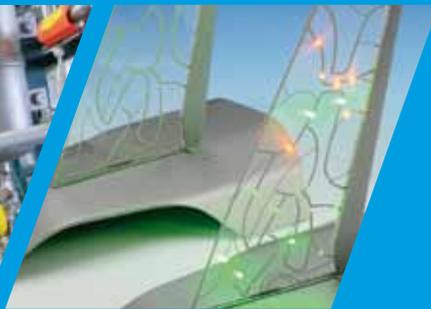




VTT Review 2016

VTT
75
years



VTT
75
years

The research examples presented in this review represent only a small fraction of VTT's activities, although they do provide some idea of the many and varied ways in which VTT's know-how influences technological development in Finland.

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President & CEO's review



VTT helps customers and society to grow and renew through applied research. This task is particularly important in Finland's slowly growing economy. Businesses need product and service concepts that contain the seeds of new growth. In addition, the private sector and decision-makers need our vision and support in making large-scale systemic changes in society.

VTT provides research as a service. We work via networks and create value in collaboration with the customer. We are increasingly becoming an ecosystem or network hub that comprises

Finnish and international universities, start-ups, SMEs and large companies.

There were major changes in VTT's operating environment in 2016. The outlook for economic growth and the markets was challenging. VTT's government grant decreased by 10% and public funding from Tekes fell by 5% compared to the previous year. However, VTT Group's operating income – government grant and turnover combined – fell by only one percent, because the parent company's turnover for EU projects grew by 12% and turnover for commercial projects by 2%.

VTT had 460 international research projects and two major piloting and research facility ventures underway in 2016. Manufacturing techniques for renewable fuel were developed at the bio and circular economy piloting centre Bioruukki, while the second phase of the biomass and fibre spinning facility progressed to the kick-off stage. VTT's new nuclear safety laboratory facilities began operating in the Centre for Nuclear Safety and hot cells are being built. These new capabilities will provide opportunities for growth, new services and competence development.

In 2016, we renewed our strategy together with our employees. Challenge-driven way of working and excellence in science and technology are at the core of VTT's strategy. VTT aims at understanding customers' and society's needs and opportunities by working in a challenge-driven way. To match these needs, we co-develop impactful solutions together with the customers. In this way we help customers to succeed and promote sustainable growth and wellbeing in the society. VTT has created an impact, for example, when our customers' knowledge and skills grow, they gain access to new networks, their business renews through innovations or their turnover increases. Industrial renewal, enhanced wellbeing, and better political decision making based on research findings are examples of our societal impact.

The climate action, the sufficiency of resources, a good life, safety and security and the industrial renewal are the growth areas in which we will focus our research in order to meet global challenges and the needs of society and our customers. Our expertise, partnerships, unique research facilities and IPR will enable us to create innovations which enter the markets at the right time and are commercially successful.

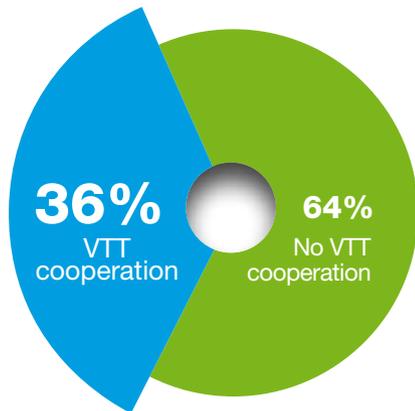
In early 2017, positive signals emerged that the Finnish economy is expected to grow slightly in the wake of the global economy. In addition, new international research and production operations are moving to Finland and the Government has indicated the need to step up innovation funding. Faith in Finnish innovation is demonstrated by the fact, for example, that a record EUR 18 million was invested in spin-offs managed by VTT Ventures Ltd in 2016.

However, sustainable growth requires a long-term approach – there are no short cuts to such growth. We will achieve the best results through cooperation. We will continue to develop our own role towards providing a platform for companies' innovations, while supporting their business activities with our expertise, research facilities and partners.

I hope that this VTT Review successfully describes our achievements of 2016 and, above all, the many ways in which we can help companies and society going forward!

Antti Vasara
President & CEO

VTT - Technology for business



VTT HAS PLAYED A ROLE IN 36% OF FINNISH INNOVATIONS*



Increase of turnover after an innovation



+44%

23%

VTT involved



+13%

26%

VTT played a major role

VTT'S INNOVATION POWER BOOSTS THE TURNOVER OF FINNISH EXPORT COMPANIES*

**Source: SFINNO innovation database*

Strong scientific and technological expertise lie at the core of VTT's activities. We provide expert services, based on applied research, for our domestic and international customers and partners, and for the private and public sectors. Through extensive cooperation, we ensure that we have world-class expertise in our focus areas and access to the latest knowledge.

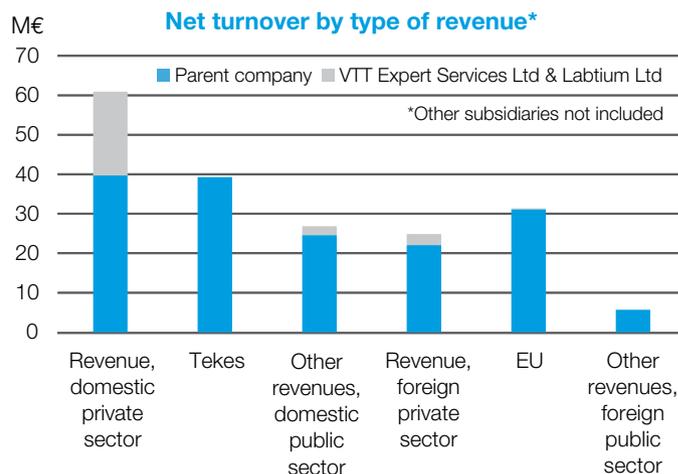
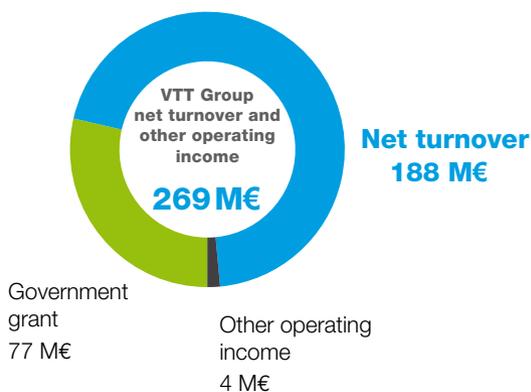
Our services cover the entire innovation process, from idea to commercialisation. Together with companies and partners, we combine a range of technologies and top expertise in developing new products, production processes and methods, as well as services that create a competitive edge and the basis for sustainable development and well-being. On the basis of technology forecasting and R&D&I in emerging growth sectors, we are active participants in the regeneration of industry and business. We also produce high volumes of information in support of societal decision-making. Through our research, we aim to meet future challenges posed by climate change and the need for sufficient resources, quality of life, security and the renewal of the industrial base.

In addition to first class expertise, VTT offers a variety of, and even unique, research environments and equipment. Pilot-scale environments, such as the bioeconomy and clean technology piloting centre Bioruukki, enable an entire new product development chain – from basic research and process development to prototyping and small-scale production.

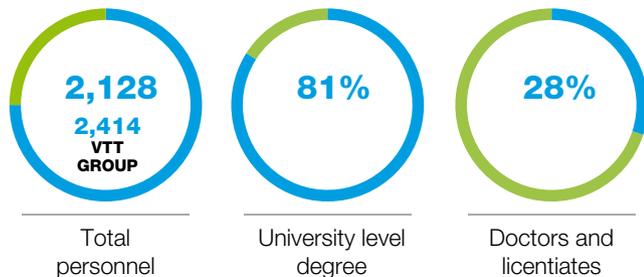
Our customers have stated that cooperation with us has improved their competitiveness, profitability and networking. Customer surveys indicate that VTT has played a major role in creating new products, via research projects conducted together with customers. Around 27% of respondents to a customer survey in 2015 stated that VTT's expertise had been indispensable to developing a new or improved product or process.

* Loikkanen, T. et al. Roles, effectiveness, and impact of VTT. Towards broad-based impact monitoring of a research and technology organisation. 2013. VTT, Espoo. VTT Technology 113. 106 p. + app. 5 p. <http://www.vtt.fi/inf/pdf/technology/2013/T113.pdf>

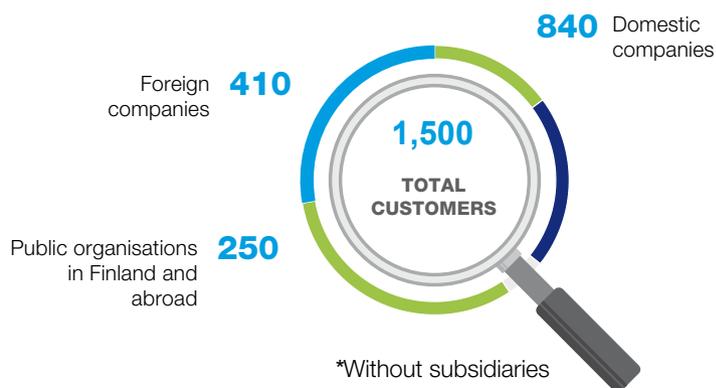
VTT GROUP NET TURNOVER AND OTHER OPERATING INCOME



