Finland a European Leader in Biotechnology

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Biotechnology is a significant new growth industry in Finland. Development has been rapid during the last few years; Finland is now one of Europe’s top biotech countries and home to ten per cent of Europe’s biotechnology companies. In the continental ranking, Finland takes sixth place behind the UK, Germany, France, the Netherlands and Sweden.

Finland has a long and successful track record in biotechnological research. Modern biotechnology got off to a strong start in the mid-1980’s with a major role being played by large-scale programmes run by the Academy of Finland, the National Technology Agency (Tekes) and the Finnish National Fund for Research and Development (Sitra). To a large extent, these programmes have provided the foundation for today’s expertise and the business that has grown around it.

Finland’s knowledge-based growth strategy strongly supports R&D. Alongside information and communications technology (ICT), biotechnology holds top priority in the government agenda.

Finland’s knowledge-based growth strategy provides strong support for research and development. Investments in R&D have risen steadily throughout the 1990’s. In autumn 1996 the Finnish Government made a decision to further substantially increase investments in R&D during the following three years. The largest part of the public funding was to be channelled from the privatization of state-owned companies.

As a result of the government efforts, as well as an even faster growing input from industry, the amount of money spent on R&D as proportion of GDP increased from 2.04% in 1991 to 3.19% in 1999. During this period, the input almost doubled in real terms. Relative to GDP, the input is second highest in the world. Of the total investment, 30% is funded by government and 70% by industry. In 1999, more than EUR 4 billion was spent on R&D activities in Finland.

The strong R&D input has given good results: the ICT sector is now a stronghold of the country’s economy. Biotechnology is considered to be a new and promising sector for the future.
According to the 2001 Competitiveness Report released by the International Institute for Management Development (IMD), Finland ranks third in the world as a competitive location for business. The assessment is based on 286 criteria, including economic growth, investment levels, employment, technology development and application, use of new information technology and R&D cooperation.

Interactions among industry, universities and research institutes are of particular importance to the life sciences sector. The interaction has long been of self-evident importance in Finland, and is strongly encouraged by the government and other decision makers. A recent survey on Community Innovation carried out by the European Commission also clearly mentions the well-functioning cooperation.

The biotechnology industry

Currently, there are more than 120 biotech companies in Finland, providing some 4,200 jobs, with a combined turnover of close to EUR 700 million in 2000. If pharmaceutical plants are added to the total, the figures are 10,800 jobs and a combined turnover of EUR 1,860 million.

Large companies concentrate on the production of pharmaceuticals, diagnostic test systems, industrial enzymes and the application of biotechnology in food processing.

Most of the new biotechnology companies are operating in medical and diagnostic fields or biomaterials, while others offer services in clinical research, patenting and marketing analysis.

Typical for a small start-up biotech company is that 80% of its sales goes to research and development (16% in the pharma industry), and the production is mainly directed to the international market (up to 90% to export).

In both expertise and the number of start-ups, Finland is a front-rank country. The company start-up rate is convincing: of the total number of 123 companies, 75% were established in the 1990’s. The last three years have seen dozens of new start-ups and new ones are appearing monthly.

National technology programmes an essential contributor

The strength of the Finnish biotechnology industry is high-level knowledge. The groundwork was laid in the 1980’s with strong public investments, and the input, together with a firm contribution by industry, has continued resolutely ever since.

The total figure for public expenditure on biotechnology in the 90’s was EUR 340 million.

A major role has been played by the large-scale national research and technology programmes run by the Academy of Finland and the National Technology Agency, Tekes. Also Sitra, the Finnish National Fund for Research and Development has contributed to the funding since the mid-80’s.

The Academy of Finland, is an organization involved in research funding, operating within the administrative sector of the Ministry of Education. The mandate of the Academy is to finance high-level research through individual projects, programmes, centres of excellence, research posts and researcher training. It also serves as an expert body on science policy issues. The annual funding volume was EUR 157 million in 2000, which is equivalent to about 12% of the total public R&D expenditure in Finland.

Tekes, established in 1983 and operating under the Ministry of Trade and Industry, is the principal source of public funding for applied technology research and industrial R&D. The funds are awarded from the State budget.

