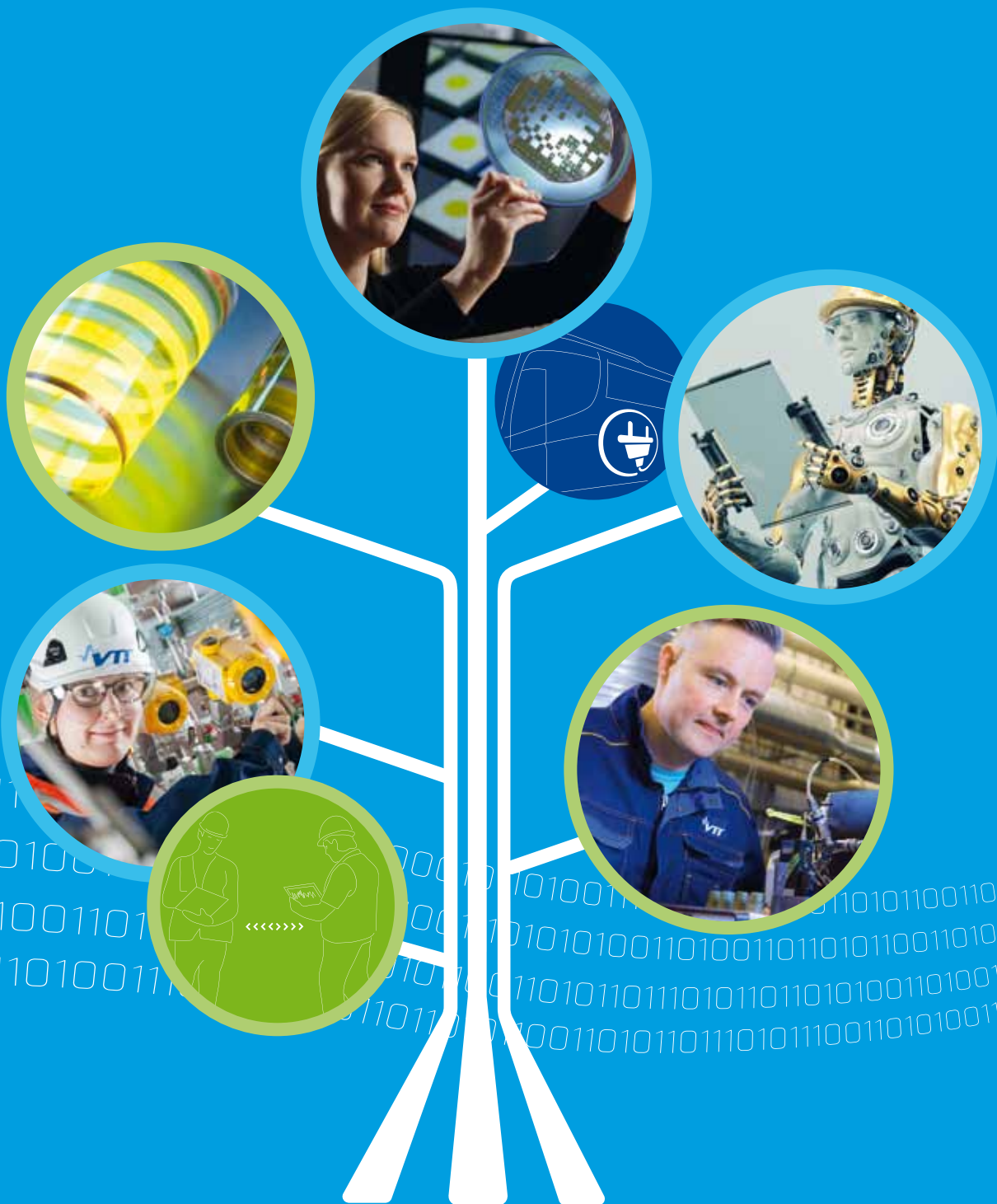




TECHNOLOGY FOR BUSINESS

VTT Review 2015



Contents

Page

- 3 Review by President & CEO
- 4 VTT - Technology for business

EXAMPLES OF RESEARCH RESULTS



6 Knowledge intensive products and services



10 Smart Industry and Energy Systems



14 Solutions for Natural Resources and Environment

- 18 We are building Finland's future together with our partners
- 19 VTT's research programmes support the business sector and society
- 21 Domestic and international cooperation
- 24 Unique R&D infrastructure
- 25 VTT has power
- 26 Impact of VTT
- 28 Awards and prizes
- 29 VTT publications
- 30 Subsidiaries' services accelerate market entry for products
- 32 Sustainable development as a key part of what we do
- 34 VTT's technology expertise creates competitiveness and growth for Finland
- 35 VTT management group and organisation
- 36 Finance and personnel

Review by the President & CEO



” National technology development priorities in the Finnish Government Programme are a precise fit with the technologies chosen by VTT, which is playing a key role in building growth and well-being in Finland.

VTT's first year after its incorporation was successful, both financially and in terms of impact. Demand for research was brisk in all business areas, with some areas even experiencing a labour shortage. The first phase of Bioruukki, the largest Nordic bioeconomy research environment, was commissioned. Bioruukki enables the more rapid commercialisation of bioeconomy innovations. Concerns about cuts in public research funding dominated the national technology and innovation policy debate. Both VTT Group and the parent company recorded an operating profit.

VTT has had a challenging operating environment for many years, despite tentative signs of recovery in the Finnish business sector. The Finnish economy has yet to return to robust growth and R&D investments are at a standstill after several years of structural transition in the industrial sector. In public discussions, high hopes have been vested in new types of business operations and the growth of service exports. Digitalisation, cleantech, the bioeconomy and well-being and health were defined as national technology development priorities in the Finnish Government Programme. These themes are a precise fit with the technologies chosen by VTT, which is playing a key role in building growth and well-being in Finland.

VTT has been highly successful in competing for international research funding. It was involved in 445 international public research projects in 2015. VTT made a very strong effort in the initial EU Horizon 2020 programme application rounds. So far, it has maintained its position as the largest single recipient of EU research funding in Finland, as well as remaining a significant player at European level. Funding of this kind and multi-national research networks will play a very strong role in the future.

Commercial contracts increased from the previous year, both as a share of turnover and in terms of the total sum invoiced. Based on an increase of over EUR 2 million, European customers accounted for the sharpest rise in cross-border invoicing.

VTT has built a research and piloting centre for biomass refining in Kivenlahti, Espoo. Bioruukki offers companies an outstanding opportunity to create new technologies and fulfil the aims of the national bioeconomy strategy. It operates in priority cleantech areas for Finland: bioenergy, the manufacture of valuable products (such as biochemicals) from biomass, and recycling. Key project funding was granted by the Finnish Government for the further development of Bioruukki.

For VTT, publishing research results on premium forums is a key way of stepping up its impact. In 2015, a total of 614 VTT articles were published in scientific journals. Of these articles, 70% involved at least one external partner and 43% at least one foreign partner.

We were also highly active in inventions and patenting. Our IPR revenue reached a record level of EUR 2.8 million. Noteworthy licensed intellectual property rights include technology solutions for the processing of oats and production of bio-oil. 48 patent applications were filed on the basis of inventions and 292 new invention notifications were made.

VTT Ventures Ltd's investments in spin-offs, whose business is based on technology developed by VTT, provide a route for the commercialisation of research results. Its portfolio included 21 companies by the end of the year, which accumulated around EUR 8.2 million in new capital.

VTT Expert Services Ltd launched the new vtt-todistus.fi certification search service and the Omasertifikaatti.fi eServices portal. We are continuously developing our service portfolio, proactively adapting it to changing customer needs to leverage the potential of digitalisation, for example.

Antti Vasara
President & CEO

VTT - Technology for business



We use
4 million hours
of brainpower a year to develop new technological solutions.

Many industries and sectors are undergoing major structural changes. In addition, digitalisation is rapidly transforming the world, creating new opportunities in the industrial and service sectors and in everyday life. Technological innovations and the new practices they engender will lead to the creation of services that boost and ease business operations, while enabling greater international competitiveness and the identification of new business opportunities.

VTT produces research and innovation services and information in support of decision-making for companies, society and other customers, and creates the preconditions for sustainable development, employment and well-being in society. Our services cover the entire innovation process, from idea to commercialisation. We use over 4,000,000 hours of brainpower a year to generate new technological solutions. Together with companies and other actors, we are developing new business opportunities and participating in Finland's industrial transition through technology forecasting and proactive R&D in emerging growth areas such as digital health technology, transport automation, the bio and circular economy, and the reorganisation of the food chain.