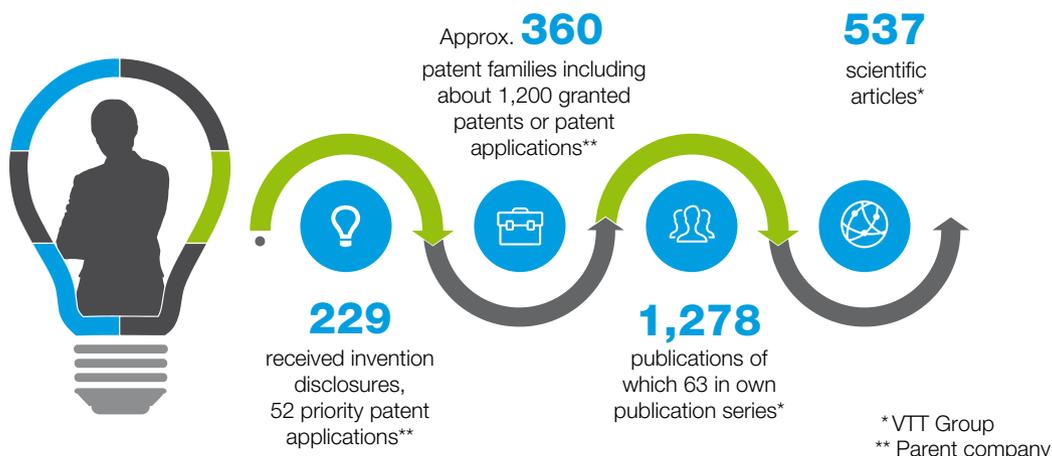
PERSONNEL



CUSTOMERS



IPR AND PUBLICATIONS



Impact of VTT

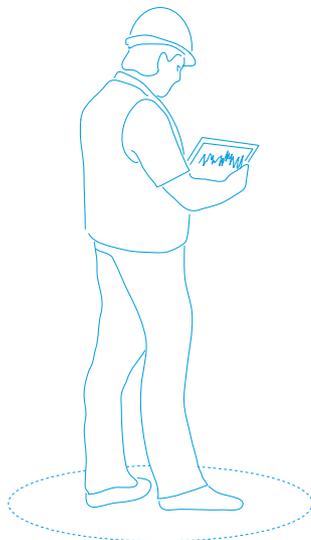
VTT creates growth

Share of survey respondents who had this benefit as their goal in their VTT project and felt that the benefit was generated in the project:

- 96% thought that a VTT project **promoted networking.**
- 93% reported that their **knowledge base and expertise improved.**
- 81% said that a VTT project **promoted their marketing.**
- 77% believed that a VTT project **speeded up or otherwise improved research and development work.**
- 70% confirmed that **new products, services or processes were created.**
- 69% believed that a VTT project **contributed positively towards the opening up of new business opportunities.**
- 68% reported that **their competitiveness improved.**
- 56% reported that a **whole new technology was adopted.**
- 53% said that a **new business concept or a new earnings model was created.**

VTT customer survey 2015, Taloustutkimus Oy

Technology development and research create new business and employment



Payroll growth



Productivity growth



Turnover growth

SMES EXPERIENCED STRONG GROWTH AFTER INNOVATIONS WHERE VTT PLAYED A MAJOR ROLE.*

* Source: VTT Customer Survey 2015, SFINNO innovation database and Statistics Finland databases. Based on 732 innovations registered for Finnish SME companies between 1982 to 2012.

Well-being at work as a success factor

WE INVEST IN THE DEVELOPMENT OF MANAGEMENT AND LEADERSHIP

Leadership and good management are VTT's key success factors. During the spring, we involved our entire organisation – in a number of ways – in the creation of a new strategy and new approach to leadership. We also organised two Manager Days, with good leadership and team development as the main themes.

We also arranged an Active Caring Roadshow, aimed at early intervention and, in support of this, introduced an electronic tool for well-being at work discussions. Around 160 managers participated in these programmes. We developed our feedback culture by providing a Productive day-to-day discussions online course.

WELL-BEING AT WORK IS AN IMPORTANT SUCCESS FACTOR FOR VTT

VTT's well-being objective involves increasing each employee's feeling of well-being, developing the work of managers, and using the Lean-thinking model to simplify current processes. Mental well-being, self-management, time management and acknowledging diversity were discussed in team workshops. Workshop attendance was high, with 92 out of 120 teams participating. Other well-being themes included mindfulness and sleep, weight control and neck/spine groups. We introduced the Cuckoo electronic break-time workout application at the end of the year. We provided human resource coaching for the prevention of musculoskeletal disorders and problems with coping at work in particular.

PERSONNEL DEVELOPMENT BY A RANGE OF MEANS

VTT's success is based on continuous learning by the whole staff. In addition to on-the-job learning, our development programmes focused on coaching in sales skills and project work, one of the aims being to attain IPMA C certification. We continued VTT's internal mentoring programme, which was attended by more than 30 mentoring pairs. We also completed our first joint mentoring programme with Aalto University and the Finnish Broadcasting Company.



We reformed our development discussions, introducing an evaluation model for excellence and impact.

GOOD EMPLOYER IMAGE THE KEY TO ATTRACTING TALENT

Measures for strengthening our employer image were focused on students. We raised our profile among students, e.g. through recruitment fairs, cooperation with student organisations and our summer job campaign. In addition, we developed and activated our social media communications. We did well in the Responsible Summer Job campaign, being awarded the Biggest Improver prize. We were rated number 5 among technical and natural sciences professionals, and number 8 among students, in Universum's employer attractiveness rankings.

REWARDING IS AN IMPORTANT PART OF A GOOD EMPLOYEE EXPERIENCE

We aim to have a fair and motivational reward system. We embarked on developing our reward criteria and processes as a whole. The aim was to simplify our reward system and increase its impact. As an important short-term incentive, we will raise the value of our recognition rewards, through which we will reward excellence in a range of ways, using VTT's common strategic indicators as criteria.

VTT 2016–2020

VISION

A brighter future is created through science-based innovations.

MISSION

VTT helps customers and society to grow and renew through applied research

CORE VALUES

- Together for the client
- One step ahead
- Passion for innovation
- Support and respect to the core

ETHICAL STANDARDS

- Impartiality
- Reliability
- Integrity
- Responsibility

VTT strategy: we make an impact through scientific and technological excellence

Challenge-driven way of working and excellence in science and technology are at the core of VTT's strategy.

VTT aims at understanding customers and society's needs and opportunities by working in a challenge-driven way. VTT co-develops impactful solutions to match these needs. In this way we help customers to succeed and promote sustainable growth and wellbeing in the society.

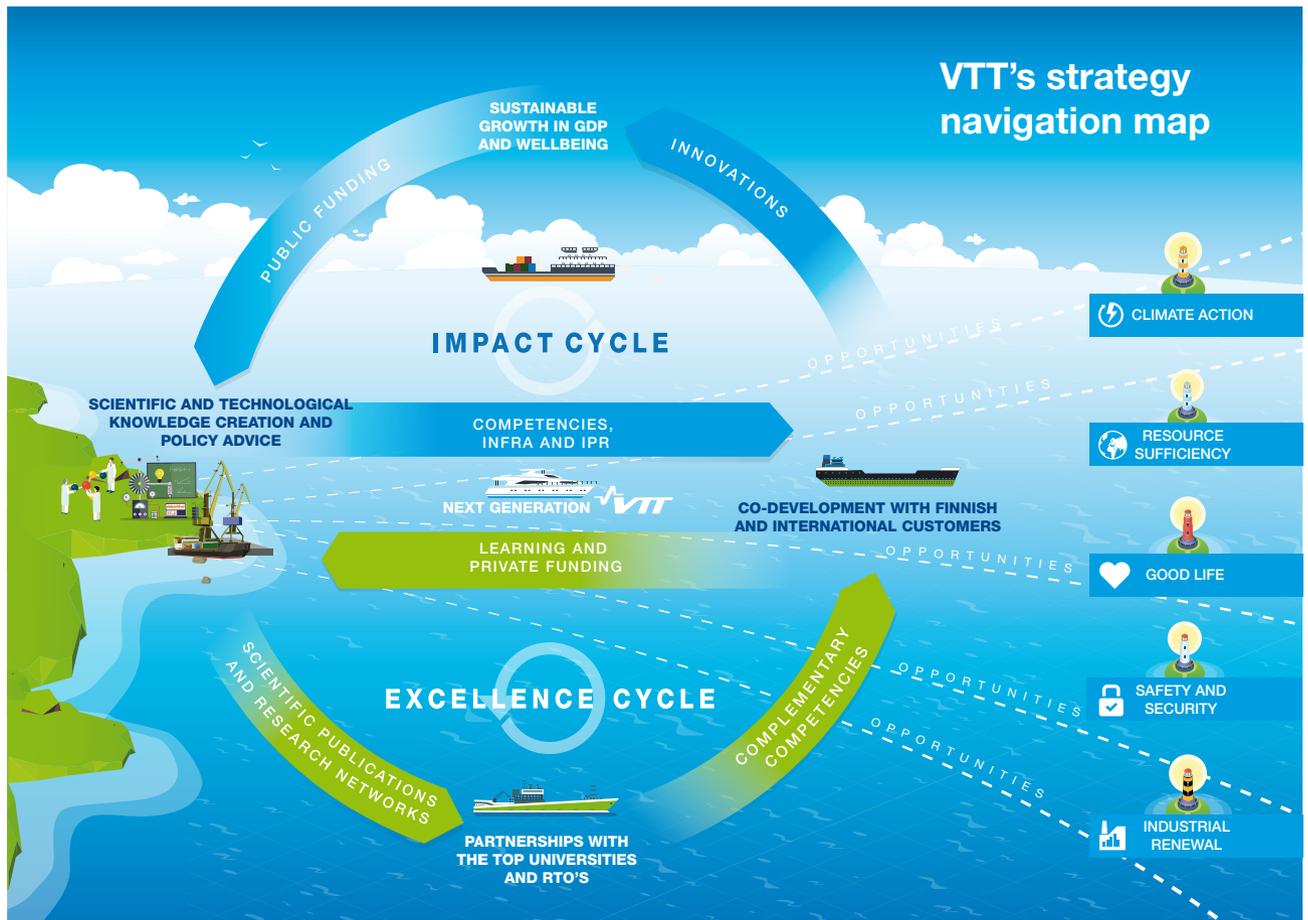
Scientific and technological excellence in all our work is the basis for VTT's impact. To further develop our competencies and identify new growth opportunities, we work with demanding customers and challenges around the world.

