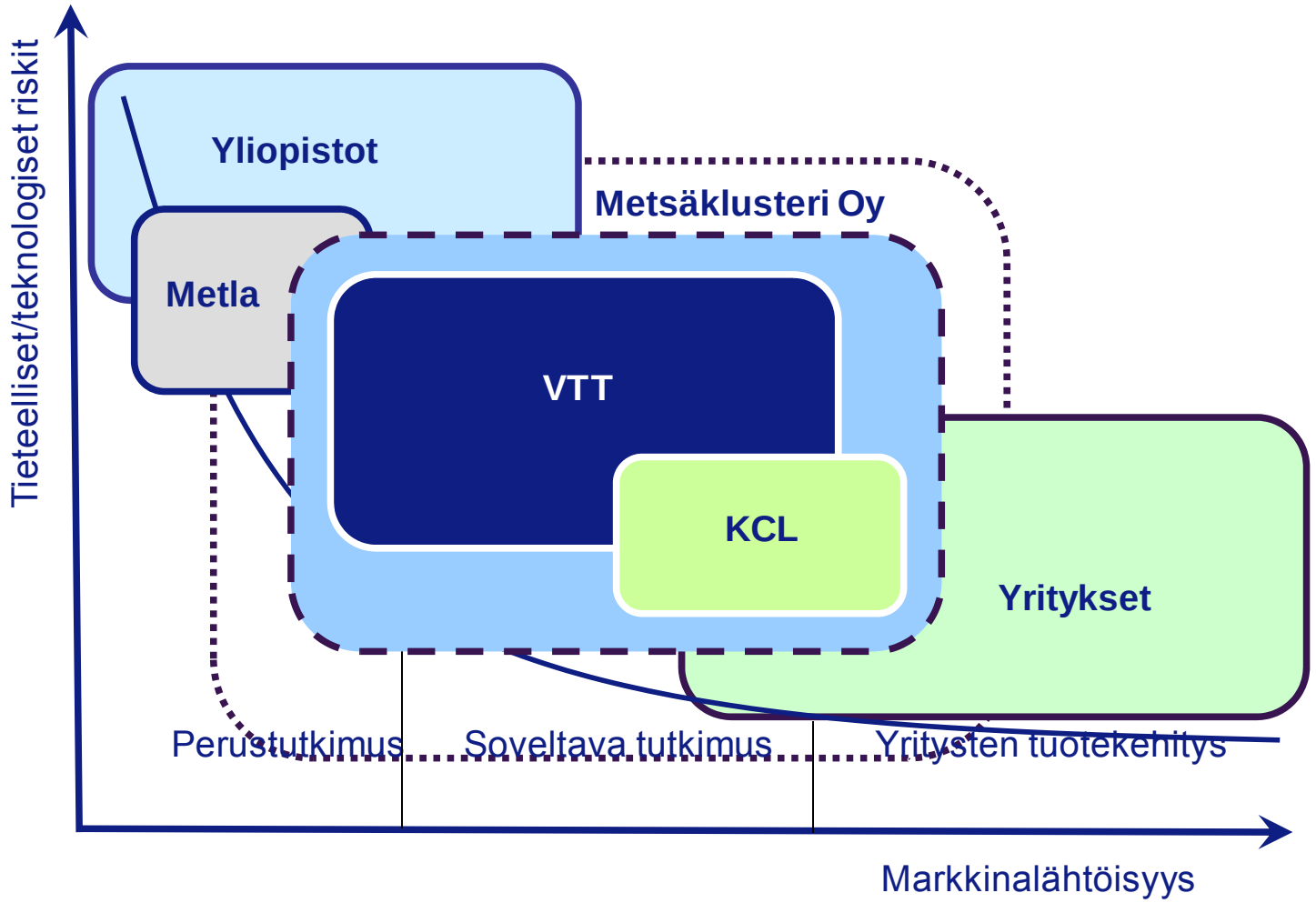
Business from technology

VTT:n metsäteollisuustutkimuksesta

SKY:n vuosikokous 14.4.2011

Klaus Niemelä

Metsäteollisuuden tutkimus- ja innovaatiojärjestelmä 2009



KCL-VTT-yhteenliittymä muodostaa maailman johtavan metsäteollisuuden tutkimus- ja osaamiskeskittymän

- Yhdistämällä tutkimus- ja palvelutoiminnan resurssit vahvistetaan perinteistä toimintaa sekä luodaan edellytykset metsäklusterin uudistumiselle.
- KCL:n ja VTT:n tutkimustoiminnan yhdistäminen vahvistaa tutkimus- ja innovaatiotoimintaa strategisesti tärkeillä alueilla ja mahdollistaa toiminnan kasvun.
- KCL:n ja VTT:n laboratoriopalveluiden yhdistäminen luo asiantuntijapalveluille uuden liiketoiminta-alueen ja tarjoaa metsäteollisuuden laboratoriotoiminnalle uusia sovellusalueita.
- KCL tuo VTT:n piiriin metsäsektorin asiakasrajapinnan syvän tuntemuksen, sektorin ydinalueiden huippuosaamisen ja vahvan tilauskannan.
- VTT tarjoaa KCL:n osaamiselle mahdollisuuden useiden osaamisten integroinnille sekä uusia sovellusalueita osaamiselle myös muille toimialoille.
- Oleellista on kyetä erilaisia osaamisia ja teknologioita yhdistämällä löytämään aivan uusia sovelluksia ja innovaatioita.

VTT's and KCL's focus areas/competences for forest industry

VTT

Sustainability

- Intelligent and resource efficient processes
- Sophisticated measuring, automation and control methods

Novel fibre based products

- Biomaterials
- Converting
- Value added products

Bioenergy

- Reasonable use of energy
- Bioenergy as a source for heat, electricity, solid and liquid fuels
- Control of raw material flows

Research environments from laboratory to pilot scale

Modelling **Simulation** **Measurements**

KCL

Sustainable papermaking

- Engineering of raw materials
- Nano- and biomaterial applications
- Surface treatment
- Sustainability research

Wood-based biomaterials

- Mechanical defibration
- Wood-based chemicals
- Biomaterial properties

Print media & end use

- Ink/paper interactions
- Inkjet printing
- End-use preference

Challenge

- 170 research scientist and technicians to be integrated in VTT's organisation

Result

- 50 persons to VTT's Expert Services (analysis & testing)
- 120 persons to VTT's TK

VTT knowledge clusters & KCL integration

Process Chemistry & Bioprocessing

Systems engineering/
Sustainability asessment

BIO AND PROCESS TECHNOLOGY

MICRO-TECHNOLOGIES AND SENSORS

INDUSTRIAL SYSTEMS

ENERGY AND PULP & PAPER

ICT

MATERIALS AND BUILDT ENVIRONMENT

Fibre Processes &
Functional fibre products

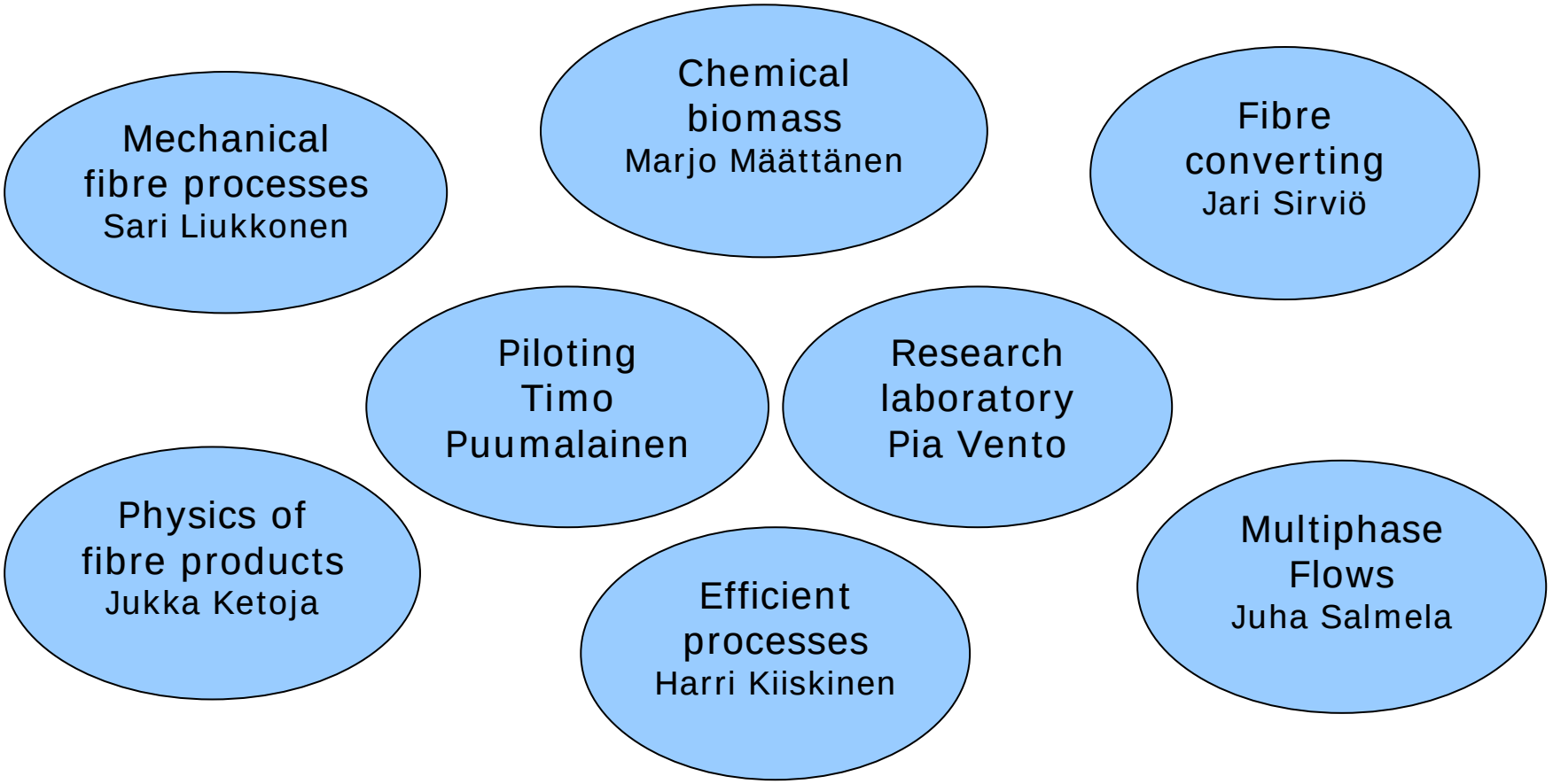
Media technologies/
User-centric media concepts

VTT Energy and pulp & paper

- Fibre Processes
- Functional Fibre Products

Fibre processes TK510

Janne Poranen, Technology Manager



Research professor: Kari Edelmann
Development managers: Petri Jetsu and Pekka Taskinen
Customer manager: Terhi Saari

