



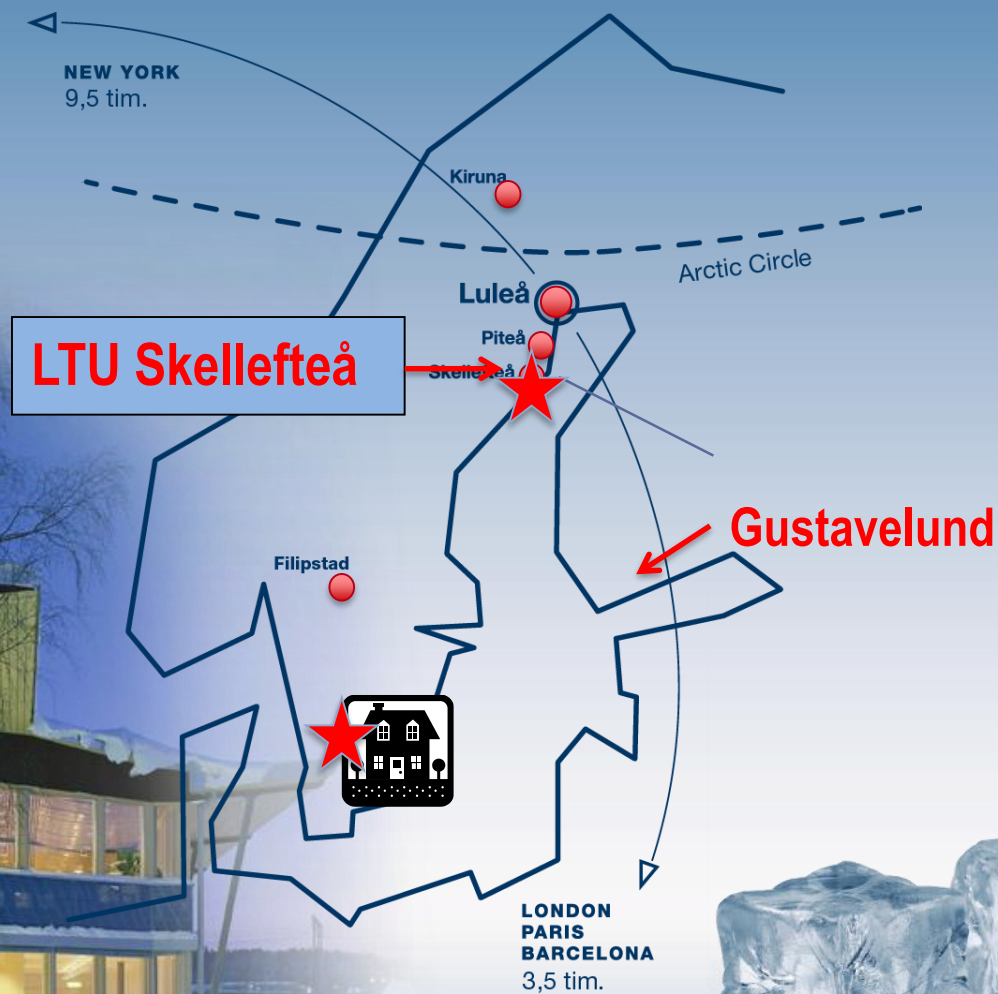
Great ideas grow
better below zero!

***Luleå University of
Technology, Sweden***

***Wood Science and
Engineering***

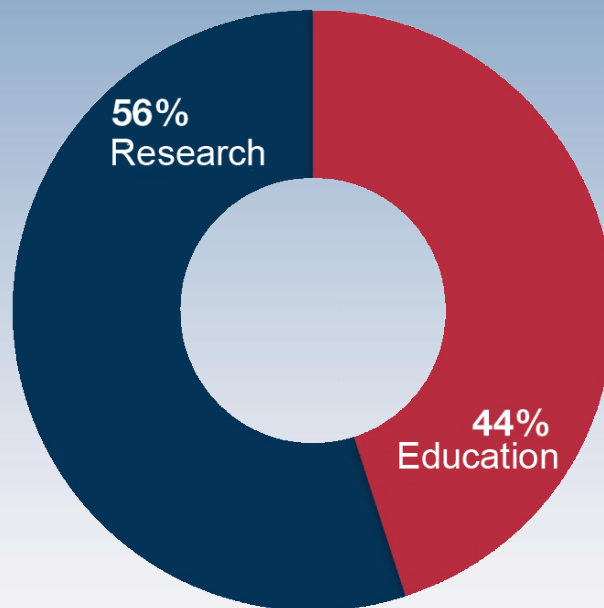
Dick Sandberg
*Chaired professor and
head of wood division*