Development of excellence requires network-based cooperation with the world's top players. VTT is a key operator in both Finnish and international innovation networks and research organisations. We connect Finnish companies and other actors, particularly with European value chains and EU projects. We have more than 2,000 internationally networked

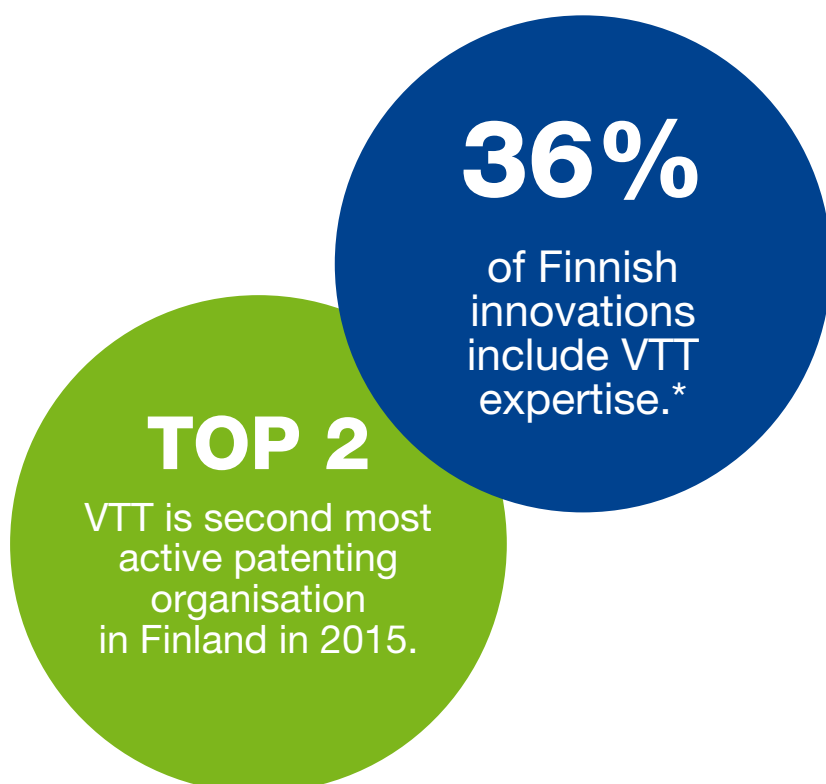
researchers, with over 300 ongoing EU projects each year. Alongside the private sector, VTT has also intensified its participation in selected global innovation environments.

In addition to its multidisciplinary expertise, VTT has unique research environments and facilities that enable an entire new product development chain – from basic research and process development to prototyping and small-scale production. In close cooperation with the customer, we create tailored solutions meeting each partner's needs.

In promoting innovation, VTT's input-output ratio is in a class of its own within Finland. VTT accounts for only around 4% of Finland's R&D volume. However, 36% of Finnish innovations have links with VTT's competencies. We are also strongly accelerating the regeneration of Finland's export industry and the growth of its SME sector. Following innovations with strong participation from VTT, turnover in Finland's main export sectors has grown by an average of 26% and among SMEs by 44%. According to the 2015 customer survey, our customers were highly successful in attaining their objectives through their VTT projects: 70% said that the results of VTT projects generated new or improved products, services or processes; 68% reported that their competitiveness had improved as a result of a VTT project.

A leading R&D research organisation in Nordic countries

We provide expert services for our domestic and international customers and partners, both in private and public sectors.



MISSION

VTT produces research services that enhance the international competitiveness of companies, society and other customers at the most important stages of their innovation process, and thereby creates the prerequisites for growth, employment and well-being.

CORE VALUES

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

ETHICAL STANDARDS

- Impartiality
- Reliability
- Integrity
- Responsibility

Turnover 185 M€
(VTT Group 2015)

Personnel 2,470
(VTT Group 31.12.2015)

Wide national and international cooperation network

Unique research and testing infrastructure

* 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>

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. Within these areas, we operate in global cooperation with domestic and international companies, providing services that cover the entire technology chain 'from chip to cloud'.

Our operations focus on information security solutions, telecommunications solutions for critical infrastructures, analysis methods for large data volumes, sensors and measurement solutions, and innovative nano, micro and printed manufacturing technology. Solutions for the industrial internet, digital health technology and the digitalisation of society are a particular focus area. Our metrology research explores precise measurement traceability solutions meeting the needs of industry, research and accredited laboratories. We champion a new type of market-oriented, 'from research into business' model.



Focus areas
Industrial internet
• Digital health
• Hyperconnected society

References

Online space for co-innovating services with users

CUSTOMER: F-SECURE CORPORATION

CHALLENGE

How to involve users in company's innovation process and to allow flexible interaction with consumers?

SOLUTION

Consumer study using VTT's Owela work space. It is open and innovative environment for the consumers to share their creative thoughts.

BENEFITS

- The results of the study were immediately actionable and impacted product portfolios and roadmaps.
- Online method has allowed continuous and rich interaction with consumers.
- Valuable insight on consumer long term usage behaviour.

Additional information

Harri Nurmi, Key Account Manager, tel. +358 40 571 7753, Harri.Nurmi@vtt.fi

” *For us this study was remarkable, because it not only offered immediate improvement ideas, but also gave us deep strategic insights about our customers and their behaviour.*

Ville Nore

Usability Specialist, User Experience
F-Secure Corporation

New features for augmented reality application

CUSTOMER: INGLOBE TECHNOLOGIES

CHALLENGE

How to get a robust, state-of-the-art 3D tracking engine for augmented reality solution?

SOLUTION

VTT provided important background technology and skills to develop a robust, template-based 3D tracking approach for standalone and mobile devices.

BENEFITS

- Ease of integration in Inglobe's platform.
- Solution matched the required flexibility and robustness and enables new application workflows.

Additional information

Harri Nurmi, Key Account Manager, tel. +358 40 571 7753, Harri.Nurmi@vtt.fi

” *Independently of the fact that we had a shared goal, we worked with VTT like if we belonged to the same team. Definitely, the team is friendly and professional at the same time.*

Graziano Terenzi

CEO

Inglobe Technologies Srl

Knowledge Intensive Products and Services

Examples of research results

VTT is committed to improving the capacity of enterprises and organisations to respond to the rising level of cyberthreats. VTT recently set up the **Cyber War Room**, where cybersecurity testing can be performed in a controlled environment, reliably and confidentially.



VTT coordinates a large EU Horizon 2020 project on **5G network and system security and resilience**. 5G-ENSURE follows an innovative "Security by Design" approach where **5G inherent security needs** are understood and addressed by design.



VTT has developed a new high-volume production method for **hot embossing microscopic channel structures** onto large areas of plastic film at a low cost for use, for example, in **wearable technology and cosmetic applications**. One of VTT's goals is to engineer a smart fabric adjustable with a mobile app for controlling the wearer's temperature.



VTT has developed a **miniature gas sensor** that can be connected to mobile devices. Gas measurements made with smartphones will make activities such as the **detection of internal air problems** easier.

Based on OLED technology and implemented by means of a printing machine, this method developed by VTT provides an opportunity to create **patterned and flexible light-emitting surfaces** on advertising **displays, info signs and lighting fixtures**, for instance.

The international UNISONO project supports the future human missions to Mars. A new **communication solution** allows orbiting space station in outer space to maintain **uninterrupted contact with robots** working on the surface of a planet.

VTT has developed a prototype of a **tree that harvests solar energy from its surroundings** - whether indoors or outdoors - stores it and turns it into electricity **to power small devices** such as mobile phones, humidifiers, thermometers and LED light bulbs.



Spin-off company Dispelix Oy will commercialise a new display which brings **visual information** directly into the user's field of vision, as a **high-definition image on an eyeglass lens**. This will enable smartglasses to replace even smartphones or tablets, while still allowing users to see the world around them.

VTT and the Japanese research institute AIST are studying how the adoption of **ICT-based applications designed for the elderly will improve care service** both at home and in assisted living facilities with the help of, for instance, a robot assistant.

Read more:

