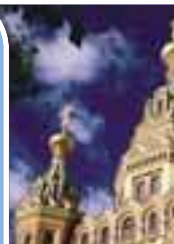




Silicon chips renewed
sensor technology.
Page 18



Good beer faster
with VTT's innovations.
Page 22



VTT is seeking positions
in Silicon Valley and
St. Petersburg.
Pages 30 and 33

Magazine on Technology and Innovations ■ December 2006



innozone

President of KONE
Corporation Matti Alahuhta:
**Magnificent
innovation can
come from a
mature industry.**



VTT creates business from technology

VTT in brief

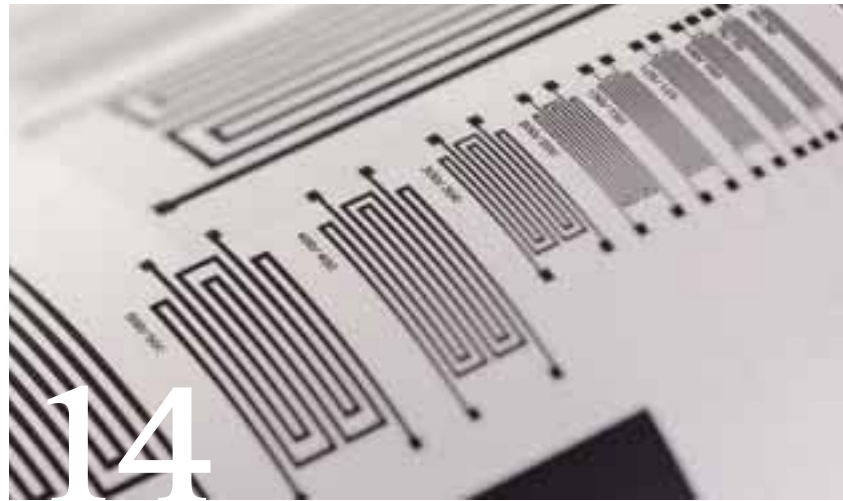
VTT Technical Research Centre of Finland is the biggest multidisciplinary contract research organisation in Northern Europe. VTT provides high-end technology solutions and innovation services. From its wide knowledge base, VTT can combine different technologies and create new innovations and a substantial range of world-class technologies and applied research services, thus improving its clients' competitiveness and competence. Through its international scientific and technology network, VTT can produce information, upgrade technology knowledge and create business intelligence and added value for its stakeholders.

The examples given in the VTT Innozone magazine only represent a fraction of VTT's operations, yet they help in acquiring a general view of VTT's wide-based know-how.

VTT's key technology fields

- Applied Materials Technology
- Bio and Chemical Processes
- Energy
- Information and Communication Technologies
- Industrial Systems
- Microtechnologies and Electronics
- Technology in the Community

Juha Sarkkinen



Lehtikuva



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Antonin Halas

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Page 14 Intelligent features can be added into everyday products by combining printing technology and biotechnology.

Page 26 During the last five years VTT has developed sustainable technologies in a research theme called Clean World.

"We chose renewable raw materials and novel energy technologies as our focus research subjects," says Liisa Viikari, leader of the theme.

These choices have turned out to be hot topics of today.

Page 22 "VTT has excellent possibilities to measure, understand and control biological reactions, microbiological interactions and physical phenomena in malting and brewing processes," says Silja Home from VTT.



innozone

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C Comprehensive

TEXT: JUHA KONTU
PHOTO: RISTO LAINE

The largest multidisciplinary research organisation in Northern Europe, VTT offers its customers a varied range of technology and research services. VTT's extensive competencies help companies develop new products, production processes and services; sharpen their competitive edge on a global scale, and contribute to the overall well-being of our society.

Can you give us examples of what VTT's expertise has achieved?

"The demand for functional foods is increasing rapidly, and this is a field where we have come far. The importance of health-promoting foods has now been recognised on a global scale," says Jouko Suokas, Executive Vice President at VTT. He is responsible for VTT's nine customer business areas.

"Structural safety and lifetime management at power plants requires a different type of expertise. The Master Curve Technology developed by VTT has been adopted as part of the ASME (American Society of Mechanical Engineering) standard for theoretical and experimental review of structural integrity. We apply this expertise also to the review of the critical elements in mobile equipment.

VTT is involved in several projects concerned with renewable energy sources. In the spring we launched St1 BioFuels, a joint venture that manufactures ethanol from waste generated by the food processing industry. The technology was developed at VTT.

We also promote the establishment of a whole new industry by studying and developing printable electronics. The results can be used, for example, in intelligent packaging or bioactive paper."

world-class expertise for a global market

What kind of added value benefits can VTT offer to global enterprises?

"Our state-of-the-art, multi-technology expertise is recognised internationally. This is our most important asset. Few contract research organisations in the world can demonstrate such wide-ranging expertise. We have an extensive customer base and we understand not only their needs but also the needs of their customers.

We have a considerable international network: we are involved in hundreds of EU projects and partner with top players in every field. In Finland, research is held in high regard and it merits sizeable investments. We have a strong culture of cooperation in Finland, of which VTT is a perfect example."

What can VTT offer that enterprises themselves lack?

"Technology advances at such a rapid pace that few enterprises can keep up with the developments in all core technologies. By combining our wide-ranging technology expertise with an extensive network of internationally recognised partners, we can offer our customers significantly more wide-ranging competencies than most enterprises acting alone."

What is VTT's ability to commercialise its technology expertise built on?

"We have some 6,000 customers representing all major industrial sectors. Our approach to customer and market information management is professional; we cooperate closely with our customer companies; we integrate the visions and views of our customers with those of their own customers. Our customers' needs are the cornerstone on which all of our activities rest.

Our own business intelligence service provides us with in-depth market information, as well as insights affecting our customer segments. We combine technology expertise with an understanding of market changes,

and apply this approach also to our own innovation process which transforms technology into successful business.

This approach is what makes us stand out in our field."


What kind of partnership does VTT offer its international customers?

"At its most extensive, partnership covers the entire innovation process. We begin with a foresight review and move on to technology, business method and concept development and further to demonstration, piloting, evaluation and, finally, commercialisation.

The first steps of the process are enormously important. You have to be able to see when the market is opening and technology is ripe to be able to launch just-in-time solutions."

How can VTT be contacted?

"We have an active presence in international publications, events and conferences. An excellent way to reach us is at www.vtt.fi, where you can easily find a person to contact.

We also have a network of agents around the world. In addition to Finland, we have offices in Silicon Valley in California, USA, in St. Petersburg, Russia, and in Shanghai, China." 

»» We understand not only our customers' needs but also the needs of their customers.



The KONE way to do it

IN THE GLOBALISED WORLD

TEXT: JUHA KONTU
PHOTOS: MIKAEL LINDEN AND KONE

Only fifteen years ago the slogan went: 'Think globally, act locally'. As true as it may have been then, in the genuinely globalised world of today, the slogan has been rephrased.

"The key to success can now be captured in the phrase, 'Think locally, act globally,'" **Matti Alahuhta**, the President of KONE Corporation, says.

"Global companies need an understanding of local needs to really be able to grasp what is locally relevant. This understanding needs to be accompanied by global ways to operate that give the scale advantages of acting globally. Product platforms should be globally uniform, and these platforms must have the flexibility for customisation to local needs. All this can be captured in the phrase, 'Think locally, act globally'. This idea works nowadays in most industries," says Mr. Alahuhta.

KONE is one of the world's leading elevator and escalator companies. It provides its customers with industry-leading elevators and escalators and innovative solutions for their maintenance and modernisation. In 2005, KONE had annual net sales of EUR

3.2 billion and about 27,000 employees. The company has 800 service points in over 40 countries.

KONE is well known for its competitive products. The Finnish company that operated locally in the beginning has developed into a global player. Its competitive strength is based on successful innovation and business focus.

"In the future, the key factor is how we are able to become more customer-focused and, at the same time, meet the needs of local markets with our flexible, global product platforms."

What is essential in Mr. Alahuhta's view, is the skilful combination of customer-oriented product development and the continuous enhancement of business processes.

"What we need are customer-orientation, competitive products and a competitive cost structure at the same time. This thinking is essential for all our activities."

Surprised by a great innovation

R&D is fundamental to building competitiveness, especially in a global environment.

"In many industries, radical technological innovations have become increasingly rare, but this does not mean that they are impossible," Mr. Alahuhta says.

"It has been surprising to see how magnificent innovations can come from a mature industry such as ours."

The installation of autowalks, familiar to users of airports, has been previously restricted by the need for approximately one metre of free space beneath them.

"KONE's new modular autowalks requires only 20 cm of free space underneath, making it possible to install autowalks practically anywhere, either permanently or temporarily. Thanks to this technological breakthrough, we can offer customers at a lower overall cost an application that is lighter, more flexible, environmentally friendlier than traditional solutions. This product named InnoTrack™, shows that the development of significant innovation in a mature industry is not impossible."

Changes in needs trigger innovation

According to Alahuhta, the key feature of the InnoTrack™ innovation process was to search for a solution to actual customer needs.

"We identified future changes in customers' business systems and needs and how they would reflect on our products. The operating model proved to be effective: we achieved a radically better solution along with 20 patented innovations without





KONE IN BRIEF

KONE is one of the world's leading elevator and escalator companies. It provides its customers with industry-leading elevators and escalators and innovative solutions for their maintenance and modernization. KONE also provides maintenance of automatic building doors. In 2005, KONE had annual net sales of EUR 3.2 billion and about 27,000 employees. Its class B shares are listed on the Helsinki Stock Exchange.

MATTI ALAHUHTA

Doctor of Science (Technology), Helsinki University of Technology

President, KONE Corporation 2005–
Member of the Group Executive Board of Nokia Corporation 1993–2004; Executive Vice President, Chief Strategy Officer of Nokia Corporation 2004; President of Nokia Corporations Mobile Phones 1998–2003; President of Nokia Telecommunications 1993–1998

Member of the Board for BT Group
Member of the Foundation Board for the International Institute for Management Development (IMD)



**"Think locally,
act globally."**

» having to make enormous financial investments.”

“We wanted to start by really understanding the customer’s needs. After this, we challenged our creativity and skills. The development of InnoTrack™ is a great example of R&D activities at their best.”



New business opportunities: urbanisation of the Far East and aging Europe

Forty per cent of KONE’s turnover is generated by the sale and installation of new elevator and escalator products. The rest is accrued from modernisation and maintenance. The majority of new equipment goes to Asia, where strong economic growth and rapid urbanisation are driving the company’s growth.

