

VTT's Annual Report

1997



TECHNICAL RESEARCH CENTRE OF FINLAND

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Mission

VTT is an impartial expert organisation that carries out technical and technoeconomic research and development work. VTT develops technologies both to improve the competitiveness of companies and the basic infrastructure of society, and to foster the creation of new businesses. VTT thereby promotes growth of the Finnish economy in accordance with the national industrial strategy.

Core Values

Our core values are:

- Responsiveness to the views and needs of customers*
- Cooperation*
- Successful performance*
- Continuous development*



Review by the Director General



VTT's operating environment continued to develop favourably in 1997. Research spending in the corporate sector continued to grow quickly, and that growth has now spread beyond the electronic and electrotechnical industry. The effects of the general increase in public research expenditure planned by the State for the years 1997 – 1999 began to show up in financing decisions. The research programmes of the European Union and other international frameworks also offered good opportunities. This trend was visible in both jointly funded projects and our commercial activities. At the end of the year our order book was in a very healthy state.

VTT has been continuously participating as one of many actors in restructuring the Finnish economy. Its more visible features include the ever broader application of information technology in different areas of society and the rapid growth of production and R&D spending in the electronics and electrotechnical industry. VTT's income from customers in this industry have risen over the past decade at about the same pace as the companies' own R&D spending, although lately at somewhat slower rate. The economic restructuring

process has been supported by VTT through reallocation of the research funds. However, a shortage of qualified personnel in the fields of electronics and information technology has limited our possibilities in this regard. Similarly, the meagre growth of public research funds in recent years has been a limiting factor; it has been appropriate for us to play a role also in developing the community infrastructure as well as in raising the level of technology and competitiveness in industries other than those exhibiting rapid growth.

R&D spending in Finland has grown very quickly by all international standards. At the same time the share of the corporate sector in total R&D spending has risen to almost 70 per cent. Rationalisation measures implemented in connection with VTT's reorganisation led to a declining trend in the total number of employees which lasted until the middle of the decade. However, the number of research scientists has been growing all the time. Even so, VTT's share of all R&D carried out in Finland has fallen in recent years. I regard that as a natural development.

As companies globalise, specialise and rationalise their businesses, they tend to outsource their R&D operations. Naturally, this increases the demand for the services offered by contract research institutions. The appropriate allocation of research resources among the various fields of technology and among research fields with differently timed objectives and thus different financing structures will continue to be an important strategic task of VTT in the years ahead. But the amount of research work must also be increased, in my opinion more quickly than during the last few years, and so too must the productivity of research work be further improved.

VTT operates in accordance with the national industrial strategy formulated by the Ministry of Trade and Industry and with the development policies of the Science and Technology Policy Council of Finland. On the basis of these the Ministry has set targets for 1997 and agreed them with the Board of VTT. The targets include raising the revenues from jointly financed contract research and commercial contract assignments to 70 per cent of the Research Centre's total funding by the end of the millennium. We are on course to achieve this target. A continuous condition is that our economy as a whole is balanced and that the revenues from separately monitored commercial activities cover their expenses. This condition was also met.

On the whole, VTT achieved the goals set for it in 1997. I would like to thank the staff of the Research Centre warmly for their successful work and fruitful interaction with our partners. VTT is well equipped to face the never-ending task of continuous development.

Markku Mannerkoski



*Chairman
Jukka Viinanen
Managing Director
Neste Corporation*



*Vice Chairman
Alpo Kuparinen
Special Adviser
Ministry of Trade and Industry*



*Matti Ilmari
President
ABB Oy*

The Finnish economy grew quickly in 1997. Both the public and private sectors invested in research and development considerably more than in the previous year. EU research programmes created a good framework for wider international co-operation.

VTT's turnover rose by 7 % to FIM 1,067 million, with an increase in external income. Both domestic and international public research funding obtained through competition rose during the review year. There was a substantial increase in commercial services for industry, and the profitability of such work was good. Budget funding declined by 4 %.

The four-year term of the Board ended on 31st December 1997. The Board has worked like the board of directors of a company in the private sector. It has made decisions on fundamentally important operating policies, the allocation of budget funding, the budget proposal, and the most important investments.

Research and inspection work

The aim of VTT's research and development work and its testing and inspection services is to improve the technological competitiveness of the Finnish economy in the short and long-term, and to promote businesses based on new technical innovations as well as production and employment in Finland.

VTT's activities consist of internally initiated projects, joint projects and commercial activities. Technology-based strategic research is carried out mainly as internal projects funded directly out of the state budget. Joint projects are initiated according to needs and are funded jointly by two or more parties. Most of the work is publicly funded and categorized as strategic research. Commercial activities are performed according to direct demand from paying customers.

Research emphases according to the needs of the economy

In recent years the activities of the Research Centre have been made more responsive to market requirements. The growth in commercial activities and joint projects is indicative of this evolution. During the year the commercial activities and joint projects respectively accounted for 40 % and 46 % of VTT's activities. Most joint projects are financed by VTT, the Technology Development Centre (Tekes) and the EU, although companies are often also involved in them. Income from the private sector rose to account for one third of turnover. VTT's financing structure has developed steadily in the direction agreed with the Ministry of Trade and Industry. External income accounted for almost 68 % of total funding in 1997, whereas the target set for the end of the millennium is 70 %.

The emphasis in VTT's activities has been on research-intensive branches of industry. Information technology, telecommunications and electronics as well as industries, services and exports exploiting them have grown and will continue to grow extremely quickly. In recent years VTT has devoted the largest proportion of its budget funding to research supporting these areas. In particular, budget funding has been used to strengthen the expertise and capabilities of VTT Electronics and VTT Information Technology. In so doing, R&D services for industry and other sectors of society have also been enhanced. Budget funding allocated to VTT Biotechnology and Food Research has been kept at a high level due to the rapid development of the biosciences.

The operating framework of VTT Electronics improved significantly with the completion at Espoo of a new fully equipped microelectronics centre costing about FIM 100 million. This new facility provides an extremely competitive environment for component and materials research.



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Senior Research Scientist
VTT Building Technology*



*Markku Mannerkoski
Director General
VTT*



*Martti Mäenpää
Director General
Technology Development Centre*



*Seppo Säynäjäkangas
Professor, University of Oulu
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VTT'S RESEARCH PROGRAMMES

Basic technology programmes

- Signal Processing in Telecommunications Products
- Optoelectronics
- Silicon Technologies
- Design on Embedded Systems
- Intelligent Production Systems and Control Architectures
- Nano-phase Particles
- Metabolic Engineering
- Parallel Computing and Open Simulation Environments

Industry-specific research programmes

- Measurements and Control in the Pulp and Paper Industry
- Chemical Cycles in the Forest Industry
- Minimal Processing of Food
- Future Foods
- Engine Technology
- Reducing the Water Use in Paper Production
- Small-scale Combustion
- PROGAS
- Optimisation of Wood Handling in the Pulp Industry
- Multifuel Systems
- Steel
- New Synthetic Materials and Systems for Industrial SMEs

Electronics and information technology research accounted for almost 30 % of VTT's turnover. In addition to VTT Information Technology, several other institutes carry out a significant amount of IT research, i.e. VTT Automation, Energy, Electronics and Manufacturing Technology. Growth has been limited by the current shortage of qualified research personnel in Finland. The problematic situation showed up especially in VTT Information Technology.

The fastest rates of volume growth were in VTT Chemical Technology, Communities and Infrastructure and Electronics with an increase of the external incomes.

Efforts were made to clarify and improve customer satisfaction, and research services were packaged as marketable products. A number of significant co-operation agreements were made with customers.

VTT's Group for Technology Studies intensified its monitoring, forecasting and assessment of the long-term technology development outlook and opportunities.

Emphasis on industry and the SME sector

Income from the domestic private sector rose by 8.6% to FIM 351 million and accounted for one third of VTT's turnover. Almost two-thirds of these revenues were obtained from industry and the research work directly serving it. Continued growth from the previous year can be regarded as an indication of VTT's success in supporting the technological renewal of companies in general and industry in particular.

The biggest and fastest growing of VTT's customer groups were the chemical, engineering, electrotechnical and electronics industries. The forest and food industries were also important industrial branches. VTT has a number of important corporate clients in different segments of the services sector, e.g. trade, transport and communications. This group accounted for about 23 % of VTT's private sector income.

Of VTT's 6,000 or so customers, about 2,900 were SMEs employing fewer than 500 people. These firms accounted for about a half of private sector income, i.e. FIM 177 million, which was 5 % more than in the previous year. About 1,200 of these SMEs were micro-enterprises employing fewer than ten people. They accounted for about 15 % of private sector income.

VTT has been actively involved in the

Technology Development Centre's technology clinics, which have been created as a flexible means of transferring new technologies to SMEs. The Technology Development Centre (Tekes) has had its clinics evaluated, and the results were positive.

In order to serve the SME sector the research institutes operated in domestic networks of different industries and firms. They also play their part in developing these networks.

VTT is active in national research programmes

The national technology programmes play a significant role in VTT's strategic research. In 1997 VTT took part in 60 programmes with a duration longer than one year. On these, 50 were Technology Development Centre (Tekes) programmes and the remainder were ministerial and Academy of Finland programmes. VTT was responsible for co-ordinating many activities belonging to these programmes. The Research Centre was also involved in the planning of new programmes. Among others, VTT Electronics participated very actively in the preparation of a technology programme intended to realise the development visions of the electronics and electrotechnical industry.

VTT currently has 21 of its own research programmes with a duration longer than one year. Two programmes concerning the SME sector were completed. Four new programmes were started: Future Foods (new food innovations), Wood Quality (integrated wood procurement for the forest industry), PROGAS (gasification and pyrolysis technology for solid biomass and coal) and Waste Conversion (new handling solutions for industrial and community waste). EU projects were prominent in international co-operation.

The number of ongoing international projects at the end of the year was 486, of which 306 were EU projects. Co-operation with the EU's Joint Research Centre (JRC) was increased. The number of international projects did not rise compared with the previous year, but their value rose as the size of the projects increased.

Income from abroad rose by 28 % to FIM 104 million. The countries generating the most income were Belgium, Holland, Sweden, Germany and France. Belgium tops the list because it is the origin of about two-thirds of EU income. About 60 % of income from abroad was income from EU, which was almost 40 % higher than in the previous

year. Private sector income from abroad rose by 25 %.

Closer co-operation with universities

VTT's close and wide-ranging co-operation with universities continued. In addition to joint projects, established forms of co-operation have included joint professorships, technology clinics selling services to SMEs, teaching, the guidance of further academic studies, the review of doctoral theses, the shared use of equipment, and sub-contracting. VTT and Helsinki University of Technology have two joint organisations: the Maritime Institute and MilliLab. Efforts are being made to improve co-operation in the field of microelectronics. Another co-operation forum is the universities' FUNET information network, of which VTT is a member.

Co-operation was increased in numerous research projects. New joint professorships were established: two with Helsinki University of Technology (photonics, information technology in electrical energy automation) and one with Lappeenranta University of Technology (welding technology). The Infotech Oulu basic research programme was initiated in collaboration with the University of Oulu.

Testing and inspection work

These activities include testing, calibration, the work as a national metrology laboratory, certification, inspection work and the tasks of a Notified Body. The aim is to ensure the quality and safety of products and to evaluate the export products of enterprises for the international market. The total value of these commercial activities was FIM 45 million.

VTT now has accreditations, certifications and other approvals for several hundred test and analytical methods in over 40 different fields. VTT also has the capabilities to perform tasks according to about 60 EU directives, and can act in the capacity of as a Notified Body with regard to 4 directives. In addition, VTT has one pre-notification. VTT Automation opened its new EMC laboratory for the performance of electromagnetic compatibility testing.

VTT Building Technology signed export-promoting co-operation agreements on the testing and inspection of building products with Japanese, Estonian, Russian, American and German product certification organisations.

Evaluations and improvements

VTT continued with evaluations of its re-

search institutes. International experts evaluated the activities of VTT Communities and Infrastructure and VTT Information Technology. The findings were favourable, but included several development recommendations. The necessary improvements were implemented. Evaluations of the finished research programmes were continued.

The emphasis in VTT's performance management is on improving total quality. The institutes use the Finnish quality prize criteria when evaluating their operations and selecting internal areas for development. International benchmarking among several research institutes provided a good foundation for these development measures. VTT Electronics took part in this process within the framework of EACRO, as did VTT Building Technology with international research institutes of its own field. The institutes also continued with evaluations of research programmes and other strategic projects.

In an external corporate image study VTT was well placed among a group of major corporations, central organisations and public institutions. The factors that improved our position the most were the quality of our products and services and the outlook for the future.

Personnel

The main aims in the development of personnel resources and personnel management were concerned with staff number and structure, technological and other expertise, and raising the level of staff satisfaction.

Quantitative and qualitative development

Altogether 2,785 people were employed by VTT in the review year. The volume in terms of total labour input was 2,605 man-years, which was 19 man-years or 0.7 % higher than in the previous year. The biggest staff increases were in VTT Chemical Technology and Electronics.

Altogether 433 personnel were hired, of whom almost nearly one third were research scientists and almost a half trainees. 73 people were hired to fill permanent positions. The personnel turnover rate was 7.3 %. There were 386 resignations, of which 123 were from permanent positions. The average period of service was 1.3 years for trainees, 2.1 years for other employees on fixed-term contracts, and 9.9 years for employees who resigned from permanent positions.

