



ANNUAL REPORT
2002

”Through creating and applying technology, we actively enhance the competitiveness of industry and other business sectors, and thus increase the welfare of society.”

VTT'S CORE VALUES

Genuine Cooperation

Customer and Demand Orientation

Science-based Innovation

Encouraging Peak Performances

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REVIEW BY THE DIRECTOR GENERAL

The Finnish innovation environment stands at a crossroads. The merits of our competitiveness have been extolled in many international comparisons. The functional training system, high standard of research and development work, and seamless co-operation between the business, research and public sectors have won special praise.

Nonetheless threatening clouds are looming on the horizon of the research sky. Relative spending on R&D is still high at 3.4 % of gross domestic product, but the share of the public sector has been developing unfavourably. In absolute terms we have been marking time already for a few years. Public applied research organisations like VTT have fallen behind in the development of resources.

VTT has paid particular attention to highlighting the effectiveness of its research results. Decision-makers and citizens have the right to know what is being achieved thanks to public R&D spending. We have also been active in describing technological development in the media. We want to spark a national debate. Technology is increasingly affecting the lives of each and everyone of us. In which direction does our society want to go?

The Science and Technology Policy Council of Finland is the highest national body responsible for advising the government on science and technology policy issues. In a statement released at the end of the year the Council emphasised the importance of social innovation and regional development by means of expertise and its exploitation. These are both challenges for VTT.

A welfare society is only possible if economic productivity and international competitiveness develop favourably. VTT has participated in this by developing the technologies and business expertise of companies. Social innovations brought about by technological know-how facilitate the cost and quality effectiveness of welfare services, enabling our society to ensure the desired standard of services now and also in the future.

Global economic uncertainty is also reflected in the activities of VTT. Responsiveness to changes in the operating environment is an ability of increasing importance. Forecasting future expertise needs is becoming more and more difficult, and the growing complexity of the research field makes technology policy formulation problematic. The creation of new actors is politically more attractive than the development of good structures already in existence.

Regional development by means of expertise and its exploitation is a policy that VTT supports unreservedly. The global competitiveness of strong expertise centres must be safeguarded by the allocation of adequate resources. Concentrating scarce resources enables a small country like Finland to achieve the critical mass of expertise. It will also enable us to avoid the decline of Finland's much-vaunted competitiveness into mediocrity.

The economic difficulties of last year will spur us on to greater efforts in the future. VTT is prepared for the challenges that lie ahead. I warmly thank our employees, customers and other stakeholder groups.

Erkki KM Leppävuori

VTT ELECTRONICS



VTT Electronics studies and develops the latest ICT solutions as well as the technologies needed in products containing electronics. The aim is to produce new developments that will be important for the manufacturers of future telecommunications products and applications. In research into embedded software the Institute creates methods to develop and manage software of continuously increasing complexity. Research on interactive electronic systems focuses on improving the control and usability of products. The Institute also develops IC, component and module technologies in order to promote the production of the electronics industry.

The most important research results achieved in 2002 concerned wireless telecommunications, software architectures, interactive electronics and optoelectronics. Strategic research, joint projects and contract research commissions were carried out in all of these areas. For example, a quality analyser has been developed for the automation of papermaking. Software architecture expertise has been developed in four joint projects, and architecture expertise transferred to companies in three industrial projects. The development in an EU project led by VTT Electronics of a radio link capable of 130 Mbps wirelessly in a telecommunications network was also an excellent achievement. In 2002 four new spin-off companies were started on the basis of the technologies created.

The most significant investment of the year was the new Micromodule Centre, which was completed in November 2002 at a cost of about EUR 5 million. As a result of the investment, the size of VTT's clean rooms intended for electronics research and production was doubled. The new facilities and equipment will support top expertise in electronics manufacture in both the north of Finland and the country as a whole. The centre offers new facilities and equipment also for the use of companies.

Research fields:

*Advanced Interactive Systems
Embedded Software
Optoelectronics
Telecommunication Systems*

Man-years: 270

Staff breakdown

by location:

Oulu 289

Raaha 5

Turnover: 22.1 M€

VTT INFORMATION TECHNOLOGY



Following a reorganisation in 2002, VTT Information Technology now covers all the essential links of the ICT value chain. The Institute's R&D fields span the spectrum from microelectronics and microsensing, wireless technologies and communication networks to media technologies, information systems and the usability of IT systems and terminals.

One example of an excellent software project carried out in 2002 was an operative management system for wood procurement. The system calculates a unique transport programme for each wood batch, including the routing and unloading site schedules software delivery involved algorithms for processing raw data from the Envisat satellite into high-level information products. Perhaps the most notable of the numerous EU projects in which VTT participated was the development of a radio frequency identification system.

An experimental digital TV transmitter was installed in a joint effort with Helsinki University of Technology (HUT). This arrangement is a step towards realising the strategic research goal of creating a multitechnology environment. Together with HUT the Institute extended its microelectronics and nanotechnology research facilities. Clean room and pilot production facilities have been made available to small innovative companies, thereby creating a micro- and nanotechnology park on the Otaniemi campus.

In its international operations the Institute has strengthened its partnering networks. VTT is a member of the Ercim consortium, which became the new European host of the World Wide Web consortium from the beginning of 2003. A partnership has also been established with the Japanese National Institute of Earth Science and Disaster Prevention. The five-year agreement involves the development of remote sensing methods and the analysis of images taken by a radar satellite.

Research fields:

*Microelectronics
Microsensing
Telecommunications
Networks
Information Systems
Media
Human Interaction Technologies*

Man-years: 401

Staff breakdown

by location:

Espoo 384

Tampere 59

Turnover: 37.3 M€

VTT INDUSTRIAL SYSTEMS

Research fields:

*Reliability and
Risk Management
Production Systems
Production Engineering
Product Performance
Materials and
Structural Integrity
Intelligent Products
and Services*

Man-years: 550

Staff breakdown

by location:

*Espoo 396
Tampere 176
Lappeenranta 11*
Turnover: 46.9 M€

VTT Industrial Systems is concerned with the development of products, production and their associated services. The areas of research emphasis defined in the new strategy were life cycle management, safety and dependability, intelligent systems and services, machines and transport equipment for the future, networked operation, and the interaction between people and technology.

Durability modelling and structural dependability methods for mechanical components of nuclear power plants were developed in research concerning life cycle management. The safety and dependability of production and products were comprehensively studied and improved in collaboration with corporate partners. New sensor and communication technologies have played a key role in creating structural analyses, simulation models and intelligent systems and services in the development of new machines and transport equipment for the future. Progress has been made in networked operation by creating a method of measuring a company's ability to network.

During the year the Institute received a number of significant contract research commissions from abroad. These included ship modelling tests and air filter reliability measurements for customers in United States and several commissions related to the nuclear power plant safety for customers in Europe. The Institute's participation in the EU's CRAFT programme for SMEs has been particularly successful.

The Institute is responsible for co-ordination of research in two of VTT's strategic technology themes, Intelligent Products and Systems and Safety and Reliability.

New partnership agreements were made with Stanford University and Berkeley University in the United States. In Finland, partnership relations with MET Federation of Finnish Metal Engineering and Electrotechnical Industries and others were further strengthened.



VTT PROCESSES

Research fields:

*Nuclear Energy
Energy Production
Emission Control
Systems and Models
Paper and
Mineral Industries
Materials and Chemicals*

Man-years: 609

Staff breakdown

by location:

*Espoo 410
Jyväskylä 127
Tampere 61
Outokumpu 39
Nurmijärvi 10
Vaasa 5*
Turnover: 53.1 M€

The Institute's aim is to be a pioneer in the energy and forest clusters and a partner in R&D and demonstration work on effective and energy-saving technologies. The Institute's main areas of expertise are energy systems and economy, renewable forms of energy production and raw materials, nuclear energy, engines and transport, pulp manufacture, papermaking, printing and forest chemistry.

VTT's research results have provided important basic data for the preparation and handling of decision-making concerning the construction of a new nuclear power plant unit and also for the earlier decision in principle on the final disposal of spent nuclear fuel. Research and development work has made it possible to increase the competitive use of biofuels in many applications, the most important of which are back pressure plants for communities and industry, and the heating of buildings. The development of the software tools needed for the deregulated electricity market has opened up new business opportunities for power companies and information system vendors.

VTT Processes has actively participated in the Research Centre's strategic technology themes, especially in research for the themes Clean World and Intelligent Products and Systems. The Institute is also responsible for leading four of VTT's expertise portals.

In 2002 the Institute acted as the co-ordinator in eight national technology programmes and in sixteen of the seventy-two EU research programmes in which it participated. In preparatory work for the first applications for the EU's Sixth Framework Programme, particular emphasis was placed on bioenergy, nuclear waste management, the distributed energy system and, for the first time, the forest industry – in all cases together with Finnish industry.



VTT BIOTECHNOLOGY



The Institute aims to be a pioneer in the development of bioscientific applications meeting the needs of industry. Strong areas of expertise include industrial biomolecules, processes based on metabolic modification of microbes, enzyme technology, health-promoting foods, tailoring the structure of foods, and the safety of microbiological processes and products.

In 2002 a research group specialising in pharmaceutical development was established in Turku as the result of an agreement made with the City of Turku and local universities. The Institute has also been working extensively with other universities and regional development organisations.

VTT Biotechnology has developed biotechnical methods that can be applied in the processing chain of renewable raw materials in the chemicals, forest and energy sectors. In this field major contract research commissions were carried out for globally operating companies. Important development work has also been done in connection with health-promoting foods and active food packaging.

The national centre of excellence in industrial biotechnology has created a good platform for processes based on metabolic modification of yeast and for new applications of enzymes and other biomolecules. The Tailored Technologies for Future Foods programme has focused on the exploitation of biotechnical process methods in the food industry and on the control of food quality criteria that are important for consumers.

The Institute is responsible for leading the Clean World technology theme and VTT Life Science expertise portal. In 2002 the Institute took part in 28 EU projects and co-ordinated seven of them. VTT Biotechnology's research work received good marks in two international assessments. Maintaining competitiveness requires long-term strategic emphasis owing to the very rapid development of biotechnology.

Research fields:

Biomolecules

Cell Factory

Product Engineering

Microbiological Safety

Man-years: 283

Staff breakdown

by location:

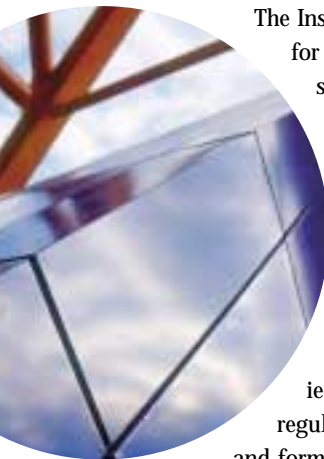
Espoo 301

Helsinki 6

Turku 5

Turnover: 21.4 M€

VTT BUILDING AND TRANSPORT



The Institute produces products, systems and services based on the latest technologies for buildings, networks and the other aspects of the built environment as well as solutions for the exploitation of information and communication technologies in construction and the management of facilities and networks. The Institute has carried development work with the aims of improving the quality, productivity and cost-effectiveness of construction, bringing life cycle thinking into practice and applying ICT in transport and logistics.

VTT Building and Transport has participated in the development of smart environments with the aim of applying new forms of communication between the user and the environment in information and automation systems of communities, infrastructure and buildings. The Institute has also studied the application of functional materials, wireless measurement technology and regulation that adapts to service conditions to control of the vibration, durability and form of building products. Increasing the efficiency of distributed energy production as part of the management of the community's whole energy chain and the development of intelligent transport and logistical processes have also been important areas of research.

New international partnerships were forged with both European and American research institutes. Significant international projects co-ordinated by the Institute in the EU's Fifth Framework Programme include the Virtual Organisation Cluster, Life Cycle Management of Concrete Infrastructures, and Life Cycle Design of Buildings. Modern Internet-based project information management solutions have been developed for use by pioneering companies as a result of the EU's joint environmental projects.