People at VTT make us unique. Wellbeing and competence development ensure that VTT people succeed in their work for customers. Built on our knowledge, partnerships, unique research infrastructure and IPR, we collaboratively develop timely and commercially competitive innovations.

VTT achieves world class research and development by focusing its research on the following societal challenges and growth opportunities for Finland. We call these VTT Lighthouses:

- Climate action
- Resource sufficiency
- Good life
- Safety and security
- Industrial renewal





IMPACT FROM VTT

- 1 We work in a challenge-driven way to create solutions to the current and future needs of our customers and society.
- 2 We formulate our research agenda based on future market growth opportunities (lighthouses).
- 3 We co-develop with customers according to differentiated service models matching their needs.
- 4 We proactively bring different customers and partners together around ambitious innovation initiatives.

EXCELLENCE FROM VTT

- 5 We want to learn and improve. That's why we continuously evaluate the impact of our work.
- 6 We always improve our way to lead people and substance to ensure excellence and continuous competence development.
- 7 We work with leading international customers and partners to further develop our competencies and identify new growth opportunities.
- 8 We invest in excellence through funding from multiple public and private sources.

Climate action

Clean energy for the future

Close to 200 countries have committed to Paris climate agreement to limit the global warming below 2°C. Rapid transformation of all the sectors that are emitting greenhouse gases are needed. Also Finland has set ambitious targets to increase the use of renewable energy to be over 50% of the final energy consumption by 2030.

Billions of mechanical devices, buildings, vehicles and industrial processes need to be changed, retrofitted or renovated to improve energy efficiency and to decrease emissions. Emergence of numerous integrated consumers and producers, called prosumers, recreates energy markets. VTT fosters novel technologies and digitalisation as opportunities to support a systemic energy transformation.

Innovations for low-carbon energy mix from versatile sources are required more urgently than ever.



Reference

Minimising energy costs and CO₂ emissions for smart cities

CUSTOMERS/PARTNERS

Helen and City of Helsinki

CHALLENGE

Minimising of energy costs and CO₂ emissions of broad city and district level energy systems.

SOLUTION

VTT developed a planning tool for energy experts and investors to find out the best combination of broad cities and districts energy systems: CITYOPT analyses cost and system information, enabling hence the optimisation of energy system and minimization of energy costs and CO₂ emissions.

CITYOPT Planning tool has been used in Kalasatama and Östersundom districts.

BENEFIT

CITYOPT Planning tool produced and optimal design in the demonstration cases: 15% cost savings and 30% CO₂ emission reductions.

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Research results

Climate action

Read more: www.vttresearch.com/vttreview2016



VTT and Helsinki Region Transport (HSL) are collaborating on the Trans-Smart programme to promote smart transportation that uses low carbon energy. Helsinki is investing in the ELECTRIFICATION OF ITS PUBLIC TRANSPORT.



VTT has been envisioning new ways of reducing energy consumption. Central heating requirements and emissions could be reduced using INDUSTRIAL WASTE HEAT IN THE DISTRICT HEATING NETWORK, for example.





VTT has developed a **BIO-CLC TECHNOLOGY** for biomass combustion in Finland's power and heat plants. The new method has been piloted using wood pellets in VTT's Bioruukki. It improves the efficiency of electricity production.



Together with the Finnish Meteorological Institute, universities and several firms, VTT has developed a clear and reliable way of defining and measuring **BLACK CARBON EMISSIONS FROM SHIPS**. The results can be used in preparations for tighter emission regulations.



CLIMATE ENGINEERING, such as reflecting solar radiation back into space, has been proposed – instead of emission reduction – as a way of cooling the climate. VTT and the Finnish Meteorological Institute have explored the associated **RISKS**.



Using a method developed by VTT, even small sources of methane-rich **BIOGAS** can be converted into raw materials for animal feed or **BIOPLASTIC** on farms, landfills and sewage treatment plants. The solution can be used to reduce greenhouse gas emissions.



Resource sufficiency

Prosperity from resource wisdom

Social changes, urbanisation, increasing wealth and consumerism lead to rapid exploitation of natural resources exceeding Earth's capacity.

VTT recognises the need for sustainable, resource efficient solutions and circular economy. Challenges can be solved by resource wisdom. Tapping into yet-unutilised reserves and closing the loops will open new potential for economy.

Industries benefit from renewables and unconventional raw materials such as CO₂. Design will enable high performance for-need-only consumables. Non-conventionally produced food helps feeding the growing population while saving water and environment.



#ResourceSufficiencyVTT



Reference

Guidebook for improved resource efficiency

CUSTOMERS/PARTNERS

INEOS, Petronor, BASF, TU Dortmund University, University of Valladolid

CHALLENGE

Improvement of resource efficiency in process industry is a highly complex task. The plants are operated under changing conditions, and the resource efficiency is determined by the actual operation, not by the ideal operation assumed during plant design. Existing Key Performance Indicators (KPIs) can rarely support daily decision making processes in plant operations. Additionally, local and plant-wide resource efficiency may be in conflict.

SOLUTION

A systematic concept (step-by-step guidance) for a successful selection and definition of real-time Resource Efficiency Indicators in order to monitor the daily operations and take short-term decisions based on the lessons learned from EU-MORE project.

BENEFIT

- Improved resource efficiency without major technological investments
- Cost savings and reduction of waste and emissions
- Broad adoption in the process industries

ADDITIONAL INFORMATION

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Research results

Resource sufficiency



VTT's plant biotechnology researchers have developed a CellPod BIOREACTOR where the ingredients for a healthy meal can be grown – in the future – at home, from plant cells, in just one week.



Within the CIRCULAR ECONOMY, materials do not end up as waste but circulate around and between supply chains. VTT is developing solutions for the EFFICIENT AND ENVIRONMENTALLY FRIENDLY UTILISATION OF WASTE AND SIDE STREAMS.



Read more: www.vttresearch.com/vttreview2016





Using VTT's **CATLIGNIN TECHNOLOGY**, reactive lignin can be produced from **PULP INDUSTRY SIDE STREAMS** to replace poisonous phenols in wood glues. Lignin reduces the carbon footprint of glues and the use of formaldehydes.



As part of the Relooping Fashion project, VTT has been developing a new, environmentally friendly **RECYCLED FIBRE MANUFACTURING TECHNIQUE**, in which worn and discarded cotton is dissolved and re-used as a raw material in filaments.



New techniques can be used to extract proteins efficiently from agricultural by-products, particularly Brewer's spent grain (BSG). This new **PROTEIN ENRICHMENT METHOD** could benefit breweries, feed producers and even the food industry.



Together with Industryhack, Helen, Lassila & Tikanoja and Valio, VTT organised the **HACK THE WASTE INNOVATION COMPETITION**. The Mushroom Power team won the competition by combining mushrooms and wood chips into a raw material for furniture.



Good life

Improved quality of life, work, health and well-being

Major global changes impact everyday life. Growing healthcare costs together with aging population demand for a paradigm shift for prevention of noncommunicable diseases and a new kind of participatory healthcare. Disruption of work – robotisation beyond factories is making many current jobs obsolete. The overload of human-technology relation, manifesting itself clearly in the gadgets we use in our work and free time, is increasing stress when it should make life easier. Urbanisation and strained infrastructures pose pressures towards design of our living environment.

Finland has the ability to answer these challenges because of well-educated population, high trust level in society and a number of growth-oriented companies. VTT develops new technology, service concepts and business models for the benefit of the individual in the future society.



Reference

Better diagnostics for neurological diseases

CUSTOMERS/PARTNERS

Combinostics Oy

CHALLENGE

Diagnostics for neurological diseases tend to involve a large amount of information. For example, a host of tests are performed to diagnose memory disorders. These produce huge amounts of data which are difficult to use optimally without the support of tools. Combined with a variety of possible background causes of symptoms, a huge data mass makes decision-making complex.

SOLUTION

VTT spin-off Combinostics develops clinical diagnostics and data analysis solutions, which enable the more accurate diagnosis of neurological diseases. The origins of the company's technology lie in its founders' research into data-based tools at VTT. The result was a completely new way of interpreting and combining a range of medical information as the basis for a clinical decision-making tool.

BENEFIT

Combinostics' software supports clinical decision making by improving the speed and quality of diagnoses. For example, neurological diseases such as Alzheimer's can be detected, and treatment can begin, at an early stage.

ADDITIONAL INFORMATION

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Research results

Good life



VTT experiments show that, in the future, WOOD COMPONENTS such as xylan and lignin could provide the food industry with the possibility to MODIFY THE STRUCTURE OF FOODSTUFFS and lower their energy content.



In Lahti, people can use an AUGMENTED REALITY APPLICATION to peer into history. We also have a SELFIE WALL that seamlessly merges the viewer with on-screen content, for an entertaining and interactive result.



Read more: www.vttresearch.com/vttreview2016





VTT has developed a safe and consumer-friendly **TREATMENT PATCH** for **EXCESSIVE SWEATING (HYPERHIDROSIS)**, which uses water as the active substance. The patch is easy to use, light and portable, and can be used to absorb medication through the skin.



Pocket Library that provides library customer with book recommendations is an example of an **INNOVATIVE MOBILE SERVICE**. Hyper-spectral iPhone camera is another novel service. Consumers of the future can use it to check issues such as the quality of food.



The optical analysis of exhaled air enables the painless, fast and reliable **DIAGNOSIS** of **HELICOBACTER PYLORI**, which causes stomach ulcers. A mobile phone application detects **ARRHYTHMIA** and can help to avoid cerebral infarctions.