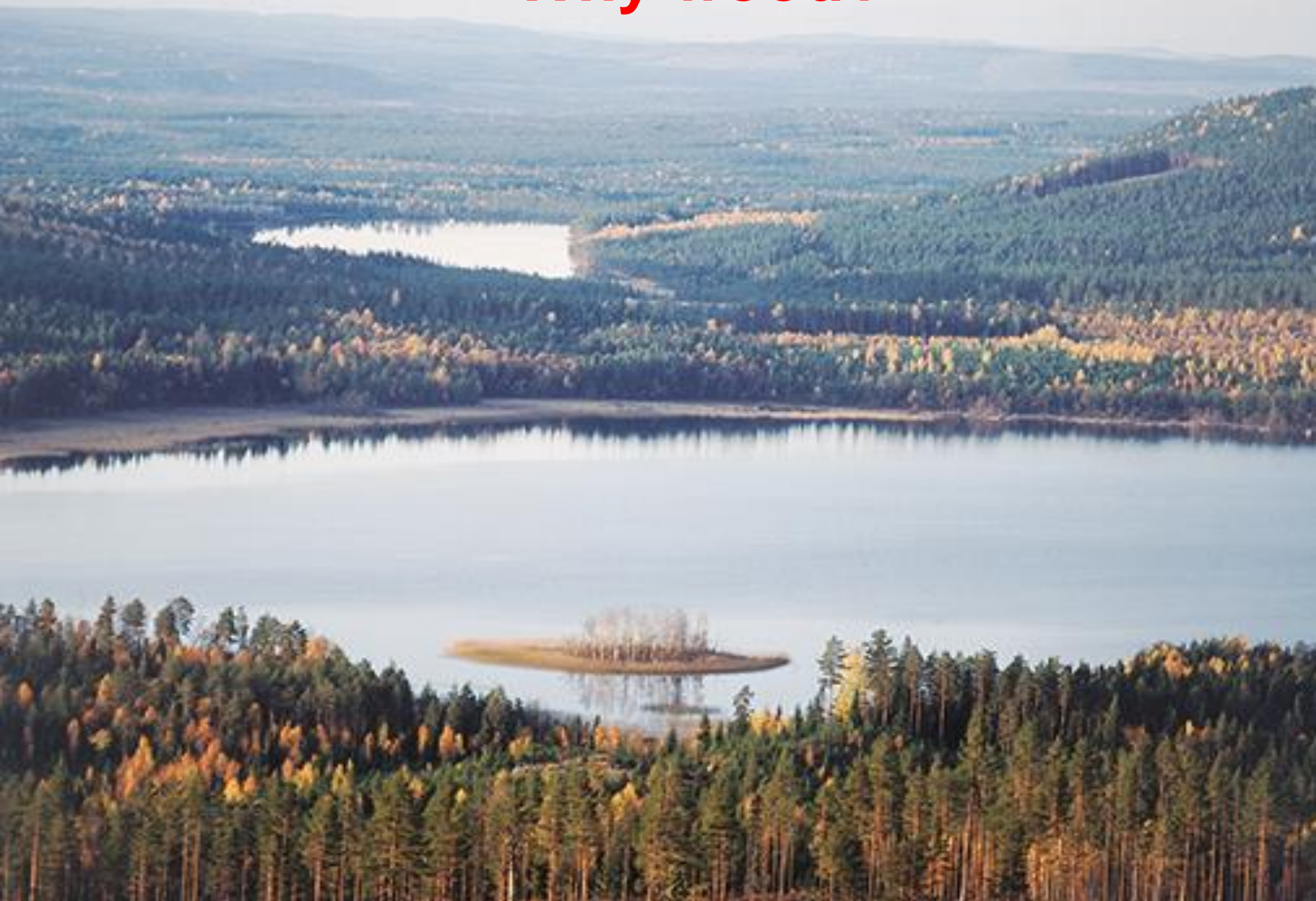


Luleå University of Technology

- Founded 1971
- Turnover Euro 0.16 billion
- 15,000 students
- 1,800 employees
 - 236 professors
 - 811 teachers & researchers
 - 327 PhD students



Why wood?





Wood Science at LTU

in Skellefteå

1) Wood Science and Engineering

in Luleå

2) Timber Structures

3) Wood and bio-nano composites

**What can we do
together?**





THE NORTHERNMOST UNIVERSITY
of Technology in Scandinavia

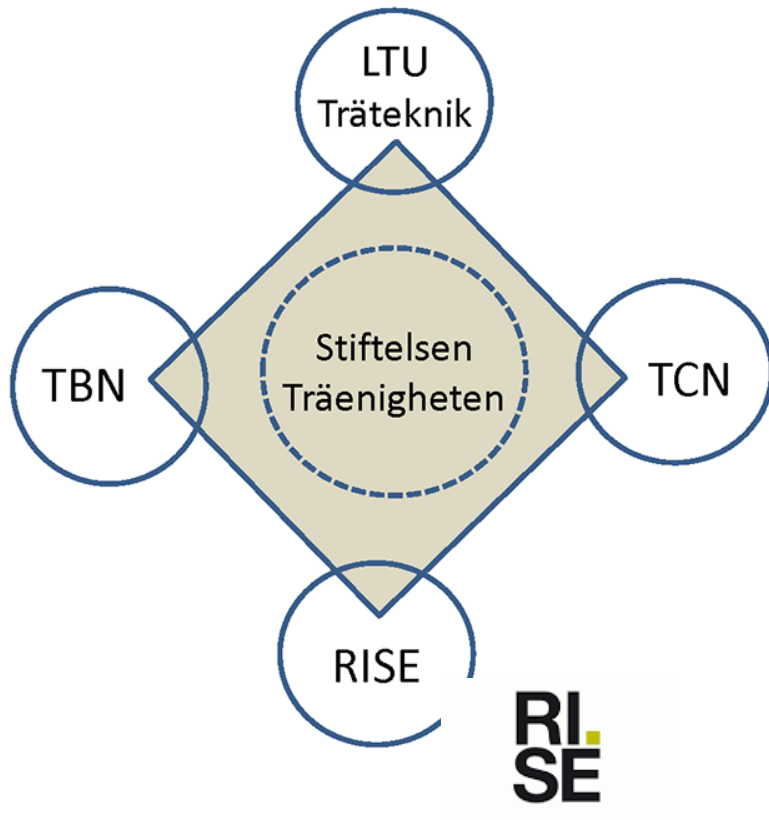
SKELLEFTEÅ



**LTU
Wood**

**RI
SE**

Wood Industry Tradition in Skellefteå



- LTU Wood Sci. & Engineering
 - Material
 - Processes
 - Wood mechanics/construktion
- Wood Industry North (TBN)
 - Joinery enterprises in N. Sweden
- RISE
 - Bio-science and wood material
 - Built environment
- Wood Centre North, TCN
 - Forest owner, sawmills and timber construction enterprises