In 2000, Tekes funded 2,297 research and development projects to a total value of EUR 370 million. Of this amount, about 30% was focused on the life sciences sector, which, along with information technology, is a top priority of Tekes. An extra contribution is made to promising biotechnology start-ups.

The national technology programmes are an essential part of the Finnish innovation chain. The aim is to create new technology expertise and product development options in business areas of the...
future. In addition, the programmes offer a solid framework for international R&D cooperation. The technology programmes are used to promote development in specific sectors of technology or industry, and to effectively pass on the results of the research to business. Planned jointly by Tekes, companies, industrial organizations, research institutes and in some cases the Academy of Finland, the programmes have proved to be an effective form of cooperation and networking for companies and the research sector. Several broad programmes are carried out together by Tekes, the Academy of Finland and government ministries.

The following technology programmes related to the life sciences are currently running, have just ended or are about to commence:

**Cell Biology Research Programme, 1998–2001**
The programme is focused on the mechanisms of cell division and differentiation, biogenesis of cell organelles and intracellular trafficking and signal transduction.

**Genome Research Programme, 1995–2000**
The primary areas include gene regulation, interactions between genes and gene products, gene transfers and knock-outs and gene therapy.

**Diagnostics 2000, 2000–2003**
The programme focuses on clinical diagnostics and is divided into four theme groups: Infectious Diseases, Degenerative Diseases, Development of Diagnostic Methods and DNA Diagnostics.

The programme will span the entire drug development process from the identification and validation of new drug effects to the creation of new medical preparations and the development of new means of administering doses. Projects will concentrate on biomedicine, the development of drugs, pharmaceutical development and essential supporting areas of research.

**Innovation in Foods, 1997–2000 (to be continued 2001–)**
The programme aims at higher quality and more competitive foods through research. New forms of cooperation are developed between the food industry and other industrial sectors and fields such as the pharmaceutical industry, biotechnology and information and production technologies.

The programme consists of four fields: neurosciences, research on the biological functions of genes, developmental biology and research on ethical aspects and socio-economic impacts.

The NeoBio programme aims to promote developments in modern biotechnology and their application in research and commerce. The programme has provisionally been divided into agrobiotechnology, new industrial biotechnology and work on projects related to the cell factory.

**Capital investors**
Conditions for biotechnology in Finland have significantly been improved by better risk financing for companies. The situation has become substantially brighter during the past two to three years, and the trend continues upwards. Besides Tekes, early stage financing is provided by the Finnish National Fund for Research and Development (Sitra) and about a dozen risk financing companies.

**Sitra** is an independent fund operating with a mandate from the Finnish Parliament. It invests capital (seed, start-up and expansion money) in high-technology firms and introduces and develops successful new
forms of business. Sitra also invests in international venture capital funds oriented towards technology. Operations are financed mainly through income obtained from endowment investment and capital gain. At present, Sitra has about 50 life sciences companies in its portfolio. The year-

venture capital operations began in the late 1980’s and today there are over 30 active venture capital organizations in the country. The private venture capital sector will continue to grow in response to the demand for capital and opportunities in growth financ-

The restructuring of industries (MBO, MBI) and growing R&D investments, together with the high competitiveness of the Finnish economy, have spurred the growth of venture capital operations. Professional venture capital operations began in the late 1980’s and today there are over 30 active venture capital organizations in the country. The private venture capital sector will continue to grow in response to the demand for capital and opportunities in growth financ-

BioFund Management Ltd, incorporated in 1997, is a private company making venture capital and private equity invest-

ments in biotechnology companies, with health care, nutrition and environment as primary targets. The size of the fund under management is about EUR 100 million.

BioFund finances business development, company investments, company acquisitions, technological development and export drives.

Other Finnish venture capital companies with focus on biotechnology include Con-

ventum Capital Ltd, Eqvitec Partners Ltd., Euroventures Advisors Ltd, Fenno Manage-

tment Oy. Also pension funds are becoming active in the life sciences area.

International capital investors have shown rapidly growing interest in Finnish biotechnology companies, with about 20 having made investments.