VTT is involved in developing the **OPASTUTKA** wearable sensor device, which helps the partially sighted to sense their environment. The device, which is worn like a heart rate monitor, has been clinically tested.



Safety and security

Resiliency in turbulent world

In our turbulent world, unexpected complex and cascading failures can lead to catastrophic effects. Ensuring safety and security of people, government, companies and infrastructures in all conditions has strong implications to technology development, business continuity and resilience models. The trends behind opportunities are increasing exposure of societies to natural and man-made threats.

Tomorrow's safe and secure society demands means and tools to detect, prevent and recover from incidents. VTT envisages and develops technologies and systemic models for comprehensive safety and security. All systems should be flexible and self-adaptive with inherent safety and security features. Designing, developing and testing complex systems enable secure use and full potential of any innovation in digital society.

Solutions to counter threats provide opportunities for trouble-free life and business.



#SafetySecurityVTT

Reference

Development and industry roll-out of cyber security (KYBER-TEO project)

CUSTOMERS/PARTNERS

National Emergency Supply Agency, Nordic LAN&WAN Communication Oy, Prosys PMS Oy, Nixu Corporation, Insta DefSec Oy, Schneider Electric Finland Oy, Neste Corporation

CHALLENGE

Various types of automation are being implemented at an accelerating pace within a range of environments critical to security of supply, from manufacturing to transport and housing. To manage fast-growing information security risks, industrial enterprises will need to deploy cyber security widely in their automated production. A cyber security breach could easily cause millions of euros of damage in terms of lost production alone. In addition, damaged equipment, environmental contamination and personal injuries could occur. The problem could affect the whole of society at worst.

SOLUTION

Due to the results of and testing performed in the KYBER-TEO project led by VTT, manufacturers now find it easier to acquire cyber-secure automation systems, while developing their own concepts, guidelines and practices to ensure cyber security and continuity. VTT's Cyber War Room helped its partners to develop managed and authentic cyber-security testing, as well as cyber-security drills for transfer to the customer, such as familiarisation with the attacker's mindset and identifying and protecting oneself from attacks. As part of the overall project, a small-scale, online cooperation forum on automation-system cyber security was developed. Such a forum would be desirable as a way of deepening confidential communication in the future.

BENEFIT

Companies will be better able to protect themselves from potential cyber threats and will learn to detect system vulnerabilities and weaknesses. Service companies can now provide manufacturers with more-tailored cyber security services. The results will also support the activities of organisations covered by the security of supply principle.

ADDITIONAL INFORMATION

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Research results

Safety and security



VTT has developed the SMART CLOTHING, which automatically adjusts to individual needs. The technology is also suitable for the demanding conditions encountered in hospitals, by firemen or during sport. Smart clothing or bracelets can also be used to improve safety.



Consumers will soon be able to log in and protect their data and devices more easily and securely. VTT is seeking a commercialising partner for a solution which combines NEW ENCRYPTION METHODS with biometric identification.



Read more: www.vttresearch.com/vttreview2016

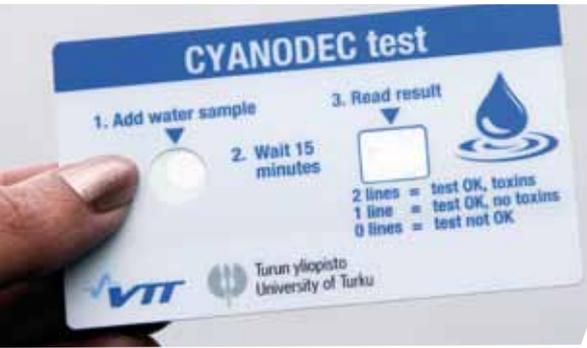




Digital technology is spreading to vehicles, the road network, buildings, security systems, and water and waste management. Tampere is an example of the cities that are utilising digitalisation together with VTT to develop SMART CITY SOLUTIONS.



SMART SENSORS are creating opportunities to enhance security and manage activities based on data gathered from the environs. VTT has added sensors and LEDs to items such as reflectors and interior decor elements measuring indoor air quality.



VTT has developed tailored solutions that bring improved CYBER SECURITY and disruption-free operations to manufacturers. VTT is also helping SMEs to participate in EU cyber security projects.



A biodegradable BLUE-GREEN ALGAE (CYANOBACTERIA) TEST, jointly developed by VTT and the University of Turku, reveals algae-based toxins in swimming water. Consumers can use this low-cost, easy test to ensure safe swimming at beaches and holiday homes.



Industrial renewal

Innovations empowering industry

Renewing design, manufacturing and service business will create new opportunities for industries in high-cost economies. The economic growth and employment of Finland are highly dependent on the success of the export industry. It is essential for the Finnish industry to be one of the leading players in implementing future digital solutions and business models.

Tomorrow's smart products and services are created in new industrial ecosystems supported by globally connected platform economy. Opportunities will emerge from the collaboration, service subscriptions and use of data. Growing share of services and novel business models based on big data strengthen the competitive advantage of Finnish industry.

Robotisation, flexible automation and artificial intelligence offer opportunities for enhanced production. Smart specialisation and digitalisation support competitiveness of production industries. High dependence on resources (energy, materials, water) can be overcome by applying solutions of circular economy.

Finland, with high innovation capability and skilled work force, is ready to be a frontrunner in next generation manufacturing and service business.



#IndustrialRenewalVTT

Reference

Commercial autonomous shipping vision planning and human-factors research

CUSTOMERS/PARTNERS

Rolls-Royce Marine Oy Ab

CHALLENGE

Commercial autonomous shipping does not exist, yet basic understanding on challenges and opportunities would be needed for consideration of how the ships would be monitored and operated in shore-based control centres.

SOLUTION

VTT did background research and basic ideation for autonomous ship operations. We mapped together with TAUCHI (University of Tampere) and Rolls-Royce Marine Oy Ab the challenges in autonomous operations by considering the existing experiences in various fields of application, such as, space operations, mining and aviation. This knowledge, along with understanding of the interaction technology trends in teleoperation and monitoring, were applied in collaborative concept ideation.

BENEFIT

- Basic understanding for developing autonomous ship operations
- Concrete ideas for the control centre environment in which the future unmanned ships would be monitored and operated
- Public presentation of the results in a concept video and conference proceeding for stirring discussion among the maritime domain



ADDITIONAL INFORMATION

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Research results

Industrial renewal

Read more: www.vttresearch.com/vttreview2016



Experiments with socially interactive service robots are moving from the laboratory into consumers' everyday surroundings. VTT and Idea-park in Lempäälä involved customers in brainstorming on ROBOT SERVICES, and tested the Pepper robot in the shopping centre.



We are looking for new business opportunities for industry, via BIG DATA and within the PLATFORM ECONOMY and its service ecosystems.





Europe is leading the world in metal 3D printing and additive manufacturing. TAILORED 3D MANUFACTURING will enable us to boost the productivity and competitiveness of both large and small companies.



VTT drew up a REVIEW ON THE FUTURE OF WORK for the Government's Report on the Future. The review includes six descriptions of change paths and the related challenges.



Jointly owned by VTT and Tampere University of Technology, the Smart Machines and Manufacturing Centre (SMACC) has been using e.g. innovation vouchers to foster the DIGITALISATION OF PRODUCTION by SMEs.



According to a barometer survey by VTT and the University of Oulu, the industrial internet already features in company strategies. Using the REBOOT FINLAND D-DAY model, we are helping companies to find new sources of competitiveness from 5G and the IoT.



VTT organisation and Leadership Team

Ministry of Employment and the Economy

VTT Board



Antti Vasara
President & CEO



Katri Kallio
Strategy Manager



Petri Kalliokoski
Executive Vice President, Deputy CEO



Erja Turunen
Executive Vice President



Jussi Manninen
Executive Vice President



Anne-Christine Ritschkoff
Executive Vice President, Strategic Research

STRATEGIC RESEARCH

Business area:
KNOWLEDGE INTENSIVE PRODUCTS AND SERVICES

Research areas

- Sensing and integration
- Connectivity
- Data-driven solutions
- National Metrology Institute VTT MIKES
- Micronova manufacturing services

Business area:
SMART INDUSTRY AND ENERGY SYSTEMS

Research areas

- Lifecycle solutions
- Nuclear safety
- Smart energy and transport solutions
- Digital engineering
- Business innovation foresight

Business area:
SOLUTIONS FOR NATURAL RESOURCES AND ENVIRONMENT

Research areas

- Industrial biotechnology and food solutions
- Biomass processing and products
- Sustainable energy and chemical technologies

FINANCE & BUSINESS SUPPORT



Tanja Huoponen
Chief Financial Officer (CFO)

HUMAN RESOURCES



Kirsi Nuotto
Senior Vice President

COMMUNICATIONS



Jussi Ollila
Senior Vice President
1.3.2017-



Matti Karhunen
Senior Vice President, General Counsel



Anu Vaari
Senior Scientist, personnel representative

VTT SUBSIDIARY COMPANIES

- VTT Expert Services Ltd, Laura Apilo, CEO
- VTT Ventures Ltd, Antti Sinisalo, CEO
- VTT International Ltd, Matias Markkanen, CEO
- VTT Memsfab Ltd, Howard Rupprecht, CEO

VTT's business areas



KNOWLEDGE INTENSIVE PRODUCTS AND SERVICES

The key R&D aims of our business area are applications – which involve the versatile exploitation of digitalisation – for industry, healthcare and intelligent environments. In these sectors, we operate globally in collaboration with Finnish and international companies and research institutes. Our services and expertise cover the entire technology chain ‘from silicon to cloud’, from micro-electronics to digital services.