www.vttresearch.com/kips_review2015

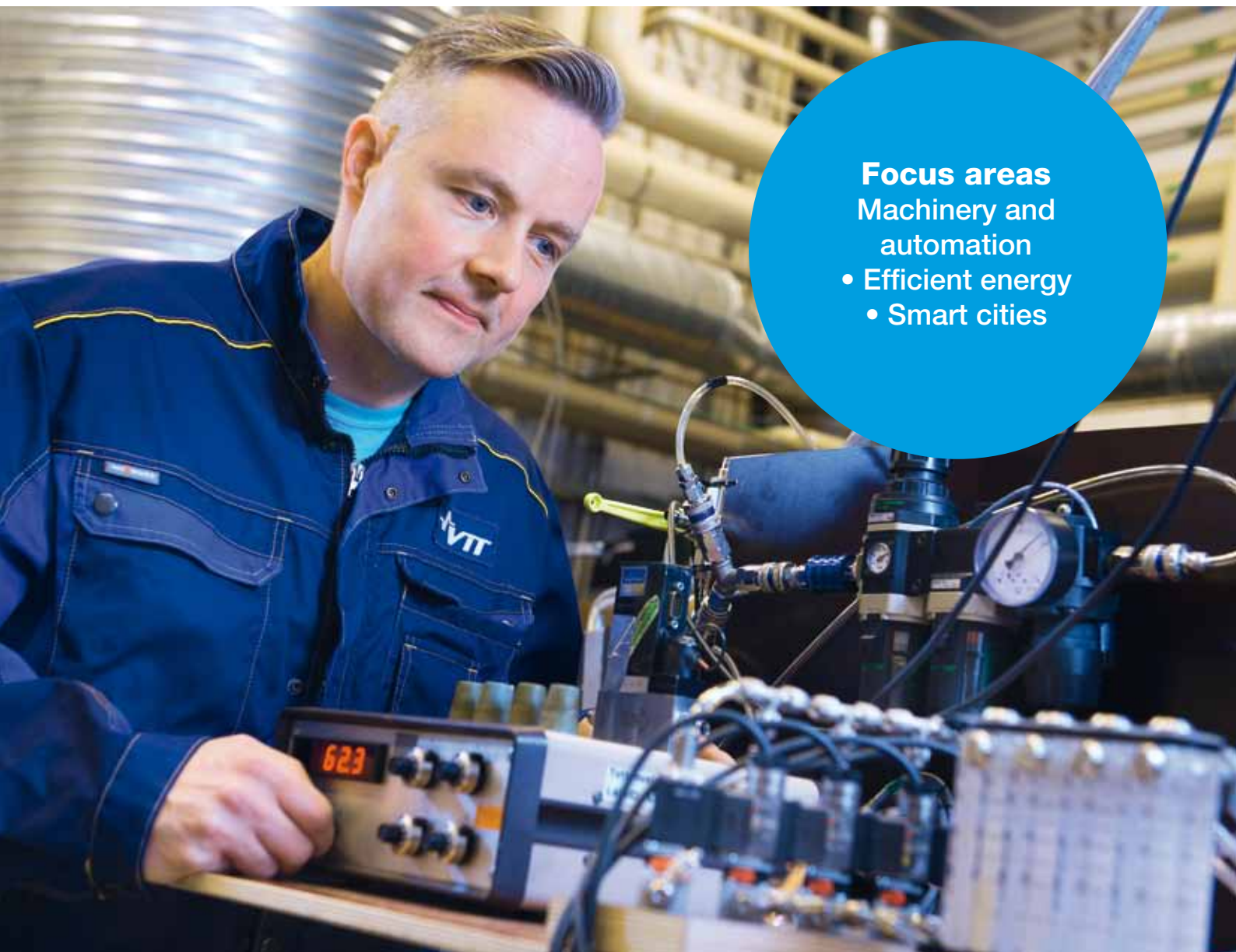


Smart Industry and Energy Systems

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.

In all of our activities, we aim to develop economically competitive solutions that combine resource efficiency and environmental aspects.



Focus areas Machinery and automation

- Efficient energy
- Smart cities

References

Spare parts and high tech solutions by AM

CUSTOMER: SANDVIK MINING AND CONSTRUCTION OY

CHALLENGE

- Leverage potential of Sandvik (unique AM chain coverage).
- Elimination of business leak to pirate part manufacturers.

SOLUTION

- A demanding component for a rock drill was manufactured with AM at VTT to prove feasibility of the method.
- A low volume simple spare part was printed and delivered in three days to customer.
- The component was successfully tested in the test bench.

BENEFITS

The company started a journey to find both novel applications and potential new business models based on AM technology.

Additional information

Tuomas Pinomaa, Key Account Manager, tel. +358 40 687 3054, Tuomas.Pinomaa@vtt.fi

” *The potential of Additive Manufacturing was proven by metal pilots. Our target is to leverage Sandvik Group competence by completing knowledge gaps using VTT research to ensure AM first steps to our core applications.*

Pasi Julkunen
R&D Manager
Sandvik Mining and
Construction Oy

VTT ProperTune® for design of wear resistant solutions

CUSTOMER: KONE OYJ

CHALLENGE

Control and improve wear performance of elevator components, predict lifetime in operational conditions, improve efficiency and enable systematic design of novel solutions.

SOLUTION

VTT developed and applied a modelling toolset based on VTT ProperTune® multiscale modelling solution. An engineering software tool for use in day-to-day design was deployed.

BENEFITS

- Enables design of novel solutions integrating material, component and system level features.
- A new design approach and tool for design of future products.

Additional information

Tuomas Pinomaa, Key Account Manager, tel. +358 40 687 3054, Tuomas.Pinomaa@vtt.fi

” *The creation of an engineering tool, together with the connection between tests at material and system level, helped to inspire use. We shall take advantage of this newly acquired knowledge based on VTT ProperTune® developments, in our future products.*

Petteri Valjus
Senior Expert
Kone Corporation, R&D

Smart Industry and Energy Systems

Examples of research results

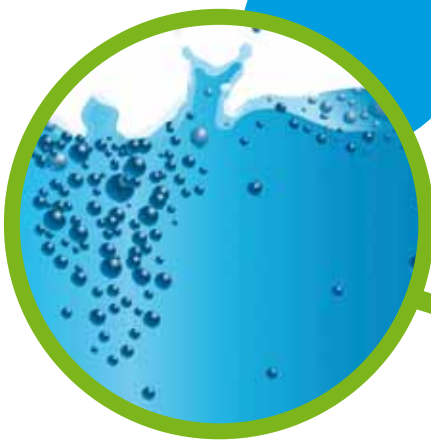
VTT and Nurmi Cylinders Oy have developed a cost-efficient, 3D-printed, reliable **hydraulic valve block** that is **66% lighter** than the original part.



In densely **built residential areas**, it is worth **generating renewable energy at local level**. Sulphur dioxide and particulate **emissions can be reduced by up to 70%** by using thermal tank energy storage.



VTT and TUT have secured a significant role under a **contract** signed by Amec Foster Wheeler **concerning the development of a remote handling system for ITER**, the world's largest fusion energy project. **High tech robotics, advanced technological tools, powerful computers and virtual reality platforms** developed in this project can be utilised also in other industries.



Convion Ltd and VTT will demonstrate **fuel cell systems for high-efficiency cogeneration of heat and power from biogas** produced in connection with waste water treatment in Italy. Fuel cell systems enable the generation of electricity from biogas that would otherwise remain unused or be burned for heat.

The first two Finnish Linkker **electric buses**, owned by Helsinki Region Transport (HSL) and manufactured based on a prototype developed by VTT started to operate in the metropolitan area. HSL will purchase a total of 12 buses from Linkker Oy.

Nearly all of the world's countries have announced **targets for reducing their greenhouse gas emissions**. **VTT's analysis of the targets from 159 countries** showed that even more ambitious reductions are needed in order to limit global warming to two degrees. Of the high-emitting countries, the one with the most room for improvement is China.

With the help of research by VTT, the Finnish Air Force has succeeded in **increasing the operational life of the high pressure turbine blades of its Hornet jet engines by 10%**. The saving for taxpayers is an estimated 3 million US dollars, or over 2.7 million euros.



For years, VTT has been cooperating with power plants and safety authorities to provide information and technology required for **safety assessments and safe use of nuclear power plants**. Nordic countries are co-developing new methods of making **seismic hazard estimates of anticipated earthquakes** in Fennoscandia. The results will also be important with regard to final disposal repositories for nuclear waste.

VTT's **robot innovation automates short production runs**. The quick-control system developed by VTT slashes substantially the programming time for industrial robots, enabling the use of automation also in short production runs of single-item products.

Read more:

www.vttresearch.com/ind_review2015



Solutions for natural resources and environment

VTT aims to become a global key player in the bioeconomy and environmental technologies. By developing various technologies and process management, we contribute to the sustainable use of key natural resources in Finland. We generate solutions for the bio and circular economy and the cleantech sector in particular – the Finnish Government regards these as major growth sectors of the future.

Sustainable development themes are highlighted in our research. We are supporting the development of the business sector in a time of structural change. In particular, we are helping the forest industry to thrive in the midst of a major transition. We provide our customers with research, development and piloting services. Biotechnology, thermochemical processes and chemical technology research form the basis of our services. We also engage in the assessment and modelling of processes and production concepts for various phases of the development path, from drawing board to industrial demo.



Focus areas

Bioeconomy

- Circular economy
- Cleantech

References

Pioneering an eco-friendly kitchen with biocomposites

CUSTOMER: PUUSTELLI GROUP

CHALLENGE

Build a kitchen concept that would minimize the environmental burden and carbon footprint of the product lifecycle.

SOLUTION

VTT developed biocomposite alternatives for kitchen furniture and conducted proof of concept tests.

BENEFITS

- Lighter material nearly 1/3
- Far stronger than chipboard
- Up to 30% reduced raw material consumption
- Carbon footprint reduced by 50%
- Diminished formaldehyde discharge

Additional information

Jouni Lattu, Key Account Manager, tel. +358 40 728 8519, Jouni.Lattu@vtt.fi

” *Without VTT’s expertise we wouldn’t have made the breakthrough that we did.*

Jussi Aine
CEO
Puustelli Group

Integrated bio oil production plant

CUSTOMER: FORTUM POWER AND HEAT OY

CHALLENGE

Create the world’s first integrated bio oil production plant and demonstrate the viability of bio oil as a replacement for fossil fuels in heat production

SOLUTION

VTT’s patented process integrates a fluidized-bed boiler with pyrolysis. Produced in this way, bio-oil is more cost-efficient than when produced in a separate pyrolysis process.

BENEFITS

- A short timeline from research to demonstration
- Replacement of fossil fuel in the generation of heat and power
- Efficient use of forestry waste streams

Additional information

Marko Nokkala, Key Account Manager, tel. +358 40 765 8706, Marko.Nokkala@vtt.fi

” *VTT’s role in our research consortium has been crucial. Their long experience and world class competence in fast pyrolysis has enabled a fast track from research to demonstration.*

Jukka Heiskanen
Head of R&D, Heat Division
Fortum Power and Heat Oy

Solutions for natural resources and environment

Examples of research results

Fazer has secured a license to a **VTT technology to extract new functional ingredients from oats**, including oat beta-glucan, protein and oat oil. This technology will open up new opportunities for product groups in the dairy, dietary supplement, snacks and cosmetics industries.