Biocentres and centres of excellence in the biosciences

Competent biotechnology centres have been formed in conjunction with universi-
ties with a strong science base in biotechno-

logy. The main centres are located in the Helsinki metropolitan area and in Kuopio, Oulu, Tampere and Turku. The centres bring together commercial biotechnology enterprises and biotechnology-focused univers-

ity research. All centres include incubators and support services for start-up com-

panies.

Helsinki has established the Helsinki Science Park, including Viikki Biocentre and the Institute of Biotechnology of the University of Helsinki. This science park provides a creative atmosphere for emerg-

ing biotechnology companies as well as for top level research groups in cell biology, biochemistry and molecular biology. The several top research groups in the fields of biotechnology, pharmacy, biomedicine, di-

gnostics, food and environmental technol-

ogy bring synergy to the science park. There is also an incubator, where compa-

nies work in close cooperation with the aca-

demic world.

Biomedicum is a newly formed centre for medical research and training on the Meilahti campus of the University of Helsinki. It provides a first-class interna-

tional research environment where investi-
gators do research on leading-edge issues in medical science. Biomedicum offers state-of-the-art facilities to some 1,000 re-

searchers and postgraduate students.

The National Public Health Institute in Helsinki produces human vaccines. The Technical Research Centre, VTT, and the Helsinki University of Technology, both lo-

cated in Espoo, close to Helsinki, work closely with the biotechnology industry.

Kuopio Science Park in Kuopio in cen-

tral Finland is a joint endeavour of the Uni-

versity of Kuopio, Technology Centre Tek-

nia, Kuopio University Hospital, the A.I. Virtanen Institute, the Geological Survey, Research Centre Neulanen and Bioteknia. Bioteknia is a core research centre focusing on areas where the University of Kuopio has gained world-wide recognition, namely animal biotechnology, molecular medicine, neurosciences, agrobiotechnology, drug de-

sign and food biotechnology. A state-of-the-

art biotechnology production unit is avail-

able in Bioteknia with its GMP-grade ani-
mal cell and microbe bioreactor laboratories as well as a GMP production unit complying with the strictest biosafety standards.

The Medipolis Science Park, based in Oulu in Northern Finland, was founded in 1990 alongside the city’s successful electronics and telecommunications science park. Of nearly 50 companies spawned by Medipolis, about a third operate in the biotechnology sector. The park works in co-

operation with Biocenter Oulu, Oulu Uni-

versity’s Faculty of Medicine and Bio-

sciences and the Oulu University Hospital.

The core competence technology fields of Medipolis cover applied biotechnology and process technology. Other strong areas among the medical technologies are in health care business operations and innova-

tive applications of telecommunications and electronics in health care products. The centre also has growing business potential in developing and producing preventative, treatment and diagnostic methods in cardio-

vascular, metabolic, autoimmune and con-
nective tissue diseases and cancer.

Biocenter Oulu is the oldest of the
Finnish bioinstitutes, founded in 1986. The aims are to perform internationally high-level basic research in modern biosciences and to carry out high quality and efficient research training. The present three-year period 2000–2002 of evaluated research activities includes ten research projects and three associate projects. Biocenter Oulu also collaborates with other Finnish bioinstitutes in coordinating various bioscience activities such as work in the areas of structural biology and DNA chip technologies.

**Finn-Medi** is a centre of expertise in Tampere, specialized in medical research and education. It comprises four research institutes and forty companies working in the various fields of health care technology, including medical research and education, technological research and education, and health care and health care education. Research and education focus mainly on cancer biology, bioelectromagnetism, telemedicine, biomaterials, AIDS research, and genetics related to the origins of rheumatism, diabetes and multiple sclerosis. About 12,000 people are working within Finn-Medi.

The research on molecular and cell biology, cancer biology, cancer genetics and basic immunology, molecular biology and developmental medicine, immunology, molecular biology and diagnostics, structural biology-function analysis, and microbial and plant molecular biology and biotechnology.

**Turku Bio Valley Ltd** was established in 1999 by the Turku City Council to build production and product development facilities for biobusiness companies. The city has invested EUR 14.3 million of start-up capital into the new Bio Valley in autumn 2001.