NATIONAL TECHNOLOGY PROGRAMMES IN WHICH VTT PARTICIPATES

- Bioenergy
- Water Management in Paper Making
- Electronic Publishing and Printing
- Electronics for the Information Society
- Fusion Energy
- Combustion and Gasification Technology
- Materials and Structures
- Energy and the Environment in Transportation
- Industrial Applications of Multimedia
- Nanotechnology
- Adaptive and Intelligent Systems Applications
- District Heating
- Computational Fluid Dynamics
- Structural Safety of Nuclear Power Plants

TECHNOLOGY CLINICS IN WHICH VTT PARTICIPATES

- EMC
- Welding
- Food Hygiene
- Machine Vision
- Usability
- Light Structures and Composite Materials
- Recycled Materials for Road Construction
- Technology Strategy in Construction
- Noise and Vibration
- Wood Drying
- Product Approval
- Casting

The process of developing the personnel structure continued. The total number of research scientists is now 1,498, i.e. 6.3 % more than in the peak year of 1991, when 2,870 people were employed at VTT. The number of research scientists carrying out more demanding specialist work has increased by 14 %. The number of office staff has been reduced by 30 %, and the number of technicians and other laboratory personnel by 15 %.

Emphasis on training and education

The focus within personnel development was on the further education of research scientists. The number of VTT employees with licentiate or doctoral degrees at the end of the year was 540, one fifth of the entire staff and one third of the research scientists. The most higher degrees are held by research scientists in VTT Biotechnology and Food Research (49 %) and VTT Energy (41 %).

There were 35 VTT research scientists working abroad for a period of at least one month, and 53 visiting researchers from other countries worked at VTT.

The emphasis in implementing training was on professional competence, communication and teamwork skills, customer service, commercial knowledge, quality work and leadership training to management level. Altogether 137 supervisors have now completed the personnel management training programme initiated in 1994. Several institutes have organised additional supervisor training.

Training costs totalled FIM 11.6 million, i.e. FIM 4,470 per man-year, the same level as in the previous year. The total cost of incentives in the form of performance-related awards and pay rises was the same as in the previous year, i.e. 3.5 % of the payroll total.

Staff welfare

Sickness leave, which is an indication of staff welfare and resolve, remained at the good level of previous years. No absences at all were recorded for 50 % of the staff. The average level of sickness leave was 5.9 days per man-year.

The average age was 40.9 years, which was slightly higher than in the previous year.

Finances

Turnover rose by 7 % in the review year and was FIM 1,067 million. The income from

commercial activities rose 8 % to FIM 428 million. Its share of total turnover remained unchanged at 40 %. The volume of jointly funded activities was FIM 493 million, of which FIM 295 million was obtained from external partners and FIM 198 million from VTT's budget funding. A further FIM 146 million of budget funding was used on VTT's own research initiatives, so the total volume of budget funding was FIM 344 million. This was 4 % lower than in the previous year.

The total external income was FIM 724 million, which was 13 % higher than in the previous year. The development of income was mainly in accordance with the set targets. Income from the domestic private sector climbed to FIM 351 million (9 %) and public sector income rose to FIM 269 million (13 %). Income from abroad also developed favourably, rising 28 % to FIM 104 million.

VTT's operating expenses were FIM 1,065 million. The increase of FIM 64 million (6 %) over the level of the previous year was mainly due to the higher volume.

Investments in fixed assets totalled FIM 90 million, an increase of 42 % over the level of the previous year.

The overall financial result according to business bookkeeping practice was a surplus of FIM 2 million. The result of commercial activities alone was FIM 13 million, which surpassed the profitability target set by the Ministry of Trade and Industry.

Outlook for the future

The Finnish economy is expected to continue to develop favourably. R&D spending will also continue to follow its upward trend.

The shear pace of technological development and the shortage of qualified personnel especially in the field of information technology will pose problems for the Research Centre. Indeed, the development of knowledge capital is a key challenge. The importance of personnel as a competitive factor will be underlined.

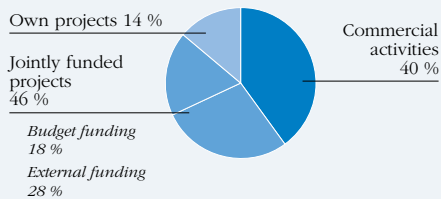
In international co-operation there is a need for more domestic corporate partners in EU project and closer co-operation with the USA and Japan.

VTT's order book at the end of the review year stood at FIM 560 million, a big improvement over the situation a year earlier. This provides a good starting point for 1998.

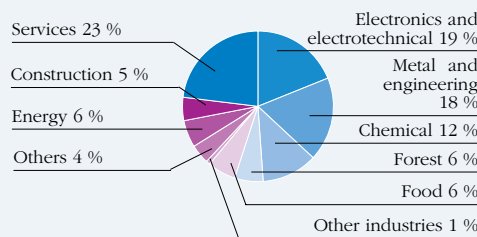
Selected statistics and performance indicators

	1997	Change-%	1996	Change-%	1995
Turnover, FIM mill.	1,067.1	7	996.4	5	950.5
• External income	723.8	13	641.6	9	587.4
Private sector, domestic	350.9	9	323.2	10	293.7
- industry and its research services	220.4	15	192.1	24	155.1
- service sector	80.1	-3	82.7	14	72.8
- energy	21.2	4	20.4	-28	28.3
- construction	17.7	-15	20.8	12	18.5
- others	11.5	61	7.2	-62	19.0
Public sector, domestic	268.5	13	236.7	-1	239.7
- Technology Development Centre	134.6	14	118.6	-13	136.8
- Ministry of Trade and Industry	20.8	6	19.7	1	19.6
- others	113.1	15	98.4	18	83.3
Abroad	104.4	28	81.7	52	53.9
- EU	59.4	39	42.8	172	15.8
- ESA	8.2	54	5.4	47	3.7
- Joint Nordic public funding	4.2	-25	5.7	-24	7.5
- other public sector	7.4	-4	7.8	-4	8.1
- private sector	25.1	25	20.0	6	18.9
• Budget funding	343.8	-4	356.5	-2	364.1
Business bookkeeping result, FIM mill.	2.3		-4.0		15.7
Surplus on commercial activity, FIM mill.	13.5		2.4		13.3
Research reports	14,408		14,000		
Publications	2,080		1,842		2,099
Patents	28		54		21
Invention registrations	92		77		72

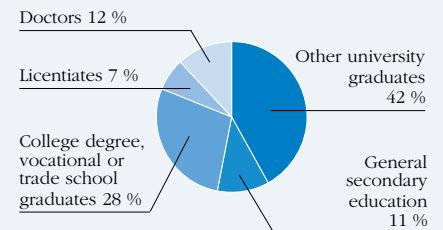
RESEARCH AND DEVELOPMENT



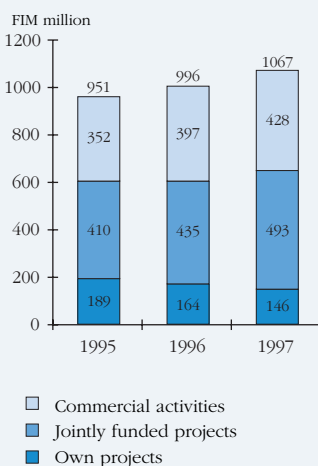
INCOME FROM THE PRIVATE SECTOR



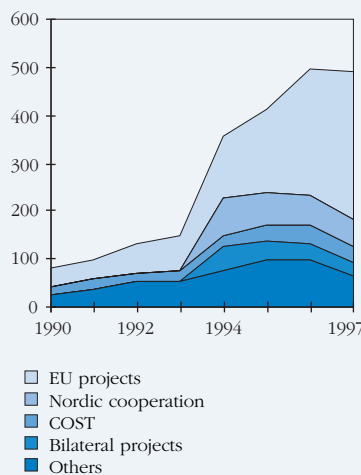
EDUCATION OF VTT'S PERSONNEL



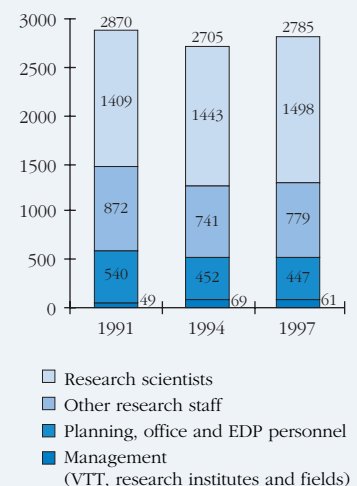
TURNOVER



INTERNATIONAL RESEARCH PROJECTS



PERSONNEL STRENGTH AND STRUCTURE



Income Statement

FIM 1,000 mk	1.1.-31.12. 1997	1.1.-31.12. 1996
Turnover 1)		
Income from commercial activities	427,861	396,644
Budget and jointly funded activities		
- income from jointly funded		
contract research	295,422	243,322
- budget-funded activities	343,824	356,466
	1,067,107	996,432
Expenses		
Personnel expenses 2)	592,744	562,473
Travelling expenses	48,170	43,359
Materials, supplies and goods	95,225	77,415
Rents	85,913	80,271
External research services	74,964	64,224
Other expenses	94,883	86,623
Increase in projects in progress	-10,994	-10,143
	980,905	904,222
Operating margin		
	86,202	92,210
Depreciation of fixed assets and other long-term expenditure 3)	72,787	84,646
Operating result		
	13,415	7,564
Financial income (+) and expenses (-) 4)	-13,782	-14,720
Result before extraordinary items		
	-368	-7,156
Extraordinary income (+) and expenses (-) 5)	2,702	3,119
Result for the financial period		
	2,335	-4,037

Budget Statement

FIM 1,000 mk					
Budget account	Appropriation or revenue estimate		Available	Used or accumulated	Deferred to 1998 (transferable allocation)
	1997	Previous years			
32.42.21. Operating expenses					
Gross expenses	1,003,000			1,078,353	
- gross income	-680,000			-730,095	
= net expenses	323,000	47,724	370,724	348,258	22,466
32.42.89 Acquisition of shares					
	1,000	1,000	0	1,000	
Use of appropriations from other govern- ment bureaus					
	4,461		7,806	999	
Donations	80	1,272	1,352	85	1,267

Balance Sheet

FIM 1,000 mk	31.12.1997	31.12.1996
ASSETS		
Fixed assets and other long-term investments		
Intangible assets 6)	12,341	12,903
Tangible assets 6)	208,199	190,817
Securities held as fixed assets and other long-term investments 7)	5,246	4,396
	225,786	208,116
Current and financial assets		
Current assets	38,465	29,254
Receivables		
Accounts receivable	180,174	176,210
Accrued income	98	114
Other receivables	265	59
Cash, bank receivables and securities held as financial assets	5,325	1,650
	224,327	207,287
Total assets		
	450,113	415,403
LIABILITIES		
Own funds		
VTT's funds 8)	214,695	209,298
Donations 9)	1,459	1,464
Budget funds 10)	11,595	15,239
Result for previous financial period (+/-)	11,635	15,671
Results for the financial period (+/-)	2,335	- 4,037
	241,719	237,635
Liabilities		
Advances received	42,070	20,565
Accounts payable	44,029	45,663
Accrued liabilities and deferred income 11)	108,554	101,042
Other current liabilities	13,741	10,498
	208,394	177,768
Total liabilities		
	450,113	415,403

Profitability of commercial activities *)

FIM 1,000		
	31.12.1997	31.12.1996
Income from commercial activities	433,991	402,735
Personnel expenses	172,129	159,407
Other direct expenses	99,875	90,585
Share of indirect expenses	148,529	150,321
Expenses, total	420,533	400,313
Surplus (+)\deficit (-)	13,458	2,422

*) includes internal items

Notes to the Financial Statements

General principles

VTT's 1997 financial statements have been prepared in accordance with the State's official administrative bookkeeping practice and the business bookkeeping practice. The financial statements include an income statement and balance sheet derived from business bookkeeping and a budget statement derived from the State's official administrative bookkeeping. Internal transactions from profit centres have been eliminated from the financial statements.

Fixed assets and depreciation

Fixed assets have been valued according to the residual values calculated on a capital cost basis. Scheduled depreciation has been calculated from the acquisition cost in the case of assets acquired during the financial year and from the net replacement cost in the case of older assets.

Scheduled depreciation changes have been calculated using the straight-line method over the expected economic lifetime of the assets concerned. The expected economic lifetimes and corresponding depreciation percentages are as follows:

	Years	Depreciation, %
Intangible assets		
• software	5	20 %
Tangible assets		
• machines and equipment	4 - 7	14.3 - 25 %

The depreciation charges for certain major investments have been calculated individually.

Current assets

VTT's 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 related to procurement and manufacture. Moreover, stocks of materials and supplies as well as advance payments made in respect of project equipment are included in current assets.

Items denominated in foreign currencies

Foreign currency receivables and debts have been converted into Finnish markka at the exchange rates ruling on the accounting date.

Income statement

1 Turnover

VTT's turnover primarily comprises external income which is obtained from contract activities or as contributions from partners involved in jointly funded projects. In addition, funds appropriated out of the state budget that are used for VTT's own research initiatives or to cover VTT's share of the costs of jointly funded projects are entered into the accounts as turnover in accordance with actually incurred costs.

2 Personnel expenses

(FIM 1,000)	1997	1996
Salaries	486,841	463,899
Pension expenses	72,017	65,740
Other personnel expenses	33,886	32,834
Total	592,744	562,473

FIM 1.5 million (FIM 1.7 million in 1996) provided by the Ministry of Labour, the Ministry of Education and the Ministry of Finance to finance salary expenses has been deducted from the personnel expenses.