Paptic Ltd's new patented technology enables the **manufacturing of a revolutionary new fibre product with plastic-like properties**. Paptic uses a new technology platform developed at VTT based on long-term research in fibre products and processes. The material can replace plastic, for example, in carrier bags and packaging.



Cellulose is a supermaterial of the future. This is the view of the VTT and the other collaboration partners who received a EUR 4.9 million grant to seek new design-driven applications for cellulose and develop related technology. These new materials and innovations can **replace fossil-based raw materials in textile products, interior decoration elements and car interior materials**.



Worn-out cotton clothing can be turned into new fibres for the fashion industry using a cellulose dissolution technique developed by VTT. A group of Finnish organisations launched a project to try out the new production technique in practice at all stages of the value chain.

VTT has coordinated the **roadmap work aiming to strengthening of protein self-sufficiency**. Means considered included increasing the production of protein-rich plants, more efficient exploitation of agro-food and fish chain by-products and side-streams, growing use of plant-based proteins in food, and new potential protein sources for food and feed.

AARRE research consortium focuses on **user centric business models of circular economy (CE)**. The goal is to solve how to transform the invisible global value of the CE into successful business boost of existing companies and new business of emerging companies.

VTT has demonstrated that **lignocellulosic biomass can be successfully converted into pure BTX chemicals**: benzene, toluene and xylene. The aim of this research is to enable the use of wood-based chemicals to replace crude oil in, for example, plastics, fuels, medicine and paints.



Foam forming technology offers companies **major cost saving possibilities** in paper and paperboard manufacturing. It also expands the use of natural fibres in the production of **recyclable and lightweight products**. Some products can even be lightened by 15–25%.

For centuries the same few yeast strains have been used in the production of lager beer, in contrast to ale, whisky, wine and cider, for which there is a wide range of yeast strains available to produce different nuances of flavour. VTT has been developing **hybrid lager yeasts so as to impart new flavour to the beer and accelerate the production process**.

Read more:

www.vttresearch.com/sonne_review2015



We are building Finland's future together with our partners

Our value propositions: Empowerment by digitalisation • Sustainability from smart communities • Competence from industrial ecosystems • Energy security from clean energy systems • Prosperity from natural resources.



In meeting the challenges facing the business sector and society, our selected focus areas are bioeconomy, low-carbon energy, digitalisation, cleantech, resource-efficient production, and health and wellbeing solutions.

PROSPERITY FROM NATURAL RESOURCES

Holistic thinking and new sources or raw materials, such as waste or industrial side streams, provide a potential competitive edge based on new business models focusing on eco-efficiency.

SELF-SUFFICIENCY WITH CLEAN ENERGY SYSTEMS

Clean and smart energy systems are key guarantors of Finland's energy security. Low emission and low carbon energy production methods also provide us with plenty of export opportunities.

COMPETITIVE ADVANTAGE FROM INDUSTRY RENEWAL

To secure our export base, we must renew our industrial sector. As a multi-technology organisation, VTT is working together with companies to improve competitiveness.

SMART COMMUNITIES – GOOD CONNECTIONS AND SMOOTH EVERYDAY LIFE

Smart traffic, eco-efficient communities and resource-wise practices equal sustainable development towards smart communities. VTT is engaged in long-term co-operation on the development of smart traffic, construction and services.

FINLAND ON THE TOP OF THE PROGRESSING DIGITAL DISRUPTION

The Internet continues to spread: we now run into it in the most surprising places and contexts. The industrial internet and universal digitalisation will have a multi-billion euro impact on the Finnish economy.

VTT's research programmes support the business sector and society

VTT supports businesses and society through innovative research programmes. These provide solutions to major economic and social challenges on a 3–10 year horizon. The objective is to achieve major sectoral breakthroughs and technological leaps forward in one or more sectors and disciplines. VTT is currently running eight research programmes: **Bioeconomy Transformation, Productivity Leap with Internet of Things, For Industry, Smart Mobility Integrated with Low Carbon Energy, Critical Technologies Towards 5G, Safe and Sustainable Nuclear Energy, Mineral Economy and Intelligent Energy systems and Regions.**

BIOECONOMY TRANSFORMATION

The **Bioeconomy Transformation** research programme is helping to implement Finland's national bioeconomy strategy, by transforming and raising the profitability of the country's biomass-based sector. To this end, technologies have been developed for biomass processing and for the new biomass-based value chains – in which forest and agrobiomasses are processed into food, fibre products, materials, chemicals and biofuels – enabled by such technologies. Concept calculation, industrial symbiosis, business model research and socio-economic studies are closely linked with value-chain-based research. The integration of ICT-based applications with the bioeconomy is an important element of the programme and the Bioruukki piloting ecosystem is an important source of support. Solutions generated by the programme are creating new business in Finland and international markets.

INDUSTRIAL INTERNET AND IOT (IOT)

The industrial internet and IoT is key disruptive market force in Finland and globally. It offers Finland an opportunity to foster new growth and become more competitive, and thereby capture more value creation. **The Productivity leap with Internet of Things (IoT)** programme involves the creation – and adoption by companies – of IoT solutions that provide a competitive edge. It also helps industry to sharpen its competitiveness by redefining its business models, networks and practices, and promotes the retention and strengthening of Finland's manufacturing industry. Target areas include equipment

and machine management, networked sensors, ICT and health, information management and processing in support of decision-making, intelligent infrastructures, an IoT service for the digital society, business breakthroughs and IoT telecommunications solutions. This will enable us to create new jobs and a framework for new investments, provide current and forthcoming domestic companies with a basis for operating globally from Finland, and help companies succeed in industrial markets in transition.

SMART MOBILITY INTEGRATED WITH LOW CARBON ENERGY

A holistic approach and the introduction of new technologies are the key to setting our transport system on the path of sustainable development. The **Smart Mobility Integrated with Low Carbon Energy** programme has seen the development of new solutions and services in intelligent transport, and in the low-carbon energy, low-emission and energy-efficient vehicle sectors. Pilot projects have led to the adoption of new technologies. Areas of research include cost-effective, system-level solutions for increasing energy efficiency and improving transport services, enabling the replacement of fossil fuels with renewable, low-carbon alternatives. In addition, new concepts have been created in traffic information technology solutions and services, the end-use of biofuels and electric commercial vehicles. The programme involves the creation of a smoothly functioning, cost-effective and environmentally friendly transport system development platform that provides new business models, services and products meeting the needs of various actors in the transport sector. The results can be utilised in a rapid time frame, which will increase companies' business opportunities and Finland's competitiveness.

FOR INDUSTRY

The technology industry is and will continue to be of huge direct and indirect importance to Finland's business sector. The SME sector in particular has considerable potential. To maintain and strengthen Finland's competitiveness, we develop technological solutions which can be used throughout Finland's manufacturing industry. The **For Industry** programme focuses on

leveraging digitalisation. Key technologies in achieving this include the industrial internet, Additive Manufacturing or AM technology, automation, robotics and embedded intelligence. We use widely exploitable technologies suitable for the Finnish SME sector, to provide a much-needed boost to domestic production and the international competitiveness of Finland's products and services.

CRITICAL TECHNOLOGIES TOWARDS 5G

Over the next decade, wireless communications are set to grow 1,000-fold and the number of wireless devices 100-fold. This will be extremely challenging due to the required frequency spectrum and more stringent energy efficiency requirements. At the same time, society is becoming increasingly dependent on wireless communications. The **Critical Technologies Towards 5G** programme is enabling better use of digitalisation, by developing technologies regarded as critical as we move into the fifth-generation mobile communication system, 5G. Optimised radio and network resource management methods, air interfaces that improve spectrum use and energy efficiency, intelligent network management solutions, and advanced RF i.e. electronics and antenna solutions, are among the results of the programme. Such technologies will lead to benefits such as the greater reliability and energy efficiency needed to achieve the desired data speeds. They will also enable the implementation of a 5G mobile communication system and help Finnish companies to achieve leading positions in new business areas.

SAFE AND SUSTAINABLE NUCLEAR ENERGY

Safety requirements concerning reactor safety and the final disposal of spent nuclear fuel have become much more stringent in Finland and elsewhere. The **Safe and Sustainable Nuclear Energy** programme focuses on responding to these growing safety requirements. Its activities are supported by the new Nuclear Safety House being built in Otaniemi and participation in the international Jules Horowitz Reactor Research project, coordinated by the CEA, at Cadarache in France. As a carbon-dioxide free energy source, nuclear energy has an important role to play in reducing global emissions.

MINERAL ECONOMY

To ensure the availability of minerals, we need to recover the small amounts of valuable materials contained in waste and industrial side streams (e.g. mining residues, metal industry slag, combustion plants, ash, construction waste, electronic waste) and find substitute materials for industry-critical metals such as cobalt, chromium, magnesium, platinum group metals and rare earth metals. New technologies and concepts for the recovery and recycling of metals and other minerals have been developed under the **Mineral Economy** programme. In addition, raw material circulation and material efficiency have been improved through material planning, product design and innovative manufacturing techniques.

VTT is an active participant in European raw material sector communities, particularly as a member of the EIT Raw Materials consortium.