The Academy of Finland nominates Centres of Excellence in Research for a six-year period. The voting for the centres is done on the basis of the agreement. A centre of excellence is a research unit or researcher training unit which comprises one or several high-level research teams with shared, clearly defined research goals, and which is at the international forefront in its field or has good potential for reaching the top.

Twenty-six new Centres of Excellence started up at the beginning of 2000. Of these, eleven are involved in projects related to biotechnology and are receiving considerable public funding for the years 2000–2005.

### Biotechnology companies

Biotechnology is a broad concept, as shown by the wide range of companies in the sector. The main interests are the development of pharmaceuticals, diagnostics, biomaterials, industrial enzymes and functional foods, or research and the provision of services for related fields of activity. Approximately half of the companies focus on wellbeing.

### Pharmaceuticals

Finland’s traditional pharmaceutical companies are at the crossroads. New R&D companies have been established worldwide, as well as in Finland, to explore innovations that can lead to commercial biopharmaceuticals. Finland has spawned several R&D companies targeted at new medical discoveries based on biomedical research. The companies are working on new pharmaceuticals and treatments for conditions such as cancer, AIDS and hereditary diseases. More than 10 companies specializing in drug discovery already exist in the country.

**Ark Therapeutics Oy** Clinical grade DNA and protein production, labware contamination testing

**BioTie Therapies Corp.** Pharmaceuticals for acute and chronic inflammatory diseases, thrombosis and cancer

**Carbion Oy** Complex carbohydrates for pharmaceutical use

**Pharmacontrol Ltd.** Pharmaceutical substances, diagnostics industry

**Finnovity Oy** Radio chemicals and imaging technology for the commercial production of radiopharmaceuticals

**FIT Biotech Plc.** Pharmaceuticals, diagnostics and FIUO products in selected areas of HIV, allergy, cancer, autoimmune diseases and medical technology

**Galilaeus Oy** Pharmaceutical substances, anticancer agents and rapid diagnostic tests

**Hormos Medical Ltd.** Pharmaceuticals for hormonal prevention and treatment of osteoporosis, urodynamic cardiovascular diseases, Alzheimer’s disease, cancer

**Oy Juvanta Pharma Ltd.** Novel Therapies for treatment of psychiatric, neurological and vascular wall diseases

**Leiras Oy** Pharmaceuticals

**MAP Medical Technologies Oy** Radio pharmaceuticals

**Medical Oy** Develops, with bioinformatics and whole-genome-based metabolic engineering, enzymes and glyco-chemistry-based pharmaceuticals for inflammatory and infectious diseases.

**Orion Corporation Orion Pharma Pharmaceuticals**

**Pharming Oy** Raw materials for the pharmaceutical industry produced in transgenic animals

**Santen Oy Pharmaceuticals**

**Siltrum Medical Systems Oy** Discovery and development of vaccines: gene expression technology for the commercial production of heterologous proteins

### Diagnostics

During its 25 year history Finland’s diagnostics industry has evolved into an economically and technologically important medical industry cluster utilizing the latest high technology. The branch includes some medium-size companies as well as a number of small companies with a strong research orientation. More than 90% of the output of the Finnish diagnostics industry is exported, mainly to European markets. The stronghold of Finnish companies is immunological reagents and equipment. It is estimated that this sector, worldwide, will soon be growing at some 15% per year. Today, the diagnostics companies in Finland have a combined turnover of EURs 254 million and employ 2000 people.

**Acell Oy** Serum-free plasma cell growth support, hen and rabbit antibodies, hybridoma cell line and monoclonal antibodies

**Finbiotech Oy** Rapid one-step tests and latex agglutination tests for human and veterinary use

**Arctic Diagnostics Oy** In vitro diagnostic systems

**BioChance Oy** Immunobdoassay technology and synthetic peptide and recombinant antigen for infectious diseases

**Biofoms Ltd.** Tests for the diagnostics of intestinal inflammatory and autoimmune diseases

**Biohit Plc.** Electronic and mechanical pipettes and consumables for use in clinical, research and industrial laboratories