Research fields:

Transport and Logistics

Business and

Process Management

Materials and Products

Structures and

Building Services

Service Centre

Man-years: 467

Staff breakdown

by location:

Espoo 433

Tampere 36

Oulu 21

Turnover: 37.7 M€

VTT INFORMATION SERVICE

The main tasks of VTT Information Service were the support in different ways of the acquisition of information by VTT research scientists and other customers, services promoting publication and the use of VTT publications, the production of VTT's common databases, and training and consulting services for customers both inside and outside VTT. During 2002 the Information Service focused more intently on developing the management of VTT's services and information resources.

The Information Service selects and acquires information sources and takes care of communication and training. In 2002 the content and usability of VTT's electronic library were improved and the number of usage permits was increased. New information sources included ISI Web of Science and IEEE Xplore. In addition to independent information retrieval, customers also ordered retrieval services performed by information specialists. The Information Service developed its services to better meet the needs of customers.

The publication of reports in VTT's own series ensures their external quality and good visibility and supports VTT's corporate image, so the Information Service must be able to keep this publication channel interesting and effective. Somewhat more manuscripts were added to the series in 2002 than in the previous year, and over 90 % of these could also be read on the Internet. The number of publications made available in electronic form more than doubled. At the same time sales figures for printed publications declined for the first time.

The Information Service's third major service entity is the production of databases. Some of the databases are intended for VTT's internal use, while others are made freely available to provide information on VTT's activities. In 2002 the Information Service endeavoured to strengthen its role in the development and management of VTT's internal databases and in the promotion of their use. The publication register, service directory (expert register), VTT's book database and research register were special areas of development.

VTT CORPORATE MANAGEMENT AND SERVICES, AND VTT TECHNOLOGY STUDIES

Emphasis in the work of VTT Corporate Management and Services was placed on the activities supporting VTT's business strategy and corporate-level development of finance, human resources, communications, information management, and planning.

A more centralised solution was adopted in information management with the aims of freeing the information management resources of the research institutes for the support of research activities and boosting efficiency at VTT level. Other significant projects of VTT Corporate Management and Services in 2002 included communications concerning VTT's 60th anniversary, the redesign of VTT's visual image and other brand-building measures, implementation of the VTT Executive Program, the definition of HR processes and the wellbeing-at-work project, measures intended to promote VTT's internationalisation, the introduction of the euro, facility strategy and programme, and development work on ways of assessing and measuring operational effectiveness.

VTT Technology Studies carries out research work in the fields of technology policy, innovation and industrial renewal, technology foresight and technology assessment. During the year the results of the Baltic ICT project ordered by the electronics industry were presented and a study was made for the Maritime Industry Department of the Federation of Finnish Metal Engineering and Electrotechnical Industries concerning its EU participation. Provisional results from a contract research commission supporting technology policy evaluation were reported to the Finnish Ministry of Trade and Industry, and a study was made for VTT on the social and regional impacts of the Research Centre's activities. The unit made two Trend Chart studies to support the EU's technology policy, and participated in the European Science and Technology Observatory's Foresight Competence Mapping and Science and Technology Roadmapping projects.



Maana Suutarinen

of prefreezing treatment
of strawberries





EFFECTS OF VTT'S ACTIVITIES

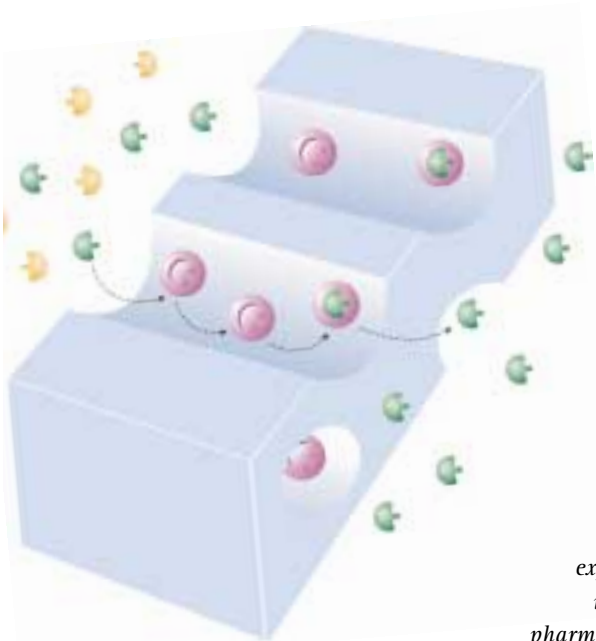
VTT is an integral part of Finland's innovation system. In addition to contract research for companies, VTT also promotes technology transfer by producing a great deal of public research knowledge and by actively participating in both domestic and international research programmes and collaboration networks. VTT envisions future technological development and has always striven to target its own resources at new, promising and techno-scientifically challenging technologies that are expected to offer new opportunities for the Finnish economy.

The effects of VTT's activities are based on research, development and test results leading to new technical innovations. By creating new technical solutions VTT helps companies to improve their competitiveness. The results of collaboration with companies include improvements in their products, equipment, production methods and processes. VTT also promotes social well-being by producing research knowledge in support of decision-making in areas such as human health, the built and natural environment, and the use of natural resources.

VTT can only report openly the results of public projects. Contract research results are confidential and their publication always requires the consent of the customer concerned. For competitive reasons customers often do not want their results published. The research examples presented on the following pages therefore represent only a small fraction of VTT's activities, though they do provide some idea of the many and varied ways in which VTT's expertise influences technical development in Finland.

VTT's R&D activities broadly cover the innovation chain from strategic basic research, through applied research, right through to product development and testing services supporting it.

The scientific expertise and knowledge foundation has been strengthened in technology-based strategic research projects.



Molecule pump technology can be exploited, for instance, in the purification of pharmaceutical substances.

Biocoated nanotubes for antibody recognition

VTT has long been involved in the development of antibody technologies to meet the needs of the pharmaceutical and medical diagnostics industries. Now this expertise has been combined with molecule pump technology developed at the University of Florida. The collaboration led to a scientific breakthrough of such significance that it was even reported in the prestigious journal *Science*.

VTT has developed antibody fragments for a molecule membrane that selectively transports a given molecule from a mixture to the other side of the membrane. In the new method, holes smaller than 1/10,000 of a millimetre are made in aluminium membrane with irradiation and silicone technologies. Genetically engineered antibody fragments are attached to these voids. The antibodies have a unique ability to distinguish even very similar molecules. These molecule pumps created by the antibodies on the membrane function in a similar way to the protein channels on the membranes of living cells. The antibodies identify and momentarily bind the selected molecules from the compound mixture existing outside the membrane and then release them on the other side of the membrane. The molecules move over the membrane towards the area of lower concentration, so the system needs no externally provided energy.

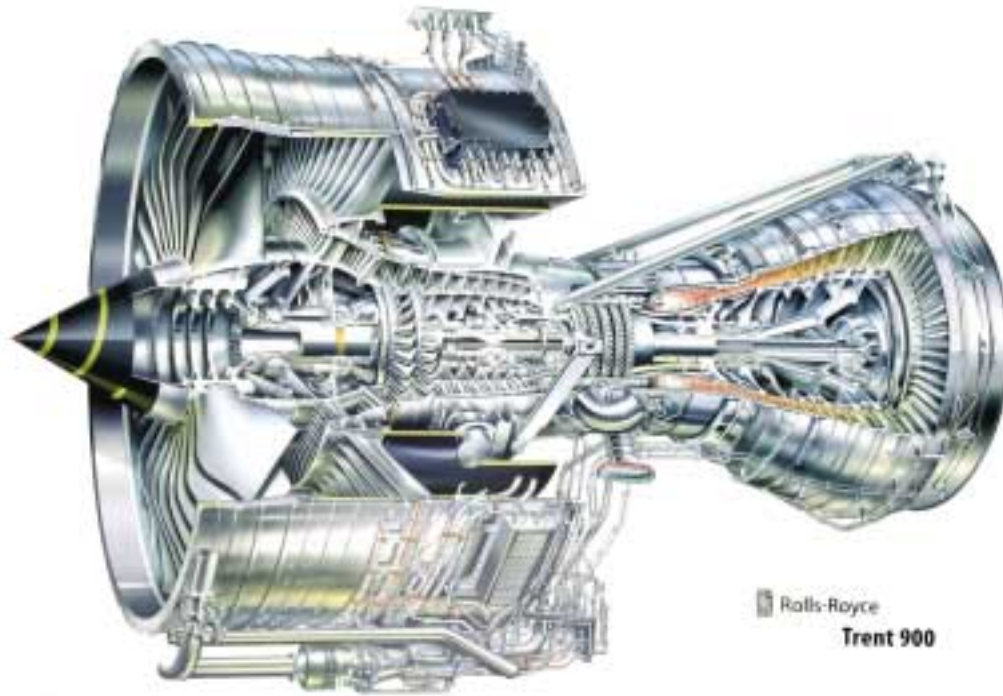
Antibodies can be created to bind almost any molecules, such as hormones, environmental toxins, antibiotics, narcotics and drugs. The purification of medical substances is an important application. By choosing different antibodies the method can be used for the separation of any molecules. The versatility of antibodies enables extensive usage of the system. The molecule pump principle can also be used to control the local content of different molecules in solution, which opens up opportunities for new applications.

Nanotechnology is currently one of the hottest topics of research and it has been selected as one area of emphasis in the EU's Sixth Framework Programme. The system developed by VTT and the University of Florida is one of the first methods aimed at nanobiological applications. VTT's partner in the research project has been the workgroup of Professor Charles Martin.

VTT has long been involved in the development of antibody technologies.



VTT constructed an easy-to-use simulator for Rolls-Royce so that the company could manage a number of concurrent functions in its product development process.



VTT's simulator boosts product development at Rolls-Royce

Rolls-Royce, a leading manufacturer of high-powered aircraft and helicopter engines, has started to use a simulator developed by VTT to boost the efficiency of product development work on its jet engines. At the same time Rolls-Royce is playing its part in strengthening the competitiveness of the European aerospace industry.

The design and production department at Rolls-Royce's Derby factory set the goal of shortening the product development time of a new engine model from 15 months to 9 months. Product development comprises, for example, the design and implementation of aerodynamics, structure, manufacturing, and the planning and implementation of a test programme. Product development also encompasses parallel processes of several engine models, and the department must also be able to analyse quickly any defect that might be reported in some already existing engine type. VTT constructed an easy-to-use simulator

for Rolls-Royce so that the company could manage a number of concurrent product development and other functions. The simulator is based on PC-level technology in general use.

VTT has a wealth of experience in production simulation, which in the case of Rolls-Royce's order it used for a new application – product development simulation. Rolls-Royce arranged the financing for the simulator development project out of a multi-year EU-funded aerospace industry project that it initiated. Dozens of European companies, research institutes and universities are involved in the project as a whole.

New concrete technology and materials

VTT and its corporate partners have developed thermo-concrete materials technology, a structural system based upon it, structural components, design methods and manufacturing technology for the structures, and a construction concept.

The project has been financed by the National Technology Agency (Tekes) and the construction industry. Its aim was to develop a hydraulic

material that is sufficiently strong, thermally resistant, easy to manufacture and handle, and economic that it could be used to fabricate single loadbearing and non-loadbearing structures for a low-energy building. The requirements demand that the properties of the material be modified to meet the special needs of different structural components. The material solution is based on the controlled pore formation of hydraulic cement, which is accomplished by using small polystyrene spheres. The other basic idea is the exclusive use of single and thus extremely simple structures as loadbearing ground, floor and roof slabs and as envelope and internal walls.

Thermo-concrete technology offers the opportunity for quite extensive international sales of technology in the form of both expertise and equipment deliveries to building component factories. On the Finnish market the technology can be applied primarily in semi-detached houses, single-family homes, and the external and internal wall structures of apartment buildings and large halls. The structures are simple and

extremely weather resistant, making them reliable in operation and reasonably inexpensive to maintain. They also help to save heating energy.

Example applications of thermo-concrete include Rautaruukki Oy's patented Termoseinä, product that was originally developed for the German market and the Specihouse concept, which was developed by Specibuild Oy and presented in prototype form for the first time at the Kotka Housing Exhibition 2002. Cellular applications have been made for the structures of Naaraharju Oy's thermal power plant, and it is intended that these will also be made for international production.

New production methods for micromechanics and electronics

VTT Micromechanics Centre has developed new methods for the manufacture and application of micromechanics and microelectronics. A SOI (silicon-on-insulator) wafer fabrication method has been developed for the

sensor industry. A method of integrating electronic circuits and micromechanical components on the same SOI substrate has also been developed. A self-dosing method for microfluidic liquids is one example of the application of micromechanics in an entirely new field.