We focus on sensors and measuring systems, telecommunications for critical infrastructure, cyber security, analysis methods for large data volumes, and innovative manufacturing technologies for nano, micro and printed electronics. Key application areas include the industrial internet, diagnostics, health technology and the digitalisation of society.

The aim of metrology research is new, customer-driven measurement and traceability solutions meeting the needs of industry, research and societal decision-making. We champion a market-oriented, ‘from research into business’ model.

SMART INDUSTRY AND ENERGY SYSTEMS

Our goal is to create a new competitive edge by producing smart solutions for industry and energy systems. We are boosting the prospects of manufacturing industry by developing new industrial innovation ecosystems and solutions based on the industrial internet. Parallel development of technology and business models is a key element in our R&D.

To promote the restructuring of the manufacturing sector, we develop new materials, design and simulation methods, and manufacturing automation solutions. We create low-carbon and intelligent solutions for energy production, transmission, distribution and use. A major international research theme is intelligent transport; we are studying this area in partnership with device manufacturers, route planners and service providers. Our services are based on our strong material and modelling competencies and our understanding of industrial operations and the social infrastructure.

SOLUTIONS FOR NATURAL RESOURCES AND ENVIRONMENT

Our business area focuses on the sustainable use of Finland’s key natural resources. We create solutions for the circular economy and cleantech sector in particular, by developing value-adding products, resource-efficient technologies and process management.

Our operations are based on our strong expertise in biotechnology and food technology, thermochemical processes, biomaterials and chemical technology. Our research and development services are complemented by a wide range of pilot facilities, strong modelling expertise and the techno-economic and environmental impact assessment of processes and production concepts.

With regard to the future, we are particularly interested in value-adding cellulose products, new circular economy technologies and business concepts, the use of carbon dioxide as a raw material, and the digital revolution in the food chain.

Subsidiaries' services accelerate market entry for products



VTT EXPERT SERVICES LTD

Together with its subsidiary, Labtium, VTT Expert Services Ltd offers commercial expert services and assessments; certification and approval services; testing, inspection and analysis services; and calibration services. The key aspects of these services have been accredited by Finland's national accreditation service, FINAS. Our accreditations cover over 1,300 standards. Labtium and VTT Expert Services Ltd have the necessary notifications to act as a Notified Body. In addition, VTT Expert Services Ltd is a certified product approval body.

VTT Expert Services Ltd is an independent, third-party testing, inspection and certification organisation. It executes

its customer assignments fairly, impartially and confidentially. Independence is ensured, while taking account of personal, financial, organisational and operational aspects on a project-by-project basis. A wide range of services help the customer to meet the challenges of rapidly changing markets. They support the customer's product development and commercialisation activities as well as maintenance throughout the product lifecycle. In turn – through geo, fuel and environmental analysis in particular – Labtium Ltd produces information for its customers' production processes and quality control. Demand for the two companies' services is arising due to regulations, as well as deficiencies and development needs in production and products.

The services are also needed in production process management.

VTT Expert Services Ltd bought the vehicle and machinery measurement and testing services of Natural Resources Institute Finland. The services were transferred via the acquisition as of June 1, 2016. The accreditations and external authorisations related to the services were also transferred. These will markedly broaden our range of services for testing vehicles and machinery.

Raising profitability and competitiveness has been a key development area for both companies. This has led to the redesign of customer work and the content of the service range, and enhanced operational efficiency. Achieving higher profitability requires an improved capacity utilisation rate, but the sluggish economy has reduced the opportunities for organic growth. Many of the services are sectoral, and special expertise is required in order to provide them. Demand has been growing slightly for various certification services. New demand has been met by developing and expanding accreditation packages.

At the end of the period, VTT Expert Services Ltd's accreditation services comprised testing, inspection, calibration and certification activities covering 33 accreditations, and 9 authorisations as a Notified Body. The quality management system has been certified in accordance with ISO 9001 and ISO 14001. Almost all of Labtium Ltd's testing and analysis functions have been accredited.

VTT VENTURES LTD

VTT's spin-offs are early-stage, technology-intensive growth companies. Technological and commercial innovation, team competencies and international potential are the key criteria when selecting target companies. VTT Ventures' mission is to develop commercialisation-ready prototypes from the most promising technologies. Its activities are one of the keys to creating new companies with investment potential.

VTT Ventures Ltd works in close collaboration with other actors in the innovation network. Its investments in portfolio companies are market-based and follow the same principles as venture capital investors. In Finland and internationally, VTT Ventures has an extensive partner network with venture capital investors.

The year 2016 was a period of active investment. VTT Ventures made investments of over EUR 3 million, investing in four new spin-offs in 2016. There were 22 companies in the portfolio at the end of the year. In 2016, these compa-

nies attracted around EUR 18 million in new capital. The financial year was profitable for VTT Ventures.

VTT MEMSFAB LTD

VTT Memsfab Ltd operates as part of Micronova's manufacturing services, in the 'Knowledge intensive products and services' business area. The company started as a contract manufacture of micro and nano-electronics components and materials in early 2011. The final product is typically a silicon disc processed and characterised in line with the customer's specifications, and containing sensors and detectors or the related parts. Future growth is primarily expected to come from optical components.



Domestic and international cooperation

Domestic and international cooperation within larger RDI communities gives VTT a chance to promote solutions to grand challenges of the society. VTT is closely linked to European innovation initiatives.

DOMESTIC COOPERATION

VTT plays a key role in national innovation partnerships and the building of networks. In its strategy, VTT emphasises more intensive, closer and proactive cooperation in areas considered critical to Finland, alongside national and international research institutes, universities and other higher education institutions, and the business sector. VTT has implemented its strategy through a strong network of R&D&I operators that enhances the use of Finnish research and development resources, while clarifying the division of duties between VTT and other actors.

VTT has been helping to achieve the objectives of Finland's growth strategy (in the strategy's main areas: the bio-economy, cleantech, digitalisation and health). VTT aims to reduce the fragmentation of R&D&I activities, by promoting the formation of subject-focused centres of expertise. The aim is cooperation based on supplementing the strengths and expertise of the actors involved, and combining academic with applied research all the way through to commercial product development. Built around the bioeconomy, the partnership between Aalto University and VTT is a good example of this. In addition to normal project collaboration, such partnerships include a joint research infrastructure funded by the Academy of Finland (bioeconomy infra), and joint professorships. Another concrete example is the SMACC alliance between VTT and Tampere University of Technology, which is seeking the more effective commercialisation and leveraging of research into intelligent manufacturing technology. A special focus of this alliance involves championing the innovation capabilities and regeneration of SMEs in the sector. The third concrete example is the PrintoCent community, a unique innovation centre based in Oulu which focuses on printed intelli-

gence and optical measurement technology; several new companies have been established as a result. PrintoCent's founding members are VTT, the University of Oulu, the Oulu University of Applied Sciences and Business Oulu.

In Finland, VTT engages in active cooperation between stakeholders (ministries, research funding agencies, industry associations, universities and colleges, research institutes, municipal and regional administration) in order to foster regular information flows and a common vision of Finland's priority areas.

EUROPEAN COOPERATION

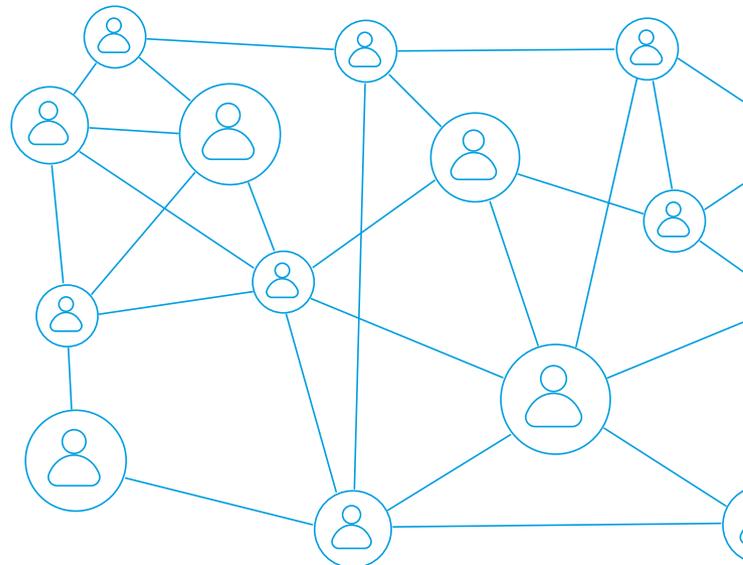
VTT's risk-taking ability and broad technology portfolio have created the basis for its participation in international cooperation. In today's world, networking, cooperation and combined competencies are needed to develop Finland's national knowledge base. In 2016, VTT was engaged in 460 (2015: 445) international public research projects. Joint European (H2020, FP7, CIP, RFCS, EIT, Art 185, ERA-Net, Eureka, Euratom, ESA, NORDFORSK) programmes form the core of VTT's international research activities. Extensive networks, positive visibility and active involvement in EU projects can provide an important springboard for Finnish innovation. VTT's EU project portfolio consists of a number of multi-year programmes and various funding instruments requiring a strong command of funding rules and contract law. EU's research and innovation framework programme is most significant in terms of volume.

The Horizon 2020 Programme is part of the Europe 2020 Strategy in areas such as employment, research and innovation, climate change and energy, education and the elimination of poverty. H2020 is important for VTT. By the end of 2016, VTT had altogether 142 positive funding agreements in H2020 and 111 H2020 projects (2015: 60) were running at VTT in 2016. VTT is active in the Industrial Leadership Pillar (Pillar 2) ICT, nanotechnologies, advanced materials, advanced manufacturing and processing, and biotechnology – and in the Societal Challenges Pillar (Pillar 3) involving raw materials, energy and climate challenges. In spite of extreme

competition, VTT has maintained its position as a major player in Europe and Finland's largest recipient of the EU research funding.