INTELLIGENT ENERGY SYSTEMS AND SMART CITIES

Energy systems and cities face the common challenge of reducing their environmental impact and carbon footprint, while ensuring business continuity and that cities continue to provide an attractive residential environment. The **Intelligent Energy Systems and Smart Cities** programme has enabled the creation of new solutions for cities, builders, energy companies and organisations in charge of merging systems, by bringing VTT's expertise in ICT, energy, electronics and the built environment to the development of the energy networks and cities of tomorrow. Key objectives include the demonstration of a zero-energy zone model, the development of information technology solutions for the integration of electric vehicles with the urban power grid, and the creation of the necessary communications alongside an intelligent energy network. The programme is creating solutions for future energy systems and smart cities.

68%
of our clients
reported improved
competitiveness.*

93%
reported that their
knowledge base
and expertise
improved.*

* Taloustutkimus Oy, VTT Customer Survey 2015. 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.

Domestic and international cooperation

445

ongoing international
public research
projects in 2015

VTT engages in research cooperation with three main objectives: to increase innovation-driven investment in Finland, reshape industrial and commercial business activities and create added value and jobs in Finland. Domestic and international cooperation within larger RDI communities gives VTT a prospect to promote solutions to grand challenges of the society.



DOMESTIC COOPERATION

VTT plays a key role in national innovation partnerships. In its strategy, VTT emphasises the intensification and stepping up of 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 by building a strong network of RDI operators that enhances the use of Finnish research and development resources, while clarifying the division of roles between VTT and other actors.

VTT has promoted the objectives of Finland's growth strategy areas: the bioeconomy, cleantech, digitalisation and health. VTT has built thematic centres of expertise based on the strengths of stakeholders and complementary competencies, combining academic with applied research all the way to commercial product development aiming to reduce the fragmentation of RDI activities. Built around the bioeconomy, the partnership between Aalto University and VTT is a good example of this. In addition to normal project collaboration, this partnership includes joint research programmes,

joint research infrastructures funded by the Academy of Finland and joint professorships. Another concrete example is the SMACC alliance between VTT and Tampere University of Technology, which is seeking 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 intelligence 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.

INTERNATIONAL COOPERATION

Maintaining the national knowledge base, and developing it further, requires active networking beyond scientific disciplines as well as cooperation across world-class innovation ecosystems.

VTT has been highly successful in acquiring international research funding. VTT was engaged in 445 international public RDI projects in 2015. European programmes lie at the heart of VTT's international research. In 2015, 242 projects under the Seventh Framework Programme (2007 - 2013) were underway, and 60 completely new projects had started under the Horizon 2020 programme.

The Horizon 2020 programme (2014 - 2020) is part of implementation of the Europe 2020 Strategy in areas such as employment, research and innovation, climate change and energy, education and the elimination of poverty.

VTT's contributions to H2020 have mainly been in ICT, nanotechnology and biotechnology areas of the industrial leadership pillar (Pillar 2), as well as raw materials, energy and climate challenges in the social challenges pillar (Pillar 3). Industry partners have contributed a share of 53% to the H2020 project portfolio in which VTT is involved.



* Taloustutkimus Oy, VTT Customer Survey 2015. 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.



VTT focused very strongly on the first H2020 calls and has maintained its position as the single largest recipient of EU research funding in Finland, as well as remaining a significant player at European level. In H2020, VTT has sought participation in those projects that will boost the competitiveness and renewal of industrial value chains in Europe and strengthen regional innovation ecosystems and their cross-border networking. This requires participation in extensive networks and long-term preparatory work, particularly in Finland's and Europe's research, innovation, industrial and regional policy sectors.

Cooperation with various networks and communities is required in order to influence European RDI policy priorities and programmes. VTT has been active in roadmap forums relevant to industry, such as European Technology Platforms communities (VTT is involved in more than 20 industry-led ETP communities), the PPP communities (Public Private Partnerships, in particular, SPIRE, Photonics, BigData, E2B, FoF, ECSEL and BBI) and the EIP initiatives (European Innovation Partnerships between the Member States, particularly with respect to raw materials, smart cities and water). In addition, VTT has been involved in official advisory groups for the European Commission and has played a key role in numerous research institute partnerships and alliances, as well as two European Institute of Innovation and Technology innovation clusters (EIT KIC Digital and EIT KIC Raw Materials). VTT has weighed in at the level of information exchange in Finland, as well as training, creating joint visions, joint advocacy and EU project collaboration.

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
- SHOKs – Strategic Centres for Science, Technology and Innovation

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)

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.

Biotechnology and food research piloting environment offers unique facilities for the development and customisation of bio and food industry technologies.



Bioruukki
The largest bioeconomy pilot and research facility in the Nordic countries.

Micronova
World-class cleanroom facility, fully equipped for the fabrication of silicon, glass and thin film-based microsystems.



VTT MIKES Metrology
is the National Metrology Institute of Finland and performs high-level metrological research and develops measuring applications in partnership with industry.



A pilot-scale research environment for fibre processes
enables the development of novel products and supports the renewal of the pulp and paper industry.



PrintoCent
World's first pilot factory for printed intelligence industrialisation.



ROViR
Remote Operations and Virtual Reality Centre for the development of remote operations and virtual reality technology in industry.



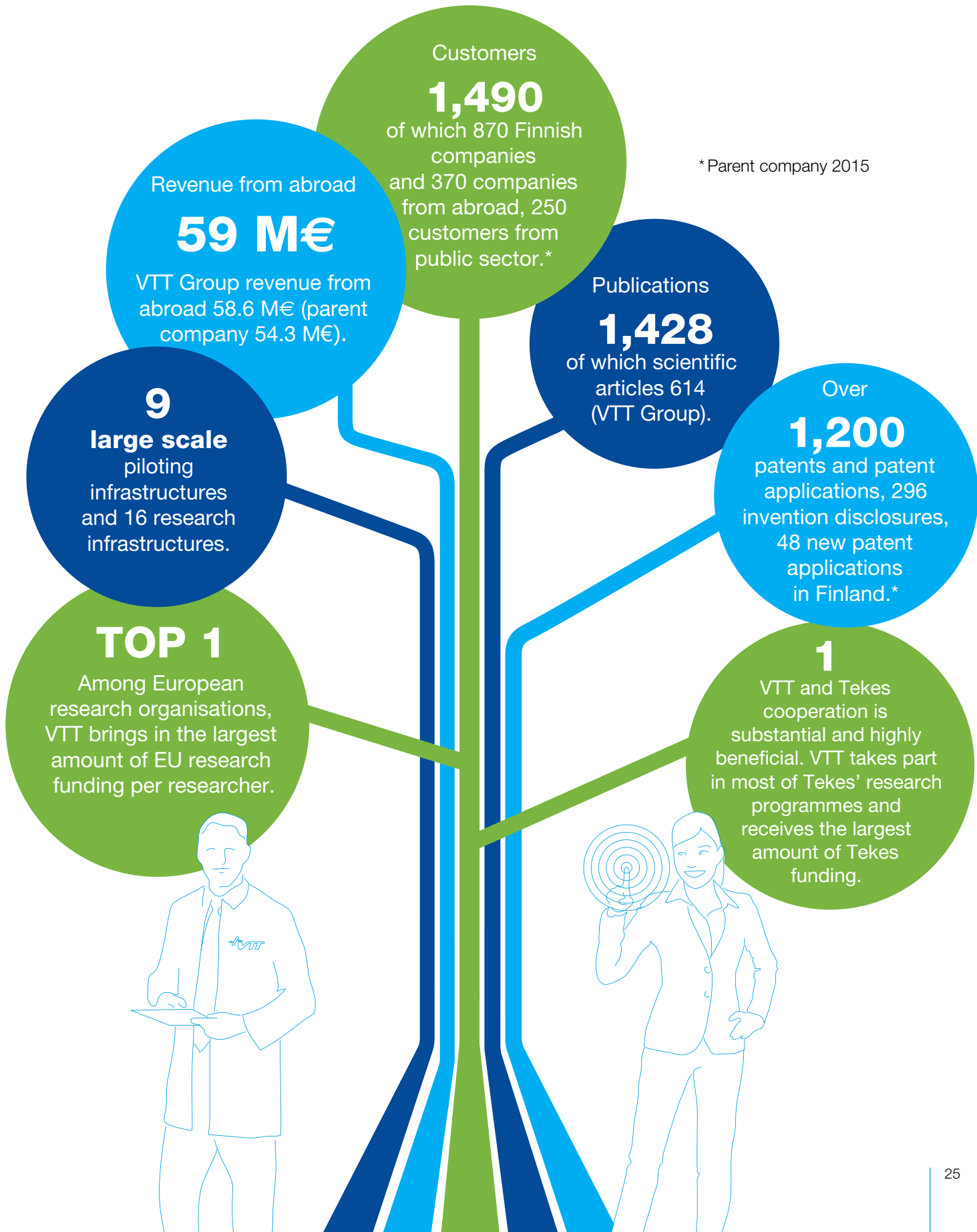
Engine and vehicle laboratory
enables research on passenger cars as well as heavy-duty vehicles up to 60 metric tons to develop energy efficiency, emissions reduction and use of 2nd generation biofuels.



Centre for Nuclear Safety for nuclear technology safety research.