Research personnel: 90

FIBRE PROCESSES - COMPETENCE

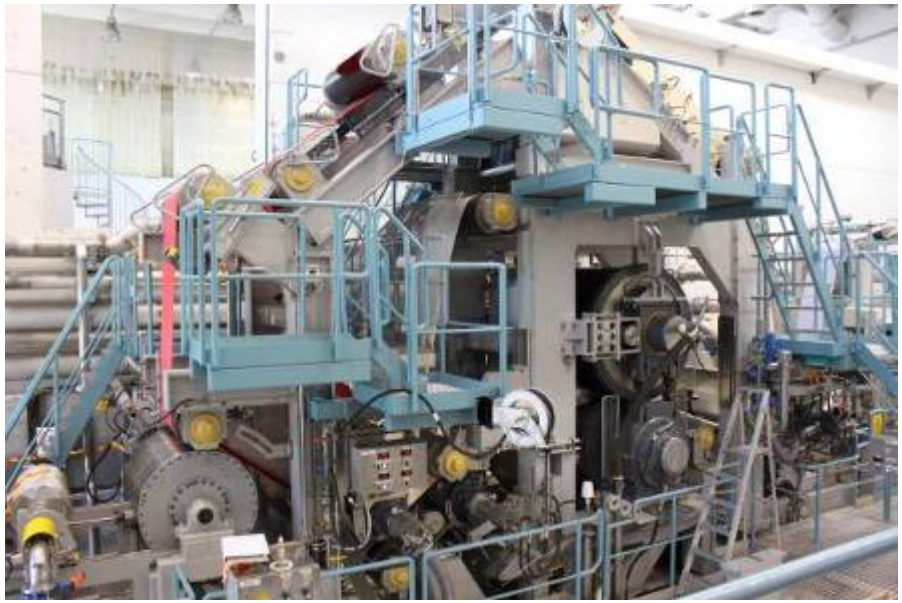
- Development of new energy efficient unit processes and concepts for pulping, papermaking and fibre products
  - Our aim is to develop end-product properties and manage production using different raw material and process concepts.

- Competence is based on the control and development of various technologies:
  - Mechanical and chemical fibre processing
  - Papermaking sub-processes
  - Fibre suspension flow
  - Wet web rheology
  - Fibre properties and paper physics
  - Impact of raw materials on the end product
  - Control of secondary flows in the pulp and paper industry

SUORA – research environment

Technical specifications:

Forming unit		Press	
Gap/Hybrid/Fourdrinier			
Web speed	2500 m/min	Max line load	2000 kN/m
Headbox flowrate	240 l/s/m	Web width	~210 mm
Web width	300 mm	Belt width	700 mm
Fabric width	500 mm		

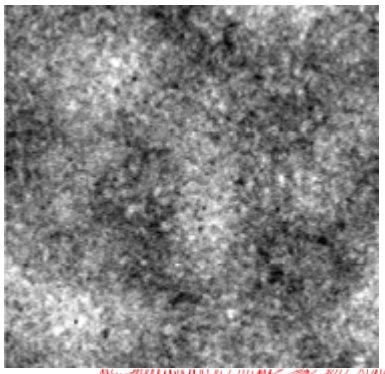


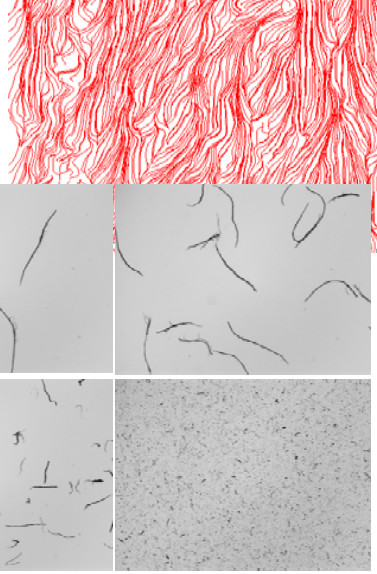
New process and product concepts
- Fundamentals of web forming
- Paper structure
- Dewatering
- Wet end process development
- Mixing, deaeration, screening
- Wet-pressing
- Sensor development
- Papermachine clothing development
- Chemical and raw material studies

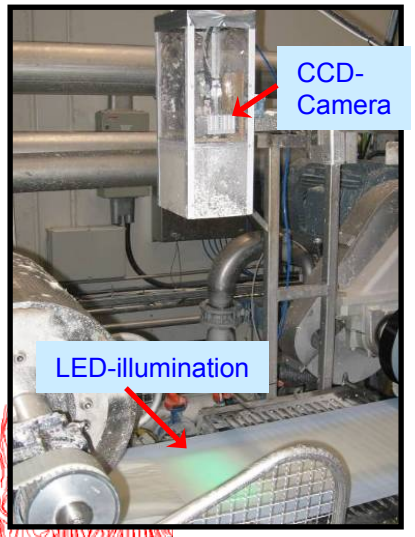
Running concepts
- Once-through (no circulation)
- Small volume circulation
  - 15 m^3 → ~300 kg
- Large volume circulation
  - 100 m^3 → ~3 000 kg

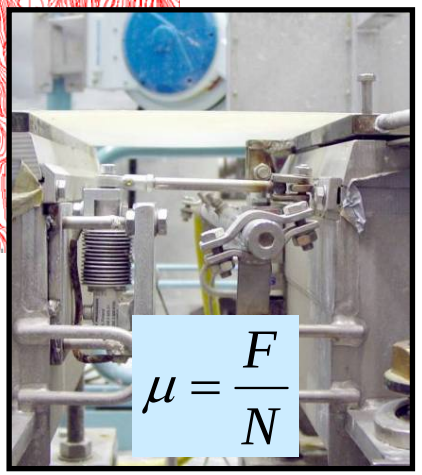
On-line measurements

- Formation of wet web
  - Optical formation of the web is measured from the forming section
- Friction
  - Friction and friction coefficient for forming fabrics and press felts
- Raw materials and process
  - FracOn^{tm} measures mass fractions from decired sources
  - Wet end chemistry
- Water removal
  - Accurate measurements for drainage and press section water removal profiles
- Measurement geometry
  - Each trial setup documented



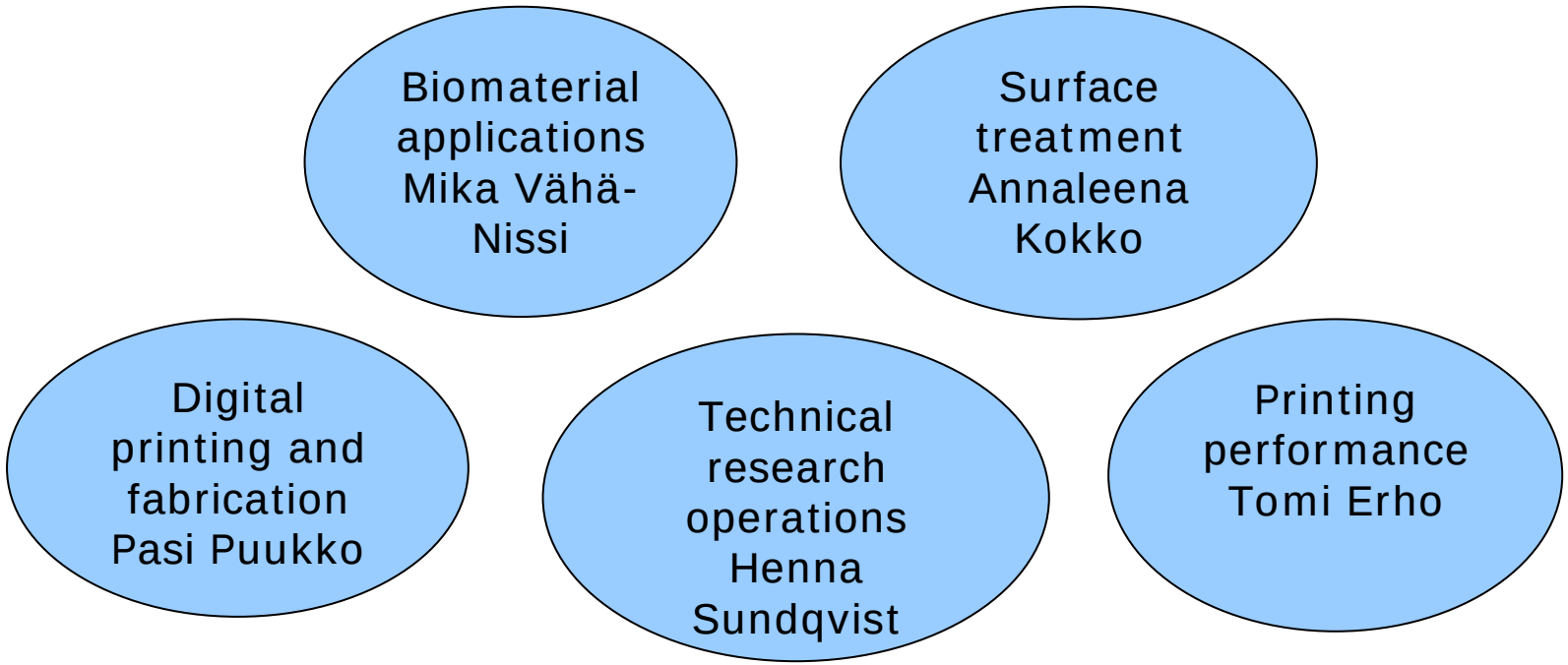






Functional fibre products TK511

Pia Qvintus, Technology Manager



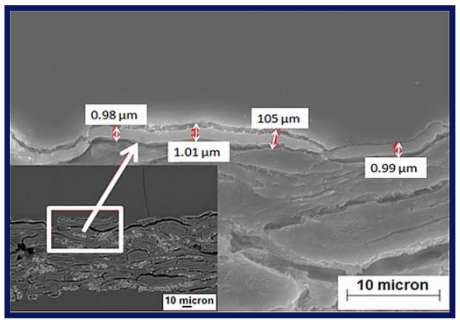
Business development manager: Tuomas Mustonen
Development managers: John Kettle and Esa Torniainen
Customer manager: Katja Jokiaho
Research coordinator: Mika Vähä-Nissi

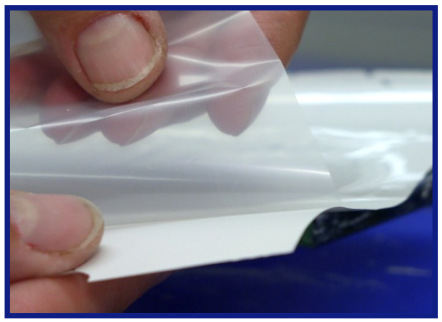
Research personnel 68

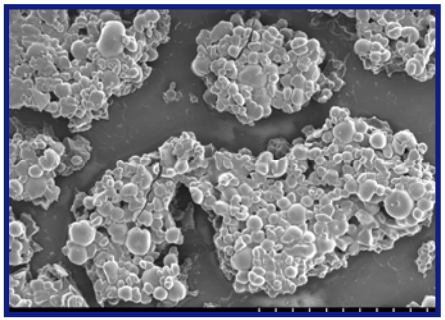
Functional fibre products: From biomaterial understanding to applications