3 Depreciation

The depreciation item includes, in addition to scheduled depreciation, non-recurrent additional depreciation of FIM 2 million mainly in respect of measuring and research equipment for Communities and Infrastructure.

4 Financial income and expenses

Financial expenses are mainly imputed interest on capital tied up in fixed

assets. This is calculated by applying a 6.8% interest rate to the value of fixed assets according to instructions issued by the State Treasury Office.

5 Extraordinary income and expenses

Extraordinary income includes actual extraordinary items, rental incomes received by VTT and revenues received from the sale of fixed assets.

Balance sheet

6 Changes in fixed assets

(FIM 1,000 mk)	1997	1996
<u>Intangible assets</u>		
Value of fixed assets at 1.1	12,903	12,712
Increases	3,522	3,233
Depreciation	4,094	3,353
Other increase/decrease	10	311
Value of fixed assets at 31.12.	12,341	12,903
<u>Tangible assets</u>		
Value of fixed assets at 1.1.	190,817	212,771
Increases	86,085	59,650
Depreciation	68,692	81,293
Other increase/decrease	11	311
Value of fixed assets at 31.12.	208,199	190,817

7 Securities held as fixed assets and other long-term investments

Shares and holdings	Number of	Ownership shares %	Par value FIM 1,000	Book value FIM 1,000
Finntech Oy	60	60	600	3,500
Helsingin Puhelin Oy	219			723
Other shares, total				213
Total				4,436

Loan receivables and other investments totalled FIM 810,000.

8 Own funds

Own funds represent the difference between total balance sheet assets and other capital items, and thus describes VTT's basic capital. It is an imputed item because VTT is an integral part of the state economy.

9 Donations

(FIM 1,000)	1997	1996
Value at 1.1.	1,464	1,500
Increases:		
- donations received	20	30
- interest income	60	55
Use of donations:		
- scholarships	85	116
- other expenses	-	5
Value at 31.12.	1,459	1,464

10 Budget funds

This item describes the amount of 1997 budget funding valued at cost that remained unused at the end of the financial period. The funding as a whole is presented in the budget statement.

11 Accrued liabilities and deferred income

Accrued liabilities and deferred income are mainly employers' pay-related payments and the imputed holiday pay liability for the financial period.

Budget statement

The state budget appropriations and their use are presented in the table in accordance with the State's official administrative bookkeeping practice.



Research Director
Jorma Lammasniemi

The growth of industries utilising electronic technologies translated into buoyant demand for the R&D services of VTT Electronics in 1997. Development work focused especially on wireless telecommunication technologies and their related products, basic expertise in electronic technologies, product design and production technology, and know-how related to sensors and instrumentation.

A new national technology programme based on extensive preparatory work was initiated in 1997 with the aim of realising the development visions of the electronics and electrotechnical industry. VTT Electronics participated very actively in the creation of this programme.

In the field of design on embedded systems, work continued on product design based on virtual prototyping and the development of a conceptualisation environment. Real-time diagnostic and optimisation solutions were developed for the telecommunications, machine automation, steel and electronics industries.

In the field of digital signal processing, signal processing algorithms required in high-speed wireless data transmission were developed for transmitter-receiver structures. Channel coding methods were also developed. Product development work was carried out on several wireless telecommunications products.

In the field of microelectronics, development work on a new-generation silicon wafer process was completed. Contract research commissions for industry have involved the transfer of microcircuit and silicon material manufacturing technologies, and the design and manufacture of sensor structures and test components. In addition, the opening of the new Microelectronics Centre has given us an excellent environment for component and materials research.

In the field of optoelectronics the research emphasis has been on the precision technologies and micro-systems necessary for sensor structures and on the development of their industrial applications.

VTT Electronics has a very wide network of contacts in the Finnish electronics industry. Two new agreements on wider framework co-operation were signed during the year. Co-operation with Helsinki University of Technology and the University of Oulu

CyPhone - the mobile phone of the future.



continued in various forms, e.g. joint professorships and the Infotech Oulu basic research programme. The portfolio of national joint projects has been strengthened, and VTT Electronics is carrying out work in Technology Development Centre (Tekes) projects in the field of digital signal processing.

TQM self-assessment, quality certificate follow-up auditing and benchmarking were all used to good effect in developing the Institute's operations and internal procedures. A steering committee is being used in strategic programs, with programme orientation and status being reviewed twice a year with the industry and co-operation partners.

VTT Electronics' overall performance during the review year was excellent. The Institute's challenging performance targets were achieved and the total volume was 267 man-years.

The rapid pace of technological development and the shortage of qualified personnel will pose challenges in the future. For this reason, the Institute's strategic research programmes will also play an important educational role.

Research fields:

Microelectronics
Electronic Circuits
and Systems
Embedded Software
Optoelectronics

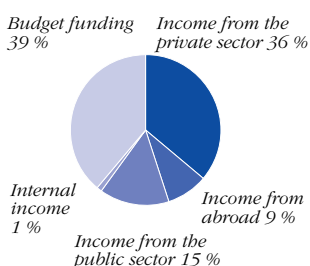
Man-years: 267

Staff breakdown

by location:

Oulu 213
Espoo 78

Turnover: FIM 129 million



VTT Information Technology promotes the competitiveness of Finland's information technology and communications industry and service companies by generating research results and generic products for customisation and commercialisation by corporate partners. The rapid development of information and communications technologies has created a favourable framework for the research and development work carried out at VTT Information Technology in 1997.



Research Director
Pekka Silvennoinen

The Institute's turnover remained stable at the level of the previous year and was FIM 82 million. Contract research continued to account for an increasingly large share of annual turnover. The highest growth was in income from abroad. The share of income from abroad in total turnover rose to 16 per cent. Volume growth was limited mainly by a shortage of qualified research scientists.

Research on information systems has focused on two main areas: supporting decision-making in operational processes primarily with regard to the management of logistical networks and intelligent problem solving, and the data sharing, retrieval and the management of industrial process data.

Communication technology research has resulted in the development of new information system architectures, protocol and application interface software suitable for data network management, efficient data transmission methods and systems, and radio wave measurement, modelling and simulation techniques.

Services based on broadband and wireless communication and the development of

test applications built upon them have been the focal points of multimedia research.

Research into electronic publishing and printing has been targeted mainly at the integration of communication processes, digital printing, the modelling of functional chains, data management and production processes, including materials and automation.

Significant new IT products included a system for electronic business-to-business trading based on workflow management as well as JAVA and EDI technologies, a software application for planning the coverage of cellular networks, an application interface for a video transmission system, and a software product for the simulation of newspaper production systems.

VTT's contribution to the advent of the information society is not limited to market-driven activities alone. The Institute has developed a simulation model for the assessment of the strength of the electromagnetic field generated by a mobile phone. It can be used to estimate the impact of the field on biological tissue and sensitive electronic devices.

In the technology programme on multimedia, sponsored by the Technology Development Centre of Finland (Tekes), the Institute developed a pilot media system where the information and news content are retrieved from the databases of the media companies and collated automatically into a personalised multimedia publication for distribution via a cable-TV network.

A panel of outside experts assessed the standard of research work carried out at VTT Information Technology. The Institute was considered to be in good shape as far as the scientific proficiency and client interface are concerned. Self-assessments of human resource development and leadership were also carried out. The results will be used to devise operating models for personnel development as well as the Institute's services and strategic planning.



A software product for wireless video surveillance was implemented on the basis of the MVQ video coding technique developed at VTT Information Technology.

Research fields:

- Information Systems
- Telecommunications
- Multimedia
- Printed Communications

- Graphic Arts Technology
- Health Care Technology

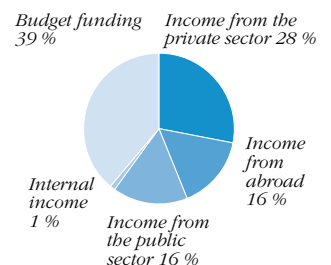
Man-years: 196

Staff breakdown

by location:

- Espoo 185
- Tampere 25

Turnover: FIM 82 million





Research Director
Heikki Seppä

The rapid development of information and communication technologies coupled with lower prices of sensors has led to an expansion in the use of measuring and control systems. As a result, automation has made the transition from plant control rooms to the factory floor, vehicles, work machines, homes and consumer goods. The demand for research services rose in the fields of measurement technology and machine automation. Companies of the electronics and telecommunications industries became the Institute's biggest clients.

There was considerable growth in micro-mechanics during the year. More than 20 research scientists are involved with micro-mechanics. The technology also finds applications in space research. Research functions concerned with telematics and the man-machine interaction strengthened substantially. Techniques developed in the Institute were applied, for example, to maritime safety.

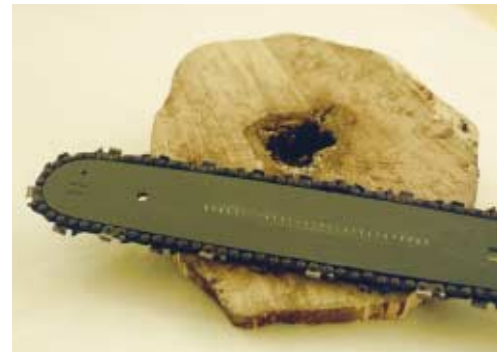
The research programmes currently underway led to projects funded by Technology Development Centre (Tekes) as well as to contract research and new products. These included sensing and control systems for a wheelchair, an eco-harvester, measuring equipment for printability characteristics, three-dimensional imaging equipment for qualitative analysis of pulp fibre, and a quality measuring system for the fines in mechanical pulp.

The developments achieved in jointly funded projects included the automation of a straddle carrier, micromechanics, and equipment technology concerning fusion power plants. VTT Automation and VTT Electronics increased their co-operation in strategic research projects concerning sensors.

Nationally important development work on process technologies exploiting multimedia and simulation models and on a learning system for automation began in co-operation with one of the most important companies of the forest cluster.

Companies of the electronics and telecommunications industries rose in importance to join the Institute's key clients. Products developed for these customers included a water flow metre, a paper reel vibration analyser, and an extremely low-noise SQUID magnetometer. Fire station software based on images transmitted from the NOAA satellite proved to be an efficient method of monitoring forest fires.

The Institute sold patents concerning



A sensor attached to the flange of a timber harvester's cutting blade measures the diameter of any butt rot present in a tree.

sensor and RF-technique to Finnish companies. The number of patents remaining under VTT's name has been carefully groomed, which has reduced the patenting costs.

The Institute participated in 47 international projects, 17 of which received half their funding from the EU's IV framework programme. A Finnish industrial partner was involved in almost all of the EU projects.

The highest profile achievements of the Institute's international activities are the Ion Beam Spectrometer, turntable and rotation actuator that were fabricated for the Cassini spacecraft, which is now on its way to the planet Saturn.

The Institute's finances improved considerably as a result of cost savings and an increase of FIM 2.5 million in external income.

The Institute's organisation and operating methods were streamlined to deepen expertise and to improve customer service.

The Institute created a new way of classifying research on the basis of experience obtained from research programmes and the centralisation of other research activities. Research projects are now placed into the following categories: sensor technology, the networked economy, service automation, and the overall reliability of automation systems.

Research fields:

Industrial Automation
Machine Automation
Measurement Technology
ProTechno

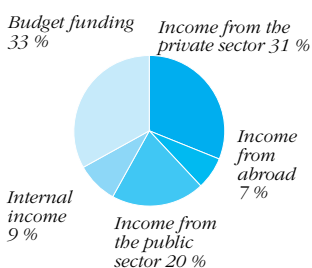
Man-years: 225

Staff breakdown

by location:

Tampere 42
Espoo 180
Oulu 16

Turnover: FIM 93 million



On the whole, VTT Chemical Technology performed creditably in 1997. Projects concerned with the environment and sustainable development made good progress. Key areas of research have been the environmental economy and environmental analysis of industry and materials technology. Industrial Physics, chemistry in pulp and paper processes and in chemical industry and analytical services have also been under strong development.



Research Director
Markku Auer

The Institute's turnover was FIM 19 million higher than in the previous year. Volume rose due to an increase in the need for research services in the private sector and improved financing opportunities in the Technology Development Centre (Tekes) and the EU.

VTT Chemical Technology had 30 significant industrial commissions in progress during the review year. The Institute played a decisive role in the establishment of three new enterprises.

The Institute's capabilities to carry out chemical technology research for the forest industry have been improved, and preparations are being made for the Chemical Cycles in the Forest Industry research programme.

The boron neutron capture technique for treatment of brain tumour is being taken into service with VTT's support.

Technical service and customer-specific product development work for SMEs in the plastics industry have become more important. The Synthetic Materials and Systems for the SME sector research programme was wound up when the targets set for it had been achieved. The Institute's activities in the SME sphere included participation in projects concerned with the application of paperless interorganisational communications in SMEs of the textile, clothing, leather and footwear industries, bringing together user groups and manufacturers of upholstery and furniture coverings, and how SMEs can gain international experience.

Altogether 12 new EU projects began during the treatments with VTT's support year. VTT Chemical Technology acted as the co-ordinator in five of these projects. Active efforts have been made to increase co-operation with other VTT institutes, especially in projects concerned with new



VTT Chemical Technology's pilot ball at Otaniemi will support the product development efforts of the chemical industry.

technologies such as aerosol synthesis of nano-materials, high-resolution electron microscopy, active noise attenuation and the environmental impacts of electronic publishing and printing.

