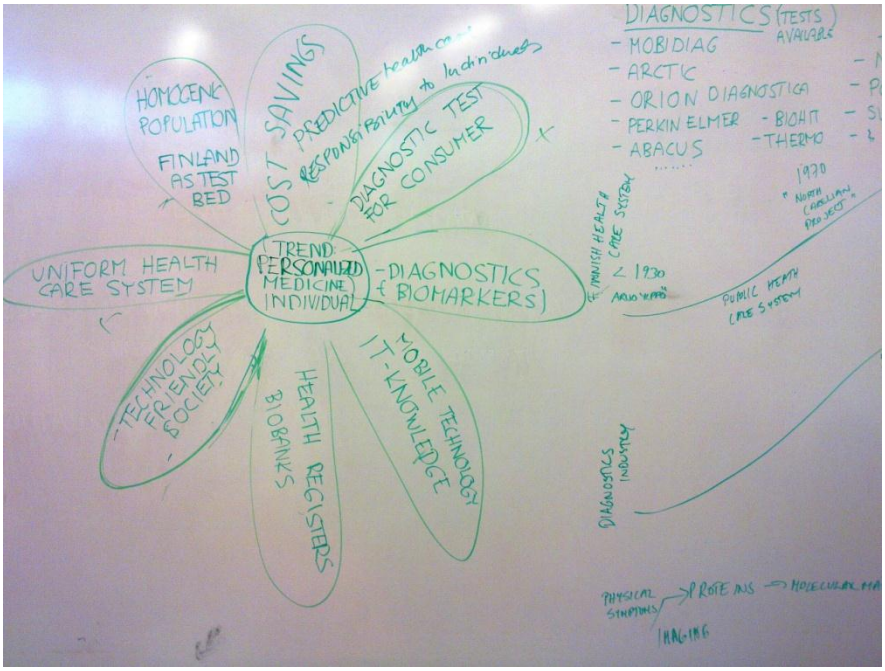


Fig 8.4 Personalised medicine – combining different areas of expertise

The diversity of the participants prevented focusing on narrow areas. But inside a company these kinds of workshops could create more concrete ideas. The workshop was commented to have offered useful tools for strategic planning. We also got a strong feeling that this kind of a community consisting of different actors from the sector should gather regularly and continue discussions on the innovation environment and the future of the biotechnology field.

# 9. Conclusions

In international comparison studies the Finnish innovation environment has been rated as one of the best in the world. Newsweek magazine recently ranked Finland as the best place to live, and the Finnish educational system is one of the best performing in the world. In addition, Finnish academic research is among the top of the world in certain areas. On the other hand, some challenges are also pointed out. Based on the latest international evaluation in 2009, the research and innovation system is complicated and fragmented, international links are weak, and higher education should be restructured (Ministry of Employment and the Economy, 2009).

In a knowledge-based society, university, industry and government have equal roles and form a triple helix in stimulating innovation (Etzkowitz *et al.*, 2007). The role of all these three players should be taken into account when creating a national strategy for the development of the life sciences sector. Increased coordination is a prerequisite for concrete steps needed to cope with the challenges recognised, because without clear roles and responsibilities the changes are difficult to put into practice. On the industrial side the increasing role of customers/users in innovation processes should not be forgotten. The Foresight workshop, organised with Stanford University, was a valuable practical example where all the triple helix parties gathered together and discussed about future scenarios of the life sciences sector. Foresight tools as well as preliminary results from this study provided the framework to guide and provoke discussion among the workshop participants. When leaders look to the future with open eyes, they can begin to see upcoming opportunities. This kind of community consisting of policy-makers, university and industrial representatives could be highly useful if meeting on a regular basis and discussing about the opportunities in the life sciences sector.

As financial constraints seem to form one of the main challenges to biotech's growth, the development of funding instruments is extremely important. Tax incentives for R&D are used in many OECD economies and, depending on national circumstances, can be an effective instrument for inducing private sector research. According to the international evaluation in 2009, the growth in businesses should be promoted through both individual and corporate tax incentives (Ministry of Employment and the Economy, 2009).

Actions that could facilitate both domestic and global partnering should be strengthened. Building a working relationship with global actors in the field is central, as even the biggest companies in the Finnish life sciences sector are pretty modest from a global perspective. In addition, more open information sharing inside the sector and across the sector borders is needed. The current study did not provide a deep insight into the challenges faced in partnering and internationalisation, but a closer look into this topic would certainly be valuable.

Steps towards more cross-disciplinary education and collaboration have been taken especially at Aalto University; however, the role of the Aalto University in the life sciences sector is not very strong. Closer collaboration between different disciplines, universities and research organisations could promote the development of the life sciences sector and create new innovative business opportunities. In particular, a closer collaboration between technical universities and biosciences was demanded. Companies have also expressed their willingness for closer collaboration with universities, but the practical models are missing in many cases.

Finland has internationally recognised expertise in certain research areas such as vaccine, neurosciences, genetic and cancer research. Furthermore, a genetically homogenous population also offers an interesting starting point for genetic research. Medical records on individual patients go back many years, and the infrastructure, e.g., for conducting clinical trials is very good. Finnish health care is well-managed and well-documented and Finnish people have a positive

attitude towards research and are willing to participate in product development. A strong IT- sector combined with the life sciences field could open new opportunities, for example in mobile health technology as well as in personalised medicine. Nevertheless, the strengths in the life sciences sector are mostly located at the front-end phase of the innovation process, whereas the commercialisation phase does not work well. Activities to strengthen the value chain from discoveries over inventions to commercialised innovations should be promoted.

Finland's distant location, small market and poor recognition abroad are challenges to companies and highlight the need to build globally networked business models. Those models should take into account a customer focus, as well as Finland's strengths. Besides funding instruments, facilitating innovations in the life sciences field needs stronger utilisation of university research, deeper understanding of the customer and market needs, as well as new innovative business models able to combine various business sectors.

# About the Authors

**Anne-Sisko Patana, Ph.D.** (Biochem) is a Senior Researcher at the University of Helsinki, Industrial Relations and Knowledge Transfer Services. During years 2009-2010 she worked in Bio-Inno project funded by Tekes. In this project she focused especially on innovation environment and customer interface in the Finnish life sciences industry. She earned her Ph.D. in biochemistry at the University of Helsinki, Institute of Biotechnology. In her doctoral thesis she studied drug metabolising enzymes, and the research was conducted in close collaboration with the Centre for Drug Research (CDR) in the Faculty of Pharmacy. In addition to scientific experience she has worked ten years in sales and marketing in several biotech companies, for example at Thermo Fisher Scientific, Instrumed and Orion Pharma.