Focus: North and middle Sweden

Wood Science and Engineering

Education

Research

Engineering

Test Centre

Wood Science & Engineering

4 Professors (+ 4 prof. em.)

1 Adjunct professor

10 senior researchers

1 Centre leader TCN

14 Doctoral students

30 active in R&E

Timber Structures

1 Professors

4 senior researchers

7 Doctoral students

12 active in in R&E

Wood and bio-nano composites

1 Professors

5 senior researchers

8 Doctoral students

14 active in in R&E

+ Research engineers & adm staff

12 pers. at RISE Skellefteå



Wood Science and Engineering

Education

Research

Engineering

Test Centre



- 1) Bachelor Wood Technology, 3 years
 - 2) Master Wood Technology, 2 years
 - ✓ *Mozambique*
 - 3) Doctoral studies, 4 years
- } M Sc

DOCTORAL THESIS



DOCTORAL THESIS



LICENTIATE THESIS



DOCTORAL THESIS



The Value of Wood
*Production Strategies in the Forestry-Wood
Chain Using X-ray Scanning and
Computer Simulation*



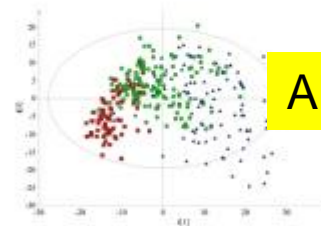
Magnus Fredriksson

Wood Fingerprints
– Recognition of sawn wood products



Tobias Pahlberg

Efficient Utilization of Sawlogs
Using Scanning Techniques and
Computer Modelling



Anders Berglund

Machining Properties of Wood:
Tool Wear, Cutting Force and Tensioning of Blades

Luís Cristóvão

All thesis you find at [www](http://www.lulea.se)



Colours of the Skellefteå ice hockey team



Wood Science and Engineering

Education

Research

Engineering

Test Centre



Wood in use

- Wood Material
 - **Durability**
 - Impregnation
 - **Chem. modification**
 - **Thermal treatment**
 - **Wood water relations**
 - Timber properties
 - Board materials
 - Composites
 - Bio insulation

Wood in processing

- Wood ind. processes
 - Raw material...
 - **Sawmilling, drying...**
 - Planing, machining....
 - Joinery processes....
 - **Scanning**
 - Process modelling
 - Sensors
 - **E-shopping**
 - **Digitalization**

Wood in built environment

- Timber Engineering
 - **Multi-storey buildings in wood**
 - **Wooden bridges**
 - **Timber engineering**
Stability, strength, stiffness
 - **CLT**
 - **Modelling/simulation**

Forestry

Pulp & Paper

Panels

Saw milling

Components

Packaging

Joinery

Furniture

Timber housing

Energy production from waste in the forestry based sector

Wood in use

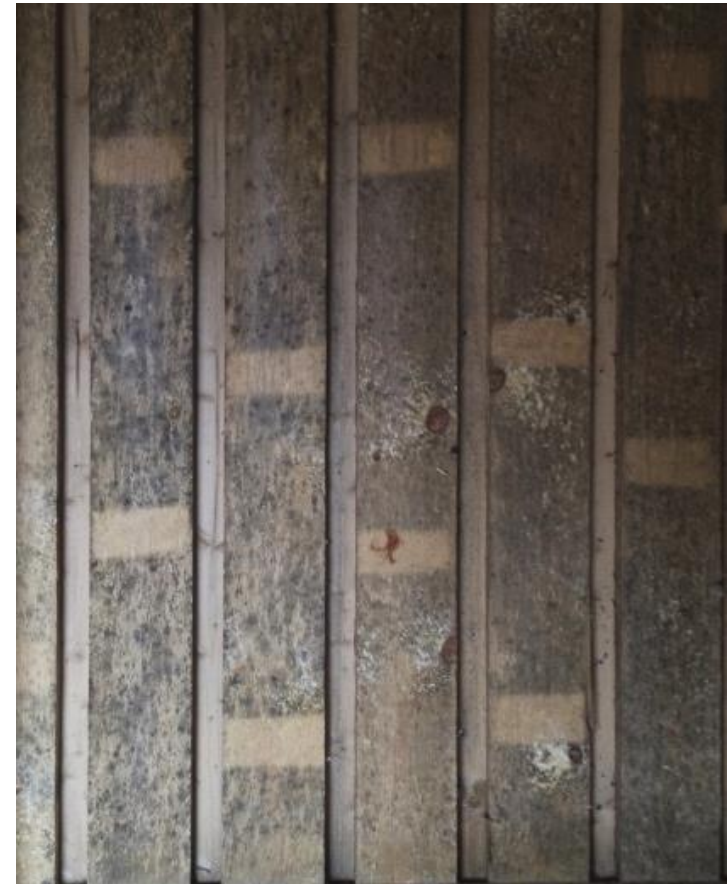


Problem?