The Institute maintained the SFS-EN ISO 9001 quality certificate. The number of accredited methods rose. The fields currently accredited are organic analysis, inorganic analysis, indoor air measurements, waste studies, textile testing, emission measurements and plastics testing.

The Institute carried out a self-assessment according to the criteria of the Finnish Quality Award with the aim of making its operations conform to the principles of total quality. On the basis of this assessment, work began on evaluating all its significant projects.

Robust growth of Finland's electronics industry is an important trend in materials technology. The economic outlook for the industry continues to be favourable. The expectation is that the activities of VTT Chemical Technology have a bright future.

Research fields:

*Industrial Physics
Materials Technology
Environmental Technology
Process Technology
Mineral Processing*

Analytical Services

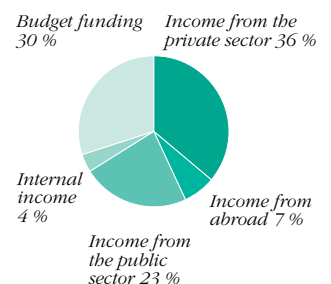
Man-years: 293

Staff breakdown

by location:

*Espoo 223
Oulokumpu 41
Tampere 63*

Turnover: FIM 135 million





Research Director
Juba Abvenainen

VTT Biotechnology and Food Research has focused on demanding R&D projects that aim to develop or exploit new technologies. The Institute's most important customers are the food cluster, the forest industry, the biotechnical and chemical industry, and the pharmaceutical and diagnostics industry.

The results of VTT Biotechnology and Food Research were excellent in 1997. Research work proceeded according to plan, the number of scientific publications was again large, and the number of patent applications submitted also rose. External evaluations of the Institute's performance were very favourable. The financial result exceeded the budgeted target.

The Institute refocused its strategic research by launching an extensive Future Foods research programme, in which biotechnical expertise will be applied to develop food processes and health foods. The program will generate information for the debate concerning food biotechnology.

The Metabolic Engineering research programme and the Minimal Processing of Food research programme both made good progress. The Institute participated actively in several national research programmes. The most significant input was made to the Innovation in Foods technology programme initiated by the Technology Development Centre (Tekes).

EU projects proceeded as expected. The Institute has consolidated its position as a valued partner and project co-ordinator. At the end of the year it was involved in over 30 EU projects. The Institute has been actively involved in preparing for the EU's fifth framework programme.

The Hygiene Clinic of the Technology Development Centre (Tekes), which is mainly targeted at SMEs in the food industry, has been particularly active. Based on this favourable experience, the Institute prepared to expand the clinic operations and to offer SMEs baking technology and packaging technology research services.

An outside evaluation ordered by VTT revealed that the Institute's work is of a high standard. The Institute also got top marks in the Finnish molecular biology and bio-



An automatic malting plant with versatile control features has been acquired for the test brewery. The new plant can also be used for studies other than those on traditional barley malt.

technology evaluation, which speeded up the preparatory work being carried out by the University of Helsinki and VTT on the establishment of a structural biology research institute.

The proportion of income generated in jointly funded projects was larger than previously, reflecting the Institute's good success in bidding rounds organised by the EU, the Technology Development Centre and the Academy of Finland. EU research funding was about 60 % higher than in the previous year.

The rapid development of the biosciences is continuously generating new research and application areas to be exploited by customer industries.

The outlook for demand and the order book looks favourable: R&D activity in the domestic food industry continues to grow and the chemical industry is showing increasing interest in biotechnical applications. Internationalisation, corporate restructuring and the growing importance of environmental and consumer issues are the key development trends in customer industries.

Research fields:

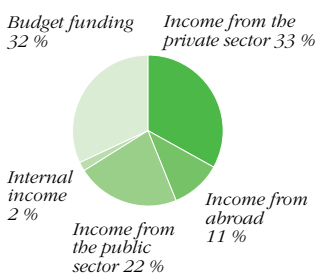
Biotechnology
Food Technology
Genetic Engineering
Microbiology and Safety

Man-years: 253

Staff breakdown

by location:
Espoo 271

Turnover: FIM 92 million



VTT Energy made a significant contribution to the formulation of Finland's energy and technology strategies and to the development of electricity market mechanisms in 1997. The development of industrial and community waste treatment technologies for the domestic and export markets emerged as a new topic of research.



Research Director
Mikko Kara



The choice of fuel can influence the exhaust gas emissions of motor vehicles. Natural gas (methane) is an excellent fuel which gives a low level of emissions in all conditions. Moreover, methane can be manufactured by purifying landfill gases.

VTT Energy successfully achieved its R&D objectives and excelled in terms of financial perform. Turnover FIM 154 million exceeded the budget target, and its structure developed according to the Institute's strategic targets. Income from abroad accounted for 9 % of turnover. The project work rate has remained high and the level of general costs very low.

An extensive background study in which the carbon dioxide emissions and energy efficiencies of Finland and other countries were compared was completed for use by industry and officials at the Kyoto climate treaty conference.

Three new technology programmes were started at VTT Energy in 1997: Wood Quality, Waste Conversion and PROGAS. A technology programme that had improved the Institute's expertise in the core competence area of diesel power plants was completed. A significant product development commission concerning the recycling of liquid packaging board was carried out as part of the Waste Conversion programme.

There were a record number of invention registrations, patents and inventions handed over to customers during the review year.

An agreement was made with Kemijoki

Oy concerning the continued co-operation and commercialisation of Arctic wind power technology.

The most important projects supporting the SME sector are related to the Small-scale Combustion and Wood Quality research programmes and waste treatment technology studies of the Waste Conversion and other programmes. A record number of the technology transfer projects were carried out with the EU's ALTENER and THERMIE funding. The know-how transferred to the SMEs mostly concerned multi-field technologies and the production of biofuels.

The Institute increased its international co-operation within the framework of EU research programmes and with NEDO (New Energy and Industrial Technology Development Organization) of Japan and with the United States.

The process of self-assessment by the Institute's research fields was initiated in accordance with the criteria of the Finnish Quality Award.

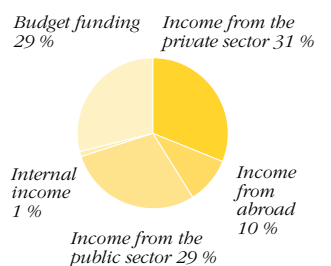
The volume of research work is growing in the areas of energy markets, energy technology for the forest industry, and advanced technology for the combined production of heat and electricity.

Research fields:
Fuel Production
Energy Production
Technologies
Nuclear Energy
Energy Use
Energy Systems

Man-years: 291

Staff breakdown by location:
Jyväskylä 108
Espoo 195
Lappeenranta 5

Turnover: FIM 154 million





Research Director
Heikki Kleemola

The demand for VTT Manufacturing Technology's research services continued to rise in 1997. In particular, there was a sharp increase in the number of commissions concerning the application of information technology and the operational reliability and safety of plant and equipment.

The Institute's external income rose by 13% thanks to buoyant demand. This enabled the Institute to maintain volume at its previous level despite the reduction in budget funding. The most robust growth was in income from abroad, which was 19 % higher than the previous year.

New methods were developed for various applications in the energy sector, e.g. control of the operational reliability, service life and structural integrity of power plants. The remaining service life of power plant components can now be more accurately estimated using an expert system developed at the Institute.

Technologies and IT applications concerning production control and networked manufacturing were developed for machine and equipment manufacturers. Finland's first high-powered Nd:YAG laser was acquired for welding and cutting. New material solutions were used in the application of active sound control to the design of low-noise equipment.

Vehicle manufacturers and transport industry entrepreneurs were served by optimising vehicle structures, improving their safety and reducing equipment noise levels. The design of work machine cabs and ship wheelhouses was improved by introducing a simulator based on virtual technology. The Institute made a significant contribution to studies concerning the Estonia car ferry disaster.

Research and development work concerning the operational reliability, safety and environmental friendliness of equipment and production systems was carried out for the process and wood processing industries. For example, information was systematically collected on questions relating to the materials used in pulp bleaching processes, and laboratory measurement methods were developed for materials research.



Finland's first high-resolution analytic transmission electron microscope will greatly improve VTT's ability to carry out research on materials.

New materials and coatings as well as their manufacturing methods were developed for material suppliers. In particular, the wear and corrosion resistance of these products were designed to withstand exacting conditions.

The increased number of commissions received from industry coupled with broad participation and responsibility for co-ordination in important national and EU projects reflects the fruitfulness and effectiveness of the Institute's activities. The national research projects in which the Institute participated were concerned with fusion research and the structural integrity of nuclear power plants. The Institute in collaboration with companies participated in about 60 projects of the EU's IV framework programme and about 10 TACIS/PHARE projects.

The Institute served the SME sector by participating in six technology clinics sponsored by the Technology Development Centre (Tekes).

The outlook for the Institute's field is good since the businesses of our key clients are expected to develop favourably.

Research fields:

Safety Engineering
Production Technology
Materials Technology
Operational Reliability
Materials and Structural Integrity
Maritime and Mechanical Engineering

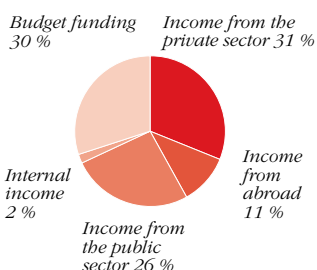
Man-years: 381

Staff breakdown

by location:

Espoo 296
Tampere 89
Lappeenranta 12

Turnover: FIM 170 million



The building industry continued its recovery in 1997. This was favourably reflected in the Institute's activities as an increase in demand for R&D services. The research objectives were quite successfully achieved. External income rose to account for almost 70 % of turnover, which is indicative of the Institute's enhanced influence and performance trend.



Research Director
Erkki KM Leppävuori



A machine vision system based on a colour camera is being used in the modelling of the raw material of the mechanical forest industry.

The role of building services increased. Energy technology, electrical systems automation systems, HVAC and an indoor climate were the main areas of emphasis during the year.

The Institute played an active part in the development of the construction and real estate cluster by analysing key technologies and business opportunities. Successful products of companies and the need for workforce competence in the future were analysed in a project funded by the European Social Fund.

The number of commissions concerned with controlling the condition of buildings increased. Building condition survey methods were developed in order to clarify damage to properties caused by moisture and mould, and these were applied on nearly 200 different sites.

A system that can be used to calculate the optimal processing route from the forest via different intermediate processes to the end-product, and to identify the most promising development points in the processing chain was developed in order to analyse the profitability of high-value products of the mechanical forest industry.

The importance of building product

quality certificates is growing quickly. Over 40 VTT Certificates were issued. In order to promote the exports of the Finnish construction industry the Institute signed co-operation agreements concerning the testing and inspection of building product with a number of Japanese, Estonian, Russians, American and German product approval organisations.

A significant proportion of the Institute's activities are targeted at the SME sector. SMEs account for 60 % of the domestic private sector invoicing, and about 200 SMEs participate in the Institute's strategic research projects.

Positive feedback was received from SMEs that have taken advantage of the technology clinics sponsored by the Technology Development Centre (Tekes). The Technology Strategy Clinic is greatly enhancing the effectiveness of the Institute's activities. Over the past two years there have been 36 projects in the Product Approval Clinic for SME exporters.

International co-operation in EU research programmes and in international organisations was vigorous. Commissions from foreign companies also increased. The Institute's income from abroad amounted to FIM 11 million, which was 9 % higher than in the previous year.

Self-assessment in accordance with the criteria of the Finnish Quality Award and benchmarking among international research institutes in the field of construction provided a good framework for the development of the Institute's operating processes.

Demand for the services of the Institute look likely to develop favourably in the long term. However, changes of emphasis dictated by technology policy have reduced the amount of budget funding allocated to the Institute by 20 % over the past three years. The further development of knowledge capital will pose a major challenge in the years ahead.

Research fields:

*Building Physics, Building Services and Fire Technology
Construction and Facility Management
Building Materials and Products, Wood Technology*

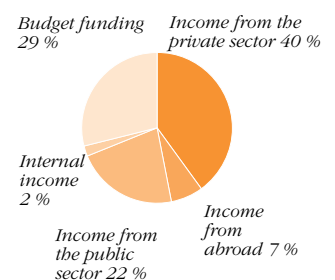
*Strategic Technology Development
Service Centre*

Man-years: 368

Staff breakdown by location:

*Espoo 327
Tampere 37
Oulu 22*

Turnover: FIM 153 million





Research Director
Asko Saarela

The review year was very fruitful one for VTT Communities and Infrastructure. Turnover exceeded the budget target by FIM 2.6 million. The considerable improvement in the Institute's financial result is primarily attributable to the efforts of the entire staff. The Institute's most important equipment procurement was a pavement testing facility.

VTT Communities and Infrastructure had five strategic projects underway in 1997. These were Eco-competitiveness, Development of the Information Infrastructure, Effect of Competition on Productivity in the Public Sector, International Expertise, and Neighbourhood Renewal.

The Institute's most important clients were the Finnish National Road Administration, the Ministry of Transport and Communication, the Ministry of the Environment, the City of Helsinki, and POSIVA Oy. In addition to these, research programmes were prepared in collaboration with UPM-Kymmene Corporation and the Finnish State Railways.

The extensive Finnish Road Structures Research Programme was extended with the Finnish National Road Administration. The program is expected to yield a 5 - 10 % improvement in the economy of road keeping.

The use of wood fibres as a reinforcing material for paving mixes was developed by the Institute in collaboration with the forest industry, thereby exploiting by-products generated in forest industry processes.