**Tamara Carleton, Ph.D.**, is investigating the organizational processes and structures that enable radical technological innovation. Her background is an interdisciplinary mix of business strategy, technology, and communication. Currently, she is the president of Innovation Leadership Board, a research and advisory firm. She holds a Ph.D. in Mechanical Engineering from the distinguished Design program at Stanford University, and her doctoral research uncovered and documented the innovation practices of the U.S. Defense Advanced Research Projects Agency (DARPA). Tamara brings an applied perspective to her research. She possesses over a decade of industry experience in corporate strategy, technology development, and marketing roles at start-ups and large companies. She has worked as a management consultant at Deloitte Consulting LLP, specializing in innovation strategy, customer experience, and enterprise applications emerging solutions. Her clients span multiple industries and have included Hewlett-Packard, NVIDIA, Monster Cable, Coca-Cola, Nokia, and JCPenney. Tamara is a Research Fellow of the Foundation for Enterprise Development and a Fellow of the Bay Area Science and Innovation Consortium. She has an M.S. in Public Relations from Syracuse University, and a B.A. in Communication from the George Washington University. She resides in Silicon Valley, Calif

**Kirsi Polvinen , M.Sc** (Biochem) is a Project Manager at Innovation Management Institute (IMI) at Aalto University. During the years 2009-2010 she was a Project Manager of Bio-Inno –project funded by Tekes. Before joining IMI, Kirsi has worked for about 20 years in biotechnology companies both in Finland and in U.S. as a Research Scientist. Among the companies were Orion Pharma, Finnish Red Cross Blood Service, Spectrum Medical Sciences, Finnish Sugar Ltd (nowadays Danisco), Valio Ltd, Altus Biologics Inc. and Howard Hughes Medical Institute. In addition to scientific experience especially in evaluation of technologies, protein chemistry and proteomics, Kirsi has experience in project management. She is especially interested in networked business models and innovation management of companies in Life Sciences field.

**Laura Kanto, M.Sc.** (Tech.) is a Researcher in Innovation Management Institute (IMI) at Aalto University. Laura has Master's degree on chemical engineering from Helsinki University of Technology (Microbiology as Major and Strategy & International Business as Minor). Before joining IMI she has worked as a researcher in the field on molecular medicine and as an application specialist in Thermo Fisher Scientific. Laura is interested in the customer interaction as a part of the innovation process especially in life science companies and new business models in the field life science.

**Hanna Nordlund, Ph.D** (Econ) is a Programme Manager at Technology Centre Innopark Ltd and works in the Digital Content Competence Cluster which is a part of the national Centre of Expertise Programme in Finland. Prior to that, she worked in Innovation Management Institute at Aalto University. Her research focused on customer understanding in innovation process and she worked with companies from various industries including forest-, engineering-, electronics-, bio- and feed industry. She earned her PhD at the University of Tampere. In her thesis she was studying construction of customer understanding in front end of innovation.

**Jussi Pihlajamaa** is a Research Manager in Innovation Management Institute (IMI) at Aalto

University. Before joining IMI Jussi worked for over 10 years career in engineer's supplementary education where he has worked as a Training manager and Managing director and Consultant (e.g. INSKO, Finnish Real Estate Institute Ltd). Based on his experience, his expertise is e.g. learning, knowledge transfer and knowledge creation. His research interests cover the development of innovative operations and assessment methods of national research, development and technology programs and organizational innovation and R&D operation. His recent area of interest focuses on innovation management, innovation processes, innovation culture, radical innovations and business models.

**Pekka Berg**, holding a Ph.D. in innovation management, is Research Director of BIT (Business-Innovation-Technology) Research Centre of Helsinki University of Technology, as well as Founder and Director of the Innovation Management Institute under BIT. Dr. Berg´s research interests cover the examination of innovative operations and maturity methods at the following levels: the mechanisms of the national innovation systems, national research, development and technology programmes and organizational innovation and RT&D operation. Information of around 400 national and international enterprises on the subject of improving the innovation activities of firms has been collected. The 5,5 million euros, and 5 years, Innovation Research Program IRP has been recently concluded by Dr. Berg. Program includes the following projects: "Discontinuous Innovation Project DIP", "Innovations in Bio-Oriented Industries BIO-INNO", Innovation in Service Operations ISO", "Requirements for Innovative Environments RINE" and "User Driven Innovation UDI". Dr. Berg also teaches in several courses in the Helsinki University of Technology and Helsinki University.
Between 2000 and 2006, Dr. Berg has been a member of the assessment group of the EU financed programme "Improvement of the Quality and Effectiveness of Education and Learning".

# Acknowledgements

The research team would like to recognize and thank Heikki Kallasvaara, Head, Industrial Relations and Knowledge Transfer Services, University of Helsinki, for his support, positive attitude and belief in this joint project.

We also want to express our gratitude and appreciation to Dr. William Cockayne, Center for Foresight and Innovation at Stanford University, who provided valuable input in the form of Foresight Workshop held on May 2010 in Otaniemi, Espoo.

Dr. Esko Oksanen Post-doctoral Fellow at Institut de Biologie Structurale is acknowledged for the cover picture presenting amprenavir in a HIV-protease active site.

Our greatest gratitude goes to all the interviewees that gave their valuable time and shared their views, concerns and wishes on the biotechnology sector. We were positively surprised by their willingness to talk and the openness of discussions.

The Finnish researchers on this study were funded from the Tekes Liito-program.

# References


Agres, T., 2010. Back from the brink. Scientific American Worldwide (A global Biotechnology Perspective) , 8-10.

Atuahene-Gima, K., 1995. An exploratory analysis of the impact of market orientation on new product performance: a contingency approach. J. Prod. Innovation Manage. 12, 275-293.

Bawa, K.S., Koh, L.P., Lee, T.M., Liu, J., Ramakrishnan, P.S., Yu, D.W., Zhang, Y., Raven, P.H., 2010. China, India, and the Environment. Science 327, 1457.

BayBio, Northern California's Life Science Association, 2010. Northern California History. Retrieved from http://www.baybio.org/about/about-biotech/northern-california-history/

Bhargava, P.M., Suresh, N., 2009. Editorial: Biotech in India–History, present and promises. Biotechnology Journal 4, 286-287.

Bioteknologia 2020 - hyvinvointia suomalaisille, Linjaukset bioinnovaatioiden hyödyntämiseksi, TEM. , 2009.

Brännback, M., Jalkanen, M., Kurkela, K., Soppi, E., 2004. Pharma development in Finland today and 2015. Technol. Rev. 163, 2004.