Mould growth on outdoor sapwood boards



Links to the drying process

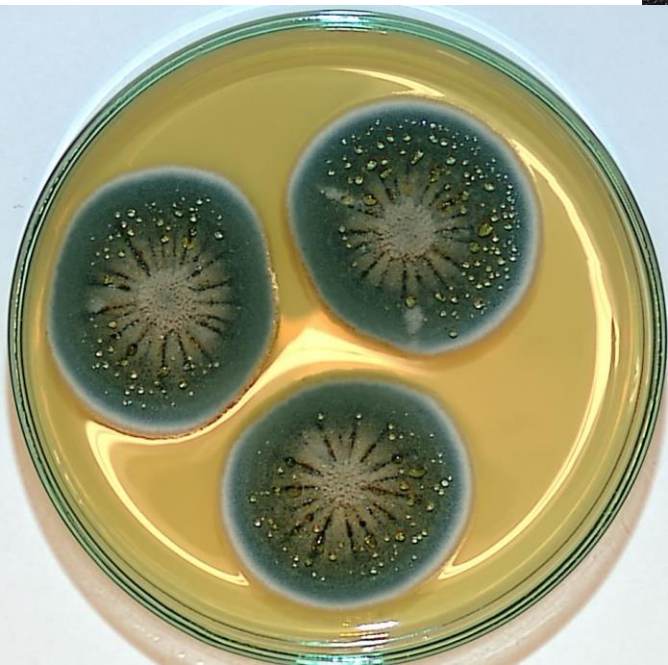
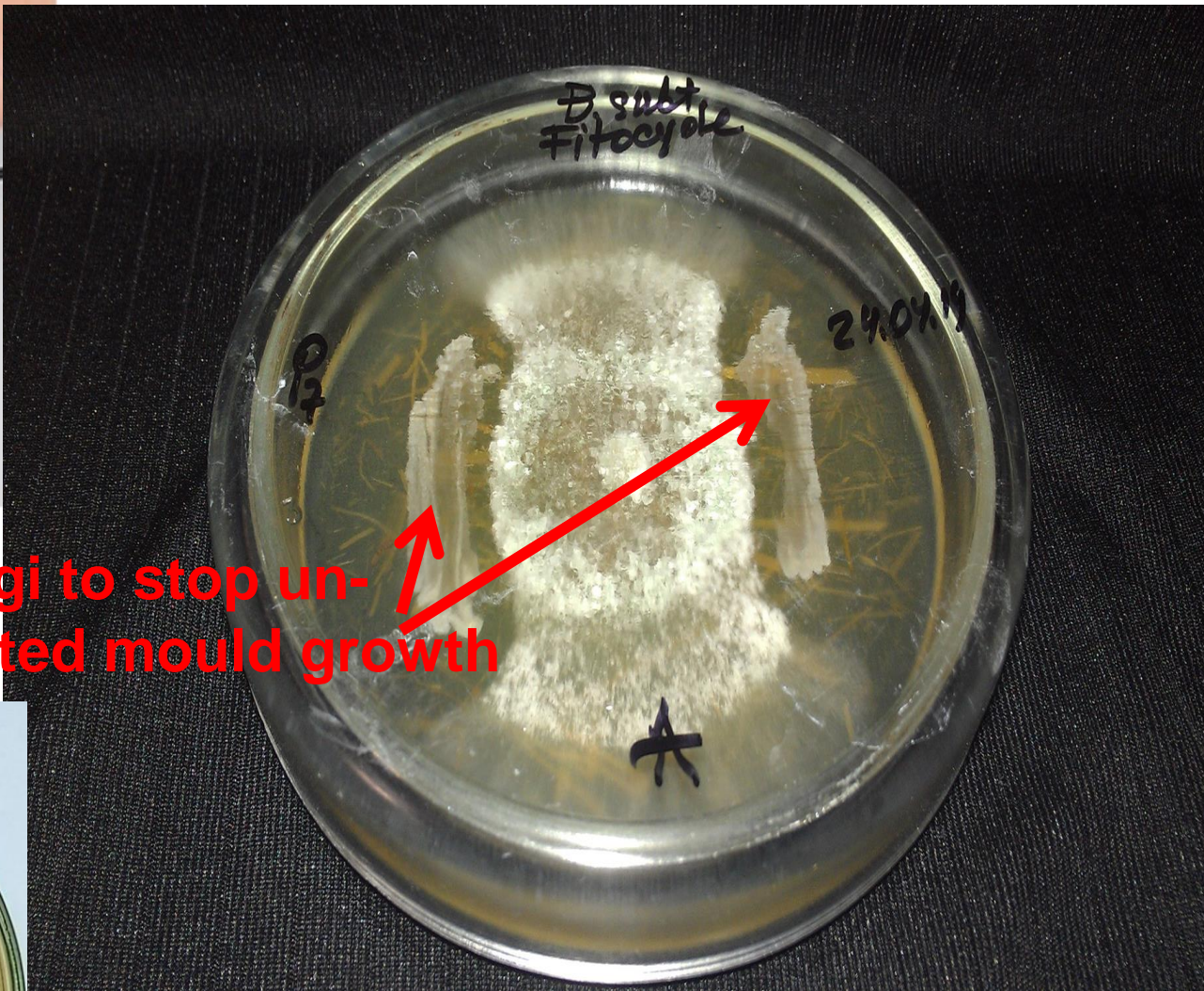


- Increased use of wood for outdoor applications
- Less harmful chemicals/alternatives
- Life cycle cost