“In China alone, 300 million people have moved into cities in the last 15 years.

During the next 15 years, the migration is expected to continue with another 350 million people moving from the countryside. The same trend is evident in many other rapidly developing countries in Asia,” Matti Alahuhta says.

“In Europe, our growth is based on the renewal of existing equipment. In addition, the population of Europe is aging, which increases the need for adding elevators to existing buildings.”

Economic growth and urbanisation in Asia will result in traffic becoming increasingly multi-layered and higher buildings being built. There will be more need for vertical transportation. MegaCities of tens of millions of people will emerge.

As an example, Alahuhta cites the Sanghai region, where getting from A to B will require new means of transportation in the future. “These megatrends will continue to provide us with great business opportunities in the future.”

Research partnerships are essential

According to Alahuhta, cooperation with VTT, as well as with other research institutions and universities, is essential for KONE.

“When global companies are considering new locations, some of the important factors they look are a favourable combination of long-term research skills, sufficient qualified staff, the country’s cost level, flexibility of labour markets and tax levels.”

Mr. Alahuhta stresses the importance of the publicly financed research sector in partnering the development of companies.

“The role of VTT and other such institutions is all the more important in long-reaching research. They support the competitiveness of Finnish companies. In the future, however, publicly financed research investments should be far more substantial than they are today. Finland has produced excellent results and has established an excellent image as a leading country in new technology. We should keep nurturing that image.”

Leadership, know-how and proactivity

Leadership of global companies is demanding. The President of KONE Corporation, Matti Alahuhta, says that for a company to succeed, its manager needs to have a holistic view of the development of the industry and the company as a part of it.

“Close proximity to the market is essential. Another asset is to have good employees who are excellent in their field. This makes it possible to delegate responsibility,” says Alahuhta, summarising his management philosophy. He is a firm supporter of team playing.

“Success requires skilled people and the right kinds of leadership and corporate culture. In most industries, companies stand out from their competitors only slightly when compared by strategies. Operational excellence, people and corporate culture are more and more important.”

In Alahuhta’s view, customer-orientation, transparency and a positive attitude are essential building blocks for success.

Positive attitude gives a positive footing

“The input of positive energy is tremendous. It is one of management’s key tasks to advance an open, objective-oriented atmosphere, allowing

people to focus on their tasks without distraction. In turn, this gives the company a significant positive footing to complete its objectives.”

According to President Alahuhta, company management has to be proactive when it comes to future trends.

“The ability to combine creativity with scale advantage at exactly the right time and place makes great things possible,” Alahuhta says and gives an example of KONE’s advance in China.

“A couple of years ago we made the decision to focus on the expanding markets in China. Now we have reached excellent results in the area.”

Today, it is much more challenging and demanding to run a globally operating company. Where does a leader like Matti Alahuhta get his energy from?

“There are many sources for strong motivation. The most important thing is that I enjoy the work of a leader. Selecting the right people in the right places is always a challenging task. Trying to understand the various markets in the global environment is intriguing. Challenges, success and the achievement of results make my work enjoyable.”

“Investors should pay more attention to companies that seek growth through R&D.”



Is there a place for R&D on the business marathon podium?

Today's companies are in a position where they ceaselessly have to evaluate their performance and balance the utilisation of their resources. Looking for success in an ever changing business environment is a great challenge for companies and simultaneously an opportunity for business consultants. The consultants can easily argue and present a long list of short and long term proposals where a glorious future can be predicted for many companies.

Dear reader, don't be alarmed. I will not go on about consultative analysis and an effusion of business performance jargon. Instead, I would like to emphasise how important it really is for the companies to actually seek after instruments that can create a long term competitive edge for them. These factors should be placed on the podium of companies' marathon race.

So what are the factors and where are they?

If you have followed the recent debate and headlines in the economic and business media, it is easy to see how same basic issues appear on the agenda of the quarter economy driven debate: without growth there will be cost savings. The equation is evident.

One could ironically argue that if some companies are good in cost savings and can thus increase their stock value, shouldn't they move from their current business into banking and finance business where savings and costs is the core business?

Instead of the cost cutting prognosis, investors should pay more attention to companies that seek growth through R&D and promising market expectations. From a stock investors' perspective, these companies should be a real investment opportunity. However, the long term perspective is often forgotten in the investment preferences. It seems that investors' mindset often does not last longer than a quarter.

In an international R&D scoreboard, published by the UK Department of Trade and Industry, the role of research and development as the key success factor was clearly indicated. This scoreboard contains extensive data on the top 1,250 global R&D investing companies. The report indicates that measured by investments and profitability, R&D is a major investment contributing to company success. According to this scoreboard study, there are well established links between R&D growth and intensity and sales growth, wealth creation efficiency as well as market value.

When the "truth" is not more complex than this, why aren't we able to see this more frequently in companies' management decisions? Or is it just the mindset of daily stock value evaluation that is setting the pace?

It is obvious that on today's list of companies, which put emphasis on R&D, there are many of those, who are the performers and winners of the future.

Olli Ernvall
Editor-in-chief

Talking about business potential of R&D and innovations

TEXT: LEENA KOSKENLAAKSO
PHOTOS: GETTY IMAGES

Is there a single winning formula for creating business from technology? Marc G. Stanley of the National Institute of Standards and Technology describes the American approach to supporting innovation and turning R&D into products.

"Science, R&D and innovation are the keys to sustaining economic growth and improvements in our standard of living."

"It's commonly recognized that science, R&D and innovation are the keys to sustaining economic growth and improvements in our standard of living. Yet there are differing views on how to create an environment that supports the development and commercialisation of newly developed science and technology," says Marc G. Stanley, Director of the Advanced Technology Program at the National Institute of Standards and Technology (NIST).

"One of the challenges is that creating new science does not guarantee that the business potential will be realised."

Stanley believes that businesses, and entrepreneurs in particular, can be a critical link in moving science to profitable business opportunities.

Smaller companies taking on the risk

"We have seen a trend in the U.S. where the research component of R&D is being shared and transferred further 'upstream' to smaller companies with greater flexibility and a willingness to take on greater technical challenges and risk."

What has caused this phenomenon?

"Several factors have contributed to this trend. Larger companies face continuing pressure from investors and stockholders to demonstrate profitability on a quarterly basis, which results in a dramatic shift away from longer-term and more basic research," Stanley explains.

Luxury of precompetitive research

"Past efforts at deregulation combined with a strengthening of the current competitive environment have also discouraged larger companies from exploring the 'luxury' of undertaking pre-competitive research," Stanley says.

According to Stanley, this dynamic has not affected only companies. The venture capital community has also faced pressure to demonstrate returns from investments in a shorter time horizon.

Scarcity of funds

The end result has been a scarcity of funds for companies and individuals who are moving new scientific knowledge to the prototype stage and beyond. This concept has sometimes been referred to as the 'funding gap' in technology development.

How can the funding gap be remedied?

"Overcoming this gap requires not only strengthening the organisations and people developing new science, but also establishing new bridges to span the gap in moving science into demonstrable products," Stanley suggests.

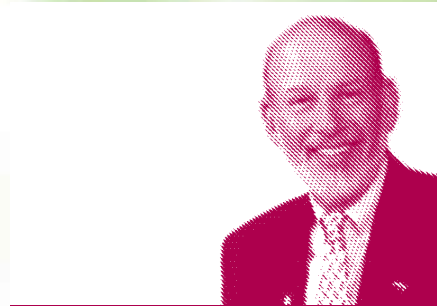
"These efforts will include collaboration, networks, partnerships, and developing 'ecosystems' where companies of various sizes are contributing across industries."

"While fully realizing that the benefits of technology will always require the comparative strengths of large businesses to produce and distribute the goods encompassing the innovation, I am convinced smaller enterprises will find more opportunities to participate in the transition towards a knowledge-based economy," Stanley says.

R&D gap between Europe and the United States

There has been much talk about an R&D gap between the EU and the U.S. Is this gap increasing?

"The U.S. is still ahead in many respects, such as the sheer volume of R&D expenditures, strong venture capital markets, a general entrepreneurial culture encourag-



MARC G. STANLEY

Director of the Advanced Technology Program at the National Institute of Standards and Technology (NIST) since June 2003 (Acting Director from 2001 to 2003, and Associate Director for the Program from 1993 to 2001)

U.S. Governor on the Israel-U.S. Binational Industrial Research and Development (BIRD) Foundation Board of Governors

American Director on the Trilateral Industrial Development (TRIDE) Executive Committee

Prior to NIST, Marc Stanley was the Associate Deputy Secretary of the U.S. Department of Commerce (DoC) by Presidential appointment. He served as Counselor to the NIST Director, as a consultant to DoC's Technology Administration, and as Assistant Secretary for Congressional and Intergovernmental Affairs at DoC.

BA from George Washington University and a Bachelor of Law degree from the University of Baltimore



ing risk taking, and national government policies in support of competitiveness and innovation,” Stanley says.

“Some of these elements can be more readily addressed than others,” he adds. “Countries can commit greater funding for R&D, or begin establishing the framework to support venture capital.”

Entrepreneurial culture

According to Stanley, perhaps the most difficult element to change is the entrepreneurial culture.

“Even within the U.S., success stories such as Silicon Valley often result in efforts to duplicate that recipe or formula in other regions. Part of the success of Silicon Valley was driven by the region’s strong entrepreneurial culture and academic strength in science,” he says.

“Risk-taking, and its inevitable result that some ventures will fail, does not represent a death sentence for the companies that do not make it,” Stanley points out. “The next project with a large potential payoff retains the possibility of being funded and pursued. That culture where

failure can be reversed is more acute in the U.S. than in other parts of the world.”

Europeans are catching up

“That being said, it appears that the R&D gap between the EU and the U.S. may actually be closing,” Stanley adds.

“Europeans are also seeking new channels for knowledge generation, diffusion, protection and application, and focusing on the importance of networks, partnerships, and mobility. In fact, a recent OECD report noted that since 1995, growth in R&D was higher for the EU than for the U.S.”

“Both the EU and the U.S. will continue to face challenges and competition from Asian economies who are also devoting greater intensity to R&D and innovation,” Stanley reminds.

How to proceed?

“There is often a temptation to look for one policy or strategic action to ensure the creation of new businesses and growth from technology. But we recognize that this is not the case. Encouraging innovation and developing entrepreneurial businesses

is not a matter of finding the correct recipe or discovering the correct formula,” Stanley claims.

“We examine all components involved in the innovation process, and try to find ways to support them.”