The sensor industry is increasingly using SOI wafers because they make it possible to reduce the size of components and at the same time to improve their characteristics. The new SOI wafer fabrication process is based on the direct bonding of two silicon wafers. The processes developed have been brought into service on the production line of Okmetic Oyj, a Finnish manufacturer of silicon wafers for sensor and semiconductor applications.

Combining integrated circuits and micromechanical components on the same wafer offers both cost and quality benefits. Thanks to the integration method developed by VTT, there is no need for the manufacturing expertise in mechanical compo-

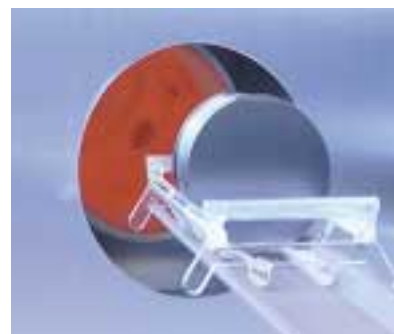
nents and integrated circuits to be under the same roof, as they generally are not in the real world. The wafers can move naturally between the wafer manufacturer, the chipmaker and micromechanics specialists.

The new microfluidic dosing method enables liquid flow on the surface of a silicon chip. This has DNA diagnostic and lab-on-a-chip applications, where the controlled dosage of small sample quantities and rapid reaction times in small volumes enable faster and less expensive analyses than at present. Active components for liquid flow, heating and measurement can also be added to the silicon substrate. It is also possible to modify the surface characteristics of the silicon substrate. When the silicon substrates are treated using methods normally used in the microelectronics industry, the substrate fabrication costs can be reduced to such a level that they can be used in analyses requiring a large number of substrates or even single usage disposability.

The light-weight thermo-concrete material solution is based on the controlled pore formation of hydraulic cement.



The method developed by VTT allows combining integrated circuits and micromechanical components on the same wafer.



VTT has developed interactive electronics and has carried out practical trials on applications enabling ubiquitous computing.

Future communication technologies as well as intelligent products and systems have been key areas of development.



Interactive intelligent electronics

The portable or wearable context-aware multimedia device has an important role to play in the future development of mobile applications and visions associated with ubiquitous computing. VTT has studied and experimented with technologies enabling interactive electronics and ubiquitous computing as well as their practical functionality, for instance, in the development of a voice-controlled terminal device that fits in a maintenance man's tool belt.

A prerequisite for the spread of wearable IT devices is the development of a functional but small-sized wireless user interface which has a low power consumption and can communicate with other intelligent devices and systems already in the environment, e.g. PCs, mobile communicators, entertainment electronics, domestic appliances and vehicle computers. The development of a sufficiently accurate indoor positioning system providing at least a one-room accuracy is also essential for the functionality of these devices.

Other related research topics included the creation of new methods for interpreting sensor data, the development of a physical indicator based on an infrared link and an image format that dynamically adjusts to the screen size as a Java implementation of a machine's 3D remote control, and the demonstration of a wireless terminal device for maintenance workers. At the same time a wireless, general purpose sensor device called SoapBox (Sensing Operating and Activating Peripheral Box) has been further developed and its application demonstrated. New solutions have been created for indoor positioning and personal identification based on speech and biometrics.

The research has also supported collaboration with Finnish industrial partners and international organisations such as Philips Research and Grenoble Ideas Lab as well as with other research institutes in Finland.

Information was offered to travellers via a palm-top computer in a web service trial staged in a realistic environment.



NewsScan for effective media scanning

The NewsScan system developed by VTT can be used to effectively follow news items on a particular subject appearing in different media. For instance, a company can scan for news items concerning itself or competitors. This kind of fast feedback is important for a company when, for instance, it is building a strong brand or is faced with a crisis demanding responsive communications. NewsScan makes use of speech identification technology and is therefore able to analyse radio and television news broadcasts.

VTT uses the NewsScan system routinely to monitor media references. Customers can subscribe to the NewsScan service, which is provided by VTT's server. The service can be easily accessed via the World Wide Web and does not require any installation or maintenance on the part of the customer. News sources can be added according to the needs and wishes of the individual customer.

NewsScan covers sources of news that ordinary WWW search engines do not generally reach. Examples include web newspapers that are updated daily or at regular intervals. The websites and press releases of companies can also be included within the scope of the system. NewsScan contains special features for scanning radio and television news broadcasts. Textual searching that recognises terms regardless of the Finnish-language hyphenation convention used in the text is one of the system's most important technologies. Often-used searches can be conveniently recorded as channels.

Services for the wireless traveller

VTT together with corporate partners has created a pilot-scale web server that provides information to travellers in the city centre of Helsinki, for instance, via a palmtop computer and an MMS-enabled phone. New techni-

cal expertise for the establishment of mobile businesses was created in the project. The trial confirmed the functionality of the selected technical solutions and shed light on the interest of users in these multimedia-based services.

The user is offered a map-based user interface with site links and automatically information on the position of the user and services. The service can provide information to the terminal device specified by the customer and in accordance with other customer preferences too. A number of users can simultaneously and independently of one another virtually change the image angle and individually scale the web camera's view. Travellers are also offered multimedia-based presentations of interesting sites and, for example, route presentation videos in which there are hyperlinks to relevant information.

The terminal device software was assembled around VTT's WML browser. This enabled the application's use on different types of mobile device. The software is mainly implemented in JAVA to facilitate portability. The GPRS network was used for data transfer and GPS technology for positioning.

The pilot system was tested in a real environment, i.e. the city centre of Helsinki, by test users. The operation of the software in the PDA device turned out to be very stable. However, slow speed of operation, random problems with GPS positioning, and periodic congestion of the GPRS network were problems. The speed of operation is expected to improve markedly as the terminal device technology is developed.

High-speed wireless data transfer

VTT has developed a fast and flexible radio modem for use in indoor WLANs (wireless local area networks). The modem's performance represents a 20-200-fold improvement over sim-

ilar commercial WLAN and Bluetooth technologies. If GSM and UMTS technologies are used as benchmarks, the new modem is 5,000 times faster than the former and 100 times faster than the latter.

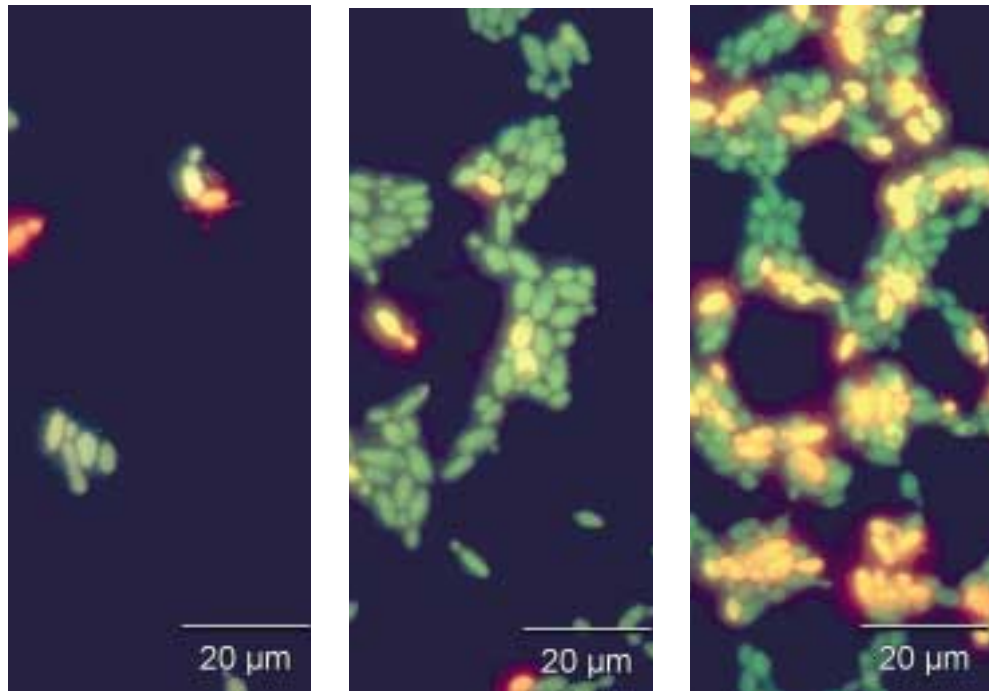
The modems can be used to construct a WLAN in the home or office environment and provides much faster transfer rates for different types of multimedia – e.g. video, music, text and data – between different devices, such as video cameras, TVs, PCs and the Internet. The high data transfer rate enables the user to download, for instance, a two-hour movie from the Internet to the terminal device in just a few minutes. Using commercial WLAN technology the same operation would take about an hour. It is also possible to relocate network devices within the indoor environment without weakening the quality of data transfer.

Up until now the speed and quality of data transfer has always been much higher with wired connections. The new radio modem developed by VTT narrows the performance gap between wireless and wired networks. The radio modem is able to adjust its operating mode so that the required quality of data transfer is achieved at the lowest possible power consumption. Furthermore, the network itself can be installed more quickly and is cheaper to build than ad-hoc networks, where each device can communicate with any other without conventional pre-installed base stations.

One aim of the VTT-led collaboration is to influence the standardisation of the new technology. VTT has acted as the leader of the EU/-WIND-FLEX project since its start-up in 2000. Nine international research organisations are involved in the technology's commercialisation. Besides VTT, they include companies and universities in Spain, Italy, Greece, Poland and Germany.

New technologies have been developed with the aim of promoting a clean world and improving the safety and reliability of production.

New knowledge on the characteristics of yeasts occurring in food processes helps to prevent yeast-related production problems.



New yeast identification methods offer good methodological capabilities to differentiate more common food-derived yeasts from others.



Controlling yeast contamination in the food industry

VTT has studied the characteristics of yeasts occurring in food processes and has created new preservation and identification methods that are better able to prevent and solve the production problems caused by yeasts.

During the project a great deal has been learned about the growth characteristics of industrial yeast contaminants and their susceptibility to different chemical, physical and biological factors. Industry can benefit from the new knowledge through the development of safer processes. Promising natural compounds with future applications in the prevention of yeast growth in foods were found during the project. New knowledge about the strength of attachment to the surface of the yeasts and about the efficacy of cleaning agents against yeast contaminants will make it easier to improve production hygiene.

Earlier yeast identification methods did not satisfactorily meet the needs of industry and research, because they were too slow and poorly discriminative. The new methods offer good methodological capabilities to differentiate more common food-derived yeasts from others. The industry can now use these methods, for example, to trace the origin of yeast contaminants, to distinguish them from beneficial yeasts, and to settle disputes either as part of a company's own quality control or as an expert service provided by VTT. In the future it will be possible to prevent, identify and control impurities, thereby reducing yeast-related production and improving the industry's competitiveness.

The project has been financed by VTT, the National Technology Agency (Tekes) and seven Finnish food products companies.

Improved production reliability

Unscheduled production line down time easily lead to significant economic and production losses. VTT together with corporate partners has developed methods of improving production reliability in a three-year project.

For example, a stoppage of Rautaruukki Oyj's plate production line costs the company EUR 10,000 an hour. Rautaruukki Oyj set itself the target of cutting one hour off its average unscheduled stoppage time of 15 hours per month. Actually, a reduction of no less than two hours per month and annual savings of EUR 250,000 in production losses

when the data provided by existing measurement and control sensors was appropriately integrated into expert systems.

As a result of the joint research projects the participating companies can boost their competitiveness by improving the reliability of their production plant using new monitoring and diagnostic systems. These methods are based on just the right combination of long experience, decision-making support systems, and information gathered from condition monitoring sensors and from sensors used in production control.

The new methods support the preventative servicing of plants delivered to remote customers as well as

repair work planned by local maintenance personnel. Technical methods supporting condition monitoring include vibration and oil analysis sensors, rule-based decision-making, reliable methods of transmitting measurement data, the use of simulation in diagnostics, and the combination of condition monitoring and control system data to enable comprehensive condition analyses and even fault predictions. The need to make further improvements in the reliability of plant and equipment has already spawned a number of continuation joint projects led by companies and VTT.