NIR for classification of fungi

Fungi to stop unwanted mould growth



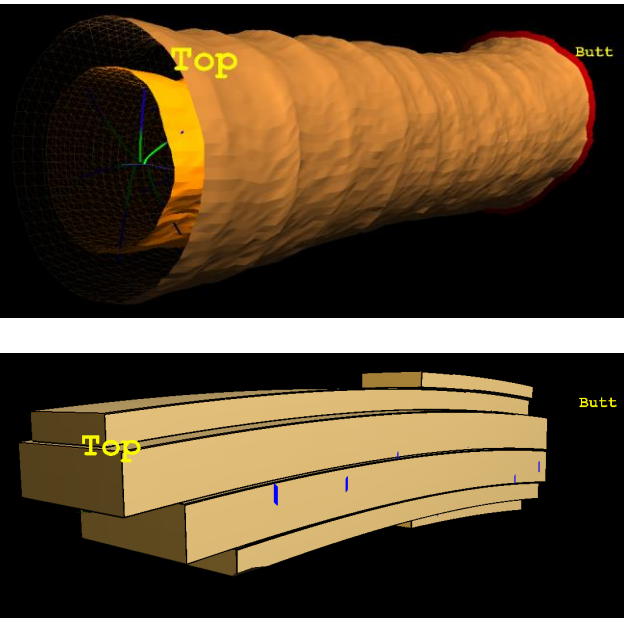
Preference study



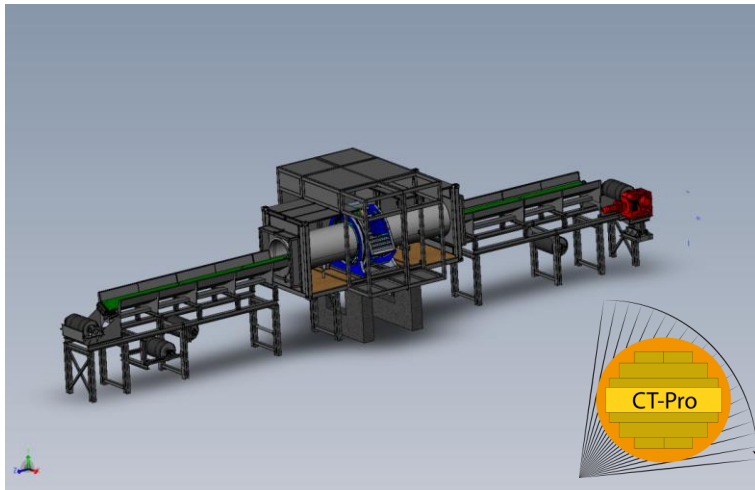
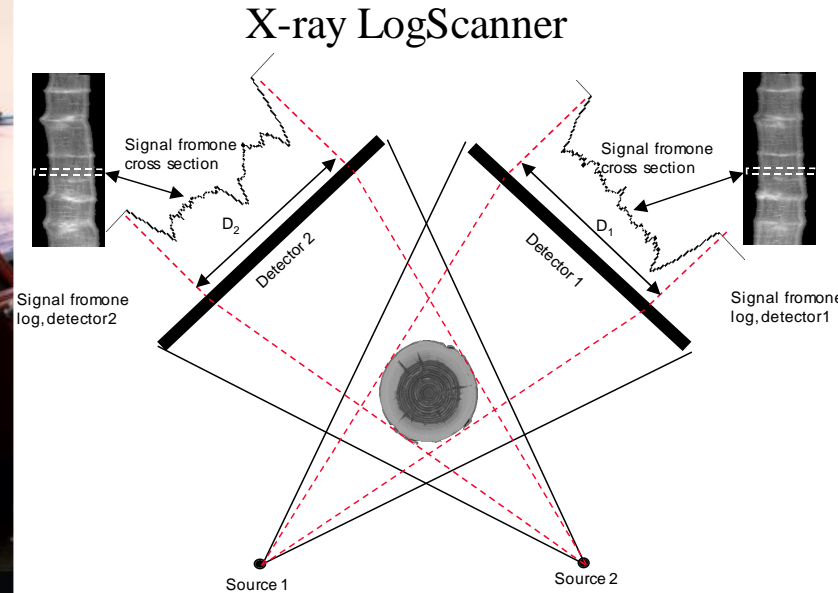
Wood in processing



Lab CT Scanner



Industrial X-ray LogScanner



- Industrial high-speed CT scanner prototype
- Scanning logs at 2 m/s
- First industrial implementation of Katsevich's reconstruction algorithms

Microtec industrial CT scanner

(The first instalation in Sweden during 2017)

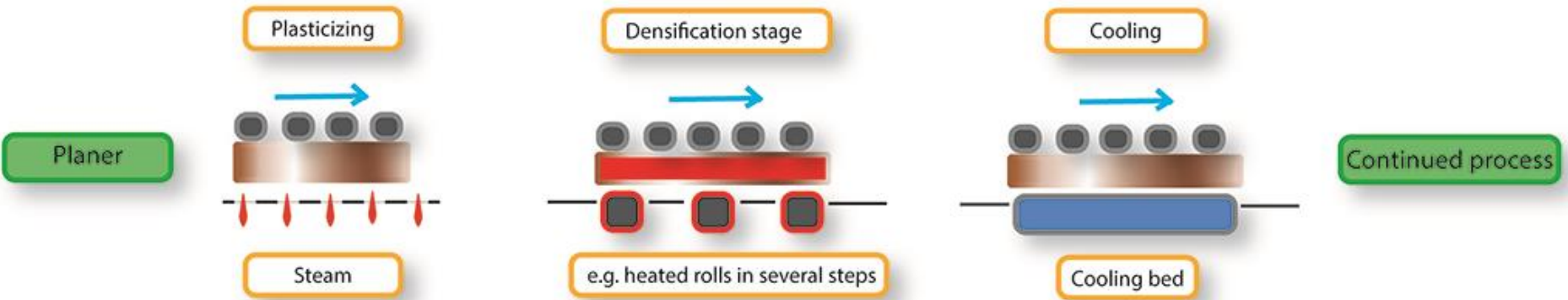


Figure 1. The first installation of a high-speed CT scanner for logs.