Focus on project selection and evaluation

Efforts in the U.S. include looking for investments with the greatest potential for broad-based economic benefit. According to Stanley, these efforts should be industry-led from the bottom up, not dictated from the top down.

“Projects should be required to go through a rigorous selection process with clearly defined milestones including the end of the funding commitment. Thorough evaluation of the funded projects will ensure proper feedback and allow better choices in the future.”

Universities and technology transfer

At a greater scale, efforts include supporting education and basic scientific research.

“Universities will continue to supply

“Without ensuring that the innovator can capture at least some of the fruits of his/her labor, improvements in the other areas will be diminished.”

THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)


A non-regulatory federal agency within the U.S. Commerce Department's Technology Administration. NIST's mission is to promote U.S. innovation and industrial competitiveness.

One of NIST's four programs is the Advanced Technology Program, which accelerates the development of innovative technologies by co-funding R&D partnerships with the private sector.

people and ideas dedicated to pushing the technological frontier. This will require a greater emphasis on institutions designed to assist the transfer of this technology out of universities and into the market. A growing number of technology transfer offices have been established in U.S. universities,” Stanley says.

Intellectual property

The final component will be to continue refinements in the protection of intellectual property.

“Without this safeguard of ensuring that the innovator can capture at least some of the fruits of his/her labor, improvements in the other areas will be diminished,” Stanley points out. 



» Business from technology

"The research in printed intelligence started with a desire to look into the ways in which bioactivity, plastic electronics materials and mass production technologies could be used in smart products," says Harri Kopola, head of VTT's new Center for Printed Intelligence.

It's hot & and innovative

AND FULL OF IMMENSE POSSIBILITIES

Intelligent features can be added to everyday products by combining printing technology with information, communication technology and biotechnology. The emerging printed intelligence technologies may well become an international multi-billion dollar business based on cost-effective, high-speed roll-to-roll mass production.

TEXT: LEENA KOSKENLAAKSO PHOTOS: JUHA SARKKINEN

VTT has been investigating and developing technologies for printed intelligence, printable optics and electronics, and their applications for years, and has gained considerable competence in this exciting and innovative field.

Initially the research work was based on a vision of 'electronics from inks', manufactured in the continuously running roll-to-roll (R2R) method, which enables cost-efficient integration and embedding of simple intelligence everywhere.

From roll to roll

Roll-to-roll manufacturing involves production in kilometres, but use and sales mainly in centimetres. R2R printing is an affordable and high-speed method of mass-producing high-volume products even with the simplest of printing machines.

"An important avenue opener for R2R manufacturing methods was the PRINTO project in 2002–2004. The project team developed printable inks, roll-to-roll processing methods such as gravure, flexo and ink-jet printing, and simple printed passive devices such as resistors, capacitors and inductors, among other things," says Harri Kopola, head of VTT's new Center for Printed Intelligence (CPI).

"Today we are aiming for more challenging goals, such as R2R-manufactured, simple ultra-thin OLED (Organic Light-Emitting Diode) displays, printed organic transistors and solar cells, various memory devices, miniature fuel cells and multilayer electronic circuits," Kopola points out.

"We are also developing disposable biosensors, functional and intelligent large-area paper-like products, smart packages, tag and code technologies for ICT and hybrid media applications, and so on."

Multidisciplinary research

The Center for Printed Intelligence is a multidisciplinary organisation whose researchers come from a wide variety of backgrounds.

"We have recruited paper industry specialists, electronics experts, chemists, IT wizards and biochemists. Since our work consists of integrating different technologies and approaches, our research team must have insight into all the fields involved," Kopola says.

"Engineers and biochemists do not necessarily 'speak the same language', and first it was a challenge to try to understand each other's way of thinking, and the different terminology. But now diversity is our



hot

» strength, and our vision is to become the global leading innovation centre in roll-to-roll printed intelligence.”

Breaking new ground

VTT's research in printed intelligence combines different technologies in an unforeseen way. How did it all start?

“It started with a desire to look into the ways in which bioactivity, plastic electronics materials and mass production technologies could be used in smart products. We also wanted to benefit from the synergy generated through the similar manufacturing methods used in the paper and printing industries,” Kopola explains.

Today, VTT is seeking to break new ground in the area between the traditional paper and printing industry on one hand, and cutting edge ICT/electronic industry on the other. The aim is to promote commer-

cialisation and birth of business for new products that utilise both of these industries.

Printed intelligence is a sizzling hot research topic, and, according to Kopola, researchers all over the world are currently trying to identify viable product concepts and business models.

Printable electronics


In the future, printable electronics may offer new kinds of business opportunities that complement today's semiconductor solutions.

Printed optics and electronics are flexible and thin, low-cost and simple, embedded and disposable. They can be used in smart packages, displays and sensors, and can be produced via an environmentally benign process. Printed electronics can be made with functional inks on plastic, paper, textiles or foil.

Electronic, optic and optoelectronic components can be embedded in packages and printed matter. This can be done using either existing or advanced printing techniques, and the end products will provide new functions such as increased information and entertainment.

Bioactive paper

In VTT's vision of the future, bioactive paper innovations will act as invisible helpers in our lives.

Easy to use and always available, they will be capable of acting independently thanks to their biomolecular properties, and they may be widely used in health diagnostics, the food and pharmaceutical industries, testing of microbial diseases, anti-counterfeiting applications, and also for environmental and safety purposes. 



\$35 billion

The market for organic and printable electronics is expected to be a \$35 billion industry by 2015, and by 2025 it will be in excess of \$300 billion. In other words, it will be almost twice the size of the silicon industry today (Frost & Sullivan).

Get in touch

**TOGETHER WE CAN FIND SOLUTIONS
THAT CAN SERVE YOUR BUSINESS**

Companies, institutes and authorities can take advantage of VTT's competence to create new business options. Our involvement in literally hundreds of EU research programmes enables us to promote technology transfer and at the same time develop the global competitiveness of both our customers and society as a whole.

Get in touch with the persons in charge of VTT's customer relationships.



Future Uses

Let's travel forwards in time to, say, the year 2015.

The local supermarket shelves will contain food wrapped in intelligent packages indicating if the product is still eatable. If you want more product information, you can use your camera phone to read the data packed in 2D code and printed on the package.

If you are allergic, you might like to buy smart wallpapers containing embedded molecules that can identify mildew. You can measure pollen levels in the air by pressing a sensor embedded in your daily newspaper. And your diabetic sister will find it handy to use the test strips made of bioactive paper to measure her blood sugar, and have the results sent directly to her mobile phone.

When your aunt, aged 75 and living alone, gets dementia, you can have smart flooring with pressure sensors installed in her flat. The embedded sensors will act as a user interface, making it possible to monitor whether she is walking or perhaps lying on the floor in need of help.

International co-operation

VTT is currently engaged in the following European joint research projects dealing with printed intelligence:

Rolled

This VTT-led project aims to develop a cost-effective, volume-scale, R2R manufacturing technology for the realisation of flexible OLED devices, and arbitrary size and shape displays.

OLLA

The project gathers and focuses European expertise in organic LEDs to jointly realise a high-brightness, high-efficiency flat light source component for use in ICT and next-generation lighting applications.

SustainPack

The project wants to establish fibre-based packaging as the dominant player in the packaging area, and to provide consumers and users with more added-value packaging choices based on a sustainable resource.

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» Success story



Hannu Kattelus (left) and Martti Blomberg predict an increase in the demand for good sensors due to augmented measurement needs.

S I L I C O N C H I P S

RENEWED
SENSOR
TECHNOLOGY

Innovative carbon dioxide sensors are based on two silicon chips. Vaisala, an internationally recognised Finnish manufacturer of industrial and environmental measuring instruments, uses silicon components developed by VTT in its sensors.

TEXT: KIMMO TURUNEN PHOTOS: JUHA LOIKKANEN AND SUOMEN KUVAPALVELU / SILVIA OTTE

Carbon dioxide measurement has a long history. Traditional solutions use a single or double infrared measurement chamber, rotating filter wheels and a glow bulb as an infrared source.

The new method is a far cry from the previous, often very complicated constructions. It is based on two micromechanical components, or silicon chips. The result: a reliable, stable measuring instrument.

An infrared source emits light into the instrument's gas chamber. An IR detector at the other end measures the strength of the signal that passes through the gas, or air, in the chamber. An electronically tuned filter at the front of the detector selects the absorption wavelength of carbon dioxide.

"The amount of light that passes through the chamber indicates the carbon dioxide concentration. If the carbon dioxide concentration in the chamber is high, the gas will absorb most of the light. If no carbon dioxide is present, the light will pass through in full," Hannu Kattelus, D. Sc., Technology Manager at VTT, explains.

"All that is needed to obtain a reference signal is one adjustable component: a silicon chip just a few mm² in size. The required adjustment is only one hundred

nanometers – in practice there are no moving parts involved in the measurement process."

A cost-effective solution

Developed by VTT in cooperation with Vaisala (and used by Vaisala), the filter component solution is unique. The components are suitable for mass production, which gives the process a very high cost-effectiveness in relation to output.

The silicon chips are made from silicon wafers at VTT's cleanroom. One wafer yields approximately one thousand components.

Kattelus points out that the option of partnering with VTT in product development or manufacture is also available for other companies that require micromechanical components or microtechnology solutions. Production capacities of up to a million components annually are possible if the requisite chip is small.

"A cleanroom is a very expensive investment. Buying the necessary equipment and investing in process and component development is feasible only if production volumes are sufficiently high. This is where VTT can offer a shortcut."

In general VTT doesn't carry out many production operations. Micromechanics and microelectronics are an exception.

"In these fields, research and development – traditionally VTT's strong points – often result in production," says Martti Blomberg, Senior Research Scientist.

VTT predicts a more widespread use for micromechanical components as the demand for good sensors increases due to expanding measurement needs.

"This also requires production technology capable of turning out components at inexpensive unit prices."

Several applications

VTT is currently identifying further applications for this technology.

"Carbon dioxide concentration is measured using infrared light. We have been considering whether the technology could be adapted to the visible and ultraviolet range. This would make it possible to measure other gases – such as ozone – or solid substances. For example, this could be a way of identifying different types of plastic," Blomberg explains.

Electronically controlled light sources and filters can also be used in optical data



S I L I C O N C H I P S



communications, where signals using different wavelengths travel along fibre optics.

Well-being for both people and plants

The new sensors developed by VTT and Vaisala have several applications. For example, they are currently being successfully used for controlling ventilation in office premises.