Core Competencies and Activities

- Nanocellulose – from production to applications
- Natural polymers in coating and other novel applications
- Thin surface treatments for added functionality
- Self-organizing structures in paper making and converting
- Sustainable and safe solutions for packaging and other industries
- Innovative applications for fibre-based materials
- Added value for packages (indicators, bioactivity, barrier)



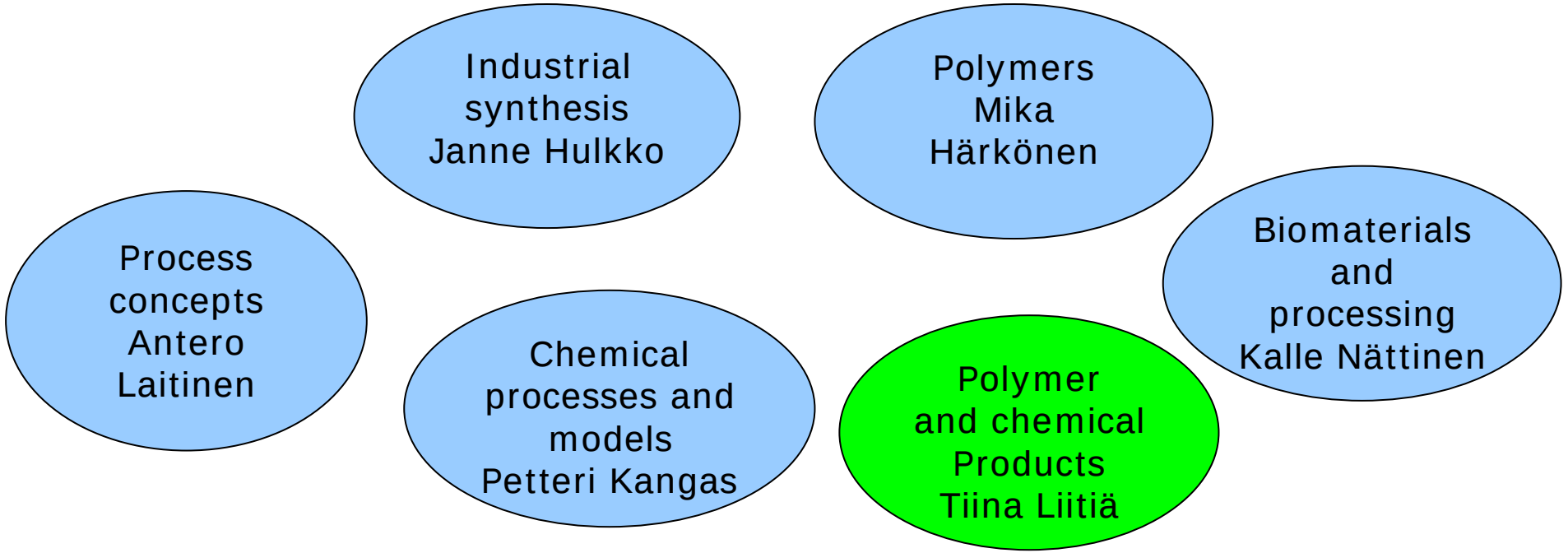




VTT Bio and process technology

Process chemistry TK406

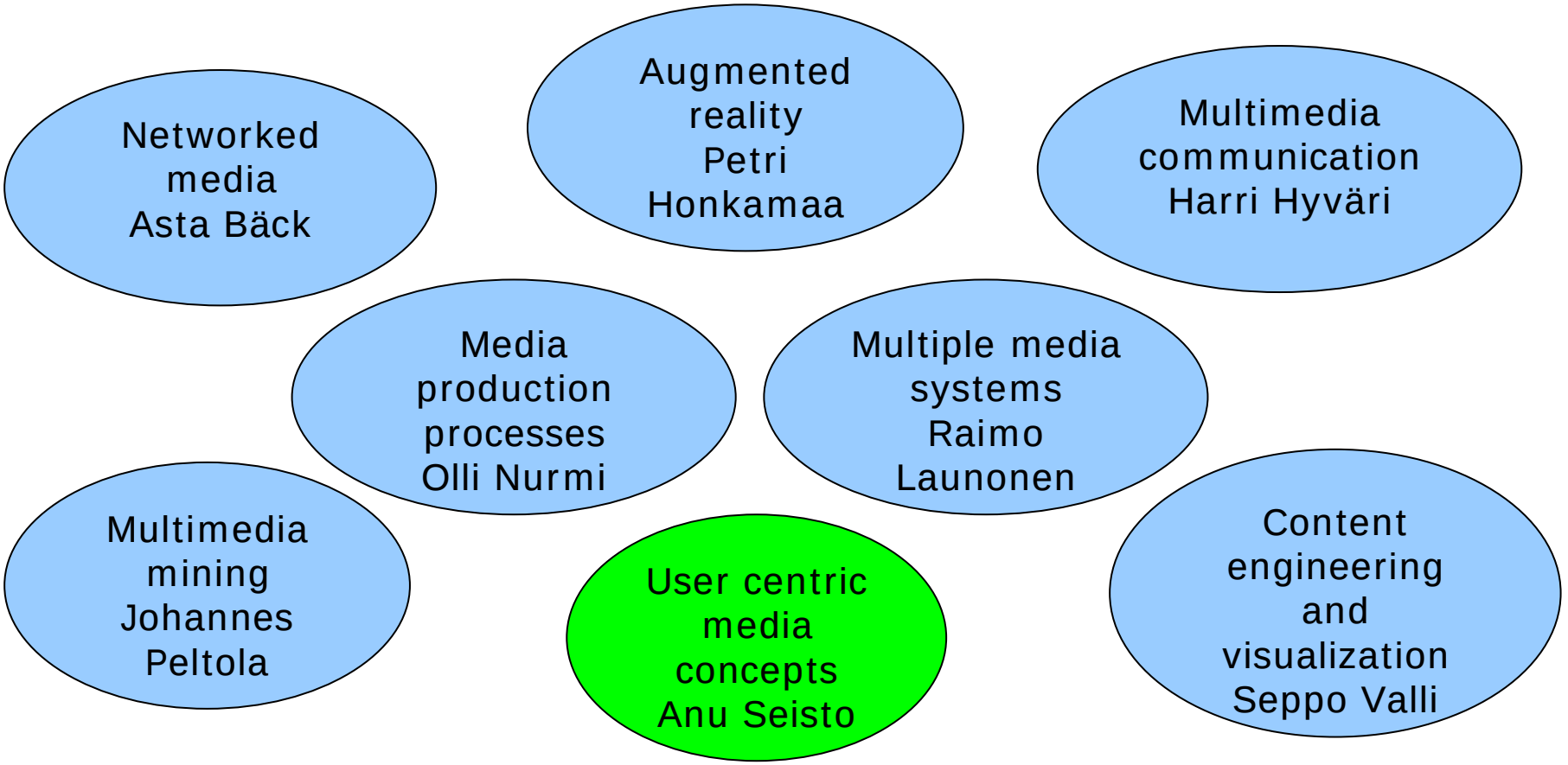
Tuulamari Helaja, Technology Manager



Research personnel: 103

VTT ICT Media Technology TK803

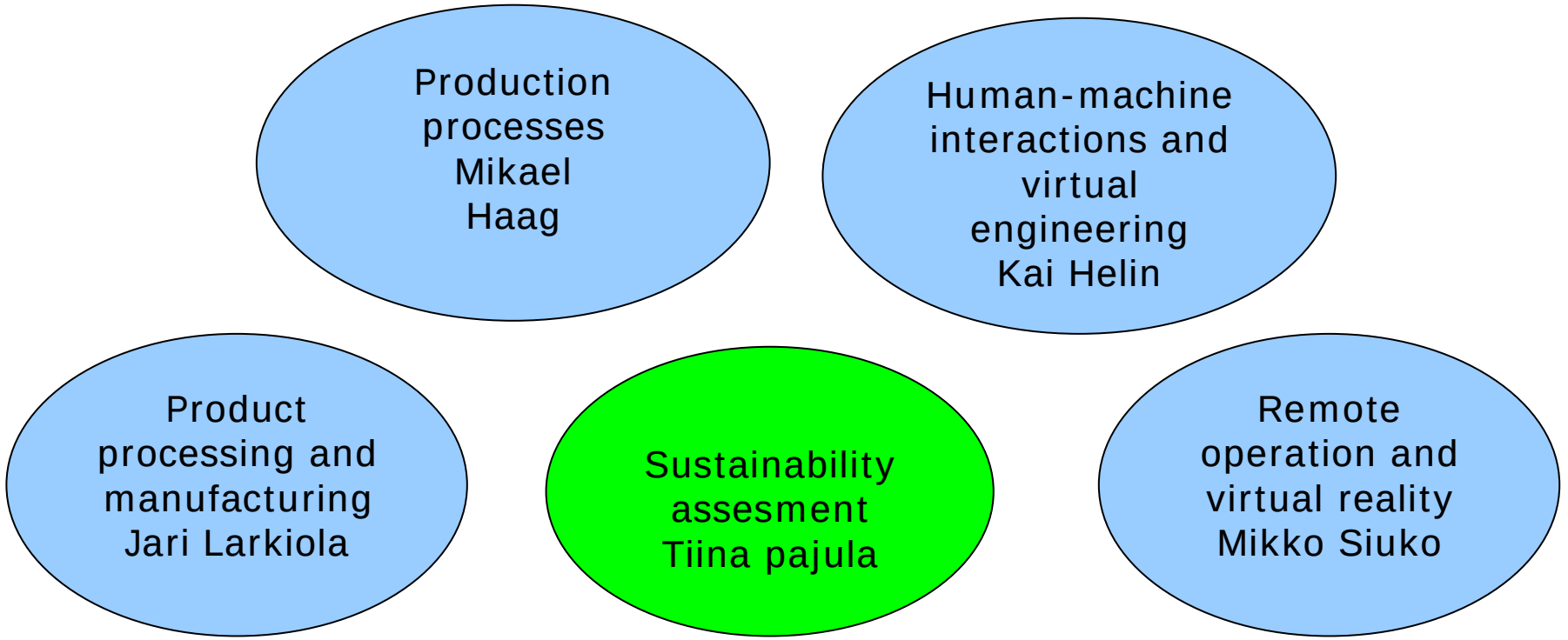
Caj Södergård, Technology Manager



Research personnel: 63

VTT Industrial systems
Systems engineering TK305

Riikka Virkkunen, Technology Manager



Research personnel 78

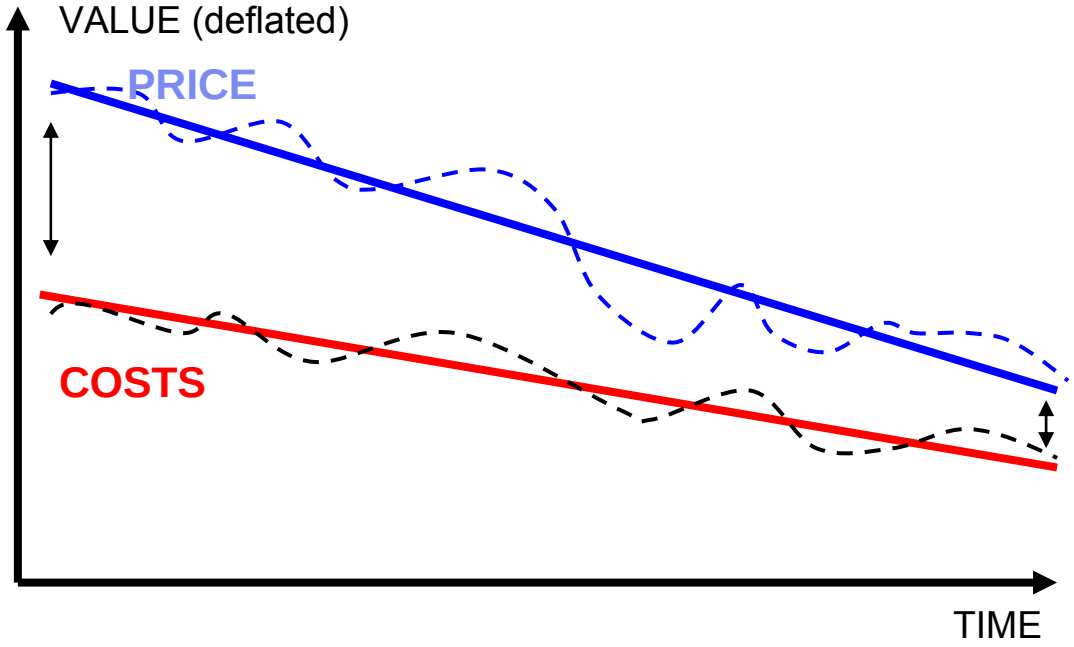
Business from technology

Re-Inventing Paper – Innovation Program 2009-2012

Esa Torniainen

Motivation

- The current products of the forest industry are challenged. To survive, the industry needs to make profit with papers for printed media and fiber based packaging materials at least for the next ten years.



- The opportunities offered by the new technologies, raw materials and end uses need to be taken into use as soon as possible.

Re-Inventing Paper –innovation program 2009-2012

- Covers the research done by VTT related to **the competitiveness of the current products of paper and board industry**.
- Program consists of various types of acitivities where companies participate in different ways. Most of the work is done in different types of consortia and company spesific projects.
- R-IP program ensures the development of VTT's offering portfolio according to the needs of the industry.
- The KCL – VTT integration enables the creation of wide offering portfolio.

Sources of competitiveness

- Re-Inventing Paper innovation programme has been organised according to the three options the forest industry has for maintaining the competitiveness of the current products:
  - **Processes** through the value chains
    - Develop the current processes to maximize the total efficiency (raw materials, water, energy) and sustainability of the production from the raw materials to the recycling
  - **Competitive** Products
    - Make the most of the available raw materials either by introducing new properties, or by increasing the price competitiveness by producing the existing properties cheaper by using the new materials