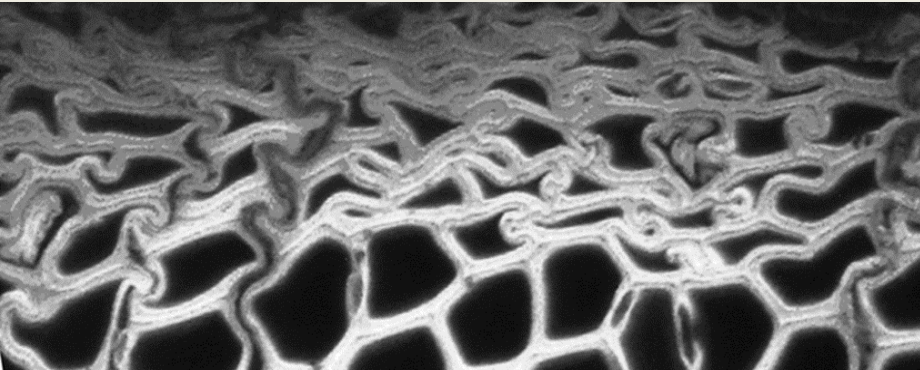
Figure 2. Left: Log with automatically detected features; sound knots (yellow), dead knots (red), splits (blue) and resin pockets (yellow). Right: Virtual break-down of log into boards.