Cardwell, W., Hautanen, K., Surov, A., Pölönen, O., Norros, T., 2010. Technopolis Online Annual Report 2009, Summary of Finnish High Tech Company Capital Rising Activity.

Carleton, T., 2009. The Bay Area's Role in Global Innovation Networks. Bay Area Science and Innovation Consortium (BASIC)

Cebul, R.D., Rebitzer, J.B., Taylor, L.J., Votruba, M.E., 2008. Organizational Fragmentation and Care Quality in the US Healthcare System. The Journal of Economic Perspectives 22, 93-113.

Chesbrough, H.W., 2003. Open Innovation: The New Imperative for Creating and Profiting from Technology. Harvard Business Press.

Clifton, N., Senyard, J.M., Pickernell, D., Packham, G., 2010. Local or Global? The Role of Local and Cross-locality Links in SME Innovation and Growth.

Cohen, W.M., Levinthal, D.A., 1990. Absorptive capacity: a new perspective on learning and innovation. Adm. Sci. Q. 35.

Cooke, P., Clifton, N., Oleaga, M., 2005. Social capital, firm embeddedness and regional development. Reg. Stud. 39, 1065-1077.

Cooper, R.G., 1999. From experience: the invisible success factors in product innovation. Management 16, 115-133.

Dalpé, R., 2003. Interaction between public research organizations and industry in biotechnology. Manage. Decis. Econ. 24, 171-185.

DeCarolis, D.M., Deeds, D.L., 1999. The impact of stocks and flows of organizational knowledge on firm performance: an empirical investigation of the biotechnology industry. Strategic Manage. J. 20, 953-968.

Deeds, D.L., Hill, C.W.L., 1999. An examination of opportunistic action within research alliances:: Evidence from the biotechnology industry. Journal of Business Venturing 14, 141-163.

Deeds, D.L., Hill, C.W.L., 1996. Strategic alliances and the rate of new product development: an empirical study of entrepreneurial biotechnology firms. Journal of Business Venturing 11, 41-55.

Europabio, 2005. Critical I Biotechnology in Europe: 2005 comparative study. BioVision 24, 03-06.. www.europabio.com,

EVCA Research Statistics - Investments, Annual Survey 2009. , 2010. Retrieved from http://www.evca.eu/knowledgecenter/default.aspx?id=2670

Etzkowitz, H., Dzisah, J., Ranga, M., Zhoub, C., 2007. The triple helix model of innovation. Tech Monitor Jan-Feb. Retrieved from http://www.techmonitor.net/tm/images/7/7d/07jan_feb_sf1.pdf

Farag, H., 2009. Collaborative Value Creation: An Empirical Analysis of the European Biotechnology Industry. Springer.

Franzoni, C., Scellato, G., 2010. The grace period in international patent law and its effect on the timing of disclosure. Research policy 39, 200-213.

Friedman, Y., 2010. Worldview scorecard, A global biotechnology survey. Scientific American Worldwide (A global Biotechnology Perspective) , 47-63.

Friedman, Y., 2009. Worldview scorecard, A global biotechnology survey. Scientific American Worldwide (A global Biotechnology Perspective) , 32-41.

Galambos, L., Sturchio, J.L., 1998. Pharmaceutical firms and the transition to biotechnology: a study in strategic innovation. The Business History Review 72, 250-278.

Geuna, A., Nesta, L.J.J., 2006. University patenting and its effects on academic research: The emerging European evidence. Research Policy 35, 790-807.

Gruber, A.C., 2009. Perspective: Biotech funding trends: Insights from entrepreneurs and investors. Biotechnology Journal 4, 1102-1105.

Harris, S.D., 2010. Venture funding up for valley startups. San Jose Mercury News (2010, August 16). Retrieved from http://www.mercurynews.com/venture-capital-survey/ci_15762568?nclick_check=1

Hege, U., 2009. Venture capital performance: the disparity between Europe and the United States. Finance 30, 7-50.

Hermans, R., Kulvik, M., 2004. Bioteollisuuden kasvupotentiaali ja terveydenhuollon kustannuskriisi. ETLA Suhdanne 2, 133-138.

Hermans, R., Kulvik, M., Tahvanainen, A.J., 2005a. ETLA 2004 Survey on the Finnish Biotechnology Industry. Discussion papers .

Hermans, R., Kulvik, M., Yla-Anttila, P., 2005b. International mega-trends and growth prospects of the Finnish biotechnology industry: Recent economic research and policy implications. Journal of Commercial Biotechnology 11, 134-145.

Hoffman, J.M., Shah, N.D., Vermeulen, L.C., Doloresco, F., Martin, P.K., Blake, S., Matusiak, L., Hunkler, R.J., Schumock, G.T., 2009. Projecting future drug expenditures—2009. Am. J. Health. Syst. Pharm. 66, 237-257.

Hunter, J., Stephens, S., 2010. Is open innovation the way forward for big pharma? Nature Reviews Drug Discovery 9, 87-88.

James, B.G., 1994. The pharmaceutical industry in 2000 Reinventing the pharmaceutical company. The Economist Intelligence Unit .

Jansen, C., Dillon, H.F., 1999. Where do the leads for licenses come from? Source data from six institutions. The Journal of the Association of University Technology Managers 11, 51-66.

Jaworski, B.J., Kohli, A.K., 1993. Market orientation: antecedents and consequences. The Journal of marketing 57, 53-70.

Joint Venture Silicon Valley Network. 2011 Index of Silicon Valley. San Jose, CA. , 2011. Retrieved from http://www.jointventure.org/index.php?option=com_content&view=article&id=157&Itemid=470

Kao, J., 2009. Tapping the world's innovation hot spots. Harv. Bus. Rev. 87, 109-114.

Katan, M.B., Boekschoten, M.V., Connor, W.E., Mensink, R.P., Seidell, J., Vessby, B., Willett, W., 2007. Which are the greatest recent discoveries and the greatest future challenges in nutrition&quest. Eur. J. Clin. Nutr. 63, 2-10.

Khilji, S.E., Mroczkowski, T., Bernstein, B., 2006. From Invention to Innovation: Toward Developing an Integrated Innovation Model for Biotech Firms*. J. Prod. Innovation Manage. 23, 528-540.

Kleyn, D., Kitney, R., RIFAT, A., 2007. Partnership and innovation in the life sciences. IJIM 11, 323-347.

Lee, Y.S., 1996. 'Technology transfer' and the research university: a search for the boundaries of university-industry collaboration. Research policy 25, 843-863.

Leydesdorff, L., Meyer, M., 2007. The scientometrics of a Triple Helix of university-industry-government relations (Introduction to the topical issue). Scientometrics 70, 207-222.