Unscheduled production stoppages at Rautaruukki Oyj were significantly reduced when the data provided by existing measurement and control sensors was appropriately integrated into expert systems.





A clear link has been found between indoor air quality and the health of building occupants. VTT's databank on indoor air chemistry benefits the construction sector and other industries.

New data on indoor air quality

VTT together with the Helsinki University Central Hospital and the University of Kuopio has established the effects of poor indoor air quality on human health and clarified the irritant effects of organic materials released from building materials.

VTT's databank on indoor air chemistry currently contains results from over 1,700 material measurements and over 1,100 indoor air measurements. Combining the clinical and chemical data obtained from the joint study with VTT's databank revealed certain depend-

ent relationships between the quality of the indoor air and symptoms experienced by building residents. For example, certain individual compounds were observed to have a statistically significant relationship with symptoms experienced in the building, e.g. irritation of the eyes and nasal cavities. The results also support the Hospital's studies on inflammation proteins.

The results of the project are used to calculate for single compounds the concentration levels at which the occurrence of different symptoms is observed to increase. These concentration levels can be applied as reference values in an

indoor air classification with a view to improving indoor air quality. This provides guidelines for the building materials industry in the further development of its existing building materials classification.

The project has been financed by the National Technology Agency of Finland (Tekes) and the Finnish Ministry of the Environment. The results can be exploited by the building materials industry, local authority health inspectors, regional centres for environmental affairs, and consulting engineers specialising in indoor air quality.

Remote sensing methods for monitoring carbon emissions

VTT's high standard of expertise in remote sensing has been further developed and exploited both in Finland and internationally. VTT led a project in which methods of measuring the carbon reserves and emissions of the world's forests were developed. The methods can be used to monitor compliance with obligations under the Kyoto Protocol. In Japan it is intended that remote sensing methods will be utilised in seeking information to prevent natural disasters and to target emergency relief efforts rationally in the eventuality of a disaster occurring.

New forest mapping methods were developed in work commissioned by the European Space Agency (ESA). Optical and radar imagery from a satellite is converted into numerical

maps, which can then be used to calculate the carbon reserves already fixed in forests and also the fixing of carbon in forests. This will improve the accuracy of reporting required by the Kyoto Protocol. It will also be possible to examine the state of the world's forests in 1990 using archived satellite imagery.

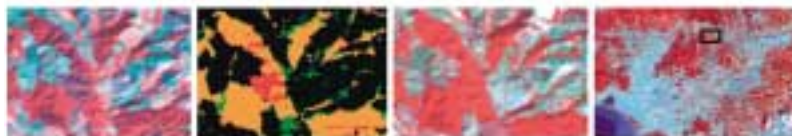
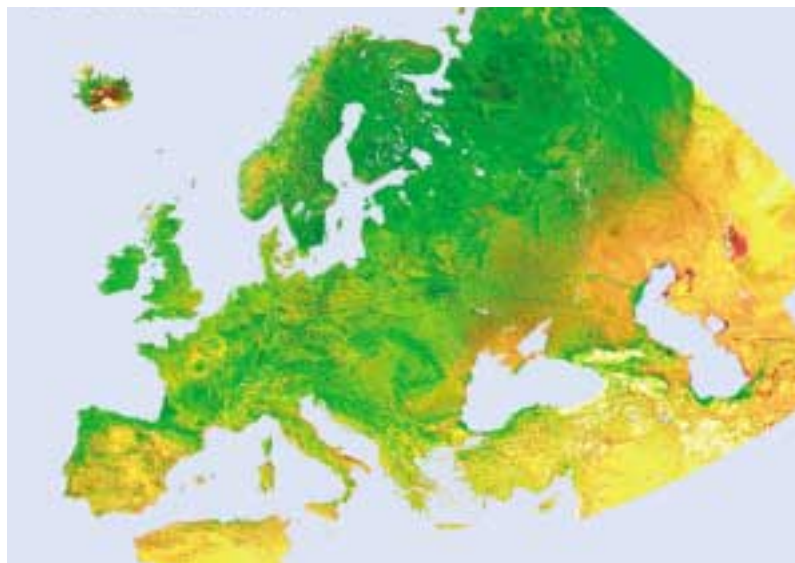
The measurement methods developed were tested in three areas: Tuscany in Italy, Eastern Finland and Borneo. Thanks to afforestation projects, countries can earn "carbon emission rights", which may be sold on the open market. However, the amount of carbon fixing in the afforested areas has to be accurately measured before it can become a marketable commodity. Satellite imagery and digital aerial photographs can be an important source of information in this respect.

Besides VTT, the project participants were Stora Enso Forest Consulting Ltd., the European Forest Institute, Gamma Remote Sensing AG of Switzerland, and as users, the Italian Ministry of the Environment and the European Commission, which was represented by the Joint Research Centre, JRC.

VTT has also signed a co-operation agreement with the Japanese National Institute of Earth Science and Disaster Prevention in order to develop remote sensing methods as a Finnish-Japanese collaboration. In Japan the aim is obtain information that can be used to prevent natural disasters or target emergency relief efforts. Thanks to the Internet, VTT's research scientists are able to analyse satellite radar imagery on a super-computer located in Japan.

Remote sensing methods can be used to study carbon reserves already fixed in forests as well as the fixing of carbon in forests.

The measurement methods developed were tested in Tuscany, Italy and elsewhere.



The emphasis in energy research has been on renewable forms of energy and the environmental effects of energy production.



VTT's pilot plant is being used in the further development of a method whereby fuels from waste are processed into a pure gas product for combustion in large power plant boilers.

New technology for the gasification of recycled fuels

VTT together with corporate partners has built a 1 MW pilot plant suitable for the gasification of solid recycled fuels (REF) and sludges. The plant is based on a new type of fluidised bed gasification and efficient gas cleaning. VTT has applied for a patent for the new technology.

VTT is using the pilot plant to further develop and test a method whereby fuels from waste are processed into a clean gas product for combustion in large power plant boilers. The results of the first trial phase indicate that the process is technically functional and that the gas cleaning is effective.

The trials provide a good starting point in connection with the Martinlaakso power plant's coal-fired boiler for the design of a full-scale demonstration plant. The pilot gasifier can be used for development work on biofuel gasification technology and also for the testing and possible commercialisation of new ideas generated by VTT and its partners.

In several European countries the aim is to cut back on the use of fossil fuels and reduce the carbon dioxide emissions of energy production. The potential market in Europe for gasifiers of bio- and waste fuels in connection with coal-fired boilers is estimated to be over 100 plants up to the year 2015, which represents equipment deliveries worth over 2 billion euro.

VTT's partners in the project have been Powest Oy and Vapo Oy.

VTT's research support energy decision-making

VTT's research results played a significant role in energy policy decision-making when in early 2002 the Finnish Government and Parliament approved a decision in principle on the proposed construction of a new



VTT's research institutes played a significant role when the Finnish government and parliament made a decision in principle on the construction of a new nuclear power plant unit.

nuclear power plant unit. After the decision by Parliament, an opinion poll conducted by Finnish Gallup indicated that VTT was regarded as clearly the most reliable participant in the energy debate.

The key questions influencing the decision-making on nuclear power were the safety of the final disposal of highly radioactive waste, the safety of nuclear power plants, and the impact of energy production on greenhouse gas emissions in the national climate strategy.

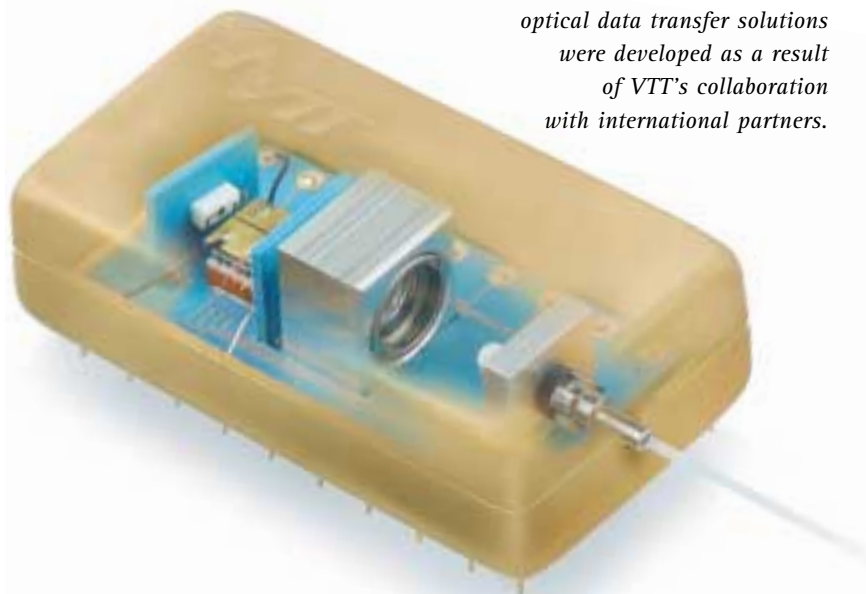
VTT's research shed light on the benefits of a diversified energy production structure and the effects of each energy form from the standpoints of climate change, the reliability of energy supply, employment and technology exports. As a result of this work VTT's credibility as an energy expert was greatly enhanced. In addition to nuclear energy, VTT is doing a great deal of work on the development of renewable energy

production technologies and energy-saving technologies.

The most important material for the decision in principle on the final disposal of spent nuclear fuel approved by Parliament in 2001 was based on safety analyses and other background studies made by VTT. Production cost comparisons made in the VTT-coordinated Climtech technology programme as well as a comprehensive long-term analysis of alternative energy production scenarios entitled "Energy Visions 2030 for Finland" have been very important in preparatory work on the nuclear power decision and in extensive handling of the issue in parliamentary committees. VTT's experts were frequently called to appear before these committees. A comprehensive review of the environmental impacts of different energy production forms was also prepared as background material for Members of Parliament.

VTT has been actively involved in international networks and projects of central importance to Finland's technological development.

New materials and components suitable for wireless terminal devices as well as new types of optical data transfer solutions were developed as a result of VTT's collaboration with international partners.



Optical solutions for wireless terminal devices and data transfer

New materials and components suitable for wireless terminal devices as well as new types of optical data storage and transfer solutions were developed as a result of international research collaboration in the three-year strategic OTECO project. The development work was steered by the technology needs of Finnish companies.

The project significantly promoted the creation of three new Finnish and one US companies, and supported the introduction of new equipment for VTT's electronics and photonics R&D environment. The new development environment also serves companies manufacturing micromodules.

The project further strengthened VTT's international co-operation network, which enhances the research centre's ability to serve Finnish customers in contract research assignments and to participate in international research projects. VTT's partners in the project included the University of Arizona in the USA, the University of Ottawa and Waterloo University in Canada, Dublin City University in Ireland, and the AIST Institute in Japan.

No fewer than 16 inventions were announced during the project, leading to the submission of several patent applications. Moreover, the collaboration with companies and research organisations gave rise to sixteen referenced publications, sixty conference papers and seven academic degree theses. The project also provided seven research scientists with the opportunity to carry out research work for their doctoral theses.

The project was financed mainly out of VTT's basic funding. The remainder of the finance was provided by the National Technology Agency (Tekes), Nokia Mobile Phones, Nokia Networks, Nokia Research Center, PKC Group and Teleste.

*New miniaturisation concept
for optical data transfer.*



Proposed amendment to a EU directive

VTT actively participates in international research that serves as the basis for the formulation of EU directives. Representatives of the European Commission gave particularly positive feedback to the research team working on the EU-FAIR's ACTIPAK project. As a result of the project, the research team has submitted to the Commission a proposal for the amendment of the 89/109/EEC framework directive concerning food packaging. This will enable the preparation of a special directive regulating the acceptability of active and intelligent pack-

aging for food applications.

The main aim of the ACTIPAK project was to initiate amendments to relevant EU regulations, such as regulation for food contact materials, food additives, and labelling, to allow the application of active and intelligent food packaging systems for improving food quality and safety in Europe. The project team clarified the special features involved in defining the acceptability of packaging for food applications, making it easier to create uniform acceptance practices. VTT's contributions to the project included participation in the development of migration methods for

active packages, testing the performance of intelligent packages, and the preparation of a consumer survey and the legislative proposals.