VTT works in close collaboration with industry and in our H2020 projects we highlight the renewal of industrial value chains and sustainable competitiveness in Finland and Europe. To achieve these objectives, VTT is making a major contribution to the development activities of regional innovation ecosystems and networking between local centres of expertise. VTT is playing a key role in forming a Finnish approach to the strategic initiative, launched by the Commission in 2016, for the development of Digital Innovation Hub (DIH) networks at EU level.

Long-term cooperation with various networks and communities is required in order to be part of priority-setting in European RDI policy and programmes. VTT is active in industry-relevant forums, such as ETPs (European Technology Platforms) and PPPs (Public Private Partnerships, particularly Photonics, BigData, Robotics, CyberSecurity, FoF, SPIRE, E2B, ECSEL, BBI and FCH). VTT is also involved in three Knowledge and Innovation Communities (KICs) of the European Institute of Innovation and Technology (EIT Digital, EIT Raw Materials and EIT Food). The common vision of



European RTOs (Research and Technology Organisations) is being promoted via active participation in EARTO (European Association of Research and Technology Organisations). VTT takes a constructive approach in stakeholder dialogue with European Institutions, examining issues in a broad innovation policy context across traditional administrative boundaries.

Principal European RTO alliances and expert groups for VTT

- EARTO – European Association of Research and Technology Organisations
- EERA – The European Energy Research Association
- EIT Digital – European Institute of Innovation & Technology
- EIT Raw Materials - European Institute of Innovation & Technology
- JIIP – Joint Institute for Innovation Policy
- NULIFE/NUGENIA – Nuclear Generation II and III Association

VTT in Finnish research alliances and co-operation forums

- Finnish Bioeconomy Panel
- FSA - The Finnish Service Alliance
- PrintoCent Innovation Centre for Printed Electronics
- FIIF – Finnish Industrial Internet Forum
- SMACC – Smart Machines and Manufacturing Competence Centre

VTT in the Academy of Finland's Centres of Excellence

- Finnish CoE in Atomic Layer Deposition (ALD) (2012 - 2017)
- Finnish CoE in Low Temperature Quantum Phenomena and Devices (2012 - 2017)
- Finnish CoE in Molecular Engineering of Biosynthetic Hybrid Materials (2014 - 2019)

Sustainable development at the heart of VTT



We take account of the principles of sustainable development in research and development and in our internal operations. Our reporting on corporate responsibility follows GRI guidelines. We describe examples of corporate responsibility in this review, and publish a report of selected GRI indicators on the VTT website (www.vttresearch.com).

SOCIAL RESPONSIBILITY

The focus areas of VTT's research – bioeconomy, low-carbon energy, digitalisation, cleantech, resource-efficient production, and health and well-being solutions – target a better living environment and a sustainable economy. Our spearhead and innovation programmes realise the goals of our research focus areas. Our research activity produces a stream of totally new, sustainable solutions to the major challenges facing society. According to studies, the utilisation rate of our research results is extremely high, which means that VTT has a highly important impact in promoting sustainable development. Our research results and experts are also widely called upon as a basis for public decision-making on the journey to a society founded on sustainable development.



RESPONSIBILITY FOR OUR OWN PERSONNEL

Together with the pension insurance company and occupational health care, VTT engaged in well-being at work projects, to improve employee well-being and the organisation's productivity. Various new projects with this aim will begin in 2017.

Systematic competence development and training, and work-based learning, form a key element of our responsibility for our own employees.

Calculated using the Zero Accidents forum method, the frequency of accidents in the parent company rose slightly compared to the previous year, at 2.12 per million working hours. The accident frequency rate throughout VTT Group was 2.19, which was somewhat higher than last year. One occupational accident resulted in a longer absence. It occurred when an employee twisted an ankle, after stumbling while walking in a laboratory (51 days of sick leave). Because only one accident, and no serious ones, occurred in the parent company, the gravity of accidents fell markedly compared to the previous year (8.9 days of sick leave per single accident).

An electronic system has been introduced for collecting, processing and reporting on safety observations made on rescue procedures, and occupational, fire and environmental safety. Operational training began in early 2016. In recent years, a large proportion of accidents have occurred due to slipping and tripping over while walking. This led VTT and accident insurance company IF to offer staff non-slip grippers for shoes. Almost half of the employees took up the offer. In addition, IF trained managers in accident and incident investigation.

We implemented the 2016 projects of the three-year plan for 2015–2017, developing environmental and occupational health and safety according to plan. The themes were the occupational health and safety culture and its development, strengthening the supervisory chain as QEHS actors, the common workplace, and cleanliness and order. Supervisors diligently engaged in occupational health and safety tours throughout our organisations.

RESPONSIBILITY FOR THE ENVIRONMENT

VTT Technical Research Centre of Finland Ltd has ISO9001 and ISO 14001 quality management systems in place, certified by DNV GL Business Assurance Finland Oy Ab.

There was a gap year in spot checks required by the Energy Efficiency Act. Electricity consumption was, by and large, at the same level as 2015 (-0.8%), despite the

mid-year addition of the Centre for Nuclear Safety and the Vakola office of VTT Expert Services Ltd.

VTT bought and cancelled a quantity of emission allowances from its EU emissions trading quota; these were equivalent to the CO₂ emissions (86 tonnes) of VTT's car fleet in 2015. VTT used an electric car in 2016, which was driven a total of 9,335 kilometres or just under 2% of the kilometres driven in VTT cars.

The number of flights continued to decline in line with the target, with a reduction of 3% in comparison to 2015. A markedly higher reduction in CO₂ emissions was achieved: almost 19%. The use of private cars has grown over the last five years, despite the fact that we encourage the use of VTT's own and rental vehicles, most of which are under three years old and therefore lower-emission than the car stock on average.

There was no further reduction in the amount of paper bought although, for 2016, this estimate is based on consumption early in the year. The previous fall in the number of printouts gave way to a rise of just over one percent from last year's minimal level. White paper disposal volumes returned to their normal quantities, despite the fact that several employees moved out of a few addresses. Eco products account for just under a quarter of purchase volumes of office equipment and around a third of unit volumes.

VTT does not operate in ground water areas, but in Espoo it does operate close to the Laajalahti Natura Nature Reserve. Monitoring of the oil spill from the Otaniemi metro building site revealed very small contaminant concentrations in wastewater sewers, at 1.5% of the threshold values given in the permit decision. It is proposed that the number of samples taken in 2017 be reduced to two from the previous three. In 2016, Environmental Deed of the Year 2015 was awarded for the switch to recyclable printer cartridges.

RESPONSIBILITY FOR RESEARCH ETHICS

In February 2016, the media ran stories of suspected research misconduct relating to a scientific article on diabetes research and concerning the Human Metabolomics Research Group. VTT commissioned five external rapporteurs to investigate the matter. No evidence was found of misconduct or the violation of good scientific practices. The researchers in question lodged a complaint, with the Council for Mass Media, about the Helsingin Sanomat articles which had raised the suspicions. The Council upheld the complaints against the Helsingin Sanomat newspaper on two counts.

Tax footprint, management and control

TAX FOOTPRINT

Tax footprint describes the amount of tax revenue a company generates for society, and how tax is paid between different countries. VTT reports taxes paid, and entered in the accounts, as part of its tax footprint. Transparent reporting of its tax footprint forms a key part of VTT's corporate responsibility activities. In each case, VTT complies with local legislation on the payment, collection, book-entry and reporting of taxes.

High quality and timely management of tax returns and other statutory obligations form a key part of VTT's management of its tax and related affairs.

At the end of the fiscal year, VTT Group consisted of four 100% owned subsidiaries in addition to the parent company: VTT Expert Services Ltd, VTT Memsfab Ltd, VTT Ventures Ltd and VTT International Ltd. In addition, VTT Expert Services Ltd owns Labtium Ltd and VTT International Ltd owns VTT Brasil Pesquisa e Desenvolvimento LTDA. VTT Brasil LTDA ceased operating in 2016 and the winding up of the company was begun via normal liquidation. The termination of the company will be completed in early 2017. At the end of 2016, VTT Ventures Ltd owned 22 associated and other companies (spin-offs).

VTT Ventures Ltd's associated companies are not included in VTT Group's tax footprint reporting. VTT has no subsidiaries in low-tax countries.

Like other public limited liability companies, VTT Ltd and its subsidiaries are obliged to pay statutory income tax and value added tax based on their business revenue.

In accordance with the act on VTT's incorporation (761/2014) the Finnish state shall compensate VTT for VAT costs paid on activities other than those incurred through purchases and office rental related to business activities pursued on a commercial basis as defined in 1:1, clause 1 of the Value Added Tax Act (1501/1993).

The compensation is adjusted annually on the basis of the most recent accumulation of value added tax for the Company. VTT Ltd did not generate any taxable income. It has confirmed losses, as well as statutory reserves

entered in its opening balance sheet; statutory reserves used to pay realised costs do not constitute taxable income in this respect. These items have not been recognised as deferred tax assets in the company's financial statements. However, deferred tax assets have been taken into account in the consolidated financial statements in accordance with the prudence principle, by recording half of their total amount, EUR 12 million, in deferred tax assets. The Group's subsidiaries have also confirmed losses subject to taxation. In the subsidiaries' accounts, no deferred tax assets have been recognised in relation to confirmed losses, in accordance with the prudence principle.

Since VTT Korea and VTT Brasilia, which form part of the Group's subsidiaries, account for a total of EUR 0.1 million (2015: EUR 0.2 million) of all of the subsidiaries' taxes, they have no material impact on tax footprint reporting. The relevant taxes and charges are listed in the table by tax category; VTT Ltd is reported separately and the subsidiaries as a whole.