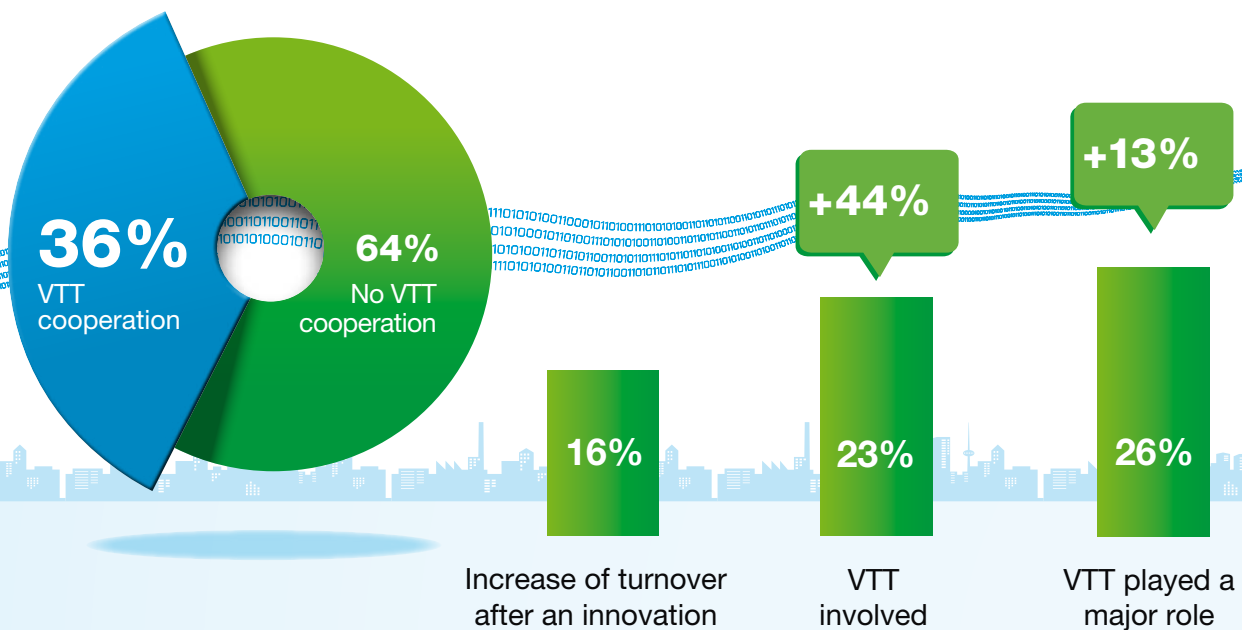


VTT has power



Impact of VTT

VTT creates growth



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

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

**Source: SFINNO innovation database*

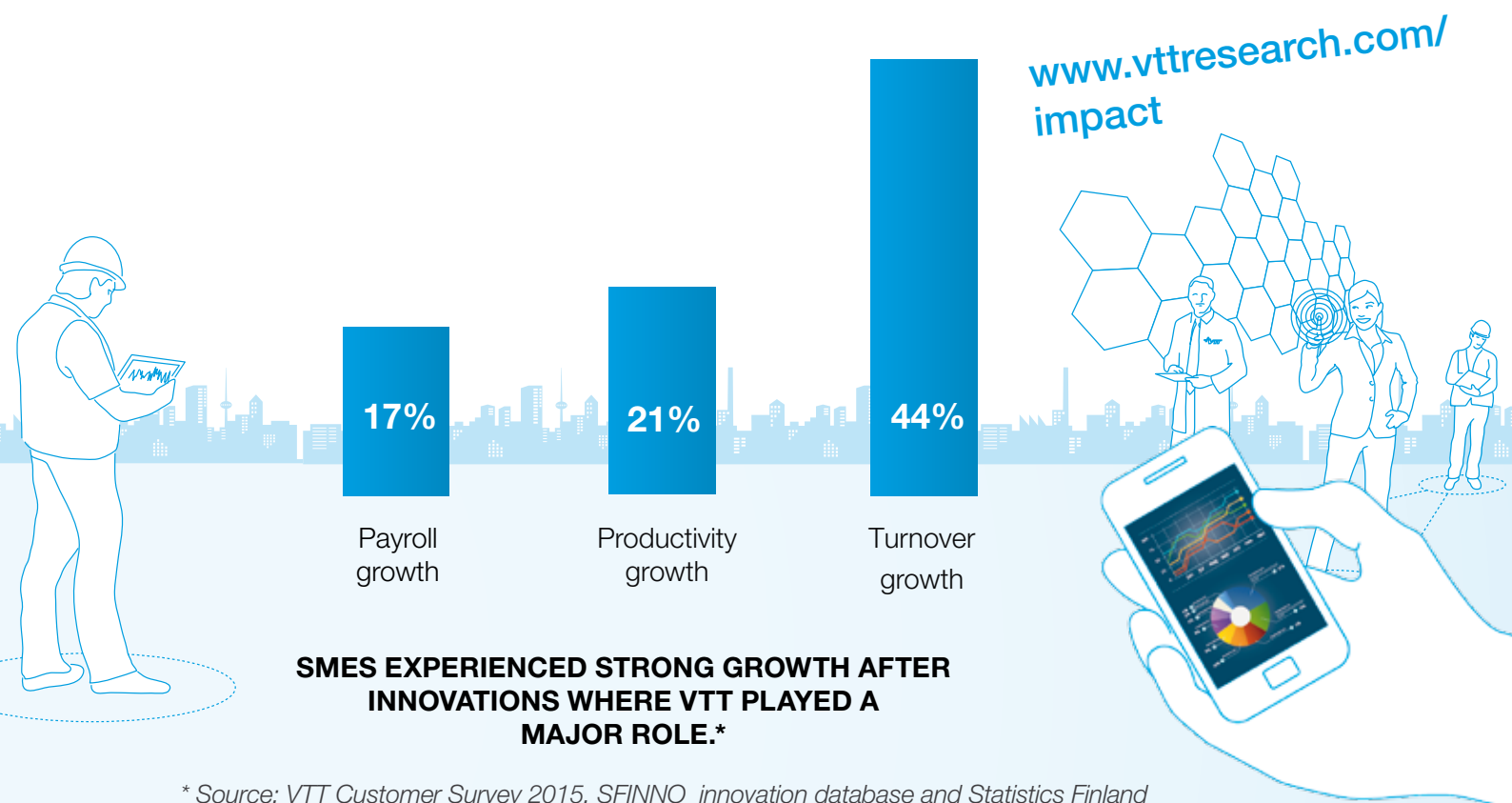
Share of survey respondents who had this benefit as their goal in their VTT project and felt that the benefit was generated in the project:

- 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.**

Innovations play major role in the competitiveness of Finnish SMEs

Technology development and research create new business and employment.

VTT has played a role in every third Finnish innovatio. As the leading research and technology company we have a supreme input output ratio in the R&D activities of Finnish SMEs.



VTT benefits for SMEs

VTT is an excellent research partner for Finnish SMEs:

- 82%** felt that the **quality of service** was excellent or good
- 76%** said that the **usability of results** was excellent or good
- 86%** rated the **personnel** excellent or good
- 79%** assessed the **activities as a whole** to be excellent or good

VTT customer survey, SME respondents 2008 - 2014, Taloustutkimus Oy

Awards and prizes

- Research Professor Miimu Airaksinen was nominated as an expert to prepare the UN urbanization strategy document in the UN policy unit 9. She is the first Finnish expert nominated in the unit.
- Anne-Christine Ritschkoff, EVP, Strategic Research, was appointed to the Executive Board of the EIT Raw Materials. EIT Raw Materials is a new innovation centre of the European Institute for Innovation and Technology (EIT). Its primary goal is to generate new innovations, experts and companies through European co-operation.
- Caj Södergård was appointed to the European Commission's high level expert group on 'European Open Science Cloud'. The group will provide strategic advice to the European Commission on research data sharing, data stewardship and data reuse in the context of the implementation of the 'European Open Science Cloud' - part of the Commission Digital Single Market Strategy.
- Senior Principal Scientist Jari Kiviaho was nominated to the scientific board of the Fuel Cells and Hydrogen Joint Undertaking (FCH JU). FCH JU supports European fuel cell and hydrogen research, technology development and demonstration projects.
- Research Scientist Helena Henno won the project proposal competition of YEAR, Young European Associated Researchers. Her idea, Fluvoid, proposed a smartphone-based home diagnostic test of influenza combined with processing of results on a large scale to track its propagation and implement warnings and preventative measures. The awarded idea was developed with Ville Antila & Lauri Reuter from VTT and partners from Sintef (Norway) and SP (Sweden).
- Minna Pikkarainen, Connected Health Professor at the University of Oulu and VTT Technical Research Centre of Finland, made it into the winning trio of the Outstanding Young Person competition 2015 that will be representing Finland in the Junior Chamber organisations' international competition in 2016.
- Senior Scientist Kirsi Hyytinen was awarded for the best PhD paper in the annual RESER conference. The paper studies the significance of collaborative forms of system and service innovations and illustrates how this collaboration can be supported with the mechanisms of network governance.
- Research Team Leader Timo Aalto won VTT Award 2014 for demonstrating considerable business thinking in his actions and for boosting business and sales.
- Research Professor Nils-Olof Nylund was awarded with VTT's Communication Award 2015. He has communicated the achievements of his research area commendably and thereby increased the awareness of both the media and consumers of the development, safety and social and environmental impacts of transport and vehicle technology.
- Aalto University received The European Paper Recycling Award 2015 from the European Recovered Paper Council (ERPC) for the development of a novel spinning technique that allows the production of textiles and garments from waste paper and waste card board. Pretreatment methods for the recycled paper and board were developed in tight collaboration with VTT.
- International Software and Systems Modeling Journal awarded Senior Scientist Anne Immonen and Research Professor Eila Ovaska with The eight year 2007 – 2014 most influential regular paper award for their article "Survey of reliability and availability prediction methods from the viewpoint of software architecture".