Densification process



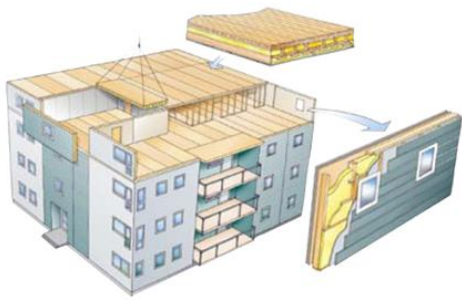
Surface densification

80 m/min



Wood in Built Environment



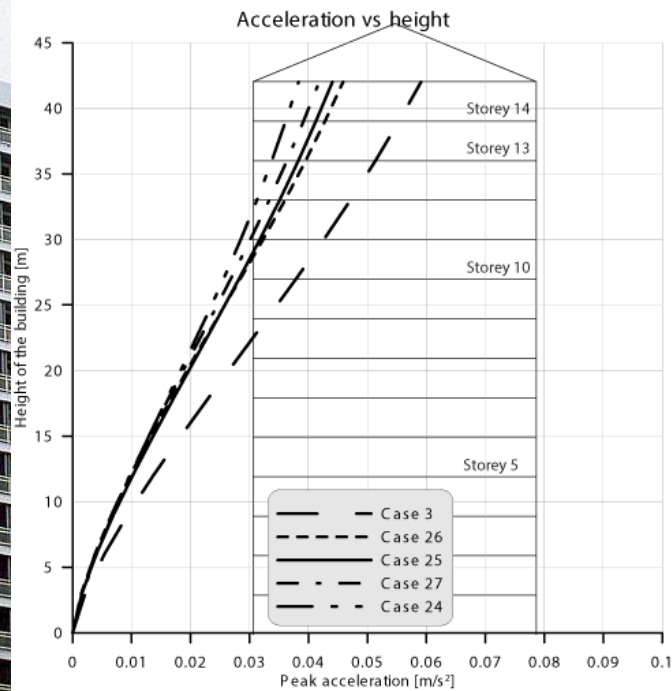


Example Timber Engineering

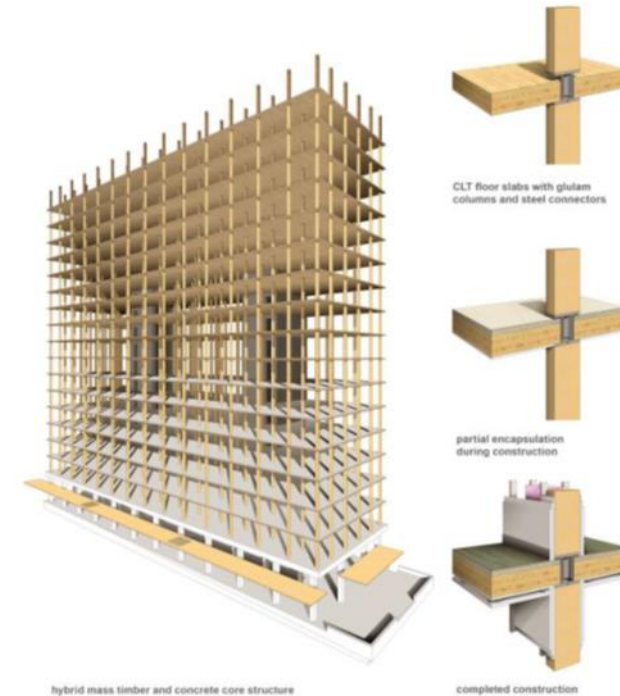
Robustness



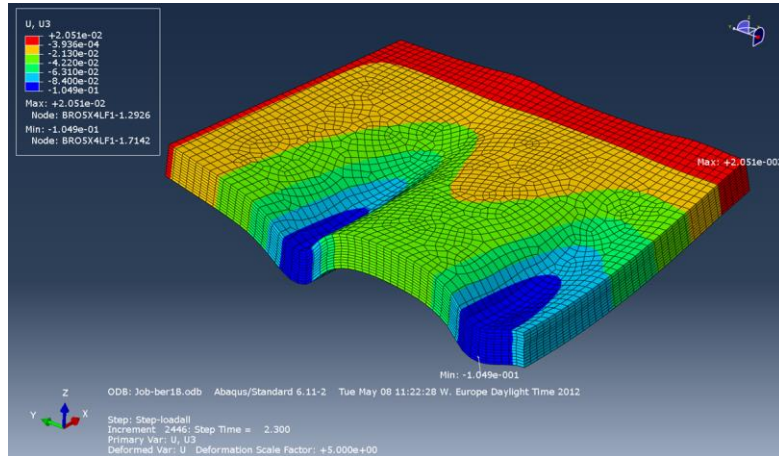
Dynamics



New construction systems



Simulations and tests of timber bridges



Wood Science and Engineering

Education

Research

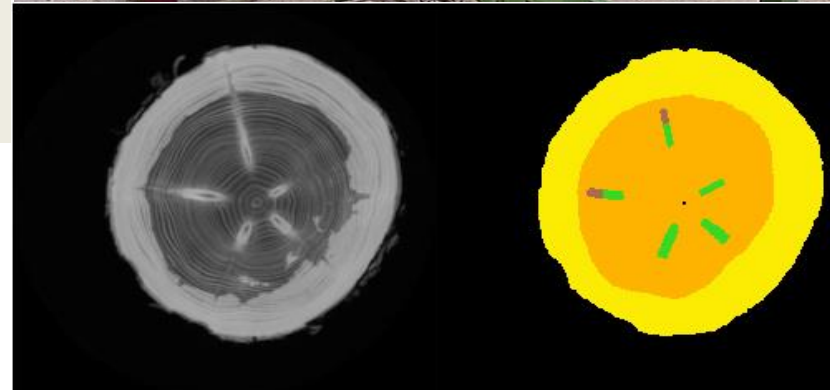
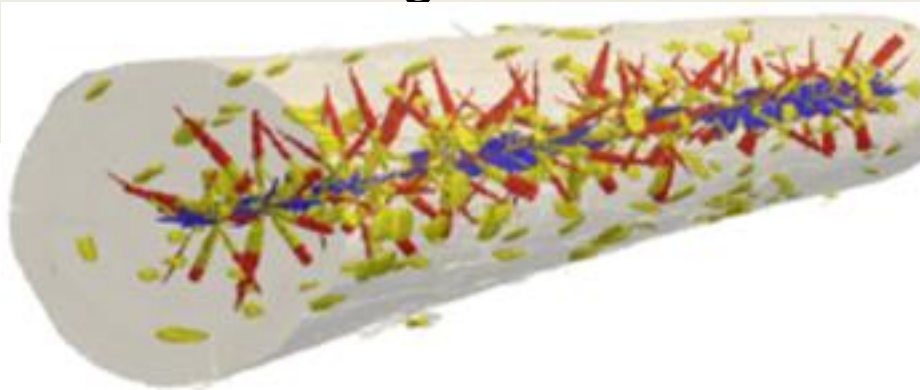
Engineering