Lilien, G.L., Morrison, P.D., Searls, K., Sonnack, M., Von Hippel, E., 2002. Performance assessment of the lead user idea-generation process for new product development. Management Science 48, 1042-1059.

Louis, K.S., Jones, L.M., Anderson, M.S., Blumenthal, D., Campbell, E.G., 2001. Entrepreneurship, secrecy, and productivity: A comparison of clinical and non-clinical life sciences faculty. The Journal of Technology Transfer 26, 233-245.

Luukkonen, T., 2005. Variability in organisational forms of biotechnology firms. Research Policy 34, 555-570.

May, M., 2009. Fighting in the face of distress. Scientific American Worldwide (A global Biotechnology Perspective) , 7-9.

Mayhew, S., 2010. Deal watch: Trends in discovery externalization. Nature Reviews Drug Discovery 9, 183.

McMillan, G.S., Narin, F., Deeds, D.L., 2000. An analysis of the critical role of public science in innovation: the case of biotechnology. Research Policy 29, 1-8.

Miettinen, R., The problem of the problem in inventive activity. For Matti Sintonen's Festschrift. Retrieved from http://www.valt.helsinki.fi/kfil/matti/miettinen.pdf

Ministry of Employment and the Economy, 2009. Evaluation of the Finnish National Innovation System-Full Report. Retrieved from http://www.tem.fi/files/24929/InnoEvalFi_FULL_Report_28_Oct_2009.pdf

Montoya-Weiss, M.M., Calantone, R., 1994. Determinants of new product performance: a review and meta-analysis. J. Prod. Innovation Manage. 11, 397-417.

Munos, B., 2006. Can open-source R&D reinvigorate drug research? Nature Reviews Drug Discovery 5, 723-729.

Neale, M.R., Corkindale, D.R., 1998. Co-developing products: involving customers earlier and more deeply. Long Range Plann. 31, 418-425.

Niemi, H., 2009. Why Finland on the top? Reflections on the reasons for the Pisa success. Keynote paper presented at the 3rd Redesigning Pedagogy International Conference June 2009, Singapore

OECD (2010), 2010. Measuring Innovation: A New Perspective, OECD, Paris based on NESTI 2009 R&D tax incentives questionnaire.

Owen-Smith, J., Riccaboni, M., Pammolli, F., Powell, W.W., 2002. A comparison of US and European university-industry relations in the life sciences. Management Science 48, 24-43.

Parhankangas, A., Hawk, D.L., Mutual development of technologies and their governance: Reliance on systemic coincidence, natural luck or strategic planning? Systemicbusiness.org. Retrieved from http://systemicbusiness.org/pubs/2003_ISSS_47th_012_Parhankagas_Hawk.pdf

Pisano, G.P., 2006. Science Business: The Promise, the Reality, and the Future of Biotech. Harvard Business Press.

Pisano, G.P., 1994. Knowledge, integration, and the locus of learning: an empirical analysis of process development. Strategic Manage. J. 15, 85-100.

Powell, W.W., 1990. Neither market nor hierarchy: Network Forms of Organization. Research on Organizational Behavior 12, 295-336.

Powell, W.W., Owen-Smith, J., Colyvas, J.A., 2007. Innovaton and Emulation: Lessons from American Universities in Selling Private Rights to Public Knowledge. Minerva 45, 121-142.

Poyago-Theotoky, J., Beath, J., Siegel, D.S., 2002. Universities and fundamental research: reflections on the growth of university-industry partnerships. Oxford Review of Economic Policy 18, 10.

Project:"Realisation of Young Innovative Company status, YIC, for biotech companies" , 2006. Promoting innovation by tax incentives. A review of strategies and their importance to biotech growth. Supported by the European Commission Specific Support Action, 6th Framework Program Contract No. LSSB-CT-2005-018768

Ryan, C., Phillips, P.W.B., 2002. Industrial innovation and regional competitiveness in the agricultural biotechnology sector: A comparative analysis of innovation structures in North America, Europe and Australia.

Salomo, S., Steinhoff, F., Trommsdorff, V., 2003. Customer orientation in innovation projects and new product development success-the moderating effect of product innovativeness. Int. J. Technol. Manage. 26, 442-463.

Saxenian, A.L., 2006. The New Argonauts: Regional Advantage in a Global Economy. Harvard Univ Pr.

Stuart, T.E., Ozdemir, S.Z., Ding, W.W., 2007. Vertical alliance networks: The case of university-biotechnology-pharmaceutical alliance chains. Research Policy 36, 477-498.

Tahvanainen, A.J., 2009. Finnish University Technology Transfer in a Whirl of Changes-a Brief Summary. ETLA Discussion Papers .

Tahvanainen, A.J., Nikulainen, T., 2010. The Research Environment in Flux–Researchers' Views on the Recent Changes in the Finnish Innovation System. (in Finnish with an English abstract/summary). ETLA Discussion Papers .

Tang, W.L., Zhao, H., 2009. Industrial biotechnology: Tools and applications. Biotechnology Journal 4, 1725-1739.

Technopolis Plc, 2011: Technopolis Online Annual Report 2010. Summary of the Finnish High Tech Company Capital Rising Activity. Retrieved from http://www.scribd.com/doc/49015719/Technopolis-Online-Annual-Report-2010

Teece, D.J., 1986. Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. Research policy 15, 285-305.

Thomke, S., Von Hippel, E., 2002. Customers as innovators: a new way to create value. Harv. Bus. Rev. 80, 74-85.

Tupasela, A., 2000. Intellectual Property Rights and Licensing. Science Studies 13, 3-22.

Ulwick, A.W., 2002. Turn customer input into innovation. Harv. Bus. Rev. 80, 91-98.

United Nations Department of economical and Social affairs population division, 2002. World Population ageing 1950-2050. Retrieved from http://www.un.org/esa/population/publications/worldageing19502050/

Valentin, F., Jensen, R.L., 2007. Effects on academia-industry collaboration of extending university property rights. The Journal of Technology Transfer 32, 251-276.

van Tulder, R., 1988. Small European Countries in the International Telecommunications Struggle. Small countries facing the technological revolution , 169.

Virtanen, A.I., 1933. The AIV method of preserving fresh fodder. Empire Journal of Experimental Agriculture 1, 143-155.

Von Hippel, E., 1986. Lead users: A source of novel product concepts. Management science 32, 791-805.

Wang, K., Hong, J., Marinova, D., Zhu, L., 2009. Evolution and governance of the biotechnology and pharmaceutical industry of China. Math. Comput. Simul. 79, 2947-2956.