The Group's effective income tax rate in 2016 was 0.0%. Most taxes were booked in Finland.

In 2016 VTT Ltd was paid a total of EUR 19 million in VAT compensation by the Ministry of Economic Affairs and Employment for non-business-related purchases and office rents (2015: EUR 19 million). EUR 16.0 million in VAT compensation was used during the financial year (2015: EUR 16.3 million). In 2016 VTT Ltd realised general state funding of EUR 77.2 million (2015: EUR 85.4 million). In addition, it received a EUR 1.0 million state investment subsidy (2015: EUR 1.1 million) and a total of EUR 5.7 million in investment subsidies in general (2015: EUR 4.3 million).

The tax reporting of VTT Group is audited by VTT's auditor, Authorized Public Accountants KPMG Oy Ab, to the extent that such reporting is included in VTT's financial statements.

GOVERNANCE AND CONTROL SYSTEM

VTT complies with the corporate governance principles defined by the Board of Directors. In all decision-making

	Consolidated figure for group		Group's parent company		Group's subsidiaries	
	2016	2015	2016	2015	2016	2015
Taxes paid						
Income taxes	0.0	0.0	0.0	0.0	0.0	0.0
Property taxes	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0
Recognised taxes						
Payroll taxes	34.3	36.0	31.1	32.9	3.1	3.1
Social security contributions	2.7	2.7	2.4	2.4	0.4	0.3
Value-added taxes	11.0	11.1	7.8	7.8	3.2	3.3
Asset transfer taxes	0.0	0.0	0.0	0.0	0.0	0.0
Other taxes	0.0	0.0	0.0	0.0	0.0	0.0
	48.0	49.9	41.3	43.1	6.7	6.8
Grand total	48.0	49.9	41.3	43.1	6.7	6.8
% share	100%	100%	86%	86%	14%	14%

and governance, the company complies with Finnish laws and regulations and the Articles of Association.

The tasks of VTT's and its subsidiaries' various bodies are governed by the laws of Finland. VTT complies with the corporate governance principles defined by the Board of Directors, which are based on the Finnish Companies Act.

VTT is committed to the Finnish Corporate Governance Code. The company has deviated from the Corporate Governance Code (2015) as follows:

Recommendation 3 – Not all candidates for Board membership participated in the Annual General Meeting of 3 May 2016.

Recommendations 18a and 18b on a Nomination Committee – Given the scope and number of issues to be prepared in relation to recommendations 18a and 18b, a Nomination Committee is not considered necessary. The Board of Directors is responsible for the tasks in question.

Recommendation 23 – Remuneration and shareholding of the Board of Directors. This recommendation states that Board and committee remuneration can be paid in full or in part in company shares and that shareholding by Board members promotes good governance. VTT is a wholly state-owned limited liability company, the ownership of which is fully held by the State. For this reason, VTT does not pay Board and committee remuneration in shares.

The Corporate Governance Code can be found at: <http://cgfinland.fi/files/2015/10/hallinnointikoodi-2015finweb1.pdf>.

VTT and its subsidiaries form a group in accordance with the Companies Act. VTT prepares its consolidated financial statements, the parent company's financial statements and its annual report in accordance with the Finnish Accounting Act and regulations, and the Finnish Companies Act.

Internal control

Internal control and risk management aims to ensure the identification, assessment and monitoring of risks affecting the company's business activities.

All planning and reporting procedures are used as tools for internal control and risk management.

The control environment is based on the values defined in the strategy, and defined and monitored processes and guidelines. Performance targets, based on which personal targets are agreed in development discussions, are set in VTT's interactive strategic and annual planning.

The compliance function was activated and a whistle blowing channel and stakeholder notification procedure were introduced at the end of the year. One internal notification was made via the channel, which is still pending. The Ethical Committee made four statements on issues related to research ethics.

Audit

The company's auditor must be an auditing body approved by the Central Chamber of Commerce. The auditor's term expires at the close of the subsequent Annual General Meeting. On 3 May 2016, the Annual General Meeting decided that Authorized Public Accountants KPMG Oy Ab (Business ID: 1805485-9) shall act as the principal auditor APA Jorma Nurkkala.

A more detailed description of the activities of the Board, internal control and risk management is available on our website (www.vtt.fi/vttreview2016).

VTT yesterday and today

75 years of results from technology

From the outset, VTT has partnered with the private sector in developing new technological solutions and has provided information in support of societal decision-making. Its research findings have been used in all fields of technology. They have also provided a springboard for spin-off businesses.



The 1940s

When VTT began operating in 1942, it focused on material research and testing. VTT developed products such as non-combustible roofing felt and wood materials for the army. In the years just after the war, VTT's food research mainly involved the quality monitoring of foodstuffs.



The 1950s

There was an increasing need for research and testing in industry. By the mid-1950s, VTT was already performing over 6,000 tests to order. It studied new, replacement building materials in its Civil Engineering Laboratory. VTT expanded its operations to engage increasingly in scientific research as well as testing.



The 1960s

VTT became Finland's largest research institute in this decade. It invested in its own operations by purchasing new equipment for activities such as corrosion studies, to be applied on vehicles and ships. A new wood processing technique saved on raw materials and improved sawing results. A new test brewery enabled the study of industrial processes in addition to the properties of yeasts and cereals.



The 1970s

VTT found new research themes in the energy crisis afflicting Finland and the emergence of environmental issues. A pilot fermenter enabled the study of bio-technical processes, such as the production of microbial enzymes, antibiotics and single-cell proteins. An autoclave built by VTT allowed it to simulate the actual corrosion conditions of nuclear power plants. By 1970, most of VTT's laboratories had been accommodated in new premises in Otaniemi.

VTT today and in the future



VTT promotes the development of production, technology and new products in the Finnish forest industry. New products are created by developing production processes and machinery, by using VTT's biorefinery and nanotechnology, and by combining biochemical diagnostics and electronic sensors with paper. New products include second-generation synthetic biodiesel, bioethanol, biofuel and bioenergy. Other future products include various biopolymers and bio-chemicals for the needs of the food, pharmaceutical and cosmetics industries.

Printed electronics will enable sensors to be combined, making it easier to integrate new functionalities with a range of products. Innovative new services and new business opportunities will be created via the social media, by combining sensors, information networks and knowledge.

New biotechnology applications will provide new opportunities in food production, for example.

OUR MISSION: TO CREATE A BRIGHT FUTURE

VTT has been producing innovative technology solutions – which improve the performance of Finnish businesses and people's quality of life – for 75 years. However, we are always looking ahead.

In honour of the anniversary of Finland's independence, we invite partners to participate in our VTT100 project and solve key business and societal challenges.

Learn more and come on board: www.vttresearch.com/vtt100



The 1980s

The use of computers proliferated in machine and equipment design. Designers could use CAD and CAM technology to test various alternatives quickly and cheaply. VTT was actively involved in developing the mobile phone. The world's first video phone was developed at VTT in 1984, but the time was not ripe for its commercialisation.



The 1990s

New, rapidly developing solutions in information technology, electronics and wireless communications were subjects of intensive study and trials. EMFI plastic provided novel solutions for sensor technology and the development of active sound elements. VTT also participated in international activities such as the space science programme of the European Space Agency. VTT began virtual prototyping, using digital computer models in support of product development and to reduce costs. Biotechnology became a growing field of research.



The 2000s

VTT's core research areas included low-energy and production technology solutions, and new technologies enabling sustainable development. VTT did pioneering research in areas such as the development of biofuels and energy solutions for construction, and the development of printed intelligence technologies. VTT also developed new wireless communication solutions, and RFID and mobile phone solutions. Nanotechnology opened up new frontiers in technology.

Dynamic VTT continues to secure Finland's growth

Throughout the years, VTT – which turned 75 at the beginning of 2017 – has been developing ground-breaking new technologies, bringing technological expertise to society and enterprises as a basis for innovative business creation together with customers. VTT's applied research has played a key role in creating practical applications from research results, in partnership with various industrial sectors.

VTT's research focuses have always emerged from the needs of Finnish industry and society. For example, VTT moved on from its early days of developing welding technology to CAD and CAM system development and then, based on research, to the current digitalisation and virtual reality based production methods. VTT's radio technology research provided the springboard for the development of mobile phone and other ICT. New opportunities have been created for the forestry industry through nanocellulose and biofuel innovations. Finland also remains a pioneer in the development of fluidised bed combustion techniques for power plants. VTT has been a key part of Finland's internationally unique innovation system.

The speed of change has kept accelerating to the point where, in 2017, keeping up with the global competition means being able to reinvent yourself and innovate continuously and faster than ever. Only those who can learn new things fast enough – and create new businesses from them – will survive. VTT's duty is to be active in ringing the 'innovate or die' alarm bell for Finland and companies based here.

The needs of most of VTT's customer sectors are changing at an accelerating pace due to developments such as digitalisation; to remain a technology leader and attractive as a partner, VTT needs to reinvent its own expertise and practices as quickly as, or even faster than, its customers. Last year, VTT's own renewal was accelerated by a strategy process seeking new growth paths. All VTT staff are participating in this in one way or another. It has been great to see the resulting excitement and discussion which, I hope, will ripple outwards and help to find better ways of making an impact – bringing renewal and growth to Finland.