“The sensors can be used to measure the level of carbon dioxide in a meeting room. The instrument shows how the carbon dioxide level increases as the meeting progresses. Ventilation can be adjusted according to demand, which reduces energy costs,” says Mikko Laakso, Product Line Manager at Vaisala.

Laakso says the demand for HVAC applications has increased strongly.

Greenhouses are also an environment where carbon dioxide concentrations must be maintained at a proper level.

“Plants thrive in high carbon dioxide concentrations. It is a type of fertilisation – the carbon dioxide concentration is kept above normal levels with the help of carbon dioxide bottles or natural gas burners.”

Long-term storage of fruit and root vegetables also requires precise measurement of carbon dioxide concentrations.

“Temperature at the storage is brought close to zero, after which the oxygen is removed and the carbon dioxide concentration maintained at a set level. It is possible to store apples, for example, this way for periods up to a year,” Mikko Laakso explains.

Focus on carbon dioxide in soil

Environmental research offers new, interesting applications for the carbon dioxide sensor. The carbon dioxide concentration in the atmosphere is increasing continuously, one of the causes being the combustion of fossil fuels.

Laakso explains there are also other factors which researchers are now aiming to discover.

“At the moment we know how much carbon dioxide the different combustion processes produce. Some of it is absorbed by oceans, plants and forests. However, the concentrations of carbon dioxide in the atmosphere are growing slower than current emissions warrant.”


Scientists believe that soil may act as a carbon dioxide sink. Its carbon dioxide balance can be measured with Vaisala’s sensors, which incorporate silicon components developed at VTT as core elements.

“The instruments can be buried in the soil for a period of time – for example, six months – to measure the amount of carbon dioxide stored or released by the soil.”

Better tools for scientists

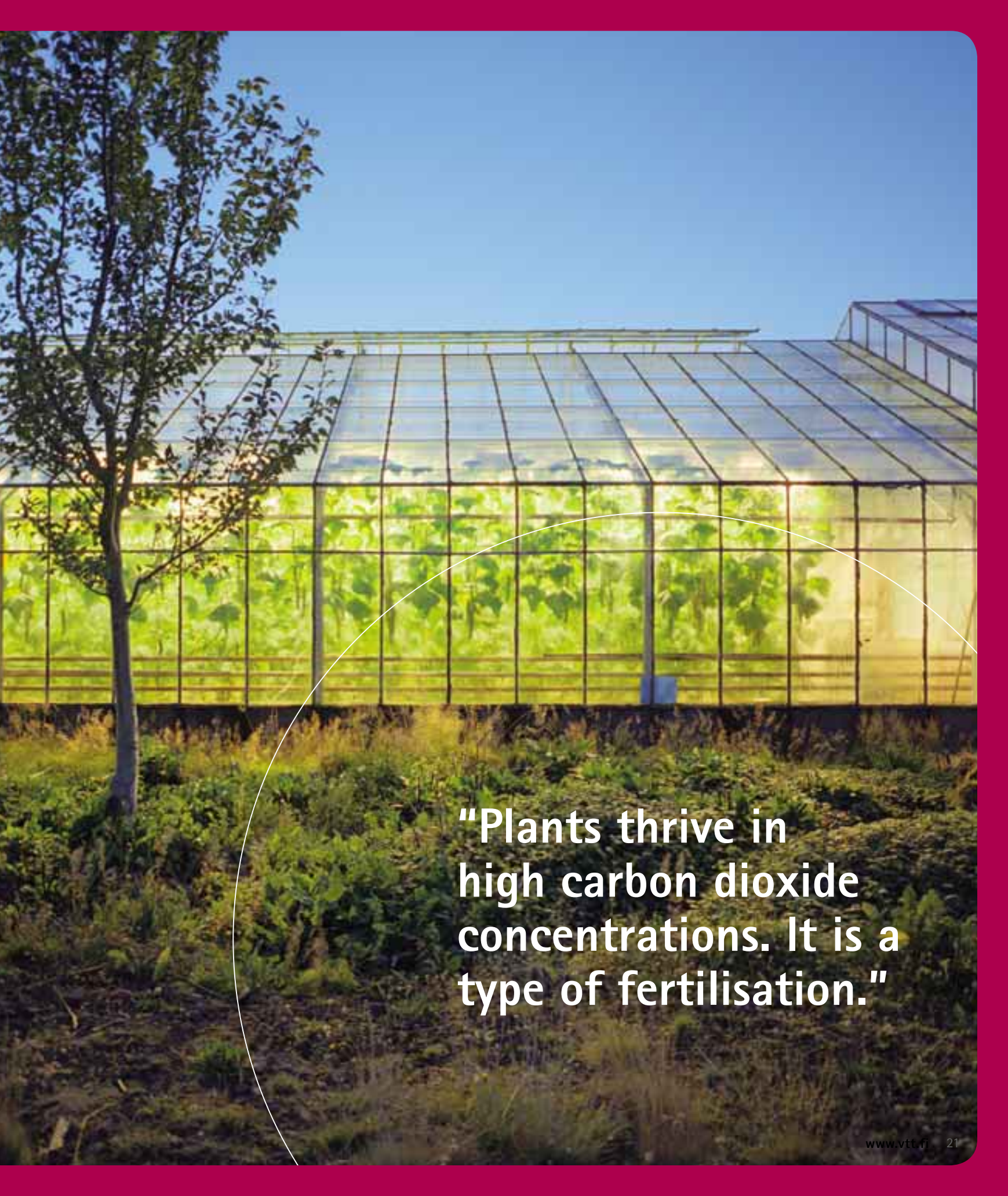
According to Laakso, the current instruments offer better tools for scientists. They make it possible to determine and measure the behaviour of various carbon dioxide sources, particularly those in soil, but also plants and even water systems.

Vaisala produces tools for those interested in measuring various natural phenomena. The new generation sensors make their job significantly easier.

“Vaisala assembles the sensors at its sensor plant, while the critical silicon chips are made at VTT. It is these specialised components that make the sensors unique,” Laakso says. 

“Specialised silicon components make the carbon dioxide measuring instruments unique,” says Mikko Laakso.





“Plants thrive in high carbon dioxide concentrations. It is a type of fertilisation.”

» Success story





Good beer

WITH VTT'S INNOVATIONS

VTT's malting and brewing research covers the entire barley-malt-beer chain from field to customer. Innovations in this field have remarkably decreased the fermentation time and improved process monitoring and quality assurance of raw-materials and products.

TEXT: AULI KARRA PHOTOS: ANTONIN HALAS AND SINEBRYCHOFF

“Our comprehensive expertise in bioscience applications and modern biotechnology as well as in instrumental analysis methods offers excellent possibilities to measure, understand and control biological reactions, microbiological interactions and physical phenomena in malting and brewing processes,” thinks Silja Home, Customer Manager, Malting and Brewing, VTT.

“Evaluation of the quality and process behaviour of new malting barley varieties in collaboration with plant breeders and very good cooperation with experts on plant physiology and farming at Agrifood Research Finland (MTT) enable us to understand barley quality development and requirements also from the farmer's point of view,” Home explains.

Through this network VTT can offer the malting and brewing industry a knowledge platform that covers the entire supply chain from barley to beer. VTT's pilot malting and brewing facilities offer an important check point prior to industrial applications.

Close collaboration with malting houses and breweries helps to understand industry requirements, future trends and targets. By combining industry's awareness of practical problems and process bottlenecks and VTT's expertise in applying bioscience advances many innovations have been created.

“Networking with companies and research institutes makes it possible to find new ideas and targets for development. Some results lead





“Networking with companies and research institutes makes it possible to find new ideas and targets for development.”

Silja Home has made a long career in improving the quality of beer and shortening the fermentation process.

» to marked innovations, such as immobilised yeast technology for beer fermentation, which has been used successfully in Finnish breweries for some time. Also smaller improvements in processing or product quality may in the long-term result in improved quality and substantial savings in processing costs in the industry,” Home believes.

In search of flavours

“VTT has studied wort fermentations by brewer’s yeast for decades. Alongside the traditional approaches, we are able to use metabolic engineering, modifying the metabolism of a yeast cell in a desired fashion to produce the primary and secondary metabolites responsible for enjoyable beer flavour,” Home explains.

VTT has versatile expertise in yeast metabolic engineering and applies modern molecular biology methods for characterisation of yeast strains and monitoring gene expression, process behaviour and flavour formation. Modern brewing technology aims at increased efficiency and consistency of the fermentation process.

One possibility is to use so called high gravity brewing, which means higher sugar concentrations in the beginning of fermentation and higher ethanol content at the end of fermentation compared to traditional brewing. This causes more severe stresses on the yeast cells, in addition to stresses caused by temperature changes, high pres-

sure and deficiency of oxygen and other nutrients.

Although fermentation conditions are changed the beer flavour must fulfil the quality requirements set for a certain beer type and brand. To be able to control yeast fermentation behaviour properly, physiological reactions must be understood on molecular and genetic levels.

Saving time and storage space

“The most time-consuming step in beer production is secondary fermentation, so called maturation. The main objective of maturation is the removal of diacetyl that causes a buttery off-flavour in beer. Various approaches have been studied to accelerate this process phase”, says Silja Home.

One approach is the immobilised yeast technology. Secondary fermentation normally lasts between one and three weeks. Immobilised yeast technology in beer production was first developed to accelerate the removal of diacetyl after the traditional main fermentation. This technology is based on binding of yeast cells on an inert carrier material e.g. wood chips.

By enclosing the immobilised yeast into a reactor, it is possible to make the process continuous. In this way the yeast concentration per volume beer is markedly increased and the maturation reactions occur much faster. Maturation time could be reduced to a few hours.

The use of continuous secondary fermentation technology means faster production cycles, leads to savings in investment costs, energy and cleaning costs and reduces beer losses and environmental load.

Another approach is metabolic engineering of yeast so that no diacetyl is produced in the fermenting beer. These kinds of engineered yeast strains have been developed and work well in pilot tests but they are not in industrial use. ↙

Making beer

Traditionally beer is produced from malt, hops, water and yeast.

Malt is germinated barley. The grain is steeped, allowed to germinate in controlled conditions, and then dried or roasted to stop the biochemical reactions.

Water is the major raw material. The quality of water also affects beer flavour and some famous breweries are proud of their own spring water which gives a special flavour note to their beers.

Malt is milled and mashed with water. Mashing is a process in which the mixture of water and malt flour is heated according to a well-defined temperature programme to carry on the biochemical reactions started in malting. In the course

Continuous development for 50 years

The oldest Finnish brewery, Sinebrychoff, has long been one of VTT's important research partners. Sinebrychoff is also a partner of the malting and brewing industry consortium, Oy Panimolaboratorio (Finnish Malting and Brewing Research Laboratory), founded in 1956.