VTT Impulse and VTT Newsletter



VTT IMPULSE:

A magazine on science, technology and business

The VTT Impulse technology magazine is aimed at VTT's partners and customers and anyone with an interest in top-level technology and its applications. **VTT impulse is now available online.**

You can order a free copy at:
www.vttresearch.com/impulse

www.vttresearch.com/news
www.vttresearch.com/references
www.vttresearch.com/results



VTT NEWSLETTER

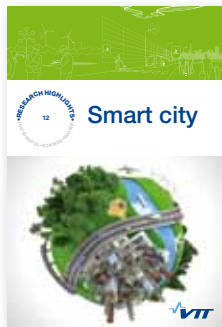
Would you like to know how research is changing the world? VTT Newsletter will give you information on the latest research results, the possibilities offered by technology, and details of future events. The newsletter appears once a month.

You can order your copy at:
www.vttresearch.com/newsletter

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.



Smart city
 Abstracts of VTT's recent research on smart cities

VTT Research Highlights 12



VTT For Industry
 Successful business at Finnish manufacturing companies beyond 2020

VTT Visions 7



An analysis of countries' climate change mitigation contributions towards the Paris agreement
 Tommi Ekholm & Tomi J. Lindroos

VTT Technology 239



Measuring broad-based innovation
 Mika Nieminen & Olavi Lehtoranta (eds.)

VTT Technology 242



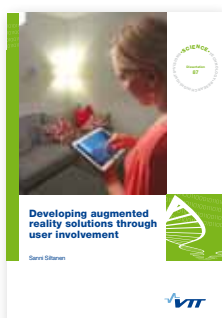
Sustainability of forest energy in Northern Europe
 Kati Koponen, Laura Sokka, Olli Salminen, Risto Sievänen, Kim Pingoud, Hannu Ilvesniemi, Johanna Routa, Tanja Ikonen, Tiina Koljonen, Eija Alakangas, Antti Asikainen & Kai Sipilä

VTT Technology 237



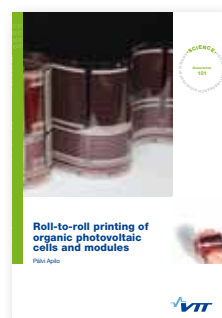
Safety culture and organisational resilience in the nuclear industry throughout the different lifecycle phases
 Pia Oedewald, Nadezhda Gotcheva, Kaupo Viitanen & Mikael Wahlström

VTT Technology 222



Developing augmented reality solutions through user involvement
 Sanni Siitanen

VTT Science 87
 Dissertation



Roll-to-roll printing of organic photovoltaic cells and modules
 Päivi Apilo

VTT Science 101
 Dissertation

Subsidiaries' services accelerate market entry for products

VTT EXPERT SERVICES LTD

Together with its subsidiary, Labtium, VTT Expert Services Ltd offers commercial expert services, surveys and assessments; certification and approval services; testing, inspection and analysis services; and calibration services. Our testing, analysis, calibration, inspection and certification services have been accredited by the national body, FINAS. Our accreditations cover over 1,000 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. We also engage in foreign accreditation.

As a provider of third-party testing, inspection and certification services, VTT Expert Services Ltd seeks to ensure that its customer's products, employees and processes meet the highest safety and health and other quality standards. In turn – through geo, fuel and environmental analysis in particular – Labtium Ltd supports its customers' production processes and quality control. By ensuring a good fit with the market, users and official requirements, the companies' services improve the competitiveness of the customer's production, products and services. Customer needs are being created by regulations, production and product problems, and production control requirements. Although plenty of players provide



standardised services, small service providers in particular lack the expertise to provide tailored solutions. This highlights the need for, and impact of, VTT's services in the industrial SME sector. VTT Expert Services Ltd is among the top five providers of conformity assessment services on the Finnish market.

Both companies have engaged in R&D focused on the customer's operations, service content and increasing operational efficiency, with the aim of improving profitability and competitiveness. They have also hugely improved their financial performance.

By exploiting digitalisation, for example, the companies are proactively and continuously developing their

service portfolios to meet changing customer needs. A new vtt-todistus.fi search service and Omasertifikaatti.fi eService portal were launched during the 2015 financial year. Labtium rationalised its service offering and office network to meet demand from the mining industry. In addition, its service range was extended with the acquisition of a precious metal product inspection operation.

Approvals from external parties are crucial when providing third-party services. The number of certificates issued by external parties increased by 28. These were primarily related to product and system approvals when providing services based on powers granted by a competent authority.

VTT VENTURES LTD

Since 2006, VTT Ventures has been making venture capital investments in spin-offs engaged in commercialising VTT's research results. These investments were booked in VTT's balance sheet until 2010, since when they have been made via VTT Ventures Ltd. VTT and VTT Ventures Ltd have invested in a total of 35 spin-off companies. The current turnover of these companies is around EUR 32 million and they have around 300 employees. The companies have attracted funding of around EUR 45 million.

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 a flow of projects 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 private equity investors.

The year 2015 saw a strong flow of projects. There was sharp growth in the number of new spin-off projects compared to 2014. VTT Ventures made investments of around EUR 1.7 million. During 2015, VTT Ventures exited from one company and decided to invest in two new spin-offs. There were 21 companies in the portfolio at the end of the year. In 2015, these companies attracted around EUR 8.2 million in new capital. The financial year was profitable for VTT Ventures.

VTT MEMSFAB LTD

VTT Memsfab Ltd engages in the contract manufacturing of micro and nano-electronics materials and components. The company makes products using VTT research and development facilities in Micronova's clean room. Using this approach, VTT can effortlessly move R&D into the production phase without having to re-initiate the process in another plant. Partly for product liability reasons, production activities aside from research (due to its exceptional nature) have been hived off into a separate company within VTT Group.

VTT Memsfab Ltd has been operating for five years. Many new customers have been added to those on board when the company was established. Memsfab has been profitable in most years since then. The company has also provided synergy benefits by promoting collaboration with VTT on many fronts. Production activities have increased industrial utilisation of the clean room's versatile infrastructure.



The sensor chips used by Elekta's Magnetoencephalography (MEG) devices to measure brain signals are made by VTT Memsfab Ltd.

Sustainable development as a key part of what we do

Eco products accounted for over 25% of purchase volume of office supplies

**25%,
+6,5%**



The frequency of accidents
0.7
per million working hours.

Significant decrease in the amount of travel.

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-3 guidelines. We describe examples of corporate responsibility in both our annual report and the VTT Review, and publish selected GRI metrics on the VTT website (www.vtt.fi).

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 steady 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

VTT is an attractive place to work with a highly rated employer brand, particularly among students and professionals in the fields of science and technology. VTT was number eight on the list of favourite employers among students and came second in the equivalent list for working professionals in 2015.

In terms of employee well-being, the focus remains on proactive work aimed at its promotion. VTT's incorporation led to cooperation with a new pension insurance company, with the aim of improving staff well-being and organisational productivity. A Presto evaluation of VTT's processes, supervisory work and operating culture – which gave a snapshot of occupational well-being and quality of working life – was performed at various levels of the organisation. The strengthening of trust and VTT's feedback culture, and the rationalisation of processes, were highlighted as focus areas.

Competence and competence development are crucial to VTT and successful business activities. In an expert organisation with experienced staff, training and coaching need to be supplemented with various on-the-job learning methods. VTT offers several such approaches. In addition, on-the-job learning and knowledge-sharing were supported by continuing VTT's mentoring programme, which involved 38 pairs.

Leadership coaching, coaching info and manager day courses were among the techniques used to train supervisors in line with VTT's development path.

VTT Professional Project Manager and internal Project Management ABC training number among VTT's tools for enhancing project management competencies. At the end of the year, 128 VTT employees had become 'IPMA-certified'. In addition, certified project managers shared their experiences at the PM Forum event. Training was also arranged to develop sales competencies, with use being made of an online self-study course.

Calculated using the Zero Accidents forum method, the frequency of accidents in the parent company was lower than last year, at 0.51 per million working hours. The accident frequency rate throughout VTT Group was 0.95, which was slightly higher than last year. Only two accidents in the parent company, and two in the subsidiaries, led to absences from work. However, because one of the accidents in the parent company was serious (56 days of sick leave), the same category has been assigned to last year's accidents overall (21 days of sick leave per single accident). On the other hand, the seriousness of accidents reduced markedly compared to the previous year. In addition, one accident that occurred during commuting – a fall on stairs – led to a long, 139-day period of sick leave.

We drafted and implemented an operational plan for the storage management of chemicals, the maintenance

of information on them, and the marking of chemical containers. User training, which was conducted throughout the organisation, began right at the beginning of 2015. More than 2,000 VTT employees participated in the eSafety online course. This course was mandatory for all employees.