Besides VTT, the other parties involved in the research collaboration were TNO, Universidade de Santiago de Compostela, ADRIAC, the University of Gent, DISTAM, Università di Milano, PIRA International, TMI Europe, the Inspectorate for Health Protection, Eastman Chemical B.V., Nestec Ltd. and Danone Biscuit. VTT's research was financed by seven companies from the packaging and food industries.

VTT was actively and influentially involved in preparing an amendment proposal for the directive on intelligent packaging technologies.





VTT played a key role in the development of a more efficient RFID tag system within the Palomar project of the EU's Fifth Framework Agreement.

New longer-range RFID tag system

Radio Frequency Identification (RFID) tags find applications in areas such as warehousing, car keys, access control, logistics and bus tickets. However, the fact that they can only be read from a rather short range has been a drawback. VTT together with a number of corporate partners has developed a technology that allows RFID data to be read from as far away as four metres. In the future it will be possible to supplement barcodes or even partly replace them by updateable RFID tags with a longer-range read capability.

An RFID tag consists of a chip-based memory circuit and an antenna. It gets its energy from a reader either in the form of a magnetic field or at high frequencies from an electromagnetic field. The reader also receives the data via magnetic or electromagnetic field. The problems associated with today's RFID tags based on magnetic-field coupling are the large size of the antenna, the dependence of the antenna's tuning frequency on the environment, the rather short read range, and price.

VTT together with Atmel Corporation, Rafsec Oy and Idesco Oy has developed a new RFID tag system in the Palomar project of the EU's Fifth Framework Programme. The system consists of a tag and a reader. It operates in the 869 Hz frequency range, which in Europe is allocated to short-range radio devices. With the Palomar system as many as a 100 RFID tags can be present in the reader's field at the same time. The power consumption of the tag's microcircuit is extremely low and enables data reading from a distance of four metres and writing at three meters. The tag also works when enclosed in a material or product that absorbs moderately radio waves, e.g. a paper roll. Trials have indicated that tag data



Simulator improves UMTS network planning

Performance analysis and resource management of the 3G UMTS network is significantly more complex than it is with existing GSM networks. In an EU project VTT has designed and built a UMTS radio network simulator which can be used in trials to handle the network's power control, handovers, admission control and load management.

Experience of previous network planning and simulation tools has been exploited effectively in the UMTS simulator project. Earlier results have been used, for instance, as input data for the simulations. It is also possible to input a vector-format road map of a geographical area into the simulator, in which case the effects of the real environment can be better taken into account in the simulations.

Furthermore, an interface library set up earlier was utilised in the creation of the simulator's user interface, so the look and feel of the prototype has been kept similar to that of other comparable prototypes.

The simulator prototype has a very modular structure, so new features can be added when and if the need arises. Telecom operators and equipment manufacturers can use the simulator in the network planning stage and also after construction to ensure smooth operation of the network and to guarantee the best possible standard of service to users.

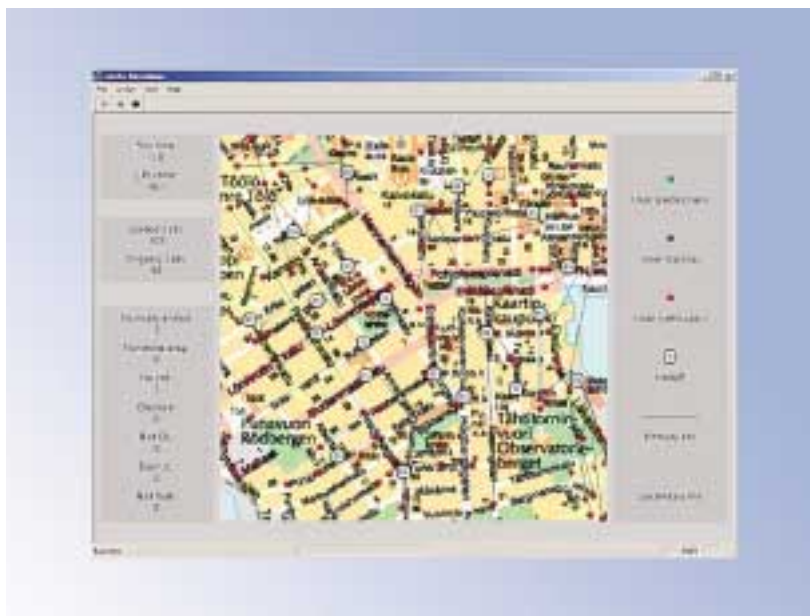
The other participants in the EU project besides VTT were NTUA/ ICCS of Greece, Motorola's Italian and British subsidiaries, Telia of Sweden and Cosmote of Greece.

can be read at a distance of one metre from a paper roll.

As the microwave-band tag reader can be a hand-held device, the size of a mobile phone, the application of RFID technology can be significantly widened in the future. It will be possible to replace the bar code on a consumer product with a postage-stamp-sized tag containing various information on the product. This will be of benefit to both the logistics chain and the consumer when searching for a particular product or product characteristic.

Almost a hundred companies and other organisations have already expressed an interest in applying the RFID tag and reader in their own products. VTT together with mobile phone and semiconductor manufacturers has submitted a project proposal for the EU's Sixth Framework Programme. One of the main aims of this project will be to exploit tags operating in the microwave band.

VTT has developed a UMTS network simulation tool which can be used in trials to handle the network's power regulation, base station changeover, connection approval and load management.



VTT's network rating method helped Sandvik Tamrock Oy and its key suppliers to improve their supplier chain network.

VTT has promoted regional development through its partnerships with companies, universities, employment and business centres, and other producers and benefiting parties of expertise.

VTT's regional operations serve especially the needs of SME enterprises.



Support for supply chain networking

VTT helped Sandvik Tamrock Oy and its eight key suppliers to create a learning and internally developing supplier chain network. A new and more profitable mode of operation was found thanks to the VAVE project (VAVE = Value Analysis Value Engineering).

VTT created a common vision and strategy for the network and built tools and operating models suitable for multilateral development. A network rating method developed by VTT was used to assess and measure the companies' desire and ability to network. The main aim was to develop and strengthen a culture based on openness and trust within the network. The rules were clearly defined and annual supply agreements were made in writing. Tamrock's subcontracting companies also developed the co-operation within their own supplier network. The cost effectiveness of the network has risen and its scope has been broadened to cover the entire life cycle of products.

VTT was responsible for network development and Tampere University of Technology for aspects such as training and cost accounting. One of the companies involved in the project, Toijala Works, developed a functionally based cost accounting model that takes account of indirect costs both product and customer specifically.

The net sales of the companies of the supplier network grew, profitability improved and both delivery reliability and product quality were raised as a result of the VAVE project. No fewer than 49 jobs were created and Sandvik Tamrock Oy's purchasing volume from the companies of the network rose by EUR 10 million.

The network rating has been tested in 16 companies in the Tampere area. Those involved included the principal suppliers, system vendors and their subcontractors. The aim is that network rating should become a new company assessment tool for regional employment and economic development centres.

VTT can help supplier networks to create new tools and operating models suitable for multilateral development.



Artificial replacements for damaged nerves in the future

VTT, Tampere University of Technology, Tampere University Hospital, and the University of Tampere (UTA) have created a new method that enables the behaviour of cells in nerve cell networks to be monitored over a period of several weeks. The method is expected to lead to medical breakthroughs in research on neural networks, toxicology and drug development.

Thanks to this internationally unique method and especially the long-term monitoring that it enables, the effects brought about by individual cells can be monitored for weeks in cell networks. The major weaknesses of current nerve cell research methods based on electrophysiology and electronics are the fact that the connection between the cell and the detecting device, the electrode, may sometimes last for only one hour and that measurements can usually be made on only a single neural network cell.

The new research method for cell networks is based on microscopically small, electrically conducting areas on a glass plate. These measuring substrates are covered by the cell adhesion biolayers for the cells to be measured. Other benefits of the new culture platform developed by VTT for cell monitoring include the wide surface of the substrate, user-friendly light microscopy and faster and more economic production compared to the silicon-based integrated circuits currently used in cell research.

This Tampere-based project is special - even on an international level - due to its rare combination of cross-disciplinary expertise: electrophysiology, cell biology, biosensor technology, electronics, mathematical modelling in neurosciences, and neurology.

Helping Tampere to pilot for eEurope

VTT is actively involved in the eTampere development programme, the aim of which is to develop information technology and its applications, IT businesses, and a network of e-businesses and e-services piloting the eEurope in the Tampere area. Another aim of the eTampere programme is to initiate national collaboration so that the resulting network would become a pilot environment for projects of the EU's Sixth Framework Programme. The telecommunications industry, telecom operators and content producers will all be able to benefit from the results of the programme's projects.

The RELab (Research and Evaluation Laboratory) project for which VTT is responsible develops new value added services for consumers and industry, and provides technical test environments for wireless services and usability studies. The aim of the project is to innovate and study new e-services that can generate profit for industry and make life easier for the citizens. The areas studied in the RELab project during 2002 included evaluation of different wireless services and consumers' experiences of digital TV.

A test environment based on WLAN technology has been built in the city centre of Tampere. The network is being used to study broadband applications, equipment and services for mobile users in a realistic environment. A WLAN-based

VTT is involved in the eTampere programme, in which a network of e-businesses and e-services are being developed in the Tampere area. The new service can be studied in a pilot environment built in the city centre of Tampere.

positioning capability was added to network services towards the end of 2002. The first large-scale user trials of the network were launched in September 2002.

The attitudes of consumers to new digital television technology and their experiences of its introduction were studied in a user trial co-ordinated by VTT. This provided a picture of the needs for digital television development in Finland. Fourteen families living in the Tampere area were given digital set-top boxes to use during the user trial.

The results of the user trial indicated that in the summer of 2002 digital television was not yet fully ready for consumer use. Details concerning the antenna installation were too difficult for the consumers to handle. Although the set-top boxes themselves proved easy to use, there were still plenty of problems associated with them initially. The uptake of digital television has been slowed down perhaps the most by unrealistic marketing and a lack of information on how digital television affects the daily lives of consumers. People need to know what benefits digital television will bring and at what cost - not further into the future, but right now. At present the consumers can get this information only by trying out digital television for themselves.



A new method developed by VTT makes it possible in the laboratory to subject paper samples to the same kind of stresses as the paper web is exposed to in the paper machine.

The competitiveness and reform of traditional industries and service providers have been improved as a result of research.



Measurements for improved paper runnability

VTT has been studying the runnability behaviour of paper with Metso Paper since 1995. The partnership has resulted in developments such as the fast-draw measurement method and the Impact measuring instrument for runnability research. The measurement data can be exploited in developing pulps, optimising paper grades, and studying and improving the runnability of high-speed production machines.

The Impact method can be used to study the strength and elongation properties of dry and press-dried paper. The device is able to take measurements at a speed of 1 m/sec, i.e. which corresponds to the draw caused by cylinder speed differences when a modern paper machine changes track. It is now possible in connection with laboratory measurements to subject paper samples to the same kind of stresses as the paper web is exposed to in the paper machine. A relationship between the elongation strain measured from press-dried paper and the runnability of the press-dried web has been observed in studies. The method has also shed light on the tensile strength and elongation behaviour of pulps.

Information obtained from the measurements can be exploited in development work on paper machine runnability and when optimising the paper machine's sub-processes for different paper grades. The results obtained have revealed in a new way the importance of pulps and their components from the standpoint of paper web runnability. The newly developed method offers fresh opportunities to optimise the raw materials of different paper grades.

Electronic communication supports project management

By using electronic data exchange and a modern CE environment, significant qualitative benefits can be reached in a multipartner project. The CE environment makes it possible to change the traditional information flow, thereby radically improving it at the design and construction stages. This is the fundamental conclusion in a Finnish-American research project which VTT, and the University of Wisconsin-Madison, USA, and ten construction sector companies from Finland participated in.

The model for benefit measuring was developed and tested mainly in the first analysed case study in Finland. Additionally, the framework was utilized in three other case studies, in Sweden, Great Britain, and the USA. In addition to qualitative benefits, benefits measured in terms of time and money can be reached.

In the European case studies, direct cost benefits were approximately double as compared to the operating costs. The indirect cost savings were manifold as compared to the direct cost benefits; however, in practice indirect cost savings are difficult to quantitatively measure. In the American case study, monetary benefits were even 20-fold as compared to the operating costs.