The Institute together with the Ministry of the Environment and the Ministry of Transport and Communications started the research programme entitled: Environmentally Favourable Community Structure and Traffic System. Another research programme entitled: Street Structures and Pavements was initiated with the Ministry of the Environment and the Federation of Municipalities.

The Institute together with the Finnish National Road Administration, the Technology Development Centre (Tekes) and industry took part in the work of a technology clinic and test building of the Environmental Geotechnology programme. The programme resulted in broader exploitation of fly ash and other industrial by-products.

The environmental impacts of potential final repositories for nuclear waste were



Water level regulation causes major changes in the ecosystem of the littoral zone.

clarified in collaboration with POSIVA Oy.

The research and development projects concerning the SME sector were small consignment logistics, tyre and stud development, and by-product projects and clinic services. All of these projects sought to improve SME competitiveness.

The Institute's new products and services included soil tomography with its measurement and interpretation methods, and a digital positioning system for the mapping of road and street networks.

The Institute works together with companies and consultants in the Baltic Rim region. These activities led to the initiation of several PHARE projects. The most notable of these are concerned with the intermodal transport system, the Venspils harbour fairway and the Baltic states' TEN network.

A number of improvements are proposed in the Institute's evaluation report. The most important of these is the definition of core competence. As a result, core competence areas have been presented in the 1998 operational plan.

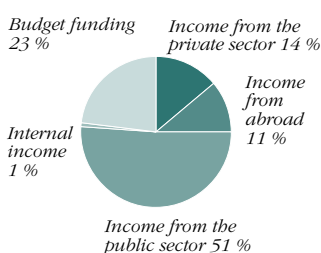
The Institute's outlook for the future is good. The biggest risks loom in 1999, prior to the commencement of the new EU projects.

Research fields:
Infrastructure and Environment
Transport and Urban Planning

Man-years: 141

Staff breakdown by location:
Espoo 148
Oulu 4

Turnover: FIM 64 million



VTT Information Service, Internal Services, and the Group for Technology Studies

VTT 1997

VTT Information Service

VTT Information Service provides information services for the Research Centre and also acts as a national information centre. It provides technical information at the different stages of R&D work also for companies and other information users.

Much time and effort was devoted to developing the Information Service's electronic library with the aim of making it easier for research scientists to perform information searches by themselves. This project concentrates on the upkeep and supply of network services and information resources that are important for technical research, e.g. electronic journals. Altogether about 300 scientific journals were available in electronic form. The use of databases maintained by the Information Service grew strongly, with about 190,000 searches being made in 1997.

Almost one fifth of all publications belonging to VTT's own publications series were made available in electronic form.

As a Nordic Centre of Excellence for Electronic Publishing nominated by NORDINFO (Nordic Council for Scientific Information), the Information Service provided training and advisory services in the field of the electronic publishing, and studied the practices of Nordic scientific libraries. In addition, the Information Service was commissioned by UNESCO to produce, for the use of libraries, guides to the design of websites and the publication of journals on the Internet.

The Information Service acted as the Finnish representative of the STN International online service. Its use has grown steadily. The Information Service also acted as a national centre for the European Space Agency's Information Retrieval Service.

VTT Information Service began to act as the co-ordinator of Finland's contribution to the MIDAS-NET (Multimedia Information Demonstration and Advisory Service) that belongs to the European Union's INFO2000 programme.



Head of VTT Information Service
Sauli Laitinen

Group for Technology Studies

The climate in which the Group operates and the demand for its services have both developed favourably. The technology research programme initiated by the Ministry of Trade and Industry has increased the demand for the Group's research services. Technology assessment and technology foresight were the most important new services offered during the review year.

The effects of EU research programs, Finnish innovations, technical innovations in the health-care sector, European integration and national innovations systems have been studied and evaluated in the Group's most important projects.

The Group became an active member of the ESTO (European Science and Technology Observatory) project, which serves the information needs of the EU. The first technology foresight project for industry was initiated in the food industry with partial funding from the Technology Development Centre (Tekes). The first customer of the new technology assessment service was the Finnish Parliament, which ordered a preliminary study of plant gene technology.

Internal Services

Implementation of the unit's development strategy continued and modification of its financial control model was completed during the year.

Significant projects concerning VTT's infrastructure in 1997 were modernisation of VTT's information network, the development of VTT's intranet services, and a basic repair programme for VTT's old building stock.

The most important projects concerned with the development of administrative services have been the development of the administration's information systems and promoting their utilisation, preparatory work for the revision of the State's book-keeping practice at the beginning of 1998, transition to the new pay calculation systems, and the development of VTT's planning and monitoring processes.

The unit has been active in the field of training and participated in the arrangement of about 170 training events in 1997. In the field communications, VTT's website has become a new and effective channel for internal communications, for showcasing VTT's activities and research results, and for customer feedback and queries.

New methods and competitive products

The Ministry of Trade and Industry has set the following aims for VTT's activities:

- the development of new and more competitive products for the enterprise sector
- the realisation of more efficient, safer and more environmentally friendly equipment and production processes for industry
- the more effective use of information technology
- improvements in energy supply, energy production and consumption, and the reduction of emissions
- the renewal of industrialised building and improvements in the quality of the built environment
- technical promotion of the birth of new enterprises and SME operation in general

The following examples of VTT's research activities are grouped according to these aims.



A positioning system integrated into a pair of eyeglasses is one example of the virtual services of the future.

Virtual services of tomorrow's mobile telecommunications

The virtual reality research group of VTT Electronics and the University of Oulu is studying the mobile telecommunications of the future and the services that these technologies will make possible. In telecommunications of the future there will be no separate terminal equipment for speech and computer data, but rather unobtrusive personal communicators attached to the user's clothes or eyeglasses.

In virtual services, conventional physical data input devices such as a keyboard, mouse or pen are replaced by virtual substi-

tutes, whose shape, material and temperature can be felt by the user but which exist only in a computer-generated virtual world. In addition, the user can input data by speech, facial expression or, for example, finger movements.

A head mounted display integrated into a pair of eyeglasses enables the wearer to see computer-generated three-dimensional views and to hear three-dimensional sound. The display is semi-transparent, which means that the wearer sees a virtual image as well as the real view.

In addition to a user interface, a positioning system that monitors the location of the user as well as his or her eye, head and limb positions can be integrated into the clothes of the user. It will allow the mobile communicator, for instance, to direct the user to a hotel or railway station in an unfamiliar city.

The parties involved in the research cooperation are Nokia Mobile Phones, Telecom Finland, Elektrobit, Polar Electro and CCC Software Professionals. Future products will be introduced on a trial basis in the Mobile City Oulu information society pilot.



EMC laboratory serves the electronics industry

VTT Automation's EMC laboratory serves Finland's electronics industry by measuring electromagnetic disturbances created by appliances as well as their disturbance tolerance. EMC tests are needed to demonstrate that electronic equipment complies with the European Union's EMC Directive. The needs of research and product development were also taken into consideration when planning the laboratory.

The EMC testing laboratory has many different test facilities, but the radiation measuring facilities are central to its performance. These are expensive special structures, and particular attention was given to the design and construction of these radiation test sites.

With regard to the measurement of radiating interference emissions the EMC directive as well as many international EMC standards refer to the open area test site developed by CISPR. This test facility contains a large metallic ground plane, on top of which the emission measurement is made in free space. VTT's open area measuring hall is constructed using glued laminated arches covered with a plastic material. It is also thermally insulated so that measurements could be made during the cold winter season.

Another important measuring facility of the EMC laboratory is the electromagneti-



The EMC laboratory serves the electronics industry by testing the electromagnetic radiation of equipment.

cally shielded chamber, the walls, ceiling and the floor of which are coated with an absorbent material. The floor absorbers can be easily removed when necessary. This coating material absorbs radio waves over a broad range of frequencies, and thus eliminates reflection caused by the metallic inner surface of the room. The electromagnetic radiation takes only one path from the source to the antenna in the measurement and the field strength declines uniformly with distance. This kind of test facility is referred to as an anechoic or radio-echoless chamber. It is used to measure radiating interference emissions and to test for tolerance of radiating electromagnetic fields.

Microelectronics Centre to support R&D

The Microelectronics Centre in Espoo was officially opened in the autumn. VTT has made this investment with the aim of playing its part in accelerating the development of the microelectronics industry in Finland, and at the same time offering the whole electronics industry first-class research and development services.

The premises needed for the study and manufacture of microelectronics must meet strict requirements with regard to both cleanliness and the absence of vibration. The elimination of vibration is assured by mounting all the most sensitive equipment on a 12-metre thick concrete slab cast directly onto the bedrock. The facilities are first-class even by international standards.

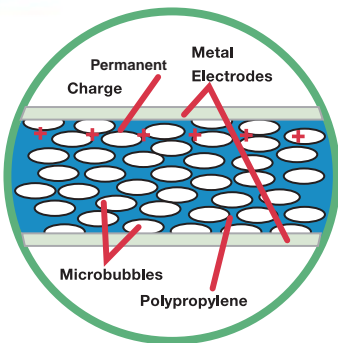
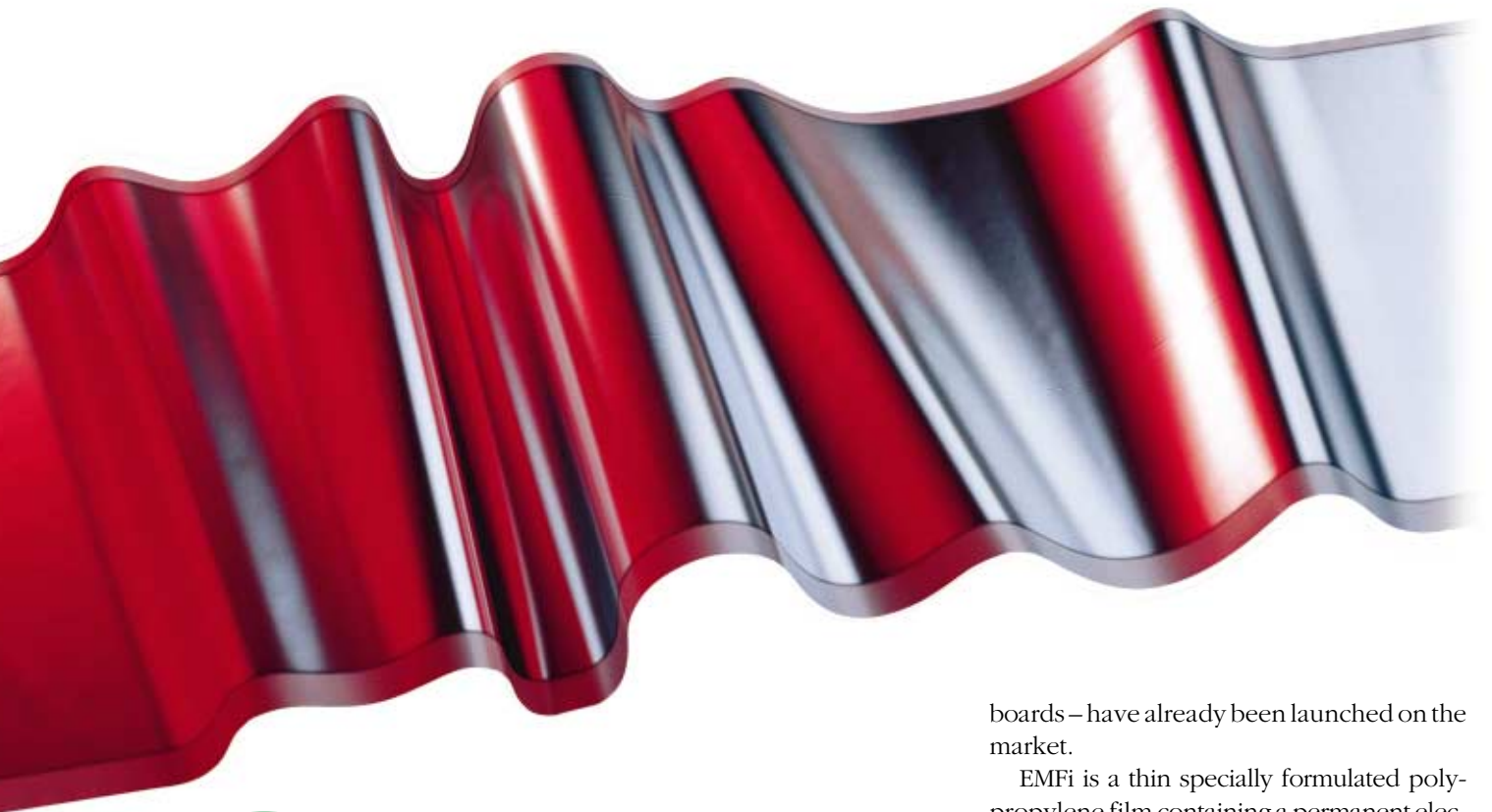
The key areas of research carried out of the Microelectronics Centre are high-frequency silicon components used in wireless data communications, silicon materials and micro-systems that incorporate electrical, mechanical and optical functions.

The clientele of the Centre includes companies of the semiconductor industry, end-users of semiconductor components, and increasingly companies which operate in areas other than the electronics industry. The Centre offers companies the opportunity to base both personnel and equipment on its premises for the duration of joint projects.



The new Microelectronics Centre will speed up the development of Finland's semiconductor and electronics industries by offering first-class research and development services.





The Electromechanical Film sensors and actuators - new opportunities for the industry.