Sinebrychoff belongs nowadays to the Danish beer giant Carlsberg Breweries. **Esko Pajunen** used to be the head of Sinebrychoff's R&D Department and has a long history of cooperation with VTT. Now he works in Copenhagen at Carlsberg Research Laboratory and tries to introduce some of the inventions already in use at Sinebrychoff breweries in Finland to other Carlsberg factories. His close cooperation with VTT originates already from the 1970's when he worked at VTT.

"Although I have moved to Denmark, I'm still able to continue the cooperation with VTT. In my new position I'm in charge of Carlsberg applied research. I also chair VTT's Advisory Board on Biotechnology, Chemistry and Environment and the Board of Panimolaboratorio. Companies need a strong background in basic research to support their applied R&D," he states.

Different perspectives

In Finland the cooperation between malting and brewing companies and research organisations has been exceptional. The industry consortium,

Panimolaboratorio engages in precompetitive research and offers a malting and brewing technology knowledge platform for its shareholders.

"The cooperation between the industry and research institutions is of mutual benefit. In companies it is not often possible to concentrate on long-term research. On the other hand research institutes also need practical applications to be able to develop new methods and test their findings", Pajunen thinks.

"When I left VTT and moved to the industry in the late seventies I soon learned that we were dealing with the same problems in research and in industry. Only the viewpoint was different", he continues.

Updating traditional methods

Most of the research results over the years have led to small improvements in everyday practices and in the quality of raw materials and products. Better understanding of biological reactions occurring in barley germination and yeast fermentation has enabled maltsters and brewers to make changes in process conditions and to set process and quality specifications.

Intensification of fermentation and shortening of the process time has been one of the major targets in Panimolaboratorio's research. Breakthrough technologies or marked innovations are rare. One example is the immobilised yeast technology.

"In the 1970s we were able to accelerate beer maturation remarkably by so-called warm storage. The economic benefits were significant as well as the quality improvements. This technique was used in Finland long before it was a subject of research for example in Germany," Pajunen explains.

The next step in shortening process time was immobilised yeast technology.

"This system provides several economical advantages that can best be realised when existing fermentation capacity must be increased or when totally new capacity is built. Also it enables us to balance the seasonal variations."

In Finland the technique has been used commercially by Sinebrychoff already for fifteen years. Carlsberg is familiar with the technique but for the time being does not use it in its other breweries.

of mashing malt enzymes break down grain components to fermentable sugars and other yeast nutrients.

The fourth essential raw material of beer is hops that gives beer its characteristic bitter aroma and flavour. Hops were originally used as a preservative agent preventing microbial contamination. Hops are added during boiling of wort.

After boiling the wort is cooled and it is ready for fermentation. A selected yeast strain is added to convert wort sugars and other nutrients to alcohol, carbon dioxide and desired flavours in controlled conditions. After fermentation, the beer is cooled and normally yeast is removed by filtration before packaging.



Esko Pajunen brings Finnish knowledge to Carlsberg Research laboratory in Copenhagen.

High-quality beer

In recent years there has been international interest in the Finnish brewing industry. Finnish breweries have merged over the years and now two of the remaining companies belong to big international enterprises.

"I'm sure that both Sinebrychoff as well as its worst competitor, Hartwall, are among the elite of their international owner's business units. This is the sign of the international appreciation of the long-term precompetitive brewing research in Finland," says Pajunen with praise.

"In general Finnish beer is of very high international quality though the number of special beers is low." ↴

Clean

Can it be achieved with novel technologies?

TEXT: AULI KARRA PHOTOS: JANNE LEHTINEN, VTT AND GETTY IMAGES

VTT has developed novel technologies to build an environmentally sustainable environment during the last five years.

"We chose renewable raw materials and novel energy technologies as our focus research subjects", says Liisa Viikari, leader of the Clean World Theme. The choices turned out to be hot topics of today.

In 2002 VTT launched its four Strategic Technology Themes, one of them being the Clean World. Now VTT is a forerunner in many technologies promoting a cleaner world. People who planned the initiative five years ago were able to forecast some of the hot trends of today's environmental concerns.

"A large part of the research carried out within the Clean World Theme processed issues related to energy: new energy technology, biofuels and renewable sources of energy, fuel cells, energy saving... These are the same themes that many research centres are only just now taking up", says Research Professor Liisa Viikari, leader of the theme.

The Clean World theme covered several fields of research at VTT and combined different technologies. Five years ago, the main issues to concentrate on were not so obvious.

"At the beginning we discussed different alternatives, such as cleaning water and environments, the Baltic Sea, new clean manufacturing technologies and distributed small scale energy production. Finally

we made the choice of concentrating on renewable raw materials since we felt it was a trend of the future."

When the programme started there were four main fields of research, and these remained the same throughout the five years – proof that the choices were good.

Combining technologies

The first research topic concentrates on bioenergy, especially on transport fuels from renewables and on fuel cells.

The second area focuses on the forest industry's processes; elaborating the properties of wood fibres and saving energy – always important topics in Finland.

Third, in the area of green chemistry, the Clean World initiative has promoted research on novel products made from renewable raw materials.

The fourth topic is devoted to cleaning harmful substances from the environment, such as how to clean polluted soil and to improve indoor air quality.

"Some topics were already active at VTT before initiating the technology theme but there have also been many new starts and

Clean World

new combinations of our various expertise areas. For example, the research on fuel cells started in this initiative. Later during the programme, design and construction of miniaturised fuel cells combined our knowledge in the areas of fuel cells, enzymology and printing techniques”, says Viikari.

Various technologies are also combined to develop added-value components from lignocellulosic raw materials. New technologies aim at production of chemicals from wood for advanced and environmentally benign adhesives, binders and coatings. The possibilities to use bark components as raw material were studied, aiming at various products mainly for fine chemical and plant protection applications.

New qualities to wood fibres

“We also developed novel application technologies for functionalising wood fibres. We have been able to bring new qualities to fibres. We can for example make them conduct electricity or repel water efficiently. There are several applications in packing materials, composites and specialty products. We have got very promising results

along with basic research,” says Viikari, listing the achievements of the initiative.

Ahead of politics

In addition to the fuel cell research, production technologies for second generation transport fuels have been developed under the Clean World initiative. Second generation biofuels can be produced from a variety of raw materials, including lignocellulosic wastes from agriculture, forestry or industry. Two basic routes have been further developed; thermochemical and biotechnical conversion of biomass into biofuels.

The thermochemical route produces synthesis gas which can be used for production of diesel fuels. Novel biotechnical conversion technologies developed include improved enzymes and fermentation technologies for the production of ethanol from lignocellulosic raw materials.

With these, some of the key technological and economical barriers can be overcome leading to better energy and CO₂ balances.

During the five years of the Clean World initiative climate change and energy



Research Professor Liisa Viikari has been leading the Clean World Theme for the last five years.

“We have been able to bring new qualities to fibres, we can for example make them conduct electricity or repel water efficiently.”



issues have become active in politics, nationally as well as internationally.

The Finnish government has decided that biocomponents in transport fuels should be advanced, following the goals and directives of the EU. Climate change is a subject for national and international concern.

"Five years ago there was not yet European legislation in the area, but our efforts support the present trends and give VTT a good position in the forefront of R&D. Within five years we have created many technologies that promote the present goals", Viikari concludes.

Biorifinery Theme continues studies

The Clean World Theme has now come to its planned end.

VTT has, however, decided to further strengthen its presence and technology leadership in many of the areas of the Clean World Theme and has thus recently launched a new 5-year research programme, the Biorefinery Theme, which will focus on concepts and technologies in the world of refining biomass into liquid fuels, chemicals, composites and polymers. The leader of the new theme is Dr Niklas von Weymarn. ↗

COMPETITIVE PRODUCTION OF SECOND GENERATION BIOFUELS

In October VTT launched a new advanced gasification test equipment that can produce synthesis gas from different kinds of biomass. In the process, synthesis gas will be refined for the production of diesel fuels.

"There could be 70–80 per cent less greenhouse gas emissions with wood-derived diesel than by using fossil fuels", estimates Development Manager Esa Kurkela.

The new gasification test equipment is the most advanced in Europe and can exploit any carbonous raw-materials, e.g. forest industry residues, bark, biomass from fields, or peat.

"We have a long and unique experience of biomass gasification and gas cleaning technologies since late the 1980s and we are pioneers in the use of renewable raw materials," says Esa Kurkela.

The new 500 kW equipment is a pilot on the way to a larger scale 50 MW power station planned to be built in Finland 2008–2009. The third phase, from 2010 onwards, encompasses the construction of a demonstration plant which will be able to cover about three percent of the transport fuel demand.

"Domestic raw materials could support five gasification plants, and they could provide almost one-fifth of Finland's transport fuel consumption", Kurkela estimates. This could be reality around 2020.

Gasification technology can also cut the costs of biofuels by half. In the future, the second-generation gasification facilities could be realized in connection with forest industry plants offering large amounts of potential by products and forest industry residues.

The sustainability of second generation biofuels comes from the better efficiency compared with traditional ways of producing liquid biofuels. Gasification also uses renewable raw materials that become more and more appealing as the price of oil is getting higher and the easily available oil resources are diminishing. ↗

GASIFICATION PROCESSES

In the gasification process, solid fuel is converted to combustible gases, condensable liquids and solid products in the presence of reactive gaseous atmosphere, such as air, steam or oxygen.

Biomass feedstock goes through the drying and pyrolysis stages in a gasifier where the volatile compounds and char are formed. The volatiles can react through secondary reactions with each other and the solid present. The final product distribution depends on gas-feedstock contact type and process conditions.

Efficient

electricity from fuel cells

A fuel cell is a device that directly converts the chemical energy of a fuel into electricity. They could be a future solution to making electricity and there are countless applications for them.

"Fuel cells can be used virtually anywhere electricity is needed. Someone has said that only imagination limits their applications", says Chief Research Scientist Rolf Rosenberg.

To put it very simply, a fuel cell is a device that has an electrolyte in the middle. On one side there is fuel and on the other oxygen. It is essential that the electrolyte does not let gas or liquid through and that it does not conduct electricity; it only lets certain ions through – some electro-

lytes allow oxygen and some allow hydrogen ions. When these ions change sides, the fuel's energy turns into electricity and heat.

The advantage of fuel cells is that their efficiency is much better than today's technologies, so much more electricity can be made from the same amount of fuel.