By using electronic data exchange and a modern CE environment, significant qualitative benefits can be reached in a multipartner building project.



Information for optimisation of the power network

Deregulation of the electricity market has confronted the electricity distribution companies with an entirely new competitive situation, in which they have to be able to maintain the quality of electricity delivered to the customer at a high level and at the same time strive to make more efficient use of existing capacity. The solution to these conflicting needs has emerged from a technology programme co-ordinated by VTT - a new system that monitors the state of the power network in real time.

The new-generation application for monitoring the real-time state of the power network has been jointly developed by Tekla Oy and VTT within the National Technology Agency's TESLA - Information Technology and Electric Power Systems Technology Programme. The aim of the network monitoring is to obtain the most reliable information possible on the current and future degree of network loading and on the quality of the electricity being distributed to customers.

When available information on the network is combined with a fast network calculation model in the monitoring system, the network design margins can be narrowed without increasing the risk of overloading the network or compromising the quality of electricity delivered to the customer. At the same time it becomes possible to react to problem situations before any damage is done. Network loading can thus be significantly increased without the need for any major additional network investments. The monitoring system also produces valuable information to support future network investment decisions.

Real-time network monitoring benefit even electricity consumers, because it makes it possible to supply power more efficiently, more reliably and more cheaply.

Digital information on sewage pipe damage

VTT has been involved in the development of a new European digital measurement and analysis system for sewage pipes. The core of the system consists of VTT's image analysis program and a highly sensitive sewage scanner from Japan. The scanner moves along the sewage pipe on a specially made cart from Austria. Helsinki was the first city in Europe to use the new system to gather information on the condition of its sewerage system. The software is also being introduced into service elsewhere in Europe, the United States and Japan.

The unique features of the new system are its digital mode of operation, millimetre accuracy, speed, ease of operation, independence of human skill in result interpretation, CEN standard compliance, and ease of data transfer to other information systems. The system digitally scans the pipe millimetre by millimetre, making it possible to measure damages, to compare measurements taken at different times, and to monitor the condition of the pipe. This saves time and network maintenance costs.

In existing systems, collecting information on the condition of sewage pipes is slow. They can only be inspected visually from video images, interpretation depends on the skill of the interpreter, and it is extremely difficult to integrate videotapes into other information systems. In addition, it is difficult to compare data recorded at different times.

With the new condition monitoring software developed by VTT the condition of the whole sewerage system can be measured on a regular schedule at ten-year intervals. It is then possible to maintain the sewerage system's service standard more efficiently and to reduce the number of environmentally damaging leaks. The sewerage system becomes safer and there is less risk of uncontrolled

overflows and pipe fractures, which currently plague residents in many countries. When industrial companies switch over to using the same kind of condition monitoring as that employed in their production equipment also in the plant's sewerage system, their operating reliability is improved and there is no longer any need to fear sewage-related production stoppages.

Development versions of the system have been tested in 31 cities in 12 different countries. One of VTT's SME partners in the project, Painehuhtelu Oy PTV, is starting to export the new DigiSewer TM system to Europe and Japan.

VTT's image analysis software forms the core of new system that provides digital information on damages to sewage pipes.



New clean room facilities of a high standard were completed in Oulu and Otaniemi to support VTT's micromechanics and electronics research.

VTT has continuously strengthened its research capabilities in selected areas of strategic importance.



New electronics and photonics research and development environment

VTT's Micromodule Centre in Oulu has been enlarged with the construction of high-standard clean room facilities intended for the research and production of electronic and photonic modules. The facilities will be used primarily as a research and development environment for wireless and optical communications and sensing applications. These new and less expensive technologies open up opportunities for new user interfaces, optical data transfer between and inside devices, and thus the creation of new businesses.

The 4 million euro extension has doubled the Centre's clean room facilities. Research equipment for electronics manufacturing will be added in the future at a total cost of almost 2 million euro. The facilities will also be offered for use by companies as incubator environment. The collaboration models will cover not only normal research co-operation but also the installation of equipment in the facilities and the shared use of the clean room and its equipment.

As a part of the Oulu region's Micro- and Nanotechnology Research Programme, VTT has launched a biotechnology research project in which cheap, disposable or continuously operating measurement sensors and equipment as well as fast analytical determination methods are being developed. The methods will also find a very wide range of analytical applications in fields such as point-of-care diagnosis, environmental analysis, quality control in the food industry, and industrial process control.

The Micromodule Centre works in close collaboration with the Northern Center of Manufacturing (NCEM) programme and supports its research goals. The North Ostrobothnia Employment and Economic Development Centre has provided financial support for the Centre's investments in new facilities and equipment. Part of the support comes from the European Regional Development Fund.

The new clean room facilities will serve as an excellent R&D environment for wireless and optical communications and sensing applications.



New research laboratory for heavy vehicles

VTT has opened a new laboratory that is unique in Finland and significant even by international standards. VTT's new research laboratory for the study of heavy vehicles will focus on truck and bus energy and emissions research. The laboratory enables advanced engine exhaust emission research in accordance with the European Union's latest directive concerning vehicle exhaust emissions.

The need to measure the exhaust emissions of heavy vehicles is growing due to tougher emission regulations, the introduction of new vehicle and fuel technologies, and competitive bidding for bus routes. There is a great deal of environmental policy pressure for lower vehicle emissions. Emission levels will soon be factored into bus tariffs.

The equipment is being used

for product development work in areas such as engines, engine control systems, fuels and exhaust aftertreatment devices, and for the evaluation of new bus technologies and research on energy saving. It is now also possible to measure particle emissions directly from heavy vehicles. In 2002 some 360 engine dynamometer test runs were carried out and over 200 chassis dynamometer measurements were made on heavy vehicles. The tests have been useful in exhaust gas research and in development work on fuels, catalytic converters and engines. On the fuel side, the EU's possible biofuel directive will require studies on the in-service properties of different biocomponents.

The laboratory's main equipment consists of a heavy chassis dynamometer for vehicle measurements and a transient engine dynamometer for engine measurements, as

well as exhaust emission measurement equipment for both devices. The chassis dynamometer, which can be used for both heavy vehicles and working machinery, is akin to a rotating highway and its rolls are 2.5 metres in diameter. The new laboratory enables VTT to conduct transient type engine and vehicle measurements, i.e. tests which simulate engine load changes as fast as in normal traffic.



The equipment of VTT's new research laboratory for heavy vehicles is being used in development work on engines, engine control systems, exhaust aftertreatment devices and fuels.

REVIEW BY THE BOARD

Global economic uncertainty affected the operating environment and businesses of VTT's customers, and demand for research and development services was weaker than expected. Public research expenditure remained at the level of the previous year. For these reasons the volume growth of VTT's activities was weak. The financial result was negative owing to slack demand and reduced R&D spending in certain sectors.

Slow growth on the R&D market

Research and development expenditure in Finland totalled EUR 4.8 billion in 2002 compared with EUR 4.5 billion in the previous year. The GDP share of research and development expenditure is estimated at well below 4%, i.e. roughly the same as in 2001 (3.4%). Compared with the previous year, R&D expenditure grew the most in the university sector (8.5%). Companies increased their R&D spending by almost 5% and the public sector by about 4%.

VTT's turnover rose 2% to EUR 218.5 million. Basic governmental funding accounted for about 31% of turnover and external income for about 69%. Income from commercial activities represented 40% of turnover and the profitability of these activities was weaker than in the previous year.

VTT continued to align its operations and develop its practices in order to improve its ability to adapt to changes occurring in the operating environment and to respond to foreseeable challenges.

VTT creates new expertise for Finland's innovation system

VTT's R&D activities broadly cover the entire innovation chain in Finland, including strategic basic research, applied research, product development, consulting and standard services. The emphasis is on applied research.

VTT's activities consist of self-financed projects, jointly funded projects and commercial activities. Self-financed projects involve technology-based strategic research. Jointly funded projects are initiated on the basis of need and typically involve the participation of VTT, the National Technology Agency (Tekes), the EU, companies or other benefiting parties. New knowledge and technologies for use in Finland's national innovation environment are created in national technology programmes. The emphasis in international research activities is on the EU's framework programmes, which yield new expertise and valuable contacts for participating companies and other benefiting parties. In its commercial activities, VTT applies research knowledge to create new products, production processes or businesses for its customers.

VTT formulated a new technology strategy covering all of its activities. Focus areas of strategic research, targeted benefits as well as short- and long-term technology goals were defined in the new strategy. The technology strategy is a forward-looking intent and view of what VTT's technology focuses should be primarily in the Finnish but also in the global innovation environment. It is based on a vision that incorporates the future needs of VTT's customers, the development outlook for different technologies, and research and technology policy trends.

VTT's societal and regional impacts found to be significant

A study of VTT's societal impacts and role as a technological expert and developer was made. The study indicated that VTT has above all speeded up technological development in Finland and supported Finnish companies in attaining international technological leadership. VTT's role in making new technological initiatives and in technology transfer has been significant. Considerable societal benefit has been achieved in improving the safety of construction, transport and industrial activity, in energy economy and in the development of energy-sav-



Pekka Ketonen



Paula Nybergh

Board

January 1, 2003

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Pekka Ketonen,
Managing Director,
Vaisala Oyj

Vice Chairman
Paula Nybergh,
Counsellor, Ministry of Trade
and Industry

Members
Kari-Pekka Estola,
Director, Nokia Research Center
Tapio Huttula,
Secretary General,
The Finnish Trade Union STTK
Ulla Sirkeinen, Director,
Confederation of Finnish Industry
and Employers
Erkki KM Leppävuori,
Director General, VTT
Anu Vaari,
Research Scientist, VTT



Kari-Pekka Estola



Tapio Huttula



Ulla Sirkeinen



Erkki KM Leppävuori



Anu Vaari

ing materials and processes. VTT has participated, for example, in the preparation of climate, energy and marine navigation strategies, and has supported decision-making and the drafting of legislation concerning gene technology.

VTT's role and the impacts of its activities at regional level were clarified in an extensive survey of companies and stakeholder groups. The survey indicated that VTT's attractiveness as a partner is based on its expertise, high standard of R&D services, dependability and impartiality. The close geographical proximity of a VTT service point is also an important reason for collaboration. Service points in different parts of the country promote the transfer of VTT's expertise and services to the regions and strengthen contacts with local industries and stakeholder groups. The biggest regional service points outside Otaniemi, i.e. Tampere, Oulu and Jyväskylä, are involved in the development of their local innovation environments. The success of the service points is based on their linkage to the local operating environment, and the fruitfulness of their activities depends on the compatible combination of VTT's expertise base and the strengths of the regions in a mutually supportive arrangement.

Examples of new regional projects

VTT established a research group specialising in pharmaceutical development in Turku as the result of an agreement made with the City of Turku, the University of Turku, Åbo Academy and Turun Biolaakso Oy. The new research group will concentrate on the latest internationally significant technologies, and will channel VTT's expertise in other fields into pharmaceutical research. In particular, the group will focus on cancer research.

A hatchery for new start-ups specialising in microtechnologies was launched in partnership with Oulu Tech Oy. Wireless communications for work machines, industrial instrumentation, road construction work, care of the elderly and hospital research were developed in collaboration with companies in the Kainuu region, the City of Kajaani, the University of Oulu's Measurement and Sensor Laboratory and the Kainuu Vocational College.

Better practices and prerequisites for development work in the construction sector were created in the EU project "Promoting Innovation in Construction Industry SMEs". Innovation systems and the commercialisation of innovations in European countries were studied from the prospective of SMEs. The parties involved in the project included employment and business centres, industry associations and representatives of innovative, export-oriented SMEs.

A forecasting management model was created for the goal-directed development of municipalities and larger regional entities. The model, which was created in connection with a doctoral dissertation work, was used to identify two key challenges facing regional development in Finland: the exploitation of innovation in the development of regional economies, and meeting the future demand for premises. Solutions to these problems are being sought in collaboration with regional actors.

Domestic industry and services still key customers

A third of VTT's turnover came from the domestic private sector, with services and the electronics and electrotechnical industry retaining their position as key customers. VTT billing rose by 18% in the electronics industry but declined by about 10% in the service sector. The customer groups in the service sector included research institutes, corporate R&D units and technical service providers. However, the biggest increase in billing (25%) was in the energy sector.