Test Centre



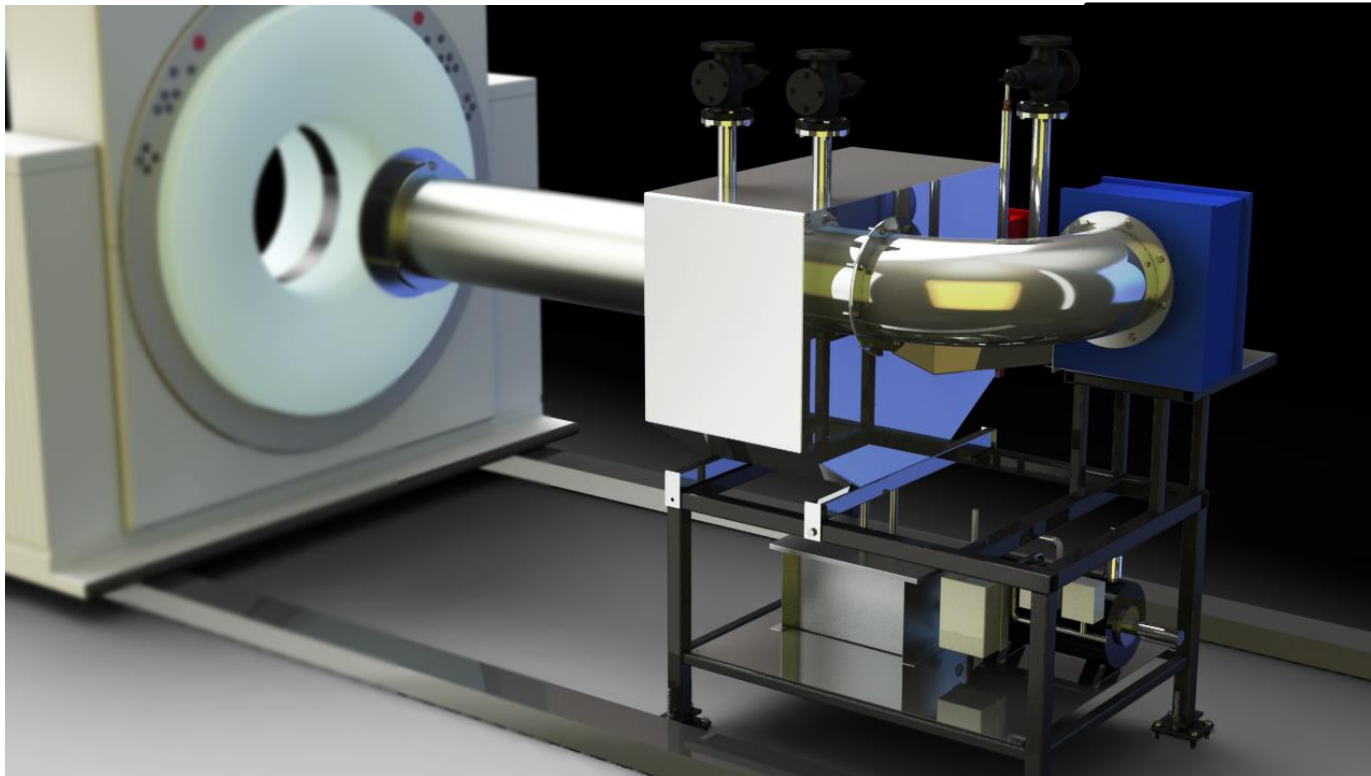
Test and laboratory functions

- Chemistry & material labb.
- Microscopy
- Impregnation
- Scanner, Visualisation – Vibe
- Wood welding
- CT scanning



Climate/drying chamber - CT scanner

Max 230 °C in superheated steam at 1 atm.

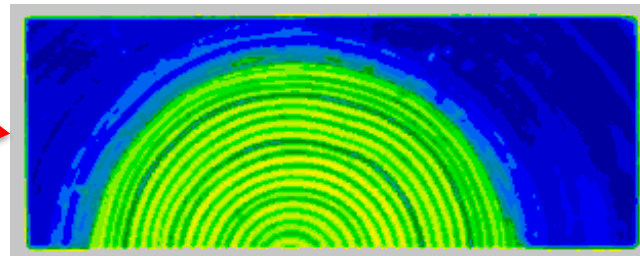
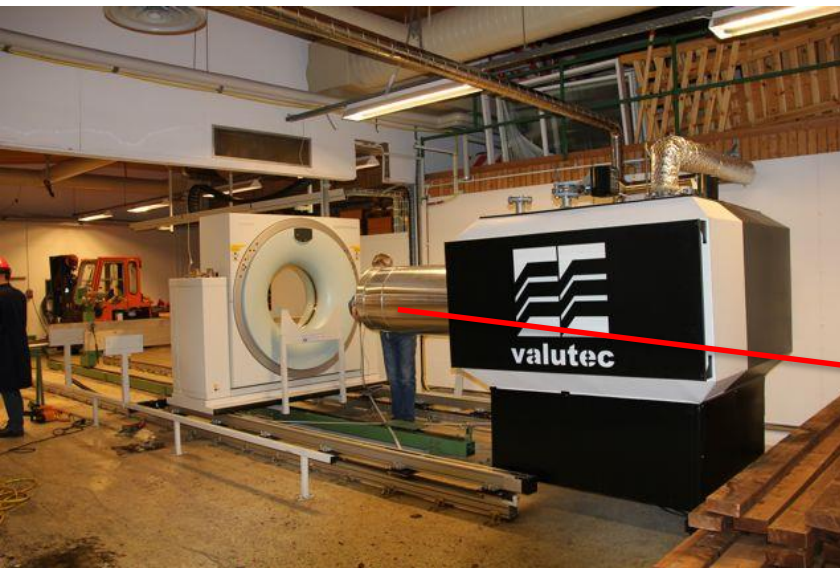
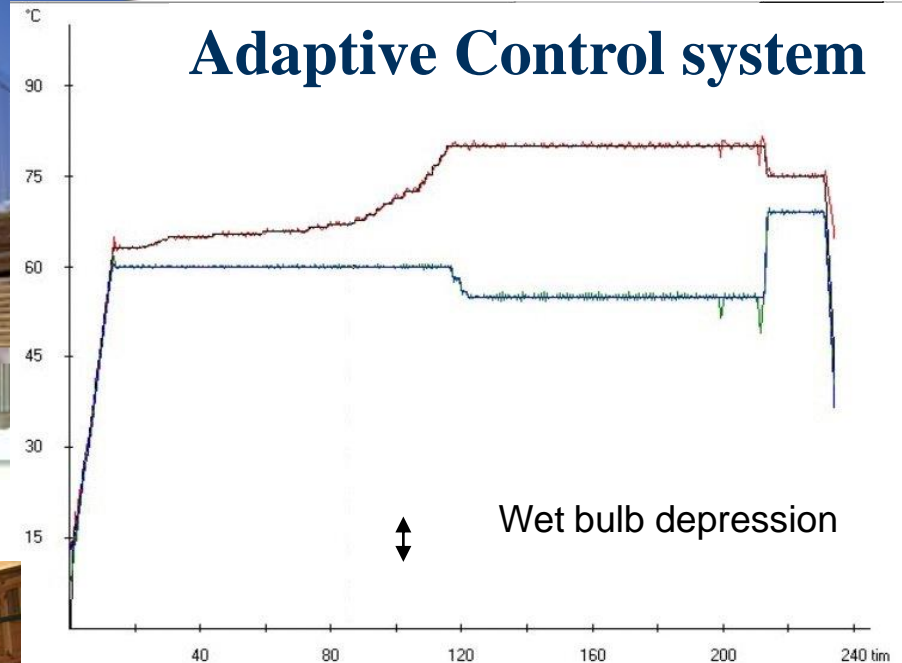


Wood drying: Process improvement

Steam heating and conditioning



Adaptive Control system





**Thank you for your kind
attention!**