For example, the efficiency of car engines is much lower than in fuel cells. This is also where the environmental sustainability of the fuel cell lies: we get more energy for the same amount of emissions.

Reducing emissions

The emissions depend on which fuel is used. Fuel cells can not stand any impurities, so if, for example, natural gas is used, sulphur must first be removed from it, and thus the fuel cell does not cause sulphur emissions. If the fuel is natural gas, the emissions from the fuel cell are

carbon dioxide, and water if hydrogen is used.

So fuel cells using hydrogen as fuel do not cause any greenhouse gas emissions. The problem is that the hydrogen needs to be made first, and this causes carbon dioxide emissions.

"When we learn how to produce hydrogen efficiently in a sustainable way we will be much closer to saving the world. Novel conversion technologies for producing hydrogen are also being developed at VTT," says Rosenberg.

Waiting for the right moment

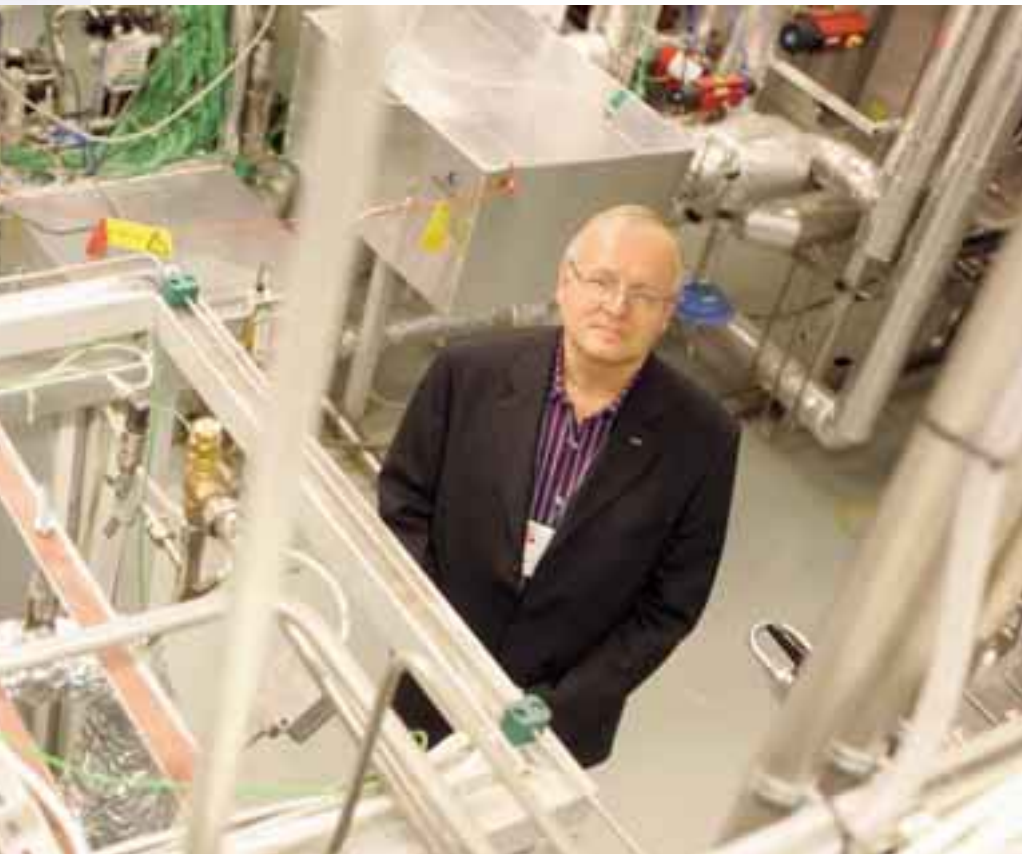
Internationally, fuel cell research started quite late in Finland, ten years behind the others. The reason we now have some world-class knowledge here is that we have put emphasis on developing the whole fuel cell system while many other research institutions have been conducting research solely on materials.

There will be many applications for fuel cells in the future, but first the research has to overcome the challenges of price and durability. The materials used in cells are still not good enough, and they are quite expensive.

The first commercial applications will be batteries in cell phones and laptops. These will come in a few years. The first commercial fuel cell power plants will be built in small houses around 2010. The commercialisation of larger fuel cell power plants will start in 2015. In cars there could be commercial applications around 2020.

"Fuel cells will become more and more appealing when the price of oil goes higher and the easily accessible oil resources diminish. Although there are no commercial applications yet, companies are very interested and want to observe the situation closely. We have 30 companies in our projects, although only Wärtsilä and Hydrocell are currently doing R&D on fuel cells in Finland. Others are still waiting for the right moment", Rosenberg explains. ↗

VTT is the world leader in the development of Planar Solid Oxide Fuel Cells (SOFC). Rolf Rosenberg is proud of the 5 kW laboratory demonstration of SOFC that produces electricity from natural gas in VTT's laboratory.



Finnish know-how into

TEXT: IRENE HERNBERG PHOTO: CORBIS

A lot of places have tried to replicate Silicon Valley – the triangle in North Carolina, Boston, Austin, Texas, even cities around the world.

The reason for Silicon Valley's success lies in the way of thinking. It is the only place in the world where failure is success. People don't look at failures as failures, they think it is part of the learning process and build something new in hope of success.

People are willing to take risks and they look at things a bit differently.



Ram Mohan, President & CEO of INBAC (International Business Acceleration Center), the new business accelerator centre jointly owned by VTT and Technopolis Ventures Ltd., is one of the elder statesmen of the Silicon Valley region. He believes that the new accelerator will provide very focused and tailor-made services

for those who want to bring technology to market in the fastest possible way and at the lowest possible cost.

INBAC opened its doors in October and early next year will function under the North American Innovation Center that is jointly owned by Sitra, VTT, Tekes, Finnish Academy and Finpro.

Ram Mohan has a strong career behind him. He has previously worked for NEC, a company providing Internet solutions,

where he created an entrepreneurial business incubator model.

"This program has been very successful. We have had five spin-offs in the last two years, all of them doing well, and several internal business units that we have established. Most importantly, our model has been copied by other companies," Mohan explains.

Been there, done that

The key movers in INBAC consist of entrepreneurs and domain experts who have "been there and done that" – people who have an equal number of failures as well as successes under their belts; mostly, Silicon Valley entrepreneurs who have a story to tell.

"We will bring them smart capital – i.e., venture companies or companies related to those areas. The goal of INBAC is not only

in accelerating technology onto the market in the fastest time possible but also providing technology and market validation to groups like VTT", Mohan explains.

"The market is tough, but if companies can make it in Silicon Valley, they can make it anywhere. That is one of the reasons why collaboration with local entrepreneurs is necessary and finding local CEOs who will actually take it to the next level is important. So I think it will be a great partnership in that sense," says Mohan.

INBAC itself is going to be working on two principles. One is a disruptive business model, and the other is open innovation.

Open innovation is a matter of synergy; the more groups work together the better output you get.

Medical devices and personalised gadgets

Assistant Professor Riitta Katila has been a faculty member of Stanford University's Management Science and Engineering Department for four years. Her area is technology strategy and innovation, and she specialises in commercialisation of technology and engineering-based innovations. One of the questions she asks in her research is why some companies are more innovative than others.

"When conquering the US markets, VTT should pay attention to the things that are of interest here today," says Katila.



American markets

Technologies in the areas related to health, such as medical devices and those related to the aging population, are rapidly growing areas in Silicon Valley. Further, finding ways to organise, mine and share the increasingly expanding information in the world (e.g., search), or personalised gadgets such as the Ipad or tivo are really popular right now.

Networking plays a major role in business decisions in the Valley. For example, venture capitalists (VC) base their decisions on who they know.

“A recent study of hundreds of funding decisions in Silicon Valley showed that none of the business plans that were submitted to a VC without pre-existing relationship or referral were funded,” Katila points out.

Concentrate on a few top research areas

According to Katila, in order to succeed in the Valley it is important to pick out a few research areas that Finland is good at and concentrate on launching them.

“Finland is an expert on telecommunications, for example,” she states.

Katila's own current research focuses on several innovation-related issues. She has studied the best strategies for technology



acquisitions and the timing of large and small firm collaborations.

California big on biotechnology

When asked about the fastest growing and most promising field

in Silicon Valley at the moment, many experts mention biotechnology. There are several universities and institutions in the Bay Area that collaborate in biotechnology.

Dr Douglas Crawford is the Associate Executive Director of the California Institute for Quantitative Biomedical Research (QB3) and sees great potential in collaborating with international institutions such as VTT.

“When the State created QB3 in 2000, the goal was to leverage UC resources to drive innovations and make sure that those innovations end up helping patients as quickly as possible. Given that as the guiding principle, we came to the table with an application which said that the future of biology would be all around the integration of engineering approaches to biomedical sciences,” says Crawford.

Cousins at distance

He explains that QB3 wants to be part of the effort of redesigning biology and

engineering sciences. As UCSF is entirely focused on engineering and health sciences, it wants to link clinical expertise with the engineering and physical science expertise on the Berkeley and UC Santa Cruz campuses. Berkeley has no medical school and is hungry for connection with UCSF. QB3 links these three campuses together.

There is very close alignment, motives and spirit between VTT and QB3.

“We both enjoy this simultaneous ambition to do great science, but also see that there are practical applications in the science that we're doing. We are both mandated to work closely with industry, so the two institutions are like cousins at a distance.”

QB3 has two things it could give VTT that could be of real value. One is to expand the scope. Crawford believes that Finland has an amazing intensity of scientific excellence, but the scope is ultimately being limited by the fact that there are only five million people in Finland, whereas there are some 35 million people in California alone.

“The National Institute of Health's (NIH) budget is 29 billion dollars, and we're the fourth largest recipient of NIH dollars at UCSF. So there are definite opportunities for investigators at VTT to network with a broader range of people,” he points out.





The Bay Area is very entrepreneurial and very driven by biotech. Crawford believes that the benefit for VTT having a greater presence in the Bay Area would be three-fold: one, to inspire entrepreneurship on the part of the VTT faculty, two, to find close collaborations with companies either moving from Finland to the Bay Area or vice versa, and three for building long-term contract research relationships between Bay Area companies and VTT.

Good at creating industries

When QB3 was established it was a well-known fact that California is really terrific in generating industries but not very good at keeping them.

"We don't build any aeroplanes in California. All computer hardware is now being made elsewhere. Who knows what will happen with software and biotech 50 years from now. But we are very good at creating industries," Crawford pinpoints.