Active noise control using electromechanical film

Working in collaboration with its inventor and industry, VTT is developing applications for the Electromechanical Film (EMFi). EMFi is a versatile sensor and actuator material with wide-ranging applications, including industrial sensors, security floors, panel loudspeaker elements, and multimedia products. The first commercial applications – touch-sensitive floors in the old persons' homes and vandal-proof key-

boards – have already been launched on the market.

EMFi is a thin specially formulated polypropylene film containing a permanent electric charge. When exposed to vibration or sound, the structure functions as a sensor. EMFi also works in the opposite direction, converting electrical energy to vibration and sound, thus functioning as an actuator. Using both sensor and actuator structures together with advanced control systems and amplifier electronics it is possible to control noise by active means.

The EU-financed FACTS project, led by VTT Manufacturing Technology, has focused on the use of EMFi panel elements for active noise control in cars and metro trains. The large consortium of European companies taking part in the FACTS project includes Fiat research centre, Ford and the metro train manufacturer ADtranz. In the domestic AKTIVA project the focal point has been on the attenuation of fan noise. The companies involved in the AKTIVA project include Koja Oy, Valmet Oy and Noisetek Oy. VTT Manufacturing Technology, VTT Chemical Technology and VTT Building Technology have been involved in both projects.

The next step in the development work are several practical applications of active noise control. In the future, it will be possible to use EMFi elements to control the acoustics of a room or to improve the sound insulation of structures, as well.



The SHS method is an efficient and economical way to produce hard metal components and thick coatings.

SHS technology for hard metal components

Large hard metal components and thick coatings of high quality can be manufactured quickly and economically using the SHS method developed by VTT Manufacturing Technology. Jyrtsin-Kierreväline Oy is starting up industrial manufacture using the new technology.

The SHS method is based on the intense exothermic chemical reaction that occurs between powdered substances to produce a new compound. The powders are packed into a mould of the desired shape and the reaction is initiated by heating the mixture locally to its ignition temperature. Immediately after the reaction the material can be pressed into a dense piece.

The necessary production plant is simple and inexpensive, and the production process is fast. This makes the new production system as a whole economically competitive. Commercial powders of good general availability can be used as production materials. Only a very small amount of energy is necessary in order to ignite the power.

The main applications are in wear- and corrosion-resistant components. The method is also suitable for high-temperature applications, ballistic materials, and electrotechnical components. In addition to hard metals, the method can also be used to manufacture ceramic materials, intermetallic compounds, and many kinds of powders.

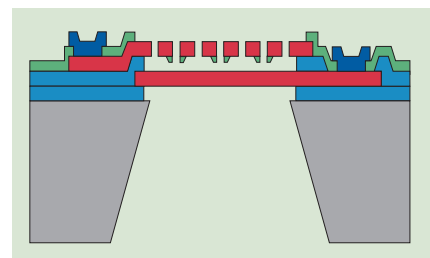
Miniaturised microphone

VTT has developed a microphone so small it could fit on top of a pin head. The microphone has been manufactured in VTT's Microelectronics Centre using surface micromechanics.

The microphone consists of two films measuring $500\ \mu\text{m} \times 500\ \mu\text{m}$ positioned about $1\ \mu\text{m}$ apart. The films are pre-tensioned and perforated so that they react to a pressure wave oscillating at a frequency of 100 Hz–20 kHz. As the film flexes, its capacitance changes and, as the charge remains the same, the potential difference between the films also changes. The voltage is indicated by a field transistor.

A small micromechanical microphone can only attain a sufficiently low level of noise if the effect of the electronics can be almost completely eliminated. VTT Automation developed a low-noise amplifier and new biasing technique for the microphone. As a result, the noise level of the microphone corresponds to the background noise level of a quiet room.

The miniature microphone can be used as a normal audio microphone in products where the size and noise level of the microphone is especially important. Together with tuned reading electronics, it can also be applied in miniaturised gas sensors in which electrical or optical power is converted through gas absorption into pressure.



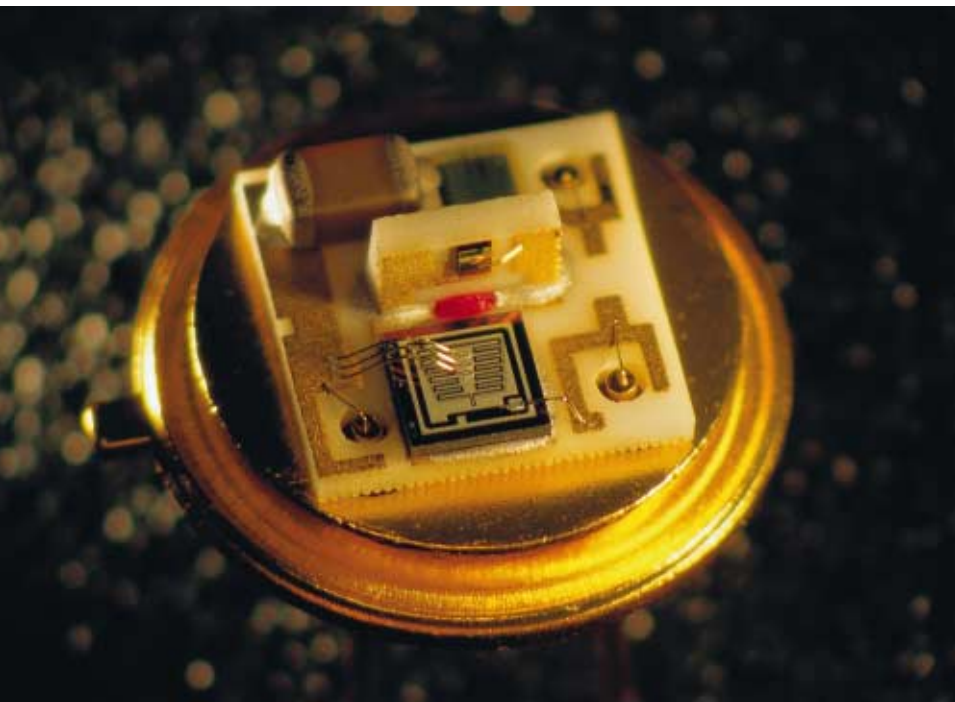
A miniaturised microphone consists of two prestressed and perforated films which react to the pressure wave.

Efficient, safe and environmentally friendly equipment and production processes

Industrial applications of optoelectronic research

Purposeful work carried out by VTT Electronics added impetus to the national research programme entitled Optopackaging that was launched at the beginning of 1997. The project will generate considerable new industrial production capacity before the end of the decade.

The turnover of Finnish industries applying optical technologies is already several billion Finnish marks. Mastering the efficient and high-quality manufacture of optoelectronic products will be crucially important in the future.



Optoelectronic sensors can be used to create products with entirely new characteristics.

VTT Electronics focuses on the development of optical components and assemblies to be manufactured with micrometer precision and accuracy. The technologies are being applied on industrial production lines.

Vaisala, Oras and Noptel Oy have introduced globally unique silicon micro-mechanics and micro-optics in products that are expected to be produced in tens of thousands. Oras's faucets work without being touched, Vaisala's sensors control the ventilation of buildings while saving energy intelligently, and Noptel's distance sensors inform robots about their surroundings. These capabilities are made possible by miniature optical sensors that are accurate, inexpensive and reliable.

Nanoparticles for single electron transistor

The transistor which is the basic component of electronics will soon reach the physical minimum dimensions. For higher storage capacity the development of novel devices is needed. The single electron transistor is a promising approach on the way to still smaller components. VTT, together with Helsinki University of Technology, has developed methods to engineer a still smaller single electron transistor.

In order to function in room temperature, the single electron transistor must be considerably smaller than the present components of about 100 nm in size. For those, a temperature of few Kelvin degrees is needed for the operation. For the tunneling junction, a metalparticle below 10 nm is utilised. It is produced via aerosol method. This particle is deposited on a substrate where transistor junctions emitter, collector, and gate are already processed by electron beam lithography. The metal particle is then moved on the surface to the right position. Insulating layers between the electrodes and the metal particle enable the tunneling phenomenon.

Monodisperse 10-100 nm metal particles have been produced at VTT by an aerosol method. The controlled moving of particles has also been demonstrated in the project. It is important to be able to control the metal particle crystal structure and surface morphology. The particles have been characterised by an analytical high resolution transmission electron microscope at VTT. Modern characterisation methods are needed in order to study the to-be-engineered transistor device.



High resolution transmission electron microscope image of silver particle surface.

Sampling and measuring methods for pulp mills

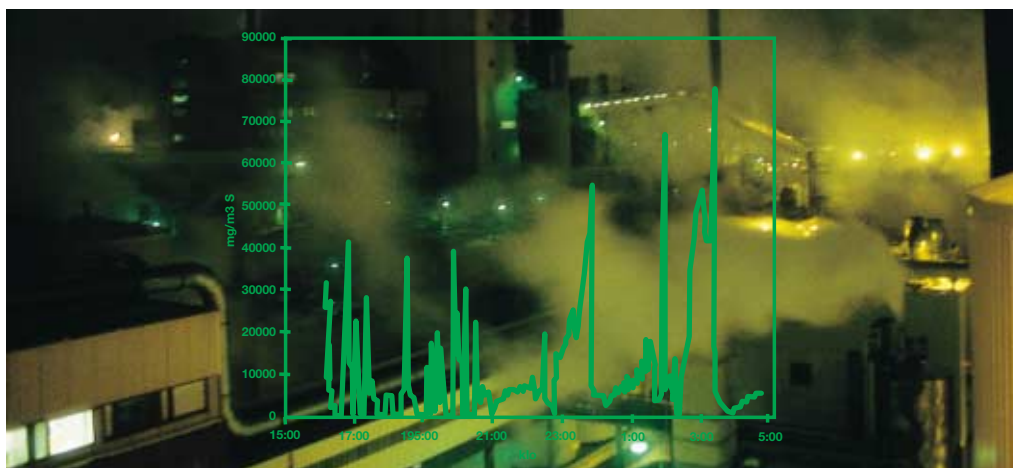
VTT Chemical Technology has developed sampling and continuous measuring methods for the volatile gaseous compounds emitted from pulp mills. The work was carried out in a project targeted at the forest industry with funding provided by the Technology Development Centre (Tekes) and industry. The results of the study will enable pulp producers to improve the recovery of process by-products.

The difficult conditions of a pulp mill set special demands on sampling. For example, measuring process gases is difficult because volumetric flow rates vary a great deal and their precise measurement is problematic. Amongst other things, a suitable method of sampling process gas flows was developed in the study.

Turpentine is one of the by-products that sulphate pulp mills sell for further processing in chemical and other industries. The methods developed in the project were used to determine the mass flows and balances of turpentine and sulphurous compounds. The recovery of turpentine can be improved, since the continuous measurements made it possible to determine which of the pulp mills flows had the highest contents of the targeted by-product.

The companies taking part in the project included Sunds Defibrator Pori Oy, Enso Oy, UPM-Kymmene Corporation, Kemijärven Sellu Oy, Metsä-Rauma Oy, Arizona Chemical Oy, Environics Industry Oy and Lännen Laboratoriot Oy.

The new sampling methods will help in the measurement of a pulp mill's mass flows and in the development of its by-product recovery processes.



Better management of GSM networks

Nokia Telecommunications Oy and VTT Electronics have collaborated in the development of knowledge-based methods for the identification and management of faults on GSM networks. The development work has been carried out within the framework of the Technology Development Centre's research programme.

Faults on GSM and other networks typically cause a flood of alarms, which is particularly problematic from the standpoint of network operation. In a GSM network, alarms are sent by the network elements to a centralised network control system. Using a functional model of a base station, it has been possible to reduce the number of and redesign the content of the alarms transmitted by base stations and to better locate the faults causing the alarms.

The functional models can also be used for product design and training as well as for fault simulation. The flexibility of the models has proven to be a key advantage of the developed approach.



A functional model of a base station is being used in the fault management of GSM networks.

New biodegradation test methods

In future, biodegradable plastics and packaging materials will be composted together with other organic household waste. VTT Biotechnology and Food Research has played a key role in the Technology Development Centre's Biopolymers research programme, in which methods of testing biodegradability have been created and standardised. The companies taking part in the research programme have benefited from the new test methods in the development of new bio-



The biogradability of packaging materials is studied in controlled composting conditions.

degradable polymers.

There is now a battery of test methods available to study the biodegradability of packaging materials. Using these methods, it is possible to estimate the biodegradability of polymers in both aerobic and anaerobic conditions. Furthermore, disintegration in composting conditions or anaerobic waste treatment plants are simulated.

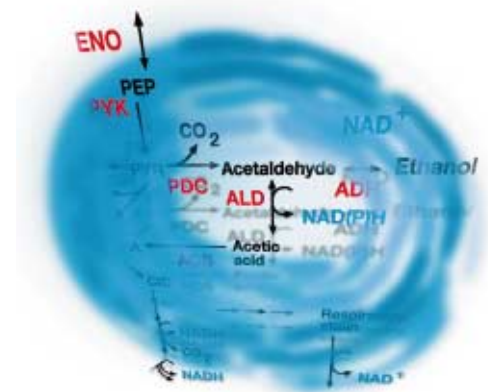
Microbiological and plant tests are currently being developed to reveal the impact of polymers and their decomposition products on the composting process.

Production of ethanol from pentose sugars by yeast

Metabolic engineering is a way of changing the metabolic pathways of a cell so that the cell produces a desired product as efficiently as possible. Metabolic engineering techniques will become important in future in enabling the production of useful compounds in a purer state and more efficiently, and the replacement of chemical processes with more environmentally friendly biochemical processes. The metabolic pathways of yeast are being altered in the metabolic engineering research programme at VTT.