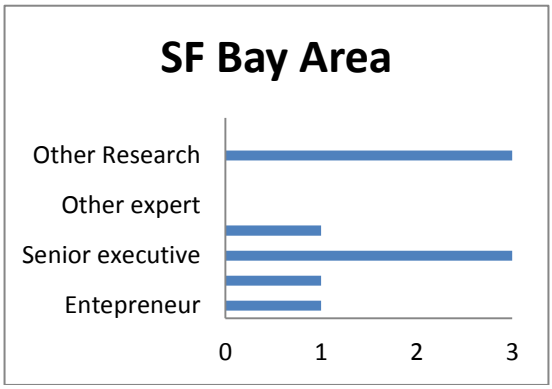
Yager, P., Domingo, G.J., Gerdes, J., 2008. Point-of-care diagnostics for global health. Biomed. Eng. 10.

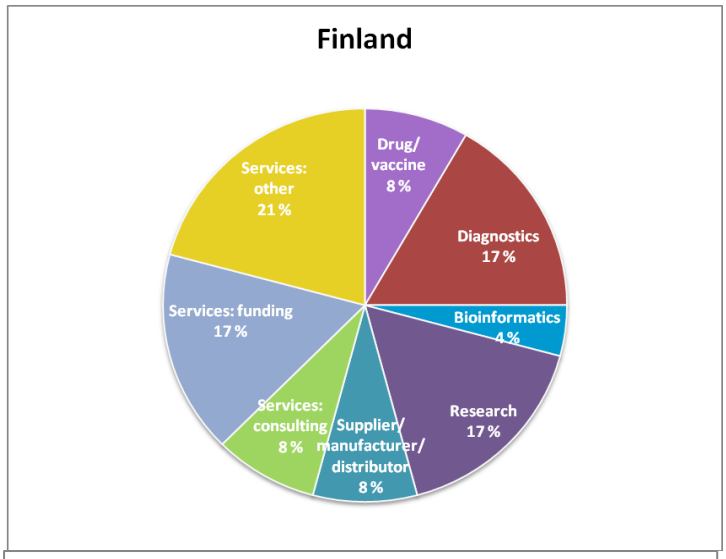
Zerhouni, E., 2007. Translational research: moving discovery to practice. Clinical Pharmacology & Therapeutics 81, 126-128.

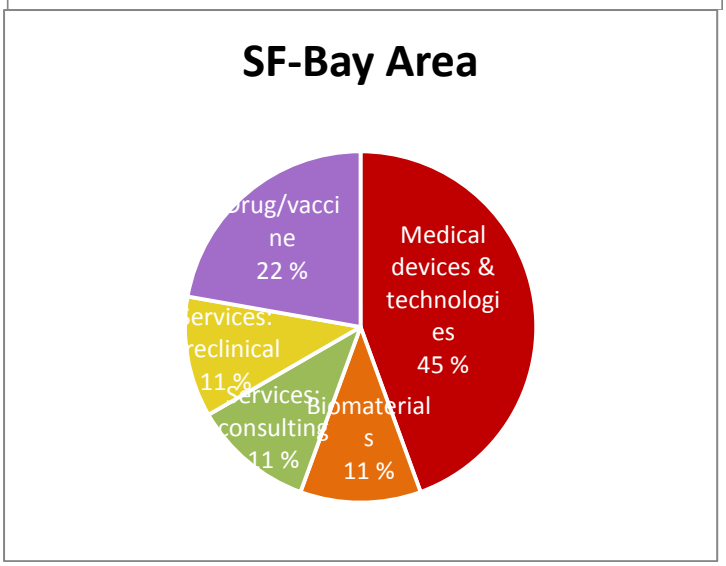
Zucker, L.G., Darby, M.R., 1996. Star scientists and institutional transformation: Patterns of invention and innovation in the formation of the biotechnology industry. Proc. Natl. Acad. Sci. U. S. A. 93, 12709.

# Appendix

## Participant profiles

# Research questions and answers in Finland

**Note: The data is more qualitative than quantitative in nature**

| **HOW DOES FINLAND OPERATE AS AN INNOVATION ENVIRONMENT FOR BIOTECHNOLOGY?** | **n=24** |
|---|---|
| **STRENGTHS** | |
| Tekes | 10 |
| Basic research | 10 |
| Strong local networks | 5 |
| Front-end of innovation process (ideas) | 5 |
| High-level education | 5 |
| Infrastructure | 5 |
| Research funding | 3 |
| Skilled people | 3 |
| Biocenters and clusters | 2 |
| Lot of public sector activities in the field | 2 |
| Homogenic society | 2 |
| Research networks | 2 |
| Good health care system | 1 |
| **CHALLENGES** | |
| Funding | 15 |
| Commercialization | 6 |
| Atmosphere/ Image | 5 |
| Small country/ small market | 4 |
| Business competence | 3 |
| Understanding global bioindustry | 3 |
| Many overlapping organisations | 2 |
| Taxation system | 2 |
| Funding for basic research | 2 |
| Big Finnish companies have not supported the start-ups | 2 |
| Ability to co-operate | 2 |
| Lack of perseverance in strategy and funding | 2 |
| Lack of big biotech companies and big pharma | 2 |
| Lack of ambition/daring | 2 |
| Difficulties to get Finnish inventions to local health care system | 1 |

| **IS THERE EVIDENCE OF CHANGE IN THE INNOVATION ENVIRONMENT?** | **n = 23** |
|---|---|
| Depressed atmosphere | 3 |
| Positive attitude towards biosector | 3 |
| Public funding for bioindustry is decreasing | 3 |
| Public funding for research is decreasing | 2 |
| Hype is fading, more realistic | 2 |
| Companies are stronger, they have learned their lessons | 2 |
| University legislation is changing | 2 |
| More cross-discipline activities | 2 |
| Too cautious | 1 |
| More competition, networking, internationalisation, university-industry collaboration | 1 |

| | |
|---|---|
| Weak signals on the growing understanding of pharma business among investors | 1 |

| **WHAT BIOSECTORS ARE THE MOST DYNAMIC?** | **n= 24** |
|---|---|
| Diagnostics | 12 |
| Functional foods | 6 |
| Biomaterials | 6 |
| All are quite equal | 4 |
| Bioenergy (note, not in the original definition) | 3 |
| Bioinformatics | 2 |
| Bio medicine / molecular medicine | 2 |
| Service business | 1 |