  - **New end uses** and increasing the effectiveness of current ones
    - Realising new end uses and thus creating new business opportunities and demand for the existing products

Offering 1/2

Side stream handling and control in pulp and paper industry

Simulation, modeling & measurements

Development of printed product

Sustainable chemical pulp mill

Processes through the value chains

Competitiveness of current products/processes and future product concepts

Productivity of papermaking process by improved control of unit processes

Print production efficiency

Energy efficient mechanical pulping

Energy and raw material savings in a papermaking line

Offering 2/2

Efficient and functional nanomaterial applications in fiber-based products

Profitability with biotechnology

Competitive Products

Use of biomaterials in paper and board applications

Development of application technologies to enable use of new materials

Multisensory properties of print and packaging products.

Hybrid Media

New End Uses

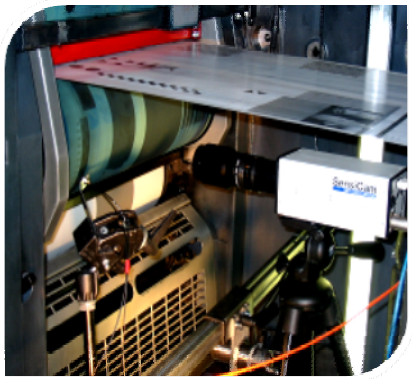
Consumer behavior

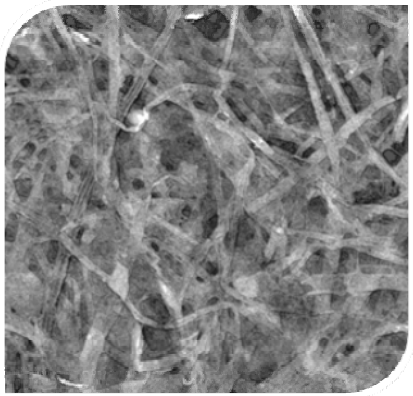
Recognising and developing new fiber-web products.

Technology enabled new business models.

VTT research tools in the forest industry sector

- Pilot facilities
- Mobile on-line / on-site measurement devices
- Analysis and special measurements
- Simulation tools
- Carbon and water footprints, LCA, etc.





Focus:
Understanding phenomena, novel properties, sustaining processes and products, on-line non-contact methods…

➔ **Business from Technology**

Spearhead programme: Industrial biomaterials and end-uses

Packaging

- Beverage packages
- Food packages
- Pharmaceuticals
- Fast food packages

Appliances

- Furniture
- LEH Components
- Vehicle parts
- Electronic devices
- Design products

Performance chemicals

- Adhesives
- Latexes
- Inks
- Plastics
- Compounds

FC FuBio

Composite reorient

PPP NanoCellulose

IndBioMat VTT projects

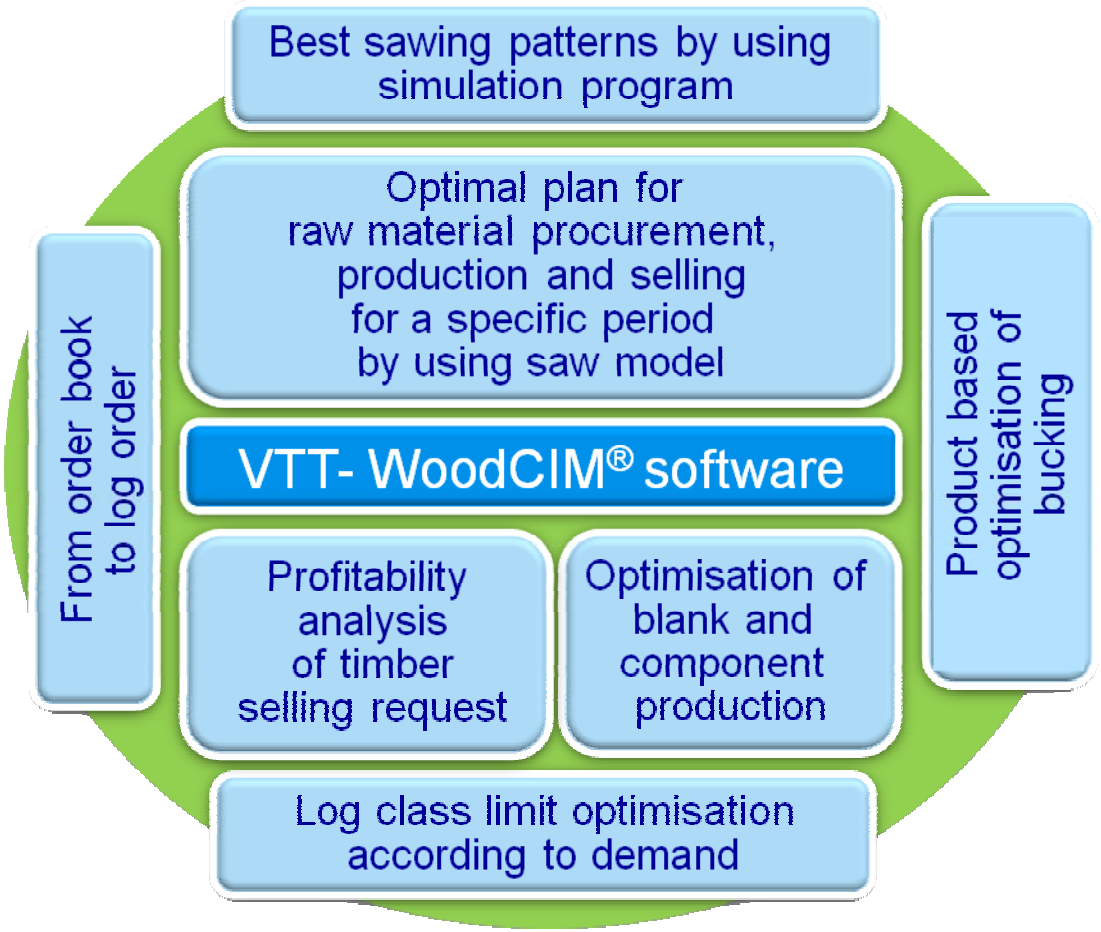
CoE WBGC

IndBioMat: Joint projects

PPP BioPolymers

Front Lignin

Solid wood research - WoodCIM ®



- Models of well known **WoodCIM®** software family for optimisation of sawing process from forest to product. Sold licences already 90 pieces.
- Generally used tool in many international research projects eg. ”Self configurable and flexible production systems at wood product industry”.
- **Industrial users:**

  Metsäliitto Finnforest, UPM, Stora Enso Timber, Koskisen Oy etc., also SME sawmills.