This programme is financed by Tekes, the EU, industry and VTT. One of the programme's objectives is to improve the production of ethanol from pentoses by *Saccharomyces cerevisiae*, baker's yeast. Baker's yeast is used industrially to produce ethanol, but cannot naturally make use of pentoses, such as xylose. However, effective pentose metabolism can be created by transferring to baker's yeast genes encoding suitable enzymes from other organisms. Several genes that affect the general metabolism of the cell have been isolated at VTT Biotechnology and Food Research, which significantly improve ethanol production. Because over 30 % of the sugars in plant materials can be pentoses, the production of ethanol from raw materials would become much more economic if the process could use pentoses as well as the other sugars.

VTT Chemical Technology is also involved in the programme, contributing with NMR measurements of the concentrations of intracellular metabolites and the fluxes of metabolic pathways.



Several genes that enhance ethanol production have been isolated at VTT.



The research equipment for whole-tree processing supports the development of new delimiting, debarking, chipping and screening methods.

New equipment for forest industry research

VTT Energy has brought into service new research equipment for whole-tree processing and pulp flows. The unique equipment will serve the needs of the forest industry and its related equipment manufacturers.

The research equipment for whole-tree processing is used to study the method's unit processes, e.g. delimiting, debarking, chipping and screening. The trees can be fed into the process one by one complete with branches, or as bundles or as cut stemwood logs. The equipment can also be used to develop new tree processing methods, whereby wood fuel and industrial raw material for the chemical and mechanical forest industry are separated.

The research equipment for fibre flows is used to study the flow phenomena and mixing of suspensions used in the manufacture of paper. The equipment consists of a pulper, four storage tanks, pumps, a thickener and a pressure screen. The equipment can also be used to develop measuring techniques for the analysis of fibre flows.

A new of high-speed video camera operating at speeds of up to 40,500 pictures per second is being used in the studies.

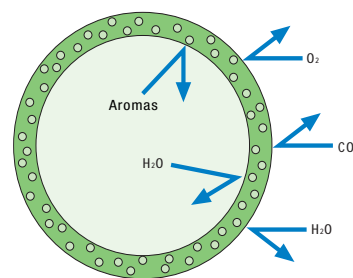
The total project costs of FIM 15 million are being met by the Jyväskylä Science Park, the Technology Development Centre (Tekes) and VTT Energy.

Preservation and protection of foods

Studies at VTT Biotechnology and Food Research have shown that a high-pressure technique is particularly suitable for the processing and preservation of meat products, freshly grated foods, fruit and berries. Improving the quality of foods by coating them with a biopolymer film has also been studied at VTT.

The high-pressure technique improves the preservation and structure of foods, and also often its flavour. Small-molecule compounds such as vitamins and aromas are better preserved at the low temperatures of high-pressure processing than they are in a heat treatment. The effects of the technique on foods have been studied in an extensive EU project and in several domestic projects.

An interesting way of improving the quality of foods is to coat the product or parts of it with a protective film made from a biopolymer. Starch, alginate, proteins, and lipids or mixtures of them are natural film materials. Projects financed by VTT, the Technology Development Centre (Tekes) and the EU have focused on the technology and properties of biopolymer films and coatings, and also on their applications, which include health foods and medicines. Ready techniques are not available, so the applicability of biopolymers to the improvement of quality or technological problems must be studied product-specifically.



The effects of coating foods with biopolymer films and the applicability of a high-pressure technique to food preservation are being studied at VTT.

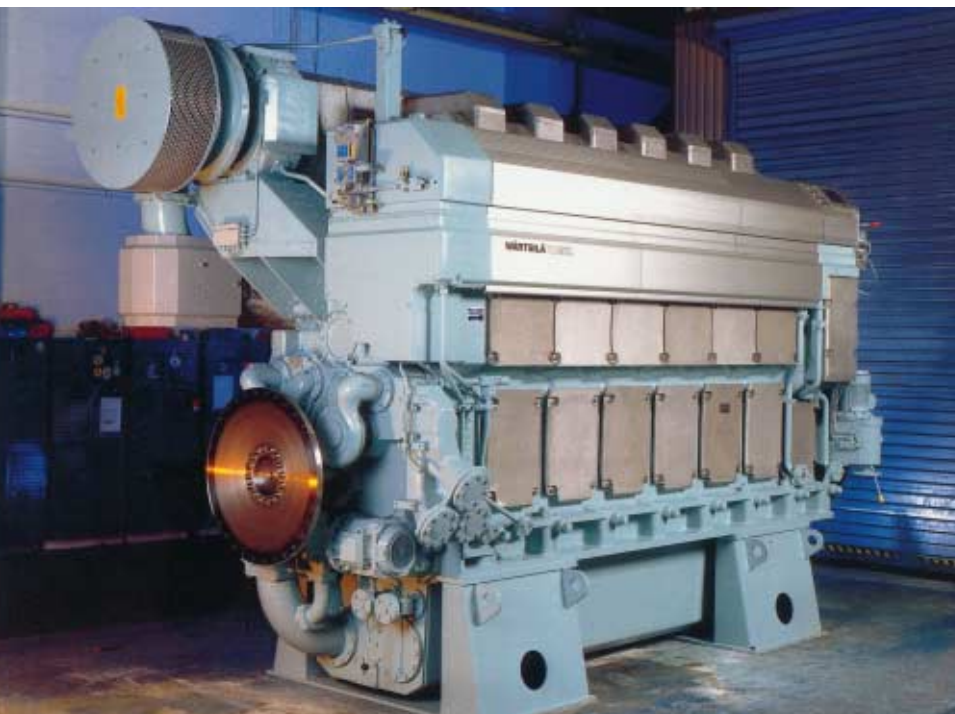


Efficiency in energy use and production, and reduction of emissions

Diesel power plant produces more electricity

Wärtsilä NSD is a leading manufacturer of medium-speed diesel engines, and holds a significant share of diesel power plants used in electricity production. Since 1995, VTT Energy has been involved in the development of a diesel power plant concept in which the net efficiency of electricity production is being raised to 55 per cent.

In today's increasingly competitive market conditions, however, the amount of electricity produced is even more important than before. In the first stage of



Numerical methods are playing an important role in efforts to optimise the structure of a diesel engine-based power plant.

the research project the structure of the diesel engine-based power plant engine was optimised by numerical methods with the aim of maximising electricity production. Most of the work was carried out by VTT Energy.

New constructions were subsequently tested at VTT in the 1.5 MW Vasa 4L32 engine and at Wärtsilä NSD's engine laboratory in the larger 46 engine. As a result of these trials the constructions were modified with regard to energy balance and reliability.

Work on new constructions continues. A reference plant is currently being built at Vaskiluoto in Vaasa to test the power plant concept.

Arctic wind power in product development stage

Arctic wind power research at VTT started in 1990, when promising results were obtained from wind studies in arctic fells in Lapland. The first wind turbine equipped with a blade heating system was erected on Pyhätunturi fell in 1993. The blade heating system was further developed on the basis of computer modelling and practical field experiments. The first commercial wind turbines equipped with the blade heating system were erected on fells of Enontekiö in the autumn of 1996.

Using flow field and heat transfer models developed at VTT, the installation areas and correct surface power distributions of blade heating elements have been defined. In addition to this, the annual consumption of blade heating energy has been considerably reduced by using an ice sensor and heating control developed at VTT. Compared with the surface elements used previously, heating elements integrated into the blades of the wind turbine have proven to be mechanically more reliable.

An agreement made between VTT Energy and Kemijoki Oy in the summer of 1997 gave impetus to the development of the blade heating system as a commercial product. VTT Energy will continue the development of arctic wind power by designing heating elements for various types of wind turbines and by further developing the heating control system and the integration of the heating system into the wind turbine's structures. Kemijoki Oy's role will include product design, marketing and manufacture. The development of technically reliable and reasonably cost-effective arctic wind power technology is a joint aim of the partners.



Applications of arctic wind power technology can be found in the Nordic countries, Canada and Russia, as well as in mountainous areas of Europe, China, Japan and other countries.



The new solutions have made it possible to reduce heating energy consumption by a half without compromising the quality of the indoor climate or sound insulation.

Energy-saving residential buildings

VTT Building Technology has collaborated with a number of companies in the development of new solutions to the problem of saving energy in residential buildings. Using these new solutions in an experimental building, it has been possible to reduce the consumption of heating energy by a half and the use of water by almost a third compared with a conventional apartment building.

Efficient integration of building structures and technical installations has made it possible to achieve a functional and economical residential building. The energy-saving experimental building, which features good sound insulation and a pleasant indoor climate, has been constructed without any significant increase in costs. Building residents living in apartments with ventilation heating or floor heating can independently regulate ventilation according to their wishes. Apartments on intermediate floors consume hardly any heating energy at all.

Development work on energy-saving buildings as well as internationalisation and commercialisation of the technologies involved is being continued in a residential building renovation project and in the construction of "Besser Wohnen" (Better Living)

buildings in Germany. The aim is to switch over to an environmentally friendly building practice by developing products from the solution models used in the experimental buildings.

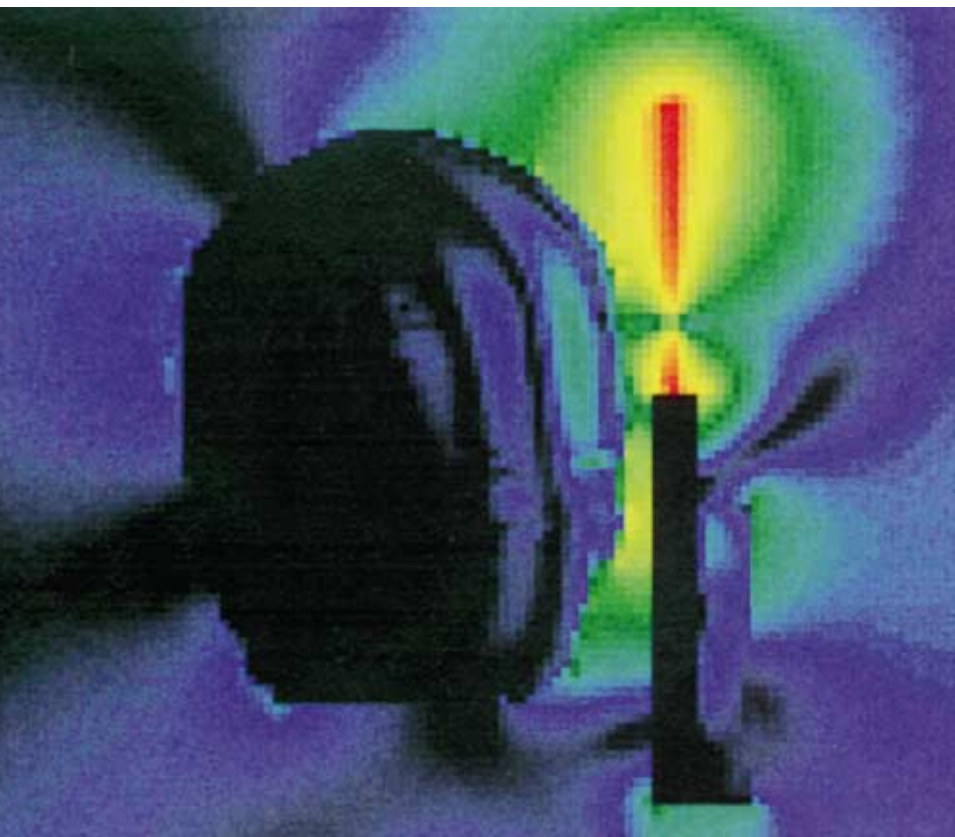
Small and medium-size companies have acted as catalysts in the development of energy-saving residential buildings. Those participating in the "Better Living" projects of the Technology Development Centre's Raket research programme included Fenestra Oy, the Housing Production Department of the City of Helsinki, Management Consultant Ilkka Hämäläinen, LVI-Parmair Oy, Oras Oy, NCC-Puolimatka Oy, Outokumpu Poricopper Oy, Parma Metals Oy, Paroc Oy, Senewa Oy LVI-Suunnittelupalvelu, Suomen LVI-Tukku Oy, the Technology Development Centre of Finland (Tekes), Oy Uponor Ab, VVO Group Ltd and VTT Building Technology.

More effective use of information technology

Using a mobile phone is not detrimental to health

VTT Information Technology has developed a numerical method to support studies concerning the possible health effects of using mobile phones. The development took place in a domestic research programme on this subject co-ordinated by VTT Information Technology. The programme did not reveal any adverse effects on human health.

The method involves the human user being described by a numerical model which is anatomical and differentiates between different tissues of the body. The



Simulation shows the radio-frequency electric and magnetic fields created by a mobile phone.

mobile phone is modelled in a similar way. The method computes the radio-frequency electric and magnetic fields generated by the antenna of a mobile phone. The knowledge of fields in tissues gives a possibility to compare the exposure to safety guidelines.

In addition to VTT's contribution, the research programme also included development work on field measurement techniques and biological research into the effects of the fields on electrical brain functions in humans and the rate of malignant tumour growth in laboratory animals.