**Bio-Noble Oy** In vitro toxicity assays, bioluminescent whole cell biosensors for environmental monitoring

**BioTop Ltd.** Biodiagnostic kits and molecular biology reagents

**Cellemeda Oy** Devices for studying subcutaneous cellular activity and for biochemical and histological analysis, cell culture, assay for in vitro and in vivo tests

**Erlab Oy** Antibodies, analytical services, in vitro diagnostic tests

**Finnoflag Oy** Novel microbe sampling and detection methods, health factors and antimicrobial agents, biosensors

**Fluilogic Systems Oy** Automated precision liquid handling equipment

**Glomega Inc.** MoAbs, diagnostic assays and kits

**Headman Oy** Laboratory diagnostics for infectious diseases

**HyTest Oy Ltd.** Monoclonal antibodies, proteins, enzymes

**InnoTrac Diagnostics Oy** Immunobioassay
Bionx Implants Oy Biosorbable implants for surgical use
Bioxid Ltd Oy Biomaterials, bioactive glass for orthopaedic, dental and drug delivery applications
Inion Oy Biomaterial-based biodegradable medical devices
JVS Polymers Oy Biodegradable and bioactive polymers and composites
Osfix International Ltd Oy Dental implants
Panipol Ltd. Conductive polymers
Stick Tech Oy Fibre-reinforced polymer materials, tooth replacement materials, adhesive materials, non-metallic materials, microinvasive treatments and aesthetic replacement

Industrial enzymes
A strong area in the Finnish biotech industry is enzyme technology, where the country has a long tradition of excellence. Branches of industry that use enzymes include the food industry, the pharmaceutical industry and industries manufacturing base materials, animal feeds and textiles.

Biotechnology in the food industry
Functional foods with health promoting effects are studied extensively in the food industry. Several companies and research institutes are working towards a combination of modern food technology and biomedical research.

Aromtech Oy Health food products, functional food
Cameleon Oy Functional food
Danisco Finland Oy Food and feed ingredients, enzymes, sugars
Hormos Nutraceutical Ltd. Nutraceuticals
Novatreat Oy Clinical foods (immune milk products)
Omecol Finland Oy Cholesterol-lowering products
UniCrop Ltd. Plant biotechnology, foreign protein production in crops, control of gene escape from transgenic plants, development of environmentally friendly fish feeds
Valio Ltd. Probiotic bacteria, starter cultures, animal probiotics, antibiotic tests

Contract research and service organizations
AboaTech Ltd. Commercialization of bioinnovations
Alkomohr Biotech Oy Ltd. R&D and consulting on industrial yeasts and on industrial and dietary enzymes
BiodLigand Oy Research services for carbohydrates and nutritional products
Bioprojects Consulting Services Business development services for Life Science SMEs
BioVitro Oy Research services for food, functional foods, pharmaceuticals
Cell Test Turku Oy Screening services for osteoporosis drug candidates
Cerebricon Ltd. Brain disease models for screening of drug efficacy and mechanism of action
CRST – Clinical Services Turku Clinical research services for pharmaceuticals, medical devices and functional foods
Fatman Bioinformational Designs Ltd Oy Computer-aided design of small molecule ligands
Oy Foodfiles Ltd. Food testing, clinical research, consultation, documentation, registration
Oy Galena Ltd. Contract manufacturing services for pharmaceuticals, natural remedies and nutritional products
Imnomedica Oy Ltd. Services in business development, technology transfer and capital investment especially for the biopharmaceutical field
Licentia Ltd. Commercialization of research results and technologies
MCA Research Laboratory Ltd. Antioxidant research, diagnosis of atherosclerosis
Oy MedFiles Ltd. Clinical research on medicinal products and medical devices
MedFiles Pharma Ltd. Pharmaceutical R&D, analytical chemistry, microbiological research, formulation and analytical development
Novagent Oy Transdermal delivery contract research
Ternics Health care sector management consulting, investment and R&D project research, feasibility & financing studies.

A complete list of biotechnology companies "Index of Biotechnology Companies, Organisations and Science Centres in Finland" can be ordered from Finnish Bioindustries, email: hannele.kuusi@kiemia.ttilittot.fi