Aaro Cantell
Chairman of VTT Board

VTT BOARD



Aaro Cantell
Chairman,
Normet Oy
M.Sc. (Tech.),
born 1964

Meetings of the
Board of Directors
11/11
Remuneration
Committee
2/3



Matti Hietanen
CEO
Terrafame Group Oy
M.L., M.Sc. (Econ.),
born 1977

Meetings of the
Board of Directors
11/11
Remuneration
Committee 3/3
Audit Committee
4/5



Kari Knuutilla
CTO
Outotec Oyj
D.Sc. (Tech.),
born 1958

Meetings of the
Board of Directors
10/11
Audit Committee
5/5



Harri Leiviskä
CFO
Suunto Oy
MBA (CU),
M.Sc. (Econ.),
born 1968

Meetings of
the Board of
Directors 9/11
Audit Committee
5/5



Petra Lundström
VP, Nuclear
Development
Fortum Power
and Heat Oyj
M.Sc. (Tech.),
born 1966

Meetings of the
Board of Directors
11/11
Remuneration
Committee 2/3



Anneli Pauli
Prof.
D.Sc., born 1955

Meetings of
the Board of
Directors 11/11



**Kaija Pehu-
Lehtonen**
SVP, Business
Development
Metsä Fibre Oy
M.Sc. (Tech.),
born 1962

Meetings of
the Board of
Directors 10/11
Audit Committee
5/5

Unique R&D infrastructure

An essential part of the national research infrastructure

VTT's unique R&D infrastructure enables the development chain from basic research and process development up to prototyping and pilot manufacturing. Our research facilities are an essential part of the Finnish research infrastructure.



Finance and personnel

Key indicators 2016

FINANCE

	VTT Technical Research Centre of Finland Ltd			
	VTT Group		Parent company	
	2016	2015	2016	2015
Net turnover (1,000 €)	188,378	184,538	162,572	157,915
Other operating income (1,000 €)	80,875	87,357	86,430	92,577
Government grant	77,235	85,384	77,235	85,384
Other	3,640	1,973	9,195	7,193
Profit for the financial year (1,000 €)	-244	3,333	1,442	2,729
Profit for the financial year (%)	-0.1%	1.8%	0.9%	1.7%
Return on equity (%)	-1.1%	2.6%	1.0%	2.1%
Equity ratio (%)	67.3%	65.5%	66.9%	65.2%

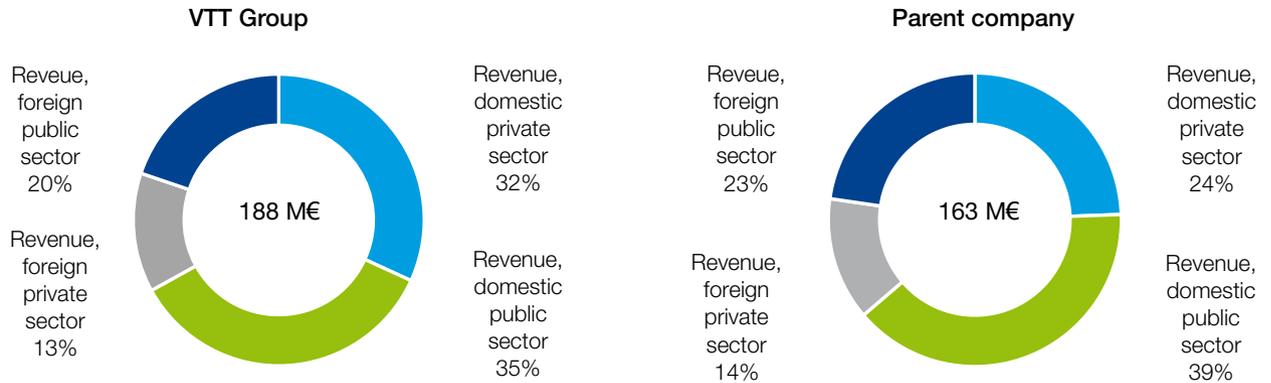
VTT Technical Research Centre of Finland Ltd's net turnover consisted of 62% public sector revenue and of 38% private sector revenue. The domestic revenue accounted for 64% and foreign revenue for 36% of the net turnover. Of the foreign revenue 83% came from Europe, 10% from North and South America, 6% from Asia and 1% from elsewhere.

PERSONNEL

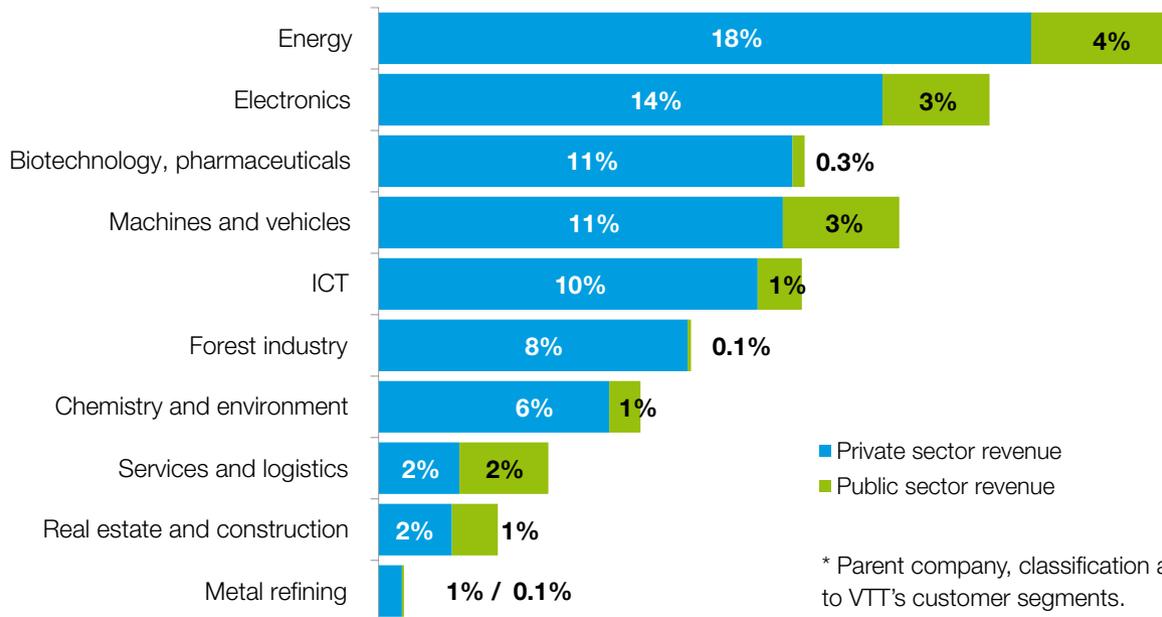
VTT Technical Research Centre Ltd had an average of 2,159 employees during the financial year. Around 1,991 person years were worked during the same period.

	VTT Technical Research Centre of Finland Ltd			
	VTT Group		Parent company	
	2016	2015	2016	2015
31.12.2016				
The average number of employees	2,439	2,532	2,159	2,252
- Management	132	145	110	123
- Scientists	1,577	1,609	1,454	1,487
- Research support	387	384	253	258
- Trainees	36	45	36	45
- Business support	282	287	275	279
Fixed-term contracts	182	166	170	155
Part-time contracts	238	205	211	182
Male	1,483	1,521	1,300	1,351
Female	931	949	828	841
Personnel costs (1,000 €)	152,298	155,880	136,986	140,858

TURNOVER BY TYPE OF REVENUE



VTT'S SALES REVENUE FROM COMMERCIAL ACTIVITIES*



PERSONNEL STRUCTURE

	VTT Group	Parent company
Total personnel	2,414	2,128
Scientists	65.3%	68.3%
Research Support	17.5%	13.6%
Business Support	11.7%	12.9%
Management	5.5%	5.2%

EDUCATION OF PERSONNEL

	VTT Group	Parent company
Doctors	23%	26%
Licentiates	5%	5%
Other university level degree	53%	53%
Lowest level tertiary education	5.5%	5.5%
General and vocational education	13.5%	10.5%

VTT publications

All publications:
www.vttresearch.com/publications

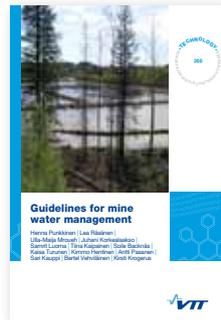
VTT employees publish research results in foreign and domestic science journals, in professional periodicals and publication series, as books, conference presentations or patents, and in the VTT publication series.



Added value from responsible use of raw materials

Päivi Kivikytö-Reponen,
Ulla-Majja Mroueh &
Jarno Mäkinen

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Guidelines for mine water management

Henna Punkkinen, Lea Räsänen,
Ulla-Majja Mroueh, Juhani
Korkealaakso, Samrit Luoma,
Tiina Kaipainen, Soile Backnäs,
Kaisa Turunen, Kimmo Hentinen,
Antti Pasanen, Sari Kauppi, Bertel
Vehviläinen & Kirsti Krogerus

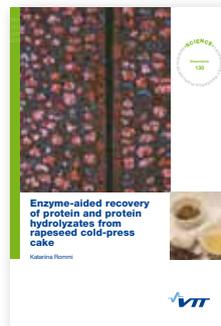
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Successful business at Finnish manufacturing companies beyond 2020 - Four scenarios

Jaakko Paasi & Nina Wessberg

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Enzyme-aided recovery of protein and protein hydrolyzates from rapeseed cold-press cake

Katariina Rommi

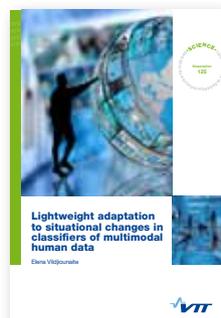
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The Industrial Internet in Finland: on route to success ?

Maarit Tihinen & Jukka Kääriäinen
(Eds.)

VTT Technology 278



Lightweight adaptation to situational changes in classifiers of multimodal human data

Elena Vildjiounaite

VTT Science 125

More information on VTT activities and research:
www.vttresearch.com

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Brighter future is created through science-based innovations

VTT Technical Research Centre of Finland Ltd is one of the leading R&D&I organisations in the Nordic countries.

We use our expertise in applied research to provide services for our domestic and international customers and partners, and for both private and public sectors.

We create impact through scientific and technological excellence, enabling companies to grow and the society to prosper.



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