As in the previous year, income from the domestic public sector made up a quarter of VTT's turnover. Ministries, universities and organisations serving industries and business were key partners in the public sector. Revenues from the National Technology Agency (Tekes) fell by 4%.

Co-operation with national technology programmes

VTT participated in the planning, implementation and co-ordination of several long-term national programmes. VTT took part in 57 programmes, of which 37 were Tekes programmes and the remainder programmes of ministries and the Academy of Finland. The research programmes not only generate new technological expertise but also increased the diverse interaction between research organisations and companies.

VTT had 20 of its own research programmes underway in the review year. New programmes started in 2002 were Bioanalysis and Bioinformatics, Systems Development for New Nuclear Power Plants, and Telematics for Transport and Logistics.

Projects of VTT's strategic technology themes make a good start

In 2001 VTT chose self-financed, multi-year technology themes as one way of achieving its strategic goals. The main goals of these themes are technological breakthroughs, significant societal impacts and internationalisation. Networking both inside VTT and globally with the best partners is essential in order to achieve first-class results. One important aim of the themes is to map out the future development trends in new technologies.

- The Future Communication Technologies theme consists of four projects: RF modules used in micromechanics, network interaction and mobility, service architectures, and technologies supporting natural interaction between people and the environment.
- The Clean World theme's main goals are increased use and refinement of renewable raw materials, combating climate change, and improved quality of the human habitat. These aims are being sought by applying new composite technologies, amongst other means.
- The Intelligent Products and Systems theme focuses on the development of intelligent products and systems suitable for the society and business concepts of the future. An intelligent product is able to adapt to different conditions and to communicate with its environment. The topics of the theme are active and communicative packaging, distributed energy system and embedded structural intelligence.
- In the Safety and Reliability theme the competitiveness of products and production is improved by applying advanced technologies, system models and measurement, modelling and assessment methods to controlling the safety and reliability of socio-technical systems. The research focuses on three areas: life cycle management methods, user-centredness and safety, and new techniques and operating concepts.

Some promising results have already been achieved in the technology themes, which have also strengthened VTT's international networks. The Future Communication Technologies theme published a roadmap of communication technologies over the next ten years, which aroused interest both in Finland and in the media abroad.

VTT visibly active in the EU's innovation environment

Income from abroad rose by a third to account for 11% of VTT's turnover. Over a half of the income came from the EU, and it grew by 35%. Another big item is private sector income, in which there was no growth, and its share of income from abroad fell to 31% (2001: 37%).

EU co-operation and preparatory work for the Sixth Framework Programme are the most important elements in VTT's international research activities. The sizes of projects associated with the framework programmes have grown in a number of different research fields.

The number of ongoing public international projects in the review year was 481, the total value of which was EUR 124 million. The number of EU projects rose to 72% (2001: 66%) of all foreign projects. VTT's foreign partners were primarily from Sweden, Germany, the

VTT'S STRATEGIC TECHNOLOGY THEMES

- Future Communication Technologies
- Clean World
- Intelligent Products and Systems
- Safety and Reliability

VTT'S OWN RESEARCH PROGRAMMES

- Wireless Telecommunications
- Optical Technologies for Wireless Communications
- Interactive Intelligent Electronics
- Product Line Architectures
- Optical Technologies for On-line Instrumentation
- New Software Technologies
- Microsystems Technology
- VTT Industrial Biotechnology
- Tailored Technologies for Future Foods
- Bioanalysis and Bioinformatics
- Nanomaterials
- Renewable Energy Sources
- Systems Development for New Nuclear Power Plants
- Fine Particle Emissions and Their Reduction
- Advanced Mechanical Pulping
- Products and Systems Based on New Technologies
- Processes for Construction and Use of the Built Environment
- Information and Communication Technology in Construction and the Management of Facilities and Networks
- Telematics for Transport and Logistics
- Life Cycle Performance and Safety

NATIONAL TECHNOLOGY PROGRAMMES IN WHICH VTT PARTICIPATES

- Business Opportunities from Space Technology
- Diagnostics 2000
- Miniaturising Electronics
- Innovation in Foods
- National Nuclear Waste Management Research Programme
- Explorative System-Integrated Technologies
- Clean Surfaces
- Sustainable Use of Natural Resources
- Fine Particles, Technology, Environment and Health
- Pigments - Raw Materials of Paper
- Proactive Information Technology
- Construction and Services
- Technology and Climate Change
- Industrial Clusters and Chemistry
- Future Products - Added Value with Microtechnologies
- Networks of the Future
- Novel Biotechnology
- New Industrial Practice
- Recycling Technologies and Waste Management
- Intelligent Automation Systems

VTT'S KNOWLEDGE PORTALS

- Nuclear
- Renewables
- ICT
- Environment
- Materials
- Pulp & Paper
- Transport
- Life Science

EU'S FRAMEWORK PROGRAMMES IN WHICH VTT PARTICIPATES

EU's Sixth Framework Programme: (VTT's planned participation)

- Life sciences, genomics and biotechnology for health
- Information society technologies
- Nanotechnologies and nanosciences, knowledge-based multifunctional materials and new production processes and devices
- Aeronautics and space
- Food quality and safety
- Sustainable development, global change and ecosystems
- Research actions targeted at SMEs
- International co-operation
- Euratom

EU's Fifth Framework Programme: (VTT is participating)

- Quality of Life and Management of Living Resources (Quality of Life)
- User-friendly Information Society (IST)
- Competitive and Sustainable Growth (GROWTH)
- Energy, Environment and Sustainable Development (EESD)
- Confirming the Role of Community Research (INCO 2)
- Promoting of Innovation Encouragement of SME Participation (Innovation/SMEs, CRAFT)
- Improving Human Research Potential and Socio-economic Knowledge Base (Improving)
- Euratom programmes (EURATOM)

Netherlands and Great Britain. The most important partner countries outside the European Union were the United States and Norway. The number of partners from candidate EU member states also rose.

There was bilateral co-operation with the United States and Japan in 74 projects.

A VTT contact point was established in Silicon Valley, California, USA. The contact point promotes contacts with regional universities, research institutes and companies, and operates in collaboration with other Finnish actors in the area. The German service point near Frankfurt consolidated its activities.

New ways of transferring technology to the market

VTT developed its organisational structure to meet the needs of the economy. VTT launched new market-based networks called knowledge portals, which are intended to improve the usefulness and availability of VTT's expertise. Between 200 and 900 research scientists now belong to each of these portals. Many research scientists belong to more than one portal, depending on the industries of their research field's customers and partners, and on the development needs of the activity. Through these new contact interfaces customers can reach the experts and expertise of VTT institutes that are most important to them.

An organisational reform led to the creation of larger and more comprehensive expertise centres: VTT Automation and VTT Manufacturing Technology were combined to form VTT Industrial Systems, and VTT Energy joined up with VTT Chemical Technology to form VTT Processes, which concentrates on the energy and forest clusters. Microelectronics research was centralised in VTT Information Technology, which now covers the most important elements of the value chain formed by information and communication technologies.

At the end of the year two significant expansion investments in VTT's micro- and nano-technology programmes were completed. The Oulu clean room facilities are part of the new micromodule development centre, and the microelectronics centre at Otaniemi, Espoo was enlarged. The latter also involved the construction of a science park, where a number of companies are engaged in small series production on leased premises using equipment and services supplied by VTT. The purpose of the science park is to promote the birth of new enterprises and new products.

Scientific knowledge strengthened

The proportion of VTT employees holding an academic degree was 68.4%. The number of research scientists rose to 1,708 (1,685). The proportion of employees holding licentiate or doctoral degrees remained unchanged at 34%. No fewer than 21.6% of research scientists held doctoral degrees, which was slightly more than in the previous year (20.8%).

The international mobility of research scientists declined slightly compared with the previous year. In the year 2002 there were 44 VTT research scientists abroad on training or project assignments (2001: 59). The most popular foreign destination was once again the United States, where 15 (28) employees were working. There were 70 (72) foreign visiting research scientists on at least one-month assignments at VTT. In addition, 46 (53) foreign nationals are permanently employed at VTT.

At the end of the review year 2,982 people were employed by VTT. The decline of volume in terms of total labour input that began in 2000 continued. The total labour input was 2,767 man-years, which was 15 fewer than in 2001. VTT's average staff turnover rate fell slightly to 6.4 % (8.5 %).

Finances

VTT conforms to the State's uniform administrative accounting practice. The financial statements presented in this annual report have been prepared accordingly. However, conventional business accounting practice is more appropriate to the nature of VTT's activities and is therefore used in internal financial control. The description of VTT's financial development given below is mainly based on business accounting practice.

Turnover rose by 2% in the review year and was EUR 218.5 million. Income from commercial activities rose by 1% to EUR 88.4 million. The volume of jointly funded activities was EUR 96.5 million, of which EUR 61.9 million was obtained from external partners (up 6% from the previous year) and EUR 34.6 million from basic governmental funding (up 4% from the previous year). Additional basic governmental funding for VTT's self-financed research fell by 3% to EUR 33.6 million, so the total volume of basic governmental funding valued at cost was EUR 68.2 million (an increase of 1%).

The total external income was EUR 150.4 million, which was 3% higher than in the previous year. Income from the domestic private sector rose by 1% and was EUR 72.9 million. Income from the domestic public sector fell by 1% to EUR 54.1 million. This included income from Tekes totalling EUR 30.7 million, 4% less than in the previous year. Income from abroad rose by a fifth and was EUR 23.4 million, of which income from the EU accounted for EUR 12.8 million (up 35% from the previous year).

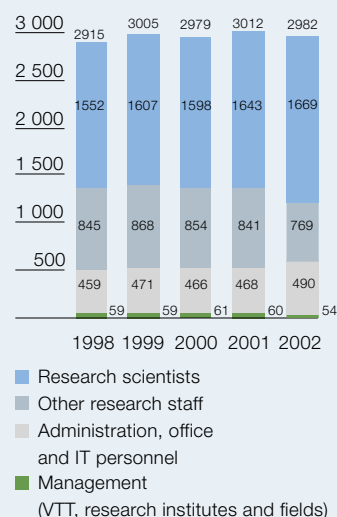
The order book for research projects at the end of the year was EUR 97.3 million, which was 2% higher than at the end of the previous year.

VTT's operating expenses were EUR 210.4 million, an increase of EUR 10.9 million or 5%. Investments in fixed assets were EUR 16.1 million (EUR 14.1 million).