The Finnish Centre for Nanocellulosic Technologies – Est. March 2008

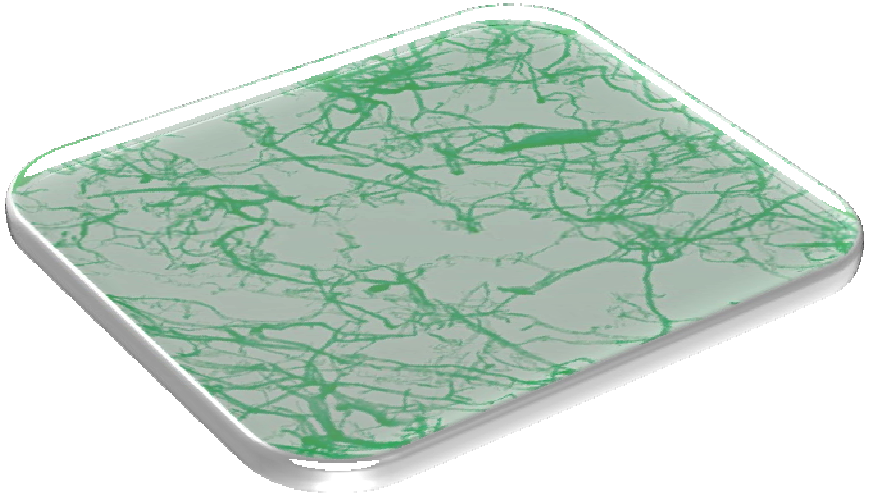
- **Combines the competencies of Aalto Univ. (TKK), VTT and UPM:**
  - Profound and cross-disciplinary basic research
  - Multi-technological applied research and high level project administration
  - Product development and techno-economical expertise

- **Sets up a project portfolio** which addresses production technology, physical and chemical modification, characterization and novel applications.

- **Combines capabilities and resources** to create and govern of needed versatile IPR.

VTT TKK UPM

Nanocellulose



Application areas

1. Paper industry
2. Electronics
3. Medical
4. Food, cosmetics
5. Material manufacturers

Features

1. Strength
2. Nano size, 1000 times smaller than fibres
3. Water absorption

=> How to utilise these features?

Manufacturing

1. Mechanical grinding
2. Enzyme treatment
3. Chemical treatment
4. Combinations

Stora Enso / Neste Oil joint venture for F-T BTL diesel fuel

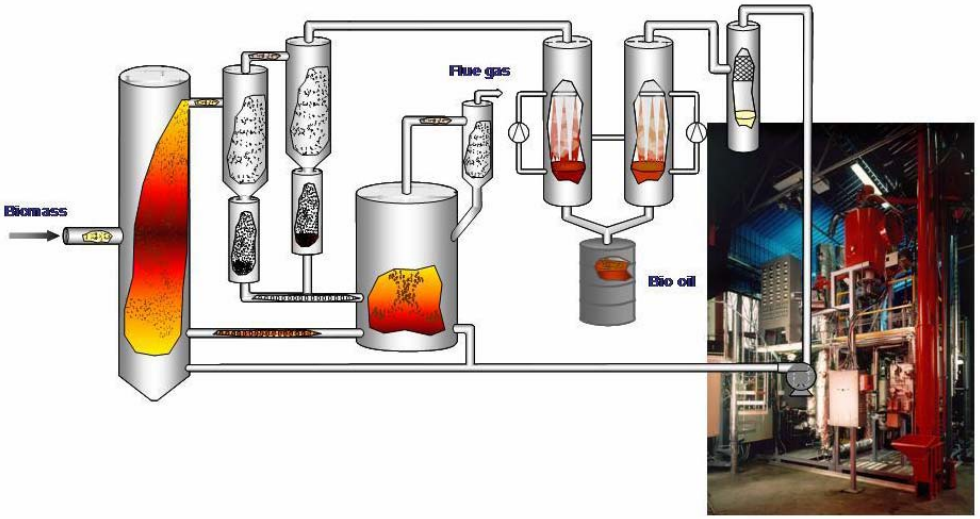
- 50/50 joint venture “NSE Biofuels Oy” to first develop technology and later produce next generation renewable diesel crude from wood / forest residues
- A 12MW demonstration plant in Stora Enso’s Varkaus mill, in use since spring 2009
- Investment decision for a commercial scale plant when the parties have enough experience from the demonstration plant
- Strong development consortium
  - Joint Venture partners:
  - Testing & research partner:
  - Gasification supplier:

From Neste Oil and Stora Enso

Metso, Fortum, UPM, and VTT are jointly developing a clean energy alternative with domestic bio-oil

Press release: Published Nov 30, 2009

- Since June 2009, the Metso R&D Center in Tampere, Finland, has been producing high-quality bio-oil from sawdust and forest residues.
- The consortium has developed a bio-oil production process in which a reactor, linked to a conventional fluidized bed boiler, can first gasify solid biomass and then compress it into liquid form.



metso power Fortum UPM VTT

SWEET Project description

- **Growth potential identified around water Efficiency due to strong synergy between Kemira and VTT.**
- **Center of Water Efficiency Excellence (SWEET)**
  - Opportunity to build a unique position and competence platform for future growth in water efficiency businesses through a major development program
- **Expectations**
  - Program fully enables aggressive growth within environmental technology area
  - Partnership needed to combine competences and accelerate time-to-market
  - Create world-class competence in water efficiency
  - Need external funding to succeed

VTT Industrial Biomaterials spearhead programme

technology | applications | business 2009-2013

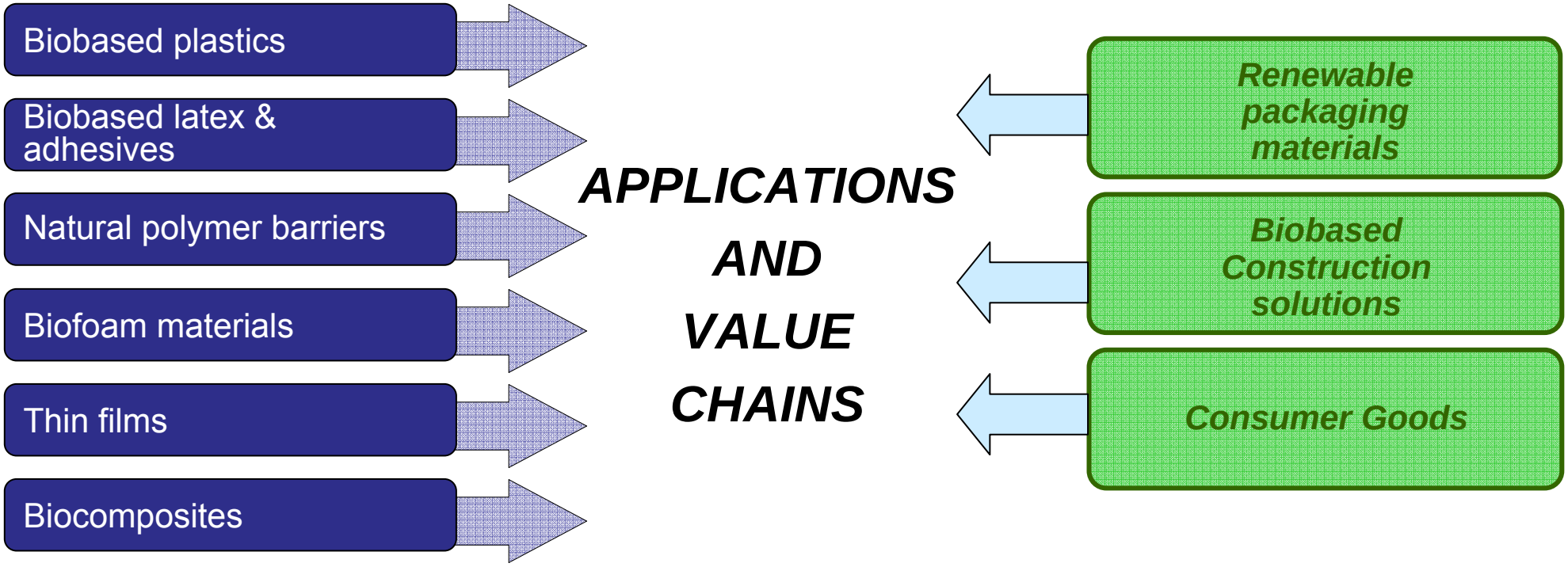
- **Combines multidisciplinary know-how of VTT:** biotechnology, nanotechnology, chemistry, coating, P&P, converting, construction, process and value chain modeling

- **What**: High performing bio-mass based materials and products replacing the non renewable counterparts in performance, product life cycle, and which do not compete with food production.

- **Why:** Enable sustainable sourcing of biomass to existing value chains, to enhance utilization of bio-refinery side-streams, and to develop materials less dependent on oil price.

KEY TECHNOLOGIES

BUSINESS ARENAS



Business from technology

TK503 Polttoainejalosteet

Teknologiaosaamiset 13.4.2011
Teknologiapäällikkö Tuula Mäkinen

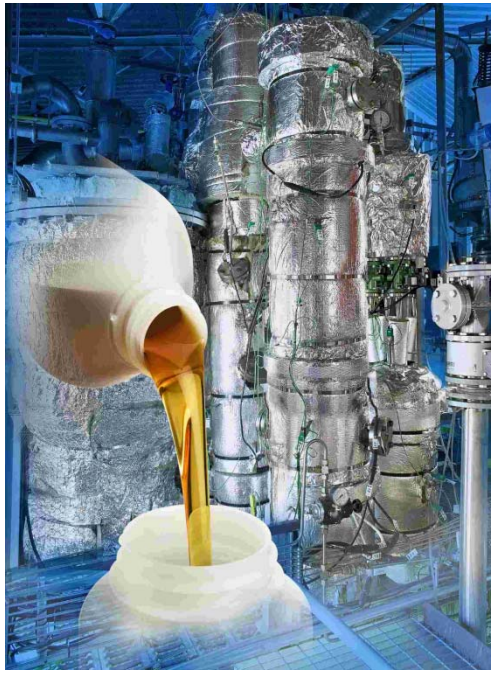
Kaasutus

- Synteesikaasu biopolttonesteiden valmistukseen
  - NSE Biofuels: Otaniemen PDU-kehitys ja Varkauden demo
  - UCGFUNDA-projekti Tekesin BioRefine-ohjelmassa
- Uudet jätteiden hyötykäyttötekniikat
  - LahtiStreams EU:n IP-hanke ja 160 MW:n demonstraatiolaitos
  - Koeajo- ja mittaustoimeksiannot
- Korkean hyötysuhteen pienvoimalakonseptin kehitys

Biopolttonesteet

- Teknologiat:
  - Nopea pyrolyysi (energiateollisuus) ja
  - ”Tislemeijeri”, hidas pyrolyysi (PK-yritykset)

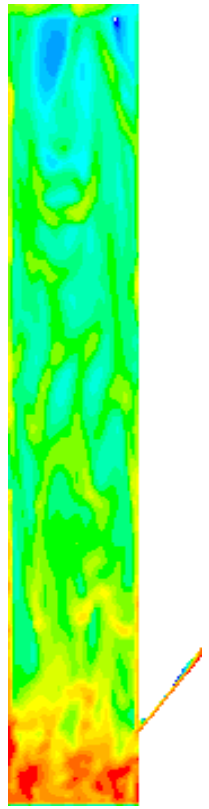
- Nopea pyrolyysi – vaiheet
  - Ensivaiheessa polttoöljyn korvaaminen bioöljyllä (Metso, UPM, Fortum pilotoivat VTT:n tekniikkaa Metson R&D-keskuksessa)
  - Toinen vaihe: biopolttonesteet ja kemikaalit (Tekes-hanke ja EU BIOCOUP)
  - Kolmas vaihe: integroitu biojalostamo