| **WHICH ARE MOST SUITED SECTORS FOR FINLAND'S STRENGTHS, AND ARE WE FOCUSED ON THE BEST OPPORTUNITIES?** | **n=23** |
|---|---|
| Diagnostics | 10 |
| Drug development | 4 |
| Functional food | 3 |
| Biomaterials | 3 |
| Service business | 3 |
| Bioenergy | 1 |
| Bioinformatics | 1 |
| Monitoring | 1 |
| Combining Nano/bio/It | 1 |
| Instruments, analysis systems | 1 |
| Forest industry | 1 |
| Food safety | 1 |
| Environmental analytics | 1 |
| Plant biotechnology | 1 |

| **WHAT ARE THE GLOBALLY INTERESTING STRENGTHS OF FINNISH BIO INDUSTRY THAT COULD BE EVEN STRONGER?** | **n= 22** |
|---|---|
| Diagnostics | 7 |
| Biomaterials, regenerative medicine | 4 |
| Functional food | 3 |
| Combining Nano/bio/It | 3 |
| Human genetics material, biobanks, Finnish sample collections | 3 |
| Forest industry, wood processing | 2 |
| Molecular medicine, biomedicine | 2 |
| Bioinformatics | 1 |
| Monitoring | 1 |
| Instruments, analysis systems | 1 |
| Food safety | 1 |
| Finnish top research: cardiovascular, asthma, allergies, immunology, cancer, central nervous system diseases | 1 |
| Personalised medicine | 1 |
| Glycobiology | 1 |
| Plant genomics | 1 |
| Special know-how in narrow sector | 1 |
| Epidemiology | 1 |
| Clinical research | 1 |
| VTT grain research | 1 |

| **WHAT ARE THE TRENDS IN THE BIO FIELD AT THE MOMENT?** | **n= 24** |
|---|---|
| Personalised medicine / co-operation of diagnostics and pharma / biotherapy | 12 |
| Ageing of population / increasing costs of healthcare | 6 |
| Pharma outsourcing | 4 |
| Preventive health care | 4 |
| Biological drugs | 4 |
| Genome and proteome mapping / systems biology | 3 |
| Bioenergy | 3 |
| Personalisation, customer and user orientation | 3 |
| Nutrition, food | 3 |
| New business models, partnering and networking | 3 |
| "Green biotechnology"/ sustainable development / environment friendliness | 3 |
| Point of care diagnostics | 2 |
| Drug discovery based on genomics | 1 |
| Transport mechanisms of drugs | 1 |
| Brain research | 1 |
| Infection diagnostics | 1 |
| Cancer diagnostics | 1 |
| Generics | 1 |
| Biomedicine | 1 |
| Biomaterials | 1 |
| Food safety | 1 |
| Decrease of fossil fuels | 1 |
| Chemical biology | 1 |
| Development of NAAT-tests | 1 |
| Biosensors | 1 |
| IT & biotechnology | 1 |
| Lifestyle diseases | 1 |
| China, India | 1 |
| Joint ventures of big companies and company purchases | 1 |
| Pandemias | 1 |
| Difficult to say | 1 |

| **DO FINNISH BIO FIRMS CONCENTRATE ON THE "RIGHT" TRENDS?** | **n=19** |
|---|---|
| Difficult to answer/ part of them has | 8 |
| Finnish firms are focused on narrow sector | 3 |
| Health and Well-being SHOK (Strategic Centres for Science, Technology and Innovation) | 2 |
| Personalised medicine is getting increasing attention | 2 |
| We should have the right mindset for risk-taking and look more on future | 1 |
| We have to build competitive advantage | 1 |
| Money in therapeutic proteins and antibodies | 1 |
| We have not awakened to environmental and industrial biotechnology and bioenergy | 1 |
| In biomaterial sector top level know-how and entrepreneurship also | 1 |
| Generic drugs business is looked down in Finland | 1 |

| **IS THE ROLE OF THE UNIVERSITY AS PART OF THE COMPANIES' INNOVATION PROCESS CHANGING** | **n= 24** |
|---|---|
| yes | 19 |
| no | 1 |
| no opinion | 4 |

| **IS THE ROLE OF THE UNIVERSITY AS PART OF THE COMPANIES' INNOVATION PROCESS CHANGING?** | **n= 24** |
|---|---|
| TEKES and EU-funding advance/force the collaboration | 9 |
| Atmosphere in universities has changed more positive towards commercialisation and collaboration with companies | 7 |
| Universities should more actively promote collaboration and networking | 7 |
| New university legislation promotes collaboration with industry | 5 |
| A new act on university inventions has simplified the IPR issues | 5 |
| University shouldn't be just R&D department for companies, but also have money for basic research | 4 |
| In biosector a stronger or weaker linkage to universities is always existing | 3 |
| Helsinki University Funds | 2 |

| **HOW IS THE COLLABORATION BETWEEN UNIVERSITY AND INDUSTRY WORKING?** | **n=20** |
|---|---|
| TEKES/EU-funding, including SHOK advance/force collaboration | 7 |
| Atmosphere has changed more positive towards commercialisation, universities and industry have become closer to each other | 6 |
| New university legislation encourages | 2 |
| A new act on university inventions has simplified the IPR issues, but IPR issues between university and industry are still problematic | 2 |
| university overhead costs are huge, which prevents firms from buying services from universities | 2 |
| **quite well** | **4** |
| **not well** | **2** |
| **collaboration is increasing** | **3** |

| **HOW IS THE COLLABORATION BETWEEN UNIVERSITY AND INDUSTRY CHANGING?** | **n= 20** |
|---|---|
| Collaboration between universities and industry has increased, universities have approached companies and are willing to collaborate | 17 |
| The new Universities Act and the new model of funding advances and increases the collaboration | 7 |
| TEKES activities including SHOK promotes the collaboration | 4 |
| More industry-commissioned research to universities | 2 |
| New generation at universities is more positive towards industrial collaboration | 2 |
| More positive attitude towards market economy and commercialism in society and in academia | 2 |
| Collaboration has become more professional on the university side | 1 |
| The Act on university inventions has influence on collaboration | 1 |

| **WHAT KIND OF OPPORTUNITIES COLLABORATION OFFER NOW AND IN FUTURE?** | **n=18** |
|---|---|
| Exchange of personnel between academia and industry | 3 |
| Reserch results more efficiently from university to practice, utilisation of results in society and in companies | 3 |
| Collaboration between industry and University Services (core units) | 1 |
| People form university and industry should work together | 1 |
| Companies could move closer to university campus | 1 |
| Outsourcing of innovation activity from companies to university - new mechanisms needed | 1 |
| In Ireland a model of funding, in which a doctoral thesis can be done in companies | 1 |