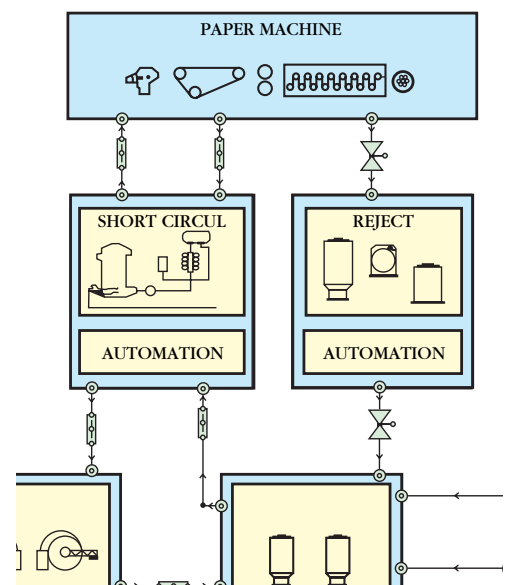
International co-operation within the framework of the COST 244 project was an important part of the research programme. The Finnish partners were STUK Radiation and Nuclear Safety Authority, the Institute of Occupational Health and the University of Kuopio. Altogether 23 research scientists took part in the research work, which was financed by Finnish mobile phone manufacturers and network operators, the Technology Development Centre (Tekes) and the Finnish Work Environment Fund.

Better control of pulp and paper processes

APMS simulation software developed by VTT Automation can significantly improve the dynamic control of complex pulp and paper production processes, thereby achieving real cost savings.

APMS is a multi-purpose tool for all stages in the lifetime of a process. It can be used for training, the planning of process implementation, fine-tuning, testing of the automation system, the development of operating procedures, and the planning of future process changes.

The software has a number of applications in the pulp and paper industry. It has been used to train operators at several different mills, to study the dynamics of the low-water papermaking process, and to develop the automation of paper grade changes.



APMS simulation software helps to improve the control of pulp and paper production processes.



The combination of product information and structural documentation will make it easier to provide customers with documentation for major equipment deliveries.

Aiding the documentation of equipment deliveries

VTT Information Technology together with Valmet Plc has developed software solutions whereby a paper machine's product information and structural documentation are combined. This will make it much easier to assemble and distribute customer documentation associated with major equipment deliveries.

The manufacture of major plant and equipment deliveries is generally distributed geographically, involving the participation of domestic and foreign units as well as outside subcontractors. The collection and distribution of customer documentation pose a problem in such a globally distributed production system. These difficulties can be resolved by software solutions that combine product models and structural documentation.

A product model means a standardised way of structuring product-related information for digital data communications and processing by applications software. Using a product model and a customised user interface, it is now possible to create different views of a document warehouse and to automatically assemble structural documentation for a customer delivery.

VTT Information Technology, Valmet Plc and Airbus Industrie are also carrying out research and development work in the DOCSTEP2 project of the EU's Telematics Programme. The aim is to develop a technical documentation production and management system for a multilingual environment, taking advantage of technologies such as SGML and STEP.

JAS approval for the testing of wooden products

Ministry of Agriculture, Forestry and Fisheries (MAFF) in Japan has granted VTT Building Technology the right to test and inspect wooden products that will be exported from Finland to Japan. This JAS approval concerns sawn timber and products processed from it, glued laminated timber, laminated veneer lumber and plywood.

VTT Building Technology has signed agreements with the approval organisations for sawn timber (JLA) and timber structures (JPIC) which provide the actual JAS certificate to companies. According to the agreements the quality control of wooden products that are to be exported to Japan can be carried out entirely in Finland. This makes life easier especially for small companies, because they are able to work in their mother tongue, even though all the documentation going to Japan has to be in the Japanese language. VTT is also able to offer the service to foreign clients.

The competence of the groups that test and inspect wooden products at VTT Building Technology was demonstrated for the Japanese authorities with quality documents. When the MAFF had approved the application, JLA and JPIC organised a one-week training course for VTT personnel. During the training it was found that the quality control systems of Japan and other countries have much in common. However, the concepts differed especially with regard to procedures related to initial inspection.

Development of industrialised construction and improvement of the built environment

According to the JAS agreement, the quality assurance of wooden products destined for Japan can now be carried out in Finland.



The accelerated pavement testing facility provides a quick way of determining the performance of roads in actual service conditions.



Solving the problems of mould growth in buildings

VTT Building Technology has focused intently on studying the technical aspects of moisture in buildings, as well as on the dissemination and application of research results concerning these mould growth problems. These studies have yielded new information on the causes of mould growth and on ways in which it may be prevented.

Mould spores are to be found everywhere in nature, and their presence cannot be avoided. Mould will start to develop as soon as growth conditions permit. The most important factors affecting mould growth are the availability of nutrients, the temperature and humidity of the building and its structures. The criteria for mould growth on the surface of building lumber have now been identified and modelled. The model is linked to simulation models for the temperature and moisture conditions of building structures, and the first long-term predictions of mould growth in wooden structures have been made.

On the basis of the research results, VTT Building Technology has been able to promote the introduction of new technologies which will result in buildings and structures that are inhospitable to mould growth and other biological processes. These research efforts also led to the development of new methods of measuring the moisture content of structures and materials, chemical methods of mould treatment and prevention, and new methods of surveying the condition of buildings.

Measuring the moisture-related performance of solutions intended for the export market serves the competitiveness of Finnish industry now and in the future. The results obtained in European research programmes dealing with moisture measurements of building materials and the chemical preservation of wood have played their part in solving the problems of mould growth.

Accelerated pavement-testing facility

The Finnish National Road Administration (Finnra) is financing the Road Structures Research Program (TPPT) currently underway in Finland. For this programme Finnra and VTT together with the Swedish Road and Transport Research Institute (VTI) have acquired a full-scale accelerated pavement testing facility. Using the new facility, the effect of real traffic over a period of several years can now be simulated in two or three months' time.

The full-scale accelerated pavement testing (APT) facility operates by moving a loaded truck wheel back and forth across the pavement using axle loads that may be in certain cases higher than those normally permitted on public roads. The facility can be moved as a semi-trailer and will be used in Finland and Sweden in alternating years. It is the only mobile testing facility in Europe and the only mobile facility in the world with full climate control. Studies in both countries are designed to complement one another, thereby avoiding unnecessary duplication of work and improving the utility of the facility.

The pavement test section is instrumented with sensors that measure strains, stresses and deformations in indifferent parts of the road. VTT has a great deal of experience in these measurements. The performance of the roads is modelled. The accelerated pavement testing facility often serves as a link in a chain of operations from laboratory tests through modelling to the test roads.

The accelerated pavement testing facility is especially useful when studying the new materials such as industrial by-products or bitumen emulsion bound materials, since laboratory tests can provide little information on the behaviour and performance of new materials in actual service conditions.



Research has yielded new knowledge about reliable building solutions and practices by which the problems of mould growth in building structures can be avoided.



Finland's first high-energy Nd:YAG laser enables VTT to transfer new technology for metal workshops.

Support to SME sector

Transferring new technologies to SMEs

In a research programme carried out by VTT Manufacturing Technology efforts have been made to find ways of transferring new technologies and expertise to SMEs. The programme focused on developing VTT Manufacturing Technology's product structure and working methods and on forging stronger links with SMEs. The results of the programme indicate that the packaging of expertise into marketable products and accurately targeting them at potential customers is essential in order to serve the SME sector.

Technological expertise was packaged into products so that SMEs could more easily purchase R&D services. Management of the entire customer interface was developed by making it a process in its own right. Updating sales data and providing responsible research scientists with sales training was also regarded as essential. Links to SMEs were sought via different kinds of networks, technology clinics and local co-operation partners. The commencement of foreign research and development work in SMEs was promoted in a Technology Development Centre (Tekes) project supporting the preparation of EU CRAFT projects.

Hi-tech SMEs know how to exploit VTT's expertise thanks to their knowledge of the R&D set-up in Finland. However, the profitable procurement of SME commissions usually requires a local presence, which can be arranged, for instance, through technology clinics or local co-operation partners such as technology centres or universities of technology. A better knowledge of financing opportunities and the ways in which companies operate is an essential part of technology transfer. This requires good co-operation with many parties outside VTT.

Usability Clinic assists SMEs

The Usability Clinic is one of 15 clinics started up under the auspices of the Technology Development Centre (Tekes). These clinics allow SMEs to take advantage of the expertise of research institutes, universities and consulting firms. The Usability Clinic assists companies in questions concerning the ease, safety and ergonomics of product use. According to a recent evaluation of the clinic's work, there is clear evidence that it has strengthened links between the SME sector and producers of research and development services.

The Usability Clinic came into being as the result of a Tekes programme carried out over several years with companies of the electrotechnical and electronics industry. The service producers involved in the clinic's work are, in addition to VTT Manufacturing Technology, Helsinki University of Technology, the University of Tampere and the Finnish Institute of Occupational Health.

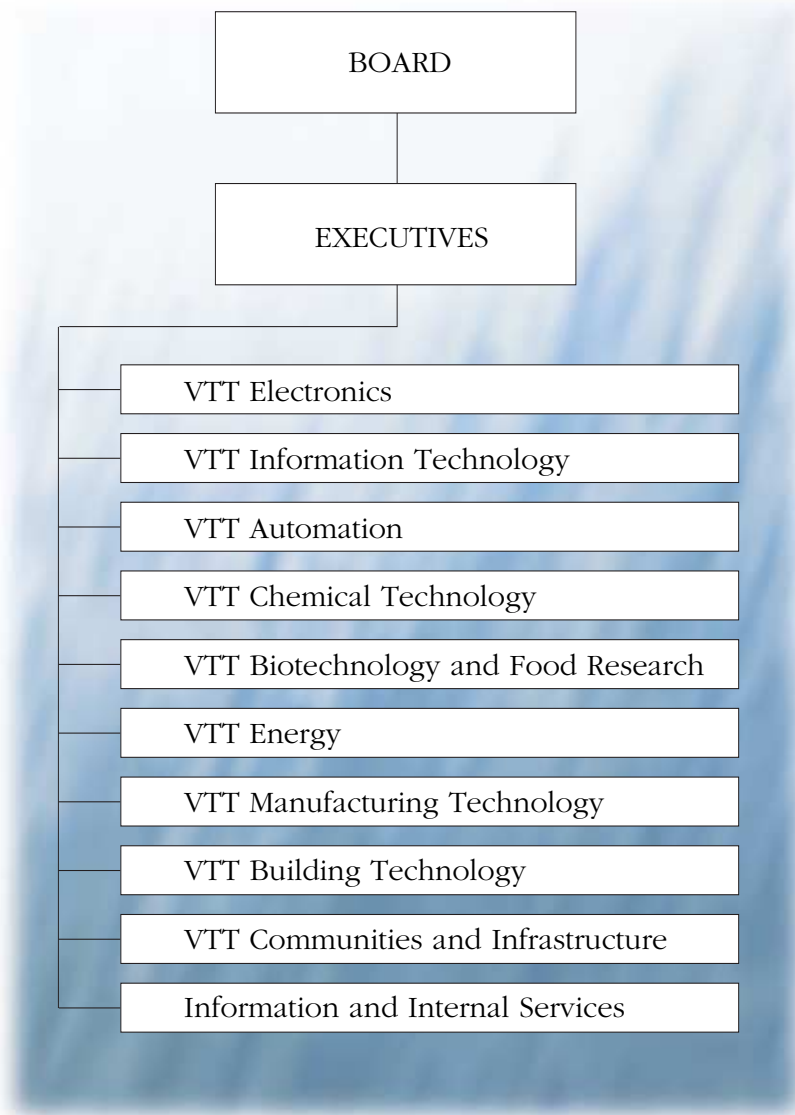
The customers of the Usability Clinic are mostly companies of the engineering, electrotechnical and electronics industries. Most commissions undertaken by the clinic have been concerned with the evaluation and development of a product's usability at the prototype stage. Some of the projects have been specifically aimed at improving product safety and developing product documentation. In a few cases the clinic has been called in at the specification stage of product development, which is the easiest and most economic way of ensuring a product's usability.

In the future the Usability Clinic will focus on, for instance, developing new user interfaces and ensuring the usability of software. One of the challenges facing the clinic is marketing, as making contact with small companies has proved difficult.



The Usability Clinic assists companies in user-centred product development.

VTT's organisation 1.1.1998



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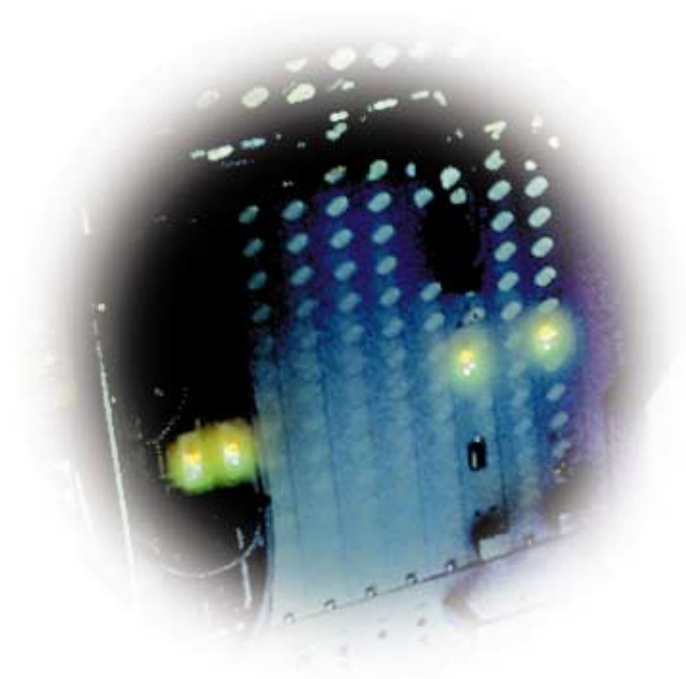
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