Business from technology

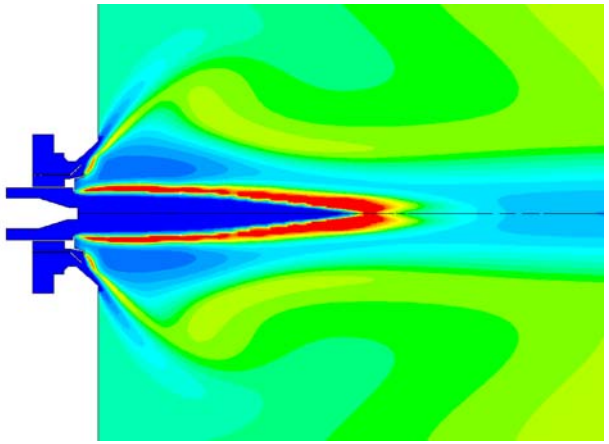
MODELLING COMBUSTION AND EMISSIONS AT VTT

UTILIZATION OF COMPUTATIONAL FLUID DYNAMICS (CFD)



Lars Kjäldman
Chief Research Scientist, Team leader

Utilizing Computational Fluid Dynamics CFD at VTT



CFD AND COMPUTATIONAL CHEMISTRY

- CFD APPLIED AT VTT SINCE 1982

- MODEL DEVELOPMENT AND TESTING
- APPLIED RESEARCH
  - INVESTIGATION OF PRACTICAL APPLICATION CASES
  - UTILIZE SIMULATION TO UNDERSTAND PROCESS BEHAVIOUR

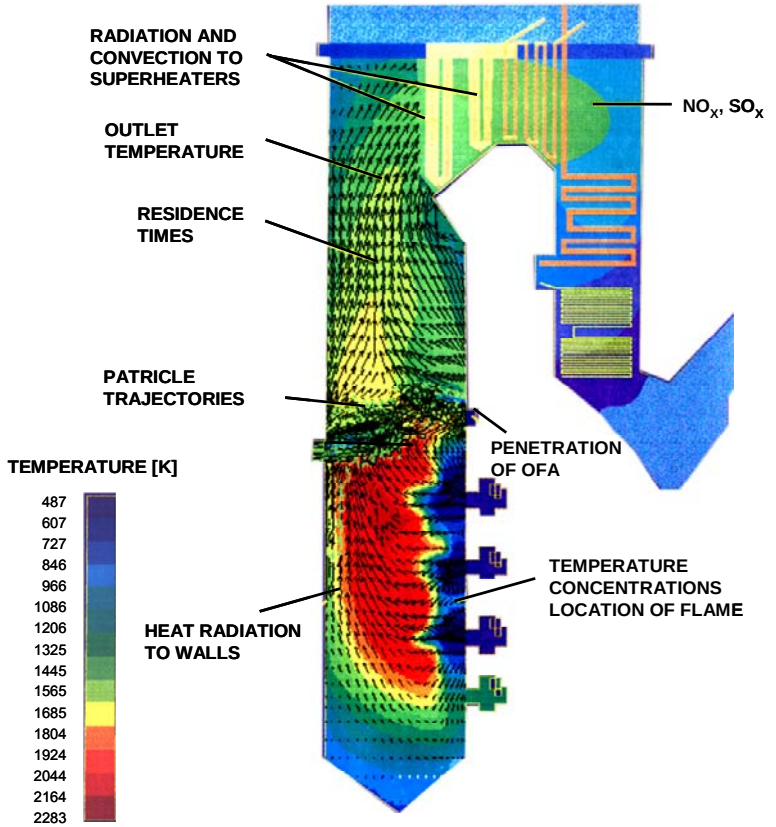
- USE OF COMMERCIAL CODES TO SOLVE THE FLOW EQUATIONS: FLUENT, STAR-CD, and open codes MFIX and OpenFOAM

- COOPERATION WITH COMPANIES AND UNIVERSITIES
- COOPERATION WITH OTHER TEAMS OF VTT

RESEARCH AND APPLICATION TOPICS

Combustion modeling team (8 researchers)

- CFD applied to combustion at VTT since 1984
- Computational combustion chemistry since 2001
- Combustion and formation of emissions:
  - Pulverised fuel combustion (boilers and burners)
  - Grate fired combustion
  - BFB Bubbling fluidised beds
  - CFB Circulating fluidised beds
  - Recovery boilers and lime kilns
- Gasification and fast pyrolysis to produce bio-oils



Demo 1989 →Development of models and methods for PF

COMBUSTION AND EMISSIONS

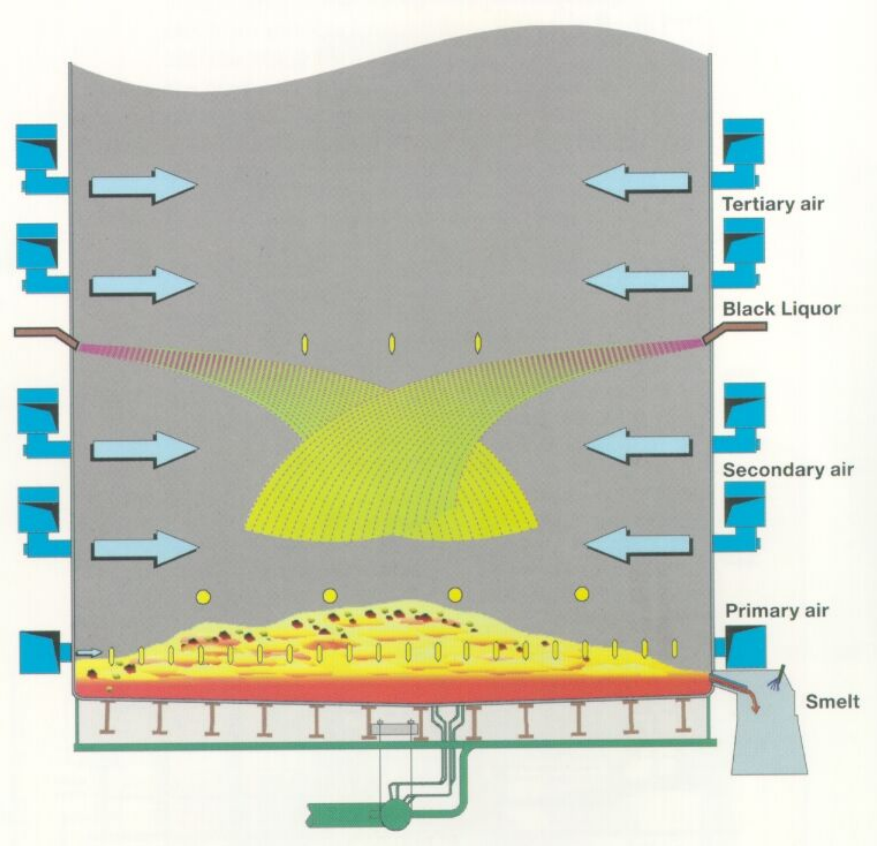
- RESEARCH NEEDED IN ORDER TO MEET
  - NEW NOx EMISSIONS LIMITS (2016)
  - GOALS TO REDUCE CO2 EMISSIONS
    - COFIRING BIOFUELS AND COAL OR PEAT
    - OXYFUEL COMBUSTION (CCS)
  - CHALLENGES TO DEVELOP PRODUCTION OF BIO OIL
    - GASIFICATION PROCESSES
    - FAST PYROLYSIS PROCESSES

- UTILIZE CFD TO UNDERSTAND PROCESS BEHAVIOR AND AS A DESIGN TOOL IN DEVELOPING PROCESSES

EXAMPLE OF SIMULATION OF RECOVERY BOILERS

CFD MODELLING OF A RECOVERY BOILER

- Complex physical and chemical processes
  - Droplet flight and behaviour
  - Gas phase chemistry
  - Char bed behaviour
  - Radiation heat transfer
  - Air injection and penetration
  - Need of simplified description in CFD
- Recent research topics
  - Black liquor chemistry modelling
  - Deforming char bed shape
- Cooperation with Andritz

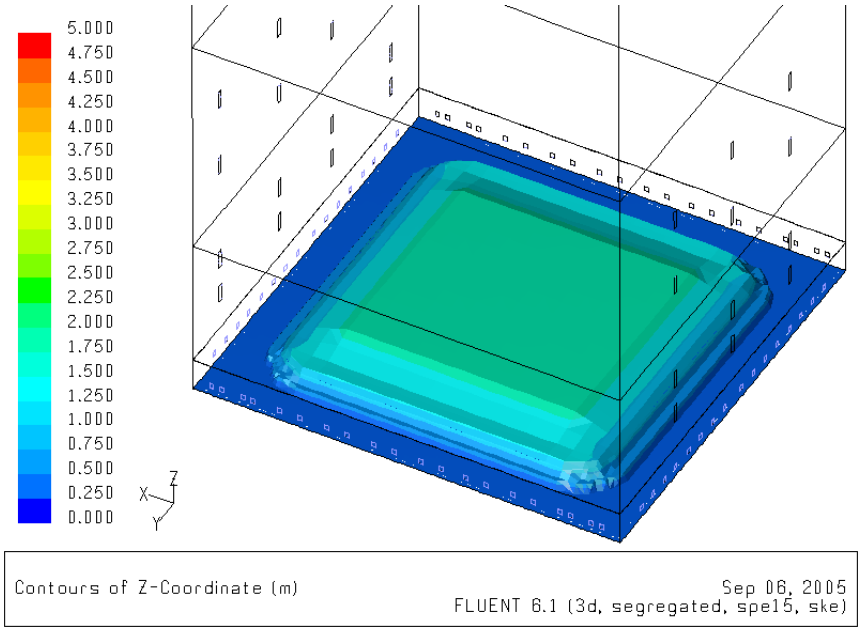


SHAPE OF CHAR BED IN A RECOVERY BOILER

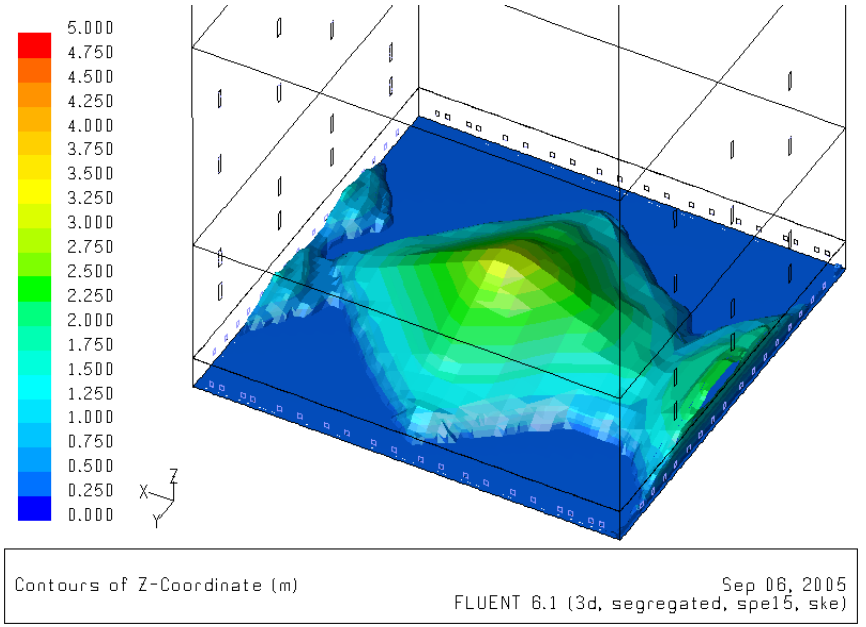
Example result calculated with bed model