| **HOW CAN FINLAND PARTICIPATE AS A GLOBAL INTEGRATOR AS WELL AS SOURCE OF INNOVATION?** | **n=23** |
|---|---|
| There is no way that Finland could participate as a global integrator | 9 |
| In future perhaps in some narrow niche area, where we have special know-how | 5 |
| In functional foods perhaps | 2 |
| In forest and wood processing industry perhaps, we have a long tradition there | 2 |
| Source of innovation, but not an integrator | 2 |
| Bioinformatics could be one opportunity, since we have strong IT know-how because of Nokia | 1 |
| To develop the telemedicine service concept | 1 |
| Pilot platform for new technologies | 1 |
| Model country for development of innovation activity in networked society | 1 |

| **WHAT CAPABILITIES DO FINNISH BIOTECH COMPANIES UNIQUELY OFFER TO POTENTIAL GLOBAL PARTNERS?** | **n=23** |
|---|---|
| Finnish top research / Specific research areas (Diagnostics, Clinical, Vaccine, Brain, Cardiovascular, Cancer, Diabetes research) | 6 |
| Use of Finland as a test-bed / Finland bringing together expertise from different fields | 5 |
| Nothing special to offer | 3 |
| Top scientists /Good companies | 2 |
| Forest industry/ Biotechnology related to forest industry | 2 |
| Clinical trials | 1 |
| Vaccine research | 1 |
| Biomaterials and tissue technology | 1 |
| Food safety | 1 |
| Rapid tests | 1 |
| Functional food | 1 |
| Public health care and databanks | 1 |
| Biological ideas and their relations to diseases | 1 |
| IT-knowledge / Bioinformatics / Bio&IT/ solutions to these areas | 1 |
| Technological solutions | 1 |
| Inventions and their protection, "Knowledged-based" capital | 1 |
| Innovation system in Finland (actors, policy makers, institutes) | 1 |

| **WHAT ARE YOUR CAPABILITIES FOR GLOBAL PARTNERING AT THE MOMENT?** | **n= 15** |
|---|---|
| Good | 14 |
| Limited, requires time and traveling | 1 |

| **WHAT ARE THE CAPABILITES OF UNIVERISITES AND COMPANIES FOR GLOBAL PARTNERING AT THE MOMENT?** | **n= 9** |
|---|---|
| Good | **5** |
| Especially smaller companies lack know-how | **2** |
| Smaller companies lack resources | 2 |

| **HOW DO BIOTECH ORGANISATIONS SELECT THEIR PARTNERS + HOW DOES YOUR ORGANISATION SELECT ITS PARTNERS?** | **n= 23** |
|---|---|
| By chance | 6 |
| strategic interest, mutual benefit | 6 |
| Personal network | 6 |
| Appropriate know-how | 3 |
| Global congresses and meetings are important | 3 |
| Basic research partners come from university | 2 |
| They have to bring added value | 1 |
| Trust and functionality | 1 |
| Potential partner should have some evidence of successful action | 1 |

| **GLOBAL PARTNERING - ADVANCING FACTORS** | **n= 20** |
|---|---|
| Funding | 6 |
| Special know-how, lacking competence | 5 |
| Understanding customer needs regionally | 2 |
| Market extension | 2 |
| Finland is a small country, you need global partners - bioindustry is global | 2 |
| Personal characteristics and networks | 2 |
| Strategic interest | 1 |
| Good experience | 1 |

| **GLOBAL PARTNERING - INHIBITING FACTORS** | **n=20** |
|---|---|
| Lack of resources | 4 |
| Lack of funding | 3 |
| Cultural differences | 3 |
| Lack of time | 2 |
| Language | 2 |
| Finland's distant location | 2 |
| Ethical issues | 1 |
| Prejudice | 1 |
| Small size of the company | 1 |
| Time difference | 1 |
| Contract manners | 1 |
| no success stories | 1 |
| Personal attitude | 1 |

| **IS IT POSSIBLE FOR A COMPANY/UNIVERSITY TO FIND A VALUABLE DOMESTIC PARTNER** | **n= 22** |
|---|---|
| yes | 19 |
| maybe | 2 |
| no | 1 |

| WHAT PATTERNS AFFECT PARTNERING WITH A DOMESTIC PARTNER | n=22 |
|---|---|
| Competence | 5 |
| Complementary offering | 3 |
| Funding (e.g. Tekes) | 3 |
| Distance | 2 |
| Confidence | 2 |
| Active Interaction | 2 |
| Biosector well networked in Finland | 2 |
| Synergy advantage in sales and marketing | 1 |
| Common technology | 1 |
| Same customer | 1 |
| Language, time difference | 1 |
| Synergy advantage in manufacturing | 1 |
| Biosector in Finland is quite fragmented, more focusing needed | 1 |
| Finland is a small country, not enough synergy advantage to merge companies | 1 |
| Preclinical tests | 1 |
| Clusters constrict | 1 |

**AT WHAT POINTS OF THE INNOVATION PROCESS/ RESEARCH ARE PARTNERS SELECTED?**

**Main response:**
At every point of innovation process / research, it depends

**Conclusions / comments**
Partners are selected too late!
Companies would like to be involved in university research already during planning. University research groups contact companies rather late.
Thinking that "ideas are stolen" / too cautious attitude in IPR issues
It is also wise to partner earlier for financial issues
Proof of concept has to be shown to commercial partners
Partners have found me
Partners need to be found before you actually need them
There is unnecessary partnering going on all the time
Partners are selected quite late, it would be positive to see partnering already in earlier phase

| WHAT ARE THE CHALLENGES IN PARTNERING WHEN PARTNER IS NOT LOCATED IN THE SAME AREA/COUNTRY? | n=23 |
|---|---|
| Language, cultural differences and body language /Misunderstandings | 8 |
| Parners have to be met face-to-face and it takes time and money | 7 |
| Data and information transfer | 6 |
| Geographical distance / Different time zones | 5 |
| No special challenges -especially when maintaining the partnership | 5 |
| Legal frameworks/ Agreements/ Regulatory issues | 2 |
| Different company cultures | 1 |
| Follow-up | 1 |
| Trust | 1 |

| **RISKS IN GLOBAL PÅRTNERING** | **n= 20** |
|---|---|
| Contracts, terms of agreement | 11 |
| IPR, legal issues | 6 |
| Ideas are stolen | 2 |
| Knowledge of local business culture and law is not strong enough | 2 |
| Bargaining position of small companies is weak | 1 |
| Selling below current price when short of money | 1 |
| Foreign owner will move the operations away from Finland | 1 |
| Data security | 1 |
| Misunderstandings due to language | 1 |
| Ethical questions | 1 |

**HOW WOULD YOU COMPARE THE BIO REGIONS AROUND THE WORLD (US, India, China, Europe, Finland *etc.*)?**

**JAPAN**

Large conglomerates with good financial standing
Tight collaboration between Industry and universities
Forerunner in industrial enzymes
Big internal market