In his opinion, California has two options: "We can either build walls or we can make California continually innovative and make sure that it's connected and plugged into the world. So we very much believe that in the long term we should be forming strong partnerships with international groups so we have a very strong development model." ↗

Additional information:

Stanford University's Management Science and Engineering Department: <http://www.stanford.edu/dept/MSandE/>
QB3: <http://www.qb3.org/>

NURTURING THE creative spirit OF THE VALLEY

TEXT: PAULA BERGQVIST

Mr. Ron Gonzales, the Mayor of San Jose, welcomes European organisations looking for opportunities in San Jose and Silicon Valley.

Silicon Valley has attracted people and high-tech companies and research institutes for centuries. Mr. Ron Gonzales sees great potential in the emerging technology fields of bioscience, nanotechnology, and solar energy and environmental technology.

"Each of these fields includes a wide range of possibilities, which plays to Silicon Valley's strength for exploring new ideas, fostering entrepreneurial start-ups, and celebrating failure as an essential step on the path to success," he says.

"Silicon Valley has reinvented itself time after time through continuous commitment to innovation, willingness to take risks, and a remarkable ability to build on our technology strengths to dream up new visions and turn them into exciting products and services."

Creative endeavours

In San Jose and Silicon Valley, 85 per cent of the job growth in the past decade has come from small companies.

"This is the reason why we have joined with our academic, business and other government partners in creative endeavours to support young companies that are exploring and developing emerging technologies such as bioscience, software, environment and energy, and international business," says Gonzales.

It has been estimated that over the past decade the incubators have led to the creation of more than 4,000 jobs.

"We must keep our city attractive to employers and their employees by doing all we can to sustain and improve the quality of our schools, neighbourhoods, transportation systems and culture, and we must nurture a creative spirit throughout the community," he says.



Mr. Ron Gonzales sees many possibilities in the technology fields of bioscience, nanotechnology, solar energy and environmental energy.

Welcome Europe!

"We certainly welcome the interest, investment and partnership from European research institutes and companies looking for opportunities to work with our local companies and universities in San Jose and Silicon Valley," says the Mayor.

San Jose has actively encouraged this activity through its economic development visits to Europe, and also encouraged exploratory visits and inquiries to San Jose.

"Because of our long-term openness to new ideas and commitment to partnerships, institutes such as VTT can take the first step by simply introducing themselves to our region's academic institutes and corporations."

He believes that this can lead to building valuable networks that create inventions, technologies, jobs, growth and profits for the mutual benefit of all partners.

"Our city's Office of Economic Development and Redevelopment Agency are very willing to work with VTT and others to identify potential relationships and solutions to obstacles in order to encourage greater European involvement with Silicon Valley," he assures us.

Mr. Gonzales is now completing his second and final term as Mayor. On January 1st the position will be taken over by Mr. Chuck Reed who won the election of November 7th. ↗



St. Petersburg prepares for reforms

TEXT: ANTTI KAUPPINEN PHOTOS: MARIA SEPPÄLÄ AND CORBIS

A metropolis with 5 million inhabitants, St. Petersburg will soon be facing new challenges in areas such as construction, traffic, energy, logistics and waste management. Russia is one of the most rapidly developing transition economies, and VTT wants its share of the growth. Having an office in St. Petersburg will help VTT create relationships and make its expertise available locally.

Valentina Matvienko, Governor of St. Petersburg, has accelerated the pace of infrastructure reforms in the city and the entire province. One of the key objectives of Ms Matvienko's administration is to promote the adoption of international technology expertise in St. Petersburg and bring the city's IT infrastructure to the competitive international level. Her aim is to make St. Petersburg a city with "a quality of life that satisfies European standards".

This goal appears second in the articles listing the city administration's objectives. The city administration has also employed various projects and financing channels with the aim of increasing technological





understanding among the inhabitants. The city's public communications system has been upgraded with state-of-the-art technology to make it easier for the people to obtain information.

Bilateral agreements with foreign enterprises are a practical example of Matvienko's reforms. Although the Soviet Union is long gone, influential politicians still retain a firm hold of the Russian economy. Matvienko has frequently attended both commercial and technological events throughout her term of office.

The awaiting challenges

One of the major problems at St. Petersburg is the poor condition of its buildings. To address this problem, Matvienko launched the 'St. Petersburg's Facades' project in 2005. Concerned with the renovation of facades and courtyards in the city's historical centre, the project is funded from the city's budget and with donations by private enterprises. A total of 120 buildings were renovated in 2005, with a further 200 buildings to be completed by the end of this year. The project will continue until the end of 2007.

Sewage problems are a permanent affliction in St. Petersburg, and the city has willingly embraced all new innovations concerning sewage system improvement. A technique making it possible to install new pipes inside the existing ones has already been piloted in the city by Finnish enterprises, with considerable success.

Pollution is another challenge the city has to address. While a water purification plant built with Finnish assistance was opened a year ago, the capacity of the public water purification system still remains well below the level required. During the past seven years many people have replaced their cars with newer models, which has improved the quality of air within the city, but it is still a far cry from the quality of air in Helsinki or Stockholm for example.

Finnish cooperation

At the General Conference of the Union of the Baltic Cities (UBC) held at the end of 2003 the cities of Tampere and St. Petersburg signed a bilateral agreement aimed at increasing the export of Finnish technology expertise to the shores of Neva.

Also VTT has long background of cooperation with the Russian scientific institutions. Now VTT is focusing its activity at St. Petersburg area's business sector. The city's strong industrial background, developing ICT market and the position as a logistics hub between West and East makes it a natural working platform for VTT.

One of the key objectives of Ms Matvienko's administration is to promote the adoption of international technology expertise in St. Petersburg and bring the city's IT infrastructure to the competitive international level.

RISING POSSIBILITIES for technology



"Russian investors now have the money and they understand the value of good planning."

VTT's expansion to St. Petersburg is being supervised by Jorma Rytönen.

VTT's expansion to St. Petersburg is being supervised by **Jorma Rytönen**, Customer Director at VTT, who has recently spent an increasing amount of his time shuttling between St. Petersburg and Helsinki.

"My task has been to sound out opportunities for various projects and then gather together the right people at VTT to continue the work. We are currently considering our next steps," he explains.

One of the goals listed in the plans is increasing the volume of business. The administration of St. Petersburg has given VTT to understand that involving Russian partners would speed up its integration with the local business sector. Rytönen also believes the time has come to recruit a few Russian engineers to the team.

Infrastructure brought up to international standards

ICT and environmental technology are the priority areas where VTT is planning to make its competencies available in St. Petersburg. Partnerships in environmental technology in particular would be highly valued. Finland has accumulated expertise in the development of methods for landfill gas combustion energy and heat recovery. In St. Petersburg, the city's first heat recovery system recently went online in the Smolna quarter, with others likely to follow.

VTT's office in Oulu has been involved in the brainstorming of opportunities for exporting Finnish ICT know-how to St. Petersburg. No actual projects have been launched as yet, but hopes are high. Matvienko's personal interest in ICT signifies a green light for VTT as well.

Naturally, VTT also has further expertise that could be useful for St. Petersburg, including management assistance in the field of construction technology. When it comes to online measurement of structures, VTT is also at the international forefront. Such methods would be a useful tool in the construction of bridges, harbours or residential housing, or for various condition surveys.

VTT's tailor-made monitoring systems, mobile communication technology, wireless data transfer & management applied for example for pipeline monitoring system makes it possible to carry out much more detailed condition surveys than before. Furthermore, VTT also has a long track record in the development of various alarm systems, which will serve as useful tools in the infrastructure reform

and later condition monitoring in St. Petersburg.

"Russian people nowadays travel widely abroad, where they see that in other parts of the world the infrastructure is in place and is well managed and maintained," Jorma Rytönen says.

"They would like to have the same level of cleanliness and methodical approach at home as well."

The only question is, are they willing to pay for it?

Cleaner energy and less congested traffic

For VTT, the single most important partnership issue concerns energy production in Russia and further investments in this area. Investing in energy production is currently a rising trend in Russia.

"Russia has plans to increase its nuclear energy production capacity and the volume of clean electrical energy it sells to the West," Rytönen says.

Russia could also introduce emission measurement systems once the upgrading of the existing oil and coal-fired power plant capacity to Western standards gets underway.

VTT's competencies also cover forecasts concerning particle emissions in traffic.

"VTT has contributed to the development of equipment with which it is possible to make forecasts of air quality," says Rytönen. In a metropolis such as St. Petersburg, accurate air quality forecasts would be invaluable to asthmatic or allergic persons.

Rytönen himself specialises in logistics and transportation technology – another area of expertise that will be on demand in St. Petersburg.

"We could solve the problem of lorry jams at the border between Finland and Russia. It is absurd to even consider building large parking areas for lorries. Instead, we should focus on improvements of the cross-the-border transport formalities, serve the transport industry and thus develop the transportation logistics at our borders."

Projects that integrate diverse competencies allow VTT the best opportunities for putting its expertise to full use.

"Russian investors now have the money and they understand the value of good planning," Jorma Rytönen explains. There is a wealth of potential emerging in the East, and Rytönen also foresees opportunities for VTT to import Russian know-how and products to the West. ↗



An embe

TEXT: MARIITTA HÄMÄLÄINEN PHOTOS: JUHA RAHKONEN

“Innovative interaction is fascinating and interesting. It also sparked VTT’s own innovation: Societal Embedding of Innovation.”

VTT’s Technology Foresight and Assessment Team is the home base for Senior Research Scientist Sirku Kivisaari, Ph.D. (Econ.). For the past few years, Kivisaari has been involved in innovating tools for constructing the future of the environment and healthcare. She is building a new, creative partnership between producers, users and political decision-makers.

In public healthcare, each organisation has traditionally developed its own solutions, information systems included. This requires a lot of resources but fails to offer economies of scale at the national level.

“We are now seeking common solutions that can be applied nationally,” Kivisaari says.

“As targets are set on a political basis, involving several decision-makers, we need

Embedder constructs social relations

discussion and a basis for cooperation. VTT serves as an impartial interpreter, working to promote mutual understanding between all parties. This is a challenging task, since the issues concerned have great societal importance and change takes time.”

VTT’s innovation specialists lower and remove the obstacles to development by making well-founded information available to the right players.

“We cooperate increasingly with service organisations. We help them identify their development needs and pave the way for cooperation with technology companies. Innovative interaction is fascinating and interesting. It also sparked VTT’s own innovation: Societal Embedding of Innovation.