- Cellular Automata based bed model
- Slope angle approximately 27°

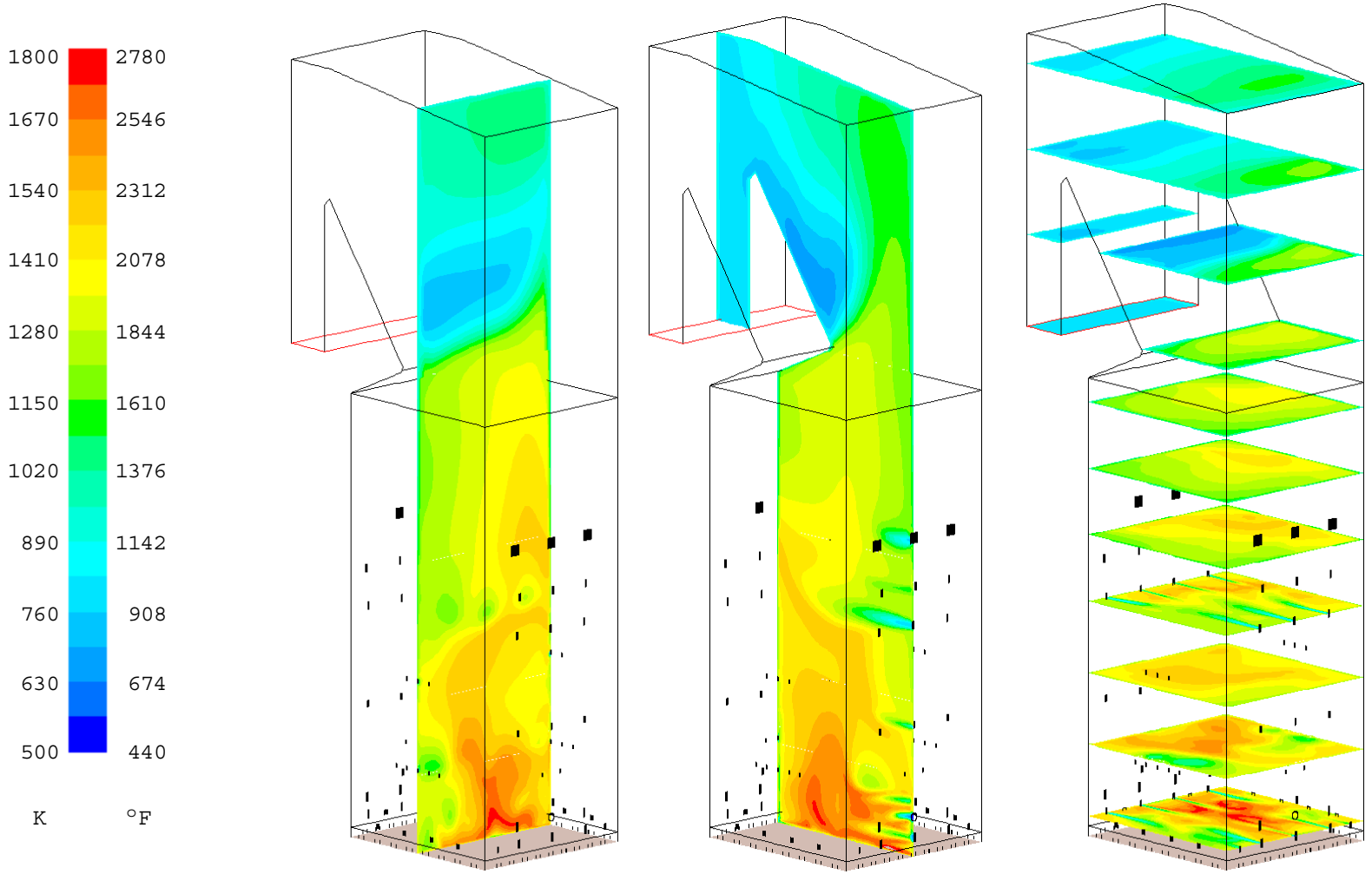
Initial bed shape



Final bed shape



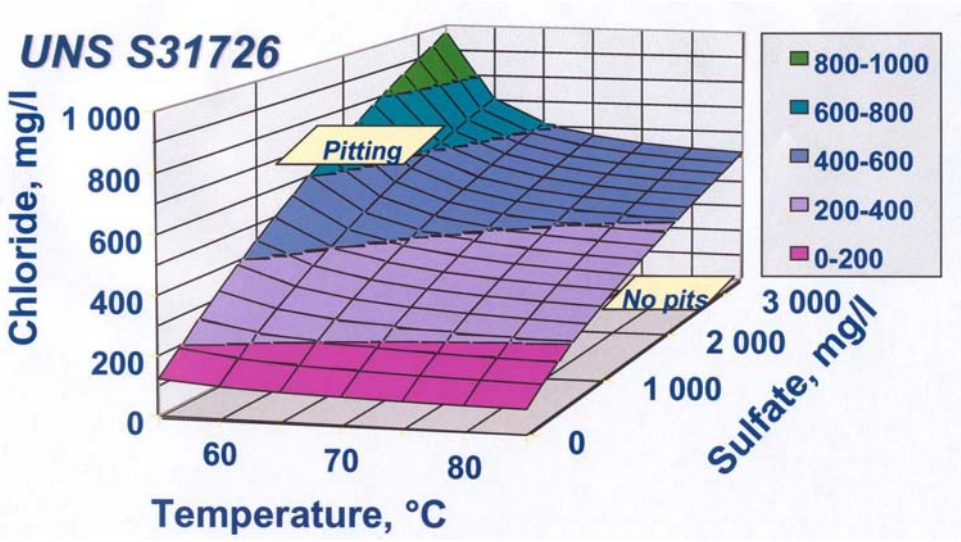
TEMPERATURE IN A RECOVERY BOILER

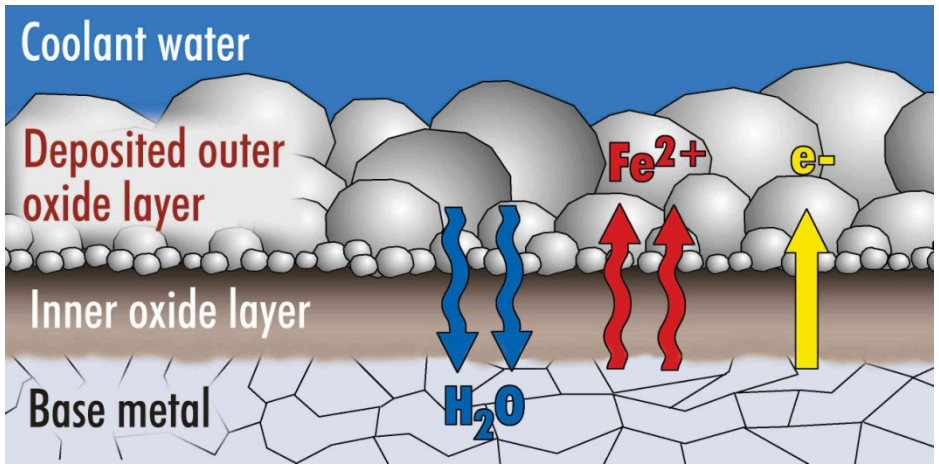


R&D for materials performance in processes

Research to specify operability criteria

- **Material ageing**
  - ✓ Mechanims – Environment, temperature, loads
- **Surface reactions**
  - ✓ Material oxidation rate
  - ✓ Metal-oxide-water interaction
- **Component life**
  - ✓ Fatigue
  - ✓ Stress corrosion cracking
  - ✓ Realistic loading cases and simulated transients

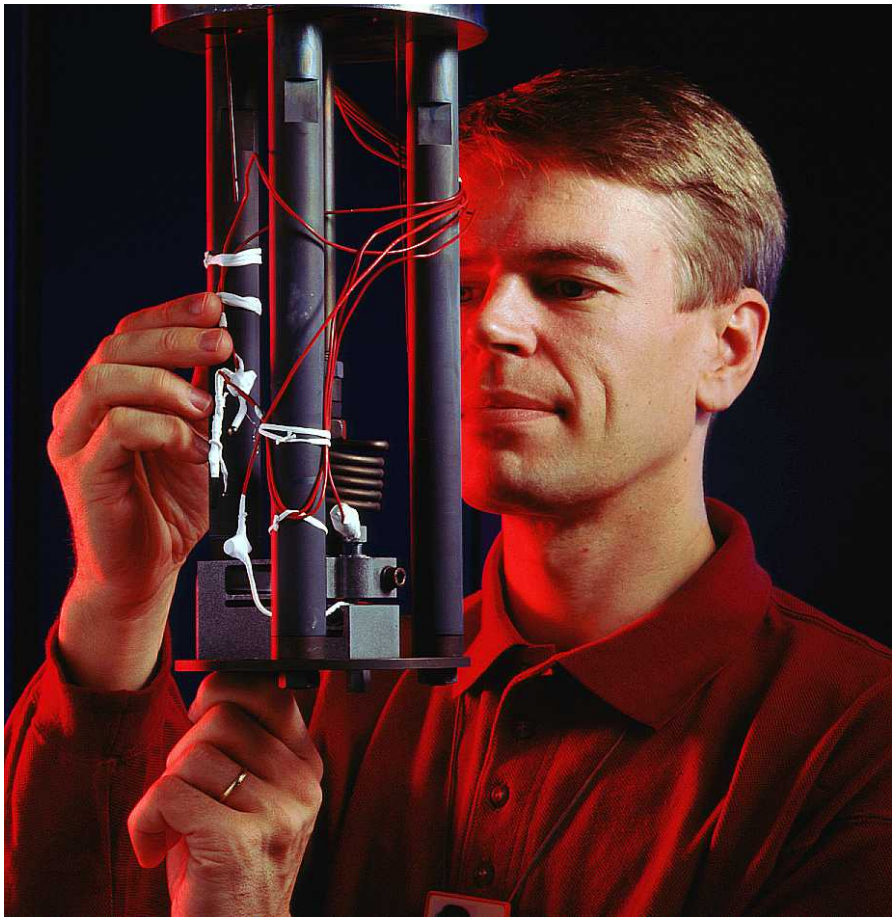




R&D for materials performance in processes

Testing & validation of materials performance

- **Corrosion**
  - ✓ Field monitoring and process data analysis
  - ✓ Laboratory tests
- **Corrosion fatigue**
  - ✓ Determination of ASME III design curve in hot water
- **Stress corrosion cracking**
  - ✓ Comparison of stainless steel grades and Ni-base alloy
  - ✓ Cold work and plastic deformation in austenitic stainless steels
  - ✓ Filler metal and SCC in duplex stainless steels