**USA**

USA is forerunner - leading position in biotechnology
More entrepreneurship, entrepreneurial culture more supportive
More funding available
Big internal market
Cliquey market
Good research
Companies are bigger
Tax reliefs
Hard competition
Systems are well-established
Lot of regulation
University-industry collaboration in biotech is functional
Technology transfer offices of the universities - successful model
Several good clusters in different States
Strong research groups, good funding possibilities
Remarkable role globally, they know how to get from idea to successful innovation
Big volumes in research and funding, bigger companies

**CHINA**

Growing market
Manufacturing business and services, financed by Western world
Research is stronger than earlier
Hard competition
People are hardworking
Not many innovations, but more are coming
Big market
Terms and reliability is still a problem
Copies everything
Wants collaboration with Western world
Good economic growth
Facilities are not so good

Lot of investments to biosector
Cheap labour
Growing fast, e.g. in health technology
Lot of manufacturing has been transferred to China and India

**INDIA**
Growing market - huge potential especially in diagnostics
People are hardworking
Specialised especially on services and production of chemical industry
Competence and education in bio sector have gone up
Communication is easy, contracts are honored more than in China
Organisations are well-established
Not strong in bioscience research nor industry
Lot of labour
Cost effective
Much interest towards e.g. regenerative medicine, but not know-how
Lot of manufacturing has been transferred to China and India

**EUROPE**
Germany, France, UK, Medicon Valley bioclusters
Slow in regulatory issues
Legislation behind in GMO-products -> GMO research and production will be moved to South America
GMO-resistance -> agriculture lags behind
Lot of regulation, legislation is problematic
Less capital or venture capitalists compared to US
Research is strong, but business not
Innovation environment is not supportive
Many people involved in various supportive organisations compared to the amount of companies
Ireland has managed to attract big pharma industry to the country
Swedes can market their products and know-how better than Finns. Sweden has more pharmaceutical industry to help biotech
Medicon Valley: Lot of critical mass, financiers, companies, functional market
Norway´s situation equal to Finland, but they are even more strict in ethical issues
Regulations for health claims are tricky in EU

**FINLAND**
Comparable to the rest of Europe excluding funding
Networking is not efficient enough
EU opportunities should be exploited in collaboration - complementary competence from Europe
China and India collaboration could offer new opportunities
Amazing amount of bioclusters
Competence and bioindustry is clustered strongly geographically
Postdoc periods abroad are important to Finnish competence
High-level basic research, researchers and publications
Small market, behind Sweden and especially Denmark
Could enhance education, as in other Western European countries
As a small country - more difficult to apply/get money from EU
Finland should focus on some niche-areas, which we know well
Small volume compared to many other European countries
Strong basic research. The innovations arising there should be utilised better

| **CUSTOMER'S ROLE IN INNOVATION PROCESS** | **n= 14** |
|---|---|
| The customer's role is crucial, many innovations originate from the customer | 6 |
| Innovations originate from customer needs, but the customer is not necessarily involved in innovation process | 4 |
| The role of the customer is changing towards increasing participation in innovation process | 3 |
| The customer's role is not strong enough | 3 |
| The customer is not involved in innovation process | 3 |
| To get preliminary feedback, the customer is asked to test products/services in early phase | 3 |
| It is challenging to acquire customer input, customers do not express their needs and wishes as much as firms hope | 2 |
| Ideas are not necessarily originated by customers | 1 |
| In bioindustry the financier is a kind of a customer | 1 |
| Customer information is not utilised in a systematic way | 1 |
| User-orientation is a current trend | 1 |

| **HAVE YOU NOTICED ANY SUCH CHANGES IN MARKET OR IN BUSINESS ENVIRONMENT THAT COULD INFLUENCE CUSTOMER INTERACTION OR BEHAVIOUR** | **n= 10** |
|---|---|
| The amount of information and knowledge is increasing and it is easier available -> demanding and conscious customer | 5 |
| More regulations for quality, customer interaction (giveaways etc.) | 3 |
| Interaction and communication is faster | 2 |
| Several different customers: doctors, patients, authorities, financiers | 1 |

| **FACTORS AFFECTING THE AVAILABILITY OF VENTURE CAPITAL** | **n=13** |
|---|---|
| Global partners/ partnering network /Big Pharma partner | 10 |
| IPR position and strength / Immaterial rights | 4 |
| Personnel | 3 |
| Commercial prospects / market niche | 2 |
| Cash flow | 2 |
| Business model | 1 |
| Rapid revenues | 1 |
| Expected increase in value | 1 |
| Attractiveness of idea | 1 |
| Level of technology | 1 |
| Reference customers | 1 |
| Length of funds/ long R&D periods | 1 |
| Real time legislation | 1 |
| Narrow capital market in Finland | 1 |
| Mechanisms to attract foreing capital to Finland | 1 |
| Factors preventive for partnering | 1 |
| Risks | 1 |
| Regulatory barriers | 1 |
| Evaluation of Tekes actions regarding research funding | 1 |

| **HOW TO SECURE CONTINUOUS FUNDING?** | **n= 12** |
|---|---|
| Cash flow already in early phase | 4 |
| Longer terms funding | 3 |

**COMMENTS**

Do not have to ensure, but functional model for financing needed

More evidence and positive examples

Seed and early growth phase funding ok, but after that finding financiers is challenging. For that phase some public or semi-public organisation needed

| **WHAT ACTIONS YOU WOULD LIKE TO DO TO GET THE GLOBAL INVESTORS/COMPANIES INTERESTED IN FINNISH BIOTECH COMPANIES** | **n= 19** |
|---|---|
| Finnish investors should show their confidence in companies and projects | 4 |
| Contacts needed | 4 |
| Top-quality basic research | 2 |
| Companies should be centralized | 2 |
| More marketing | 2 |
| Information about Finnish know-how should be spread | 2 |
| Sales skills | 1 |
| Good competence in a company | 1 |
| Projects/products should be developed further | 1 |

| **WHAT POLICYMAKERS COULD DO?** | **n=21** |
|---|---|
| Tax reliefs to investors | 6 |
| Develop funding instruments | 6 |
| Attitudes/beliefs on bioindustry | 4 |
| More visibility | 4 |
| Focus | 3 |
| More funding for basic research | 2 |
| The number of students in biotechnology field should be reduced | 1 |
| Israel-model | 1 |
| Development aid | 1 |
| Funding only for the best | 1 |
| Know-how for the companies to be able to make decisions | 1 |
| Research collaboration environment should be more attractive | 1 |
| Better understanding of bioindustry | 1 |