A spiral leads to the core

Societal Embedding of Innovation is an interactive method for supporting the adoption of societally useful innovations. As the population ages, the need for nursing and care services will increase significantly in Finland in the near future. VTT has successfully carried out several projects aiming at societal embedding of innovations in the welfare and healthcare sector.

Kivisaari describes the spiral path of learning which leads the key actors from the surface to the core. What kind of solution is to be developed? Whose approval or expertise is needed for the development? How can commitment be secured? The process must serve all parties involved, otherwise they will not join in. To be successful, societal embedding requires genuine commitment.

“Throughout the process we repeatedly address the same questions as we go along, but in ever greater depth. It is equally important to identify those who are opposed as those who are in favour of the innovation. The key issue in societal embedding is initiating and maintaining dialogue between all actors who set conditions for its development and diffusion. The purpose of the dialogue is to modify the innovation according to their needs and requirements,” says Kivisaari.

The embedders collect information by interviewing the key actors. Their differing

interests and visions need to be articulated.

“We are preparing a map of the terrain. Throughout the process we interpret the reality for those involved in the process. What an embedder does is social construction. We organise meetings and multi-voiced seminars for the key actors who vary during the process. The network expands organically,” says Kivisaari.

Sirkku Kivisaari notes that even embedders must stop from time to time, take their bearings and question their achievements.

“You must not forget the fundamental purpose of the activity. You have to balance the needs of producers, customers and societal actors. Above anything else, you must know how to listen,” Kivisaari states.

“We work for mutual adaptation of the environment and the innovation. We promote cooperation by helping the key actors understand the different perspectives and objectives of the other partners. Achieving a joint understanding requires effort. The goal of development work is to achieve a solution that can be accepted and adopted by everyone. The road to this goal is the most demanding stage in the embedding process.”

Kivisaari describes societal embedding as a demanding learning process that is only possible if everyone concerned questions their basic assumptions. Only then is it possible to start thinking in a new way.

Towards sustainable development

VTT Innovation Studies and its experts also enjoy world-wide recognition. They are involved in several international networks and participate in Nordic and EU projects.

“We have introduced the healthcare challenges into an international discussion which aims to broaden the understanding of political decision makers concerning innovations that support sustainable development. By applying the societal embedding approach we can also serve international

customers and help them find innovative solutions. The operating concept is best applicable in countries where interaction is an established part of the culture,” stresses Kivisaari. ↗

Seeking balance

Sirkku Kivisaari enjoys her responsibility as business developer. Innovations result in profitable business in customer companies. Successful embedding projects add to the common good.

In her spare time, this expert in innovation management embarks on missions of a totally different nature. Positive experiences await at the doorstep at home.

“I have lived by the sea all my life. The sea is in my bones; its tang is something I cherish. Sailing makes you understand how small you really are. I enjoy roaming outdoors with my dogs, cycling and skiing. I also spend time listening to classical music. Like poetry, music also speaks to the subconscious. It has a healing power,” says Kivisaari.

“You need to balance a demanding job with other things in your life. It also improves the quality of your work. Your vision expands.”

NEW PROFITABLE FUEL COMBINATIONS FOR POWER PLANTS



With the help of methods developed by VTT solid fuel fired power plants can improve their process follow-up and clarify the cost impacts of different fuel combinations.

Through efficient fuel planning and process management, cost savings on multi-fuel boilers can amount to hundreds of thousands of euros every year.

Emission trading has increased interest at power plants to change fuel blends to a type favouring solid biofuels. The profitability of waste incineration is also being studied at several power plants. If it is technically possible to replace coal or peat with biofuels, even small changes in the fuel blend may create significant cost savings for plants at current fuel and emission market prices.

Combusting bio- and waste fuels can, however, cause plants new technical challenges that must be taken into account when evaluating the overall cost impact.

Power plants may utilise the methods by including them in their automation and reporting systems. They help control the overall

economy of the plant, which consists of e.g. fuel costs, operating efficiency, maintenance costs, unexpected shut-downs, investments in renewable parts and emission trading costs.

Kymenlaakso Energia produces heat and electricity for Stora Enso's Anjalankoski paper mill. The company was assisted by VTT's methods in optimising the use of high-quality packaging waste.

The overall operational economy of the power plant was improved, and its energy production for paper manufacture was ensured as the number of expensive, unexpected shut-downs decreased. Fuel suppliers and automation system manufacturers can also benefit from VTT's methods.

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SPEED OF DATA TRANSFER IN ELECTRONIC EQUIPMENT NOW TENFOLD

» VTT has been a leading force in the development of optical data transfer technology suitable for the mass production of electronics equipment, increasing the efficiency of the electronics devices many times over.

Just one optical channel on the electronics circuit board could revolutionise data processing, as it can increase the speed of data transfer tenfold while keeping vulnerability to disturbances very low.

In cooperation with other companies and the Helsinki University of Technology, VTT has developed a prototype of an optoelectronic circuit board, for which a data transfer bus with four channels, equaling 40 gigabits per second, was manufactured.

The general perception internationally is that the current electronic data transfer speed of 1–3 gigabits per second, used in electronic circuit boards, is difficult to increase due to susceptibility to disturbances and the lack of physical space.

The research led by VTT focused on the development of optical data transfer buses for circuit boards that are suitable for mass production. This massive data transfer capacity will be introduced to circuit boards, with distances ranging from fractions of a millimetre to about one metre.

Optical data transfer on circuit boards is useful in super computers, in demanding connections between data traffic base stations, between computer processors and memory circuits.

A circuit board for test use was manufactured in the development project, the optical channels of which were designed in such a way that current circuit board manufacturers can produce them with only minor production changes. The aim is to implement optical data transfer on circuit boards in such a way that the changes required are as small as possible, also for the electronics assembly industry.

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Finland's most expensive radio ready for space

The development of an extremely sensitive high-frequency radio receiver for the Planck Mission has been coordinated by VTT. The radio is valued at approximately EUR 8 million. The radio receivers will be launched into space in 2008.

The receiver will be used to measure cosmic microwave background radiation originating from the early life of the universe. It will help scientists determine, among other things, the age and structure of the universe.

A European Space Agency (ESA) undertaking, the Planck probe will

be equipped with a 1.5-metre radio telescope and two receivers: one for measuring lower frequencies, one for higher.

The Finnish team designed and constructed the most challenging components of the low-frequency receiver. The development work was led by VTT and the Finnish firm Elektrobit Microwave was responsible for constructing and testing the equipment.

The receiver required several new technical solutions. In principle, Planck's receivers work the same way as a crystal radio. However, the

frequency of cosmic background radiation is a thousand times that of ordinary radio transmissions. Thus, instead of a wire aerial a parabolic aerial that is a radio telescope was used, and instead of crystals diodes and amplifiers to amplify the signal 500,000 times were used.

The technology developed in the project is already available for use, for example, in security checks, detecting vehicles through fog and telecommunications applications. It is also suitable for high-precision



cloud radars and for making unique astronomical discoveries.

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Improved video streaming for interactive video services

VTT has developed new methods with which video and audio transferred to the consumer remain good even if the data connection slows down or is temporarily disrupted. Thanks to these methods consumers will receive higher quality video services such as TV, video on demand and gaming services both at home and through mobile terminals.

The system also promotes the international competitiveness and product packaging of new services for Finnish service providers and technology companies.

The demand for and supply of high-quality video services transferred through broadband connections is increasing in homes and mobile networks. Improved video and audio quality heightens consumers' interest in increasingly versatile video services. The usability of interactive video services also improves. In gaming services, for example, the user's experience improves when the game is played via broadband connection.

VTT has researched methods that recognise changes in broadband speed in different load situations in data communication networks, which helps adapt the transferred video feed to the network status in real time. Thus the consumer will receive the best video available to his/her terminal at all times.

In addition, VTT has developed video transfer methods that enable several videos which have been optimised for different terminals and data transfer speeds to be replaced with one video that adapts to different terminals. This video can easily be adapted to changing conditions in data transfer and to suit different terminals.

Transferring video with the highest possible level of technological quality creates a basis for introducing new services based on video feeds. These include video on demand, video conferencing and web security camera applications. Consumers can use the video services with their phones, laptops, palm pilots and PCs or, for instance, with a TV that is linked to a broadband digital box.

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DIGITAL TERMINALS TAILORED TO USER'S NEEDS

VTT has developed together with its project partners a small device that tailors digital terminals and services according to users' wishes. The technology, which is similar to a SIM card, can be used with new terminals, such as mobile phones and computers.

There is no longer any need to waste time and effort learning how to use a terminal. Thus, the threshold for using increasingly popular self-service applications will become lower.

In addition to mobile phones and computers, equipment and services that can be quickly tailored include pulse counters, navigation equipment, Web browsers and services connected to movies, music and booking systems.

The user's basic information and functions are pre-stored in the device, but the device can also learn them from the user's own terminal. The profile is updated in accordance with new functions performed by the user.

The technology also makes it easier to adapt services to telecommunication technologies.

At its biggest the separate device is the size of a credit card and at its smallest the size of a SIM card. The networks and equipment independent technology that operate on the basis of the same principle as the SIM card of GSM phones can also be installed in a smart card or terminal.

The technology is currently being tested by users in Italy and Germany. The test systems use different technology platforms, including a USB memory stick, Secure Digital memory card, Java card and SIM card.

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NEW METHODS FOR FIRE RETARDANT WOOD

The fire performance of wood can be significantly improved with different chemical and physical methods without any disadvantages to the appearance of the wood or its usage qualities. VTT together with the forest industry has developed more efficient fire retarding methods for different wood products.

A number of different fire retarding methods for wood were discovered during the project. Fire retardant wood is suitable for internal and external surfaces of public premises; for all such high risk locations with people or significant property values inside.

Fire retardant wood does not produce so much heat that it would contribute to the spread of fire. And it is not easily ignitable. The product may, however, become flammable if it is coated with, for instance, the wrong type of varnish or paint.

One of the key results of the project was a new type of plywood developed by VTT and UPM in cooperation; a thin layer of aluminium foil is added under the wood surface. As a result of the method, the fire performance of the product improved significantly but the appearance and workability of plywood were maintained.

The product is suitable for very demanding applications, such as exterior walls and wet spaces, because the aluminium foil works as a vapour barrier preventing moisture from passing through the product.

The demand for fire retardant wood products is estimated to grow substantially in the near future. The methods charted in the project are now freely available and usable by all.

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Boost your

$$\left[B^u(\$+1) \pi \frac{\epsilon}{\$} \right]^{10}$$

Goal oriented research can result in new products, lower production costs, simplified chain of production or even new markets. Simply put innovations to capitalise on.

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