VTT Group structure 2011

V T T Technical Research Centre of Finland

(State-owned research centre under the domain of the Ministry of Employment and the Economy)

R&D
- Research personnel
- Research resources
- Project execution
- Competence development

Group Services
- Support functions

Strategic Research
- Self-financed research
- Jointly funded research

IP Business
- IPR sales and licensing
- IPR portfolio management

Business Solutions
- Management of customer accounts
- Contract research
- Technology licensing as a part of contract research sales

Separation of economic and non-economic activities.

VTT Expert Services Ltd
- Specialist reports and assessments
- Certification and approval services
- Testing. inspection and calibration

Labtium Ltd

Enas Ltd

VTT Memsfab Ltd
- Contract manufacturing of micro- and nano-electronic materials and devices

VTT Ventures Ltd
- Management of spin-offs

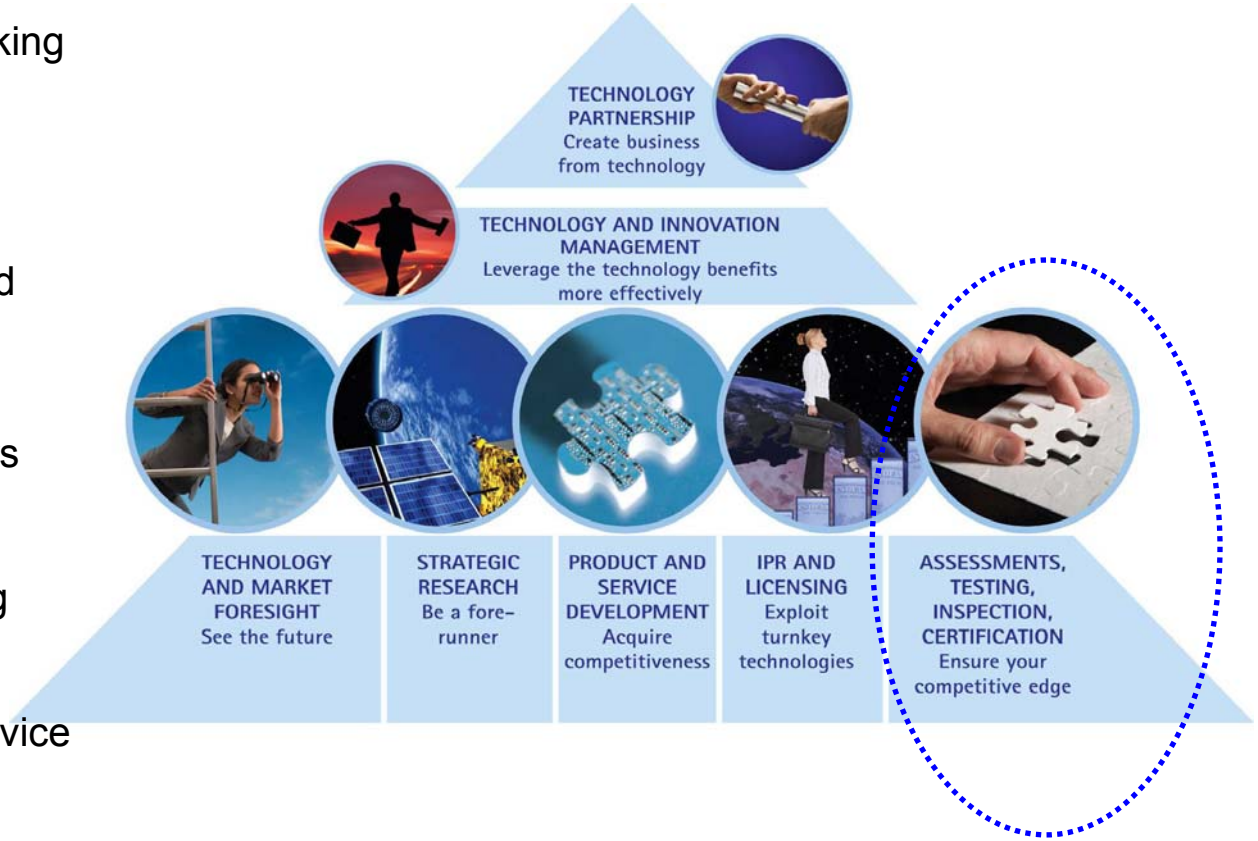
VTT International Ltd
- Administration and development of international joint ventures and contact points

Expert Services – a part of the VTT Group offering

Expert and laboratory services for the forest industry

- Characterisation of Pulps, Fibres and Fines
- Refining pulp for paper or board making
- Papermaking and furnish
- Paper and board testing
- Laboratory coating and calendering
- Laboratory printing, print quality
- Chemical analysis of pulp, paper and board
- Analysis of deposits and disturbing substances
- Chemical analyses of process waters
- Chemical recovery
- Microscopy: fibre, paper, print
- Calibration services for paper testing and colour measuring instruments

- More information Tiina Hausalo, Service Manager



Expert Services provides problem solving and performance assessment

AREAS OF ACTIVITY

- Building materials, products and structures
- Chemical analyses
- Medical devices
- Pulp and paper
- Machines, boats, vehicle equipments
- Consultations

CUSTOMER

1. Consultation
Expert opinions
Failure analyses

2. Certification and product approval

3. Conformity assessment

CHARACTERISTICS

- Customised services
- Operational excellence
- Experience based applications
- Delivery on time
- Good laboratory resources

Services offered

Environment
• Water analysis

Fiber use
- *Characterisation of pulp and wood raw material*
- *Refining of pulp*
- *Papermaking and furnishes*

Printing paper
- Paper properties
- Printing properties
- Archival quality
- Calibration services

Recovery
- Characterization of process streams
- Troubleshooting

Board and packaging
- Product safety
- Physical properties

Biofuels
- Characterization of biofuels

Biorefinery
- Characterisation of biochemicals
- Chemical safety

Recovery/energy

- Characterization of the main recovery process streams
- Chemical balances: cooking chemicals, non-process elements
- Black liquor evaporation: scaling problems, condensate characterization
- Closure of water cycles: effects on recovery
- Pulping by-products: tall oil, turpentine, lignin, etc.
- Solid wastes: characterization, reuse
- Process and wate waters: Characterisation and detailed analysis

Effluents

- Characterisation and detailed analysis of
  - → Black liquors
  - → Bleach filtrates
  - → Effluents
  - → Process and wastewaters
- Estimation of environmental impacts

Solid wastes

- Recovery boiler ESP dust
- Lime sludge
- Green liquor dregs
  - → Formation
  - → Composition
  - → Re-use or re-use potential

www.foresttech.fi

Business from technology

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ForestTech

ForestTech presents the latest VTT breakthroughs in forest value chain

Industrial Platform

An easy way to keep track of the R&D breakthroughs in paper and packaging value chains.

What is ForestTech >

Register now >

Efficient Processes

A new biomass-focused research center in Sao Paulo

Increasing demand for biomass and sustainable development technologies brings a Finnish

Inspiring Technologies

Atomic Layer Deposition

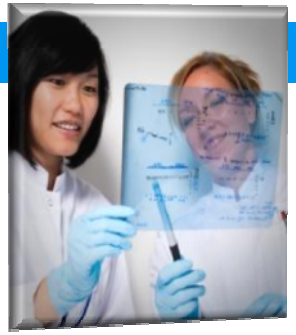
VTT Technical Research Centre of Finland has developed an environmentally friendly packaging coating solution. Especially suitable for food and

Trailblazing products

Health and environmental safety aspects of friction grinding and spray drying of microfibrillated cellulose

VTT Group in brief

Turnover 292 M€ (2010) ■ Personnel 3,167 (1.1.2011)



Customer sectors

- Biotechnology, pharmaceutical and food industries
- Electronics
- Energy
- ICT
- Real estate and construction
- Machines and vehicles
- Services and logistics
- Forest industry
- Process industry and environment

Focus areas of research

- Applied materials
- Bio- and chemical processes
- Energy
- Information and communication technologies
- Industrial systems management
- Microtechnologies and electronics
- Services and the built environment
- Business research

VTT's operations

Research and Development ■ Strategic Research ■ Business Solutions ■ IP Business ■ Group Services

VTT's companies

VTT Expert Services Ltd (incl. Labtium Ltd, Enas Ltd) ■ VTT Ventures Ltd ■ VTT International Ltd ■ VTT Memsfab Ltd

VTT on map


Saint Petersburg, Russia
Brussels, Belgium
Bay Area , USA
Seoul, South Korea
Tokyo, Japan
Shanghai, China
São Paulo, Brazil
Finland
Sodankylä
Rovaniemi
Oulu
Raahe
Kajaani
Kuopio
Jyväskylä
Outokumpu
Tampere
Lappeenranta
Turku
Rajamäki
Espoo
Helsinki

VTT's services

Results

- 290 notifications of inventions and 33 notifications of software in 2010.
- Over 1,100 patents and patent applications in VTT's patent portfolio.
- VTT Ventures Ltd had partial ownership in 19 enterprises based on VTT's technology at the end of 2010.
- 2,000 publications yearly, most of them scientific articles and conference presentations.
- 6,850 publications in VTT's own publication series since 1943. About 1,400 of them are available on the Internet.
- 93 publications in VTT's own publication series in 2010.

Research results

New business models for cloud-based business

New products from forest biorefineries

New customer value from services in the mechanical engineering industry

State-of-the-art centre for water technology

Additional value for metal products with sol-gel coatings

Grid electricity from natural gas using fuel cell technology

Research and development promote energy efficiency

Electronic services for the healthcare sector

Photos: iStockphoto, Paroc Group , Metso Oyj

For more examples see: www.vtt.fi

VTT creates business from technology