We completed the 2015 projects for the 2015–2017 three-year plan in line with our occupational health and safety development plans. These projects involved the development of our occupation safety culture, occupational safety in common workspaces, tidiness and order, as well as strengthening the supervisory chain as QEHS ambassadors. Supervisors diligently engaged in occupational health and safety tours throughout our organisations.

RESPONSIBILITY FOR THE ENVIRONMENT

VTT has ISO 9001 and ISO 14001 quality management systems in place, certified by DNV GL Business Assurance Finland Oy Ab.

VTT drew up an energy audit report for the Energy Agency, complete with site inspections of electricity consumption, in line with the Energy Efficiency Act. We consumed markedly more electricity in 2015 than in previous years. Half of this growth can be attributed to the fact that the Centre for Metrology and Accreditation merged with VTT in early 2015. There was also the increase in electricity consumption due to the start-up of the new Bioruukki research centre. Another explanation lies in the number of annual operating hours clocked up in intensive experimental environments; these hours are tied to certain research projects.

Travel continued to decline. Under 29 million flight kilometres accumulated. However, there was a slight rise in carbon dioxide emissions generated by flights. This increase may be due to the shorter distances travelled rather than a reduction in the number of journeys. Our continued success in reducing domestic travel was highly significant from the perspective of CO₂ emissions. Slightly less use was made of personal cars, rental cars and VTT's cars than in the previous year.

The amount of paper purchased fell by almost 17%, totalling just over 8,410 reams. The previous fall in the number of printouts gave way to a rise of just over one percent from last year's minimal level. Due to moves between premises, significantly more white paper (55% more than in 2014) was disposed of as confidential waste than in previous years. Eco products account for over a quarter of purchase volumes of office supplies and almost 38% of unit volumes. Purchase volumes grew by 6.5 percentage points and unit volumes by 1.2 percentage points compared to the previous year.

Water monitoring of pumping wells – in accordance with the decontamination decision made by the Uusimaa T&E Centre – was begun due to soil decontamination following the Otaniemi oil spill. The measurement results were under the specified limits for all substances analysed.

VTT's technology expertise creates competitiveness and growth for Finland

Bringing growth to Finnish companies, or companies operating in Finland, is the key challenge in securing the future of the country and on which almost all other good things depend. Growth cannot be achieved by repeating old tricks – companies need to completely reinvent themselves and develop new products and services. The greatest success stories tend to be based on building something new around existing strengths. This is true for Finland. Fortunately, in developing and exploiting technologies we have a unique trump card – VTT, one of Northern Europe's largest, most important and most highly rated R&D organisations. For example, VTT has long been one of Europe's biggest recipients of hotly contested EU research funding.

In addition to performing world-class scientific research, due to its technology expertise VTT is uniquely able to help companies reinvent themselves and grow in Finland and beyond. Over the years, VTT has gained enormous expertise and experience of how companies from various sectors can transform their operations and successfully develop new business activities, products

and services – based on cooperation with VTT. When seeking new sources of growth, it is vital to each and every one of us that we get more out of VTT's top-flight professionals and unique expertise.

Despite the crying need for just the kinds of capabilities that VTT has – to spur new growth in Finland – its funding is being subjected to drastic cuts. This is self-defeating, but we at VTT are not entirely without fault in this regard. I believe that the key issue is VTT's ability to focus its activities more on achieving growth and to become better at spreading the message about its impact. To increase VTT's potential for creating new technology-based business activities, we need to start by using case studies to show the public and our customers how money invested in VTT has grown our clients' businesses and Finland's economy. That is the best way of securing VTT's future and its public and private-sector funding.

Aaro Cantell
Chairman of VTT Board

VTT BOARD



Aaro Cantell
Chairman,
Normet Oy



Matti Hietanen
Counsellor of Government,
Ministry of Employment
and the Economy



Kari Knuutila
CTO
Outotec Oy



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President, Prof.
D. Sci., D.Sci. (Tech) h.c.



Kaija Pehu-Lehtonen
SVP, Business
Development
Metsä Fibre Oy

VTT management group and organisation

VTT MANAGEMENT GROUP

Antti Vasara, President & CEO

Knowledge Intensive Products and Services
Petri Kalliokoski, Executive Vice President

Smart Industry and Energy Systems
Jouko Suokas, Executive Vice President

Solutions for Natural Resources and Environment
Kari Larjava, Executive Vice President

Anne-Christine Ritschkoff, Executive Vice President, Strategic Research

Seppo Viinikainen, Executive Vice President, Administration

Riitta Tolvanen, Senior Vice President, HR

Matti Karhunen, Senior Vice President, Legal, IPR and security

Timo Nurminiemi, Senior Vice President, Finance

Olli Ernvall, Senior Vice President, Communications

Anu Vaari, employee representative

VTT COMPANIES

VTT Expert Services Ltd, Laura Apilo, CEO

VTT Ventures Ltd, Antti Sinisalo, CEO

VTT International Ltd, Matias Markkanen, CEO

VTT Memsfab Ltd, Hannu Kattelus, CEO

Finance and personnel

Key indicators 2015

Finance

	VTT Group	Parent company
Net turnover (1,000 €)	184,538	157,915
Other operating income (1,000 €)	87,357	92,577
Government grant	85,384	85,384
Other	1,973	7,193
Profit for the financial year (1,000 €)	3,333	2,729
Profit for the financial year (%)	1.8%	1.7%
Return on equity (%)	2.8%	2.1%
Equity ratio (%)	65.5%	65.2%

Personnel

31.12.2015	VTT Group	Parent company
Total personnel	2,470	2,192
- Management	145	123
- Scientists	1,609	1,487
- Research support	384	258
- Trainees	45	45
- Business support	287	279
Fixed-term contracts	166	155
Part-time contracts	205	182
Male	1,521	1,351
Female	949	841
Personnel expenses (1 000 €)	155,880	140,858

Turnover by type of revenue

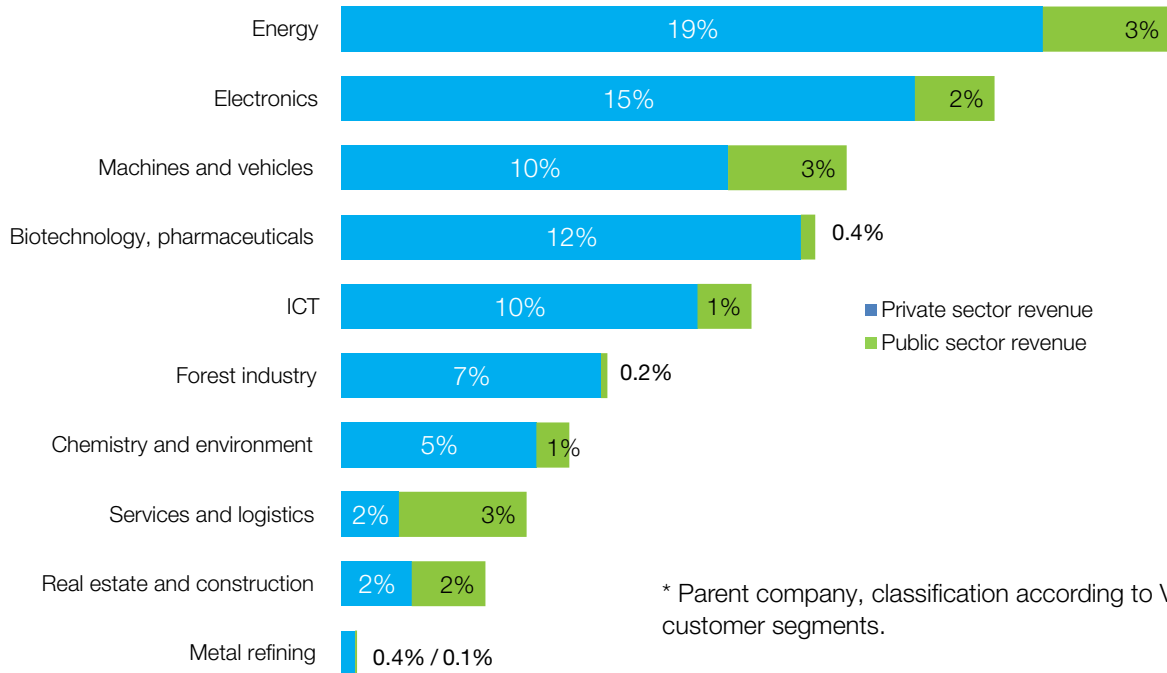
VTT Group



Parent company



VTT's sales revenue from commercial activities in 2015*



* Parent company, classification according to VTT's customer segments.

Personnel structure



	VTT Group	Parent company
Total personnel	2,470	2,192
Scientists	65%	68%
Research Support	17%	14%
Business Support	12%	13%
Management	6%	5%

Education of personnel



	VTT Group	Parent company
Doctors	23%	25%
Licentiatees	5%	5%
Other university level degree	53%	54%
Lowest level tertiary education	6%	5%
General and vocational education	13%	11%

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

Web version of VTT Review:
www.vttresearch.com/vttreview2015

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This review is printed on Galerie Art Silk printing paper, which has been granted the environmental emblem of the Nordic countries. Printed in Juvenes Print Oy.

36%

OF FINNISH
INNOVATIONS
INCLUDE VTT
EXPERTISE.

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