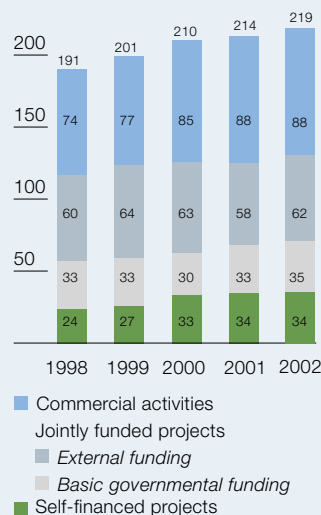
VTT's internal profitability statement

	1.1. - 31.12.		Change %
	2002 M€	2001 M€	
TURNOVER	218.5	213.9	2
External income	150.4	146.3	3
Turnover adjustment items	-0.1	-0.2	-17
Basic governmental funding	68.2	67.7	1
OTHER OPERATING INCOME	0.8	0.6	25
EXPENSES	210.4	199.5	5
Personnel expenses	128.2	121.9	5
Travel expenses	9.5	10.0	-5
Materials and consumables	13.9	13.9	0
Rents	20.9	18.9	11
External research services	13.0	12.2	6
Purchases of other services	20.7	22.4	-7
Other expenses	1.8	1.9	-5
Increase in projects in progress	2.4	-1.7	-246
OPERATING MARGIN	8.9	15.0	-41
Depreciation	13.0	12.4	5
Financial expenses	-1.9	-1.8	3
Extraordinary	3.3	0.0	
RESULT FOR THE FINANCIAL YEAR	-2.7	0.8	

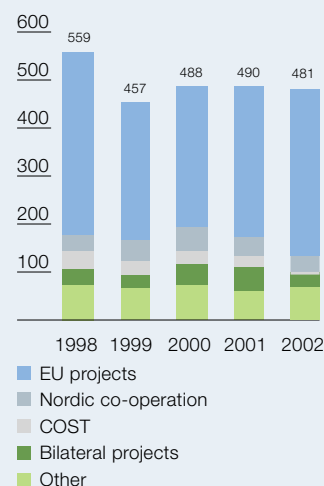
PERSONNEL STRENGTH AND STRUCTURE



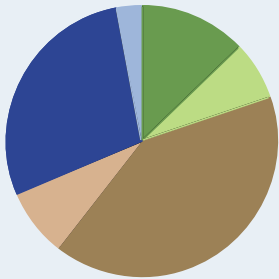
TURNOVER, M€ Internal accounting



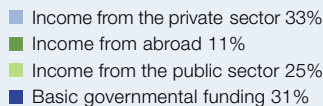
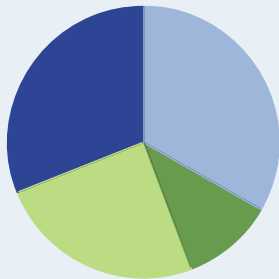
INTERNATIONAL RESEARCH PROJECTS



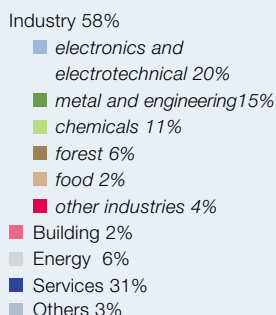
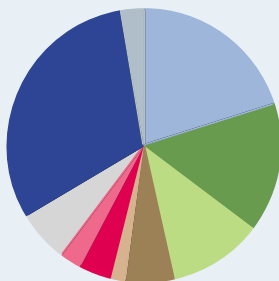
EDUCATION OF VTT PERSONNEL



RESEARCH AND DEVELOPMENT



INCOME FROM THE PRIVATE SECTOR



The overall financial result according to the internal profitability statement was a deficit of EUR 2.7 million.

The result of commercial activities alone was a surplus of EUR 0.3 million. Profitability was adversely affected in particular by weaker than expected income growth, investments in the development of the organisation and working practices, and increased expenses relating to premises.

Outlook for 2003

Events and conditions beyond the borders of Finland are creating uncertainty for both the Finnish economy and the outlook for industry. The growth in corporate R&D expenditure is expected to stop, and at the same time the public sector financing system will be reassessed and restructured. Competition in R&D services will increase in Finland and internationally. VTT's market-based role will grow. Due to the development outlook for the operating environment, the growth of VTT's turnover is expected to remain slow and the financial result modest. VTT will continue to take steps to improve its profitability.

VTT will continue to participate and maintain its a high profile in preparatory work for the EU's new framework programmes. As the project size of the new framework programmes grows, participation in them will become more challenging for VTT owing to the increased contributions of own financing.

Detailed breakdown of turnover

	2002 M€	% of turnover	2001 M€	Change % 2002/01
TURNOVER	218.5	100	213.9	2
External income	150.4	69	146.3	3
Private sector, domestic	72.9	33	72.2	1
- industry	41.9	19	39.7	5
- electronics and electrotechnical	14.7	7	12.5	18
- metal and engineering	11.1	5	11.0	1
- chemicals	8.2	4	7.9	3
- forest	4.2	2	4.3	-3
- food	1.2	1	1.3	-2
- other industries	2.5	1	2.8	-9
- service sector	22.5	10	25.4	-11
- energy	4.6	2	3.7	25
- building	1.8	1	1.6	12
- others	2.1	1	1.8	17
Public sector, domestic	54.1	25	54.6	-1
- National Technology Agency (Tekes)	30.7	14	32.0	-4
- Ministry of Trade and Industry	2.2	1	2.8	-21
- Others	21.1	10	19.7	7
Foreign	23.4	11	19.5	20
- EU	12.8	6	9.5	35
- ESA	0.7	0	0.6	5
- joint Nordic public funding	0.5	0	0.5	10
- other public sector	2.2	1	1.7	28
- private sector	7.2	3	7.1	0
Basic governmental funding	68.2	31	67.7	1

INCOME AND EXPENDITURE STATEMENT

According to the State's official administrative accounting practise

	1.1. - 31.12.	
	2002	2001
	1000 €	1000 €
Operating income:	151 036	146 762
Income from commercial activities	88 397	87 885
Rents and remunerations	508	323
Other operating income	62 131	58 554
Operating expenses:	224 623	213 287
Materials, goods and consumables:		
Purchases during the financial year	13 888	13 936
Personnel expenses	129 158	125 247
Rents	20 887	18 897
External services	32 430	30 964
Other expenses	11 391	12 011
Increase in stocks of finished goods	2 437	-1 674
Production for own use	-113	-148
Depreciation	12 977	12 401
Internal expenses	1 568	1 653
Deficit I	-73 587	-66 525
Financial income and expenses:	84	104
Financial income	92	112
Financial expenses	-8	-8
Extraordinary income and expenses:	3 265	29
Extraordinary income	3 265	40
Extraordinary expenses	0	-11
Deficit II	-70 238	-66 392
Income from taxes and obligatory charges:	1 136	2 386
Value added tax collected	16 919	16 841
Value added tax paid	-15 783	-14 455
Operating deficit for the financial year	-69 102	-64 006

BALANCE SHEET

According to the State's official administrative accounting practise

	1.1. - 31.12.	
	2002	2001
	1000 €	1000 €
ASSETS		
FIXED ASSETS AND OTHER LONG-TERM INVESTMENTS	44 961	39 532
Intangible assets	3 282	2 896
Intangible rights	1 994	2 298
Other long-term expenses	428	450
Advance payments and work in progress	860	147
Tangible assets	40 742	35 699
Machines and equipment	35 131	31 939
Fixtures and fittings	3 046	2 799
Advance payments and work in progress	2 565	961
Securities held as long-term investments	937	937
CURRENT FINANCIAL ASSETS	52 743	55 893
Current assets	5 855	8 275
Work in progress	5 831	8 268
Advance payments	24	7
Current receivables	46 668	46 945
Account receivables	46 377	46 686
Pre-paid expenses and accrued income	278	245
Other current receivables	12	10
Advance payments	0	3
Cash, bank receivables and Cash, bank receivables and Cash accounts	220	673
Cash accounts	0	
Other bank accounts		443
Other monies and bank receivables	220	230
Total assets	97 704	95 424
LIABILITIES		
OWN FUNDS	56 205	49 989
State's equity	55 957	49 731
State's equity 1.1.1998	40 409	40 409
Change in equity	9 322	10 482
Capital transfers	75 328	62 846
Operating deficit for the financial year	-69 102	-64 006
Funds' equity	248	259
Other State fund and donations	248	259
LIABILITIES	41 498	45 435
Current	41 498	45 435
Advance payments received	5 846	9 307
Accounts payable	10 125	9 309
Account entries between accounting offices	3 267	3 021
Items still to be entered in the accounts	1 875	1 945
Accrued liabilities and deferred in come	19 574	21 195
Other current liabilities	811	657
Total liabilities	95 704	95 424

NOTES TO THE FINANCIAL STATEMENTS

The financial statements presented in this annual report have been prepared in accordance with the State's official administrative accounting practice. The financial statements comprise income and expenditure statements and balance sheets. In addition, notes to the financial statements are also presented.

Accounting policies

Fixed assets

The book values of fixed assets are based on original acquisition costs.

Planned depreciation has been calculated by applying the straight-line method to the original acquisition cost over the expected economic lifetimes of the assets concerned. The periods over which fixed assets are normally depreciated are as follows:

- intangible rights 3 - 4 years
- other capitalised expenditure 7 years
- machines and equipment 3 - 7 years
- fixtures and fittings 7 years

Current assets

Current assets are costs already incurred in long-term projects in progress but not yet billed. The value of work in progress includes variable expenses as well as fixed expenses relating to procurement and manufacture.

Items denominated in foreign currencies

Liabilities and receivables denominated in foreign currencies are translated into euro using the final exchange rate quoted by the European Central Bank on the last day of the accounting period.

Balance Sheet

5. Fixed assets and other long-term investments

(1000 €)	Acquisition cost		Increases	Decreases	Accumulated depreciation		Book value
	1.1.2002				31.12.2002		
Intangible assets							
Intangible rights	9 183		1 231	178	8 242		1 994
Other capitalised expenditure	491		96		159		428
Prepayments and procurements in progress	147		713				860
Tangible assets							
Machines and equipment	115 182		13 816	4 500	89 367		35 131
Fixtures and fittings	6 355		952	273	3 988		3 046
Prepayments	961		1 604				2 565
Prepayments	937						937
Total	133 256		18 412	4 951	101 756		44 961

6. Investments

Shares and holding	Number	Holding %	Nom. value 1000 €	Book value 1000 €
Licentia Oy	3 748	37	126	589
Boneca Oy	2 500	50	168	168
Housing and real estate companies	110			80
Housing and real estate companies	263			95
Other shares and holding, total				4
Total				936

7. Own funds

Own funds comprise the equity of the State and the equity of government funds. The balance sheet at the beginning of the financial year comprised the State's equity as an imputed item representing the difference between total balance sheet assets and other equity items. The equity of government funds comprises donations made to VTT.

Income and expenditure statement

1. Income

According to the State's official accounting practice, basic governmental funding received directly from the State or indirectly through government agencies are not treated as income.

2. Personnel expenses

(1000 €)	2002	2001
Wages and salaries	105 833	103 026
Payments in kind	178	161
Pension expenses	15 683	14 765
Other personnel expenses	7 642	7 456
Total	129 336	125 408

(1000 €)	31.12.2002	31.12.2001
Holiday pay liabilities	19 569	18 835

3. Planned depreciation

By balance sheet item (1000 €)	2002	2001
Intangible assets		
Intangible rights	1 536	1 483
Other capitalised expenditure	118	29
Tangible assets		
Machines and equipment	10 618	10 245
Fixtures and fittings	705	644
Total	12 977	12 401

The planned depreciation charges include non-recurring additional depreciation charges of EUR 76,144 caused by alteration of the depreciation schedule.

4. Deficits I - II and the operating deficit for the financial year

Deficit I represents the difference between the accumulated income received and expenses incurred in VTT's actual operations, and deficit II the corresponding figure after financial and extraordinary items. The final result, when value added taxes are taken into consideration, is the operating deficit for the financial year. The operating deficit for the financial year is the difference between the income received by VTT as reported on the statement and all expenses.

8. Donations

(1000 €)	2002	2001
Value 1.1.	258	246
Increases:		
- interest income	10	12
Use of donations:		
- scholarships	20	
Value 31.12.	248	258

9. Liabilities

Liabilities comprise short-term debts. Accrued liabilities and deferred income include holiday pay liabilities. Advances received in respect of joint activities with the state administration are recorded in other short-term liabilities.

*Jorma
Lammasniemi*



*Pekka
Silvennoinen*



*Mikko
Kara*



*Juha
Ahvenainen*



*Jouko
Suokas*



*Juho
Saarimaa*



*Erkki KM
Leppävuori*



*Jarl
Forstén*



*Pentti
Grönberg*



*Anu
Vaari*



EXECUTIVES JANUARY 1, 2003

VTT Electronics
Executive Director Jorma Lammasniemi

VTT Information Technology
Executive Director Pekka Silvennoinen

VTT Industrial Systems
Executive Director Jouko Suokas

VTT Processes
Executive Director Mikko Kara

VTT Biotechnology
Executive Director Juha Ahvenainen

VTT Building and Transport
Executive Director Juho Saarimaa

Director General Erkki KM Leppävuori
Deputy Director General Jarl Forstén
Administrative Director Pentti Grönberg
Research Scientist Anu Vaari

**For further information on
VTT's research and activities
please see:
www.vtt.fi**

**VTT/Communications
Tel. +358 9 456 4106
Communications Director Olli Ernvall
Tel. +358 9 456 6747**

**E-mail addresses are formed:
firstname.lastname@vtt.fi**

Editorial staff:
VTT's Communications

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Antonin Halas, Imagemaker Oy,
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VTT TECHNICAL RESEARCH CENTRE OF FINLAND

Vuorimiehentie 5, Espoo

P.O.Box 1000, FIN-02044 VTT

Tel. +358 9 4561, fax +358 9 456 7001

www.vtt.fi