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## SP Träteknik



SP Technical Research Institute of Sweden

# GradeWood

Gradewood, WP 5, Modelling and development of grading procedures, results concerning output control

... or how to make a short story long



## Collaboration of projects

- Finding ways to grade logs according to board use by combining established and new measurement systems
  - Heartwood content
  - Strength grading
  - Saw set up optimisation to improve value yield for side boards
- Output control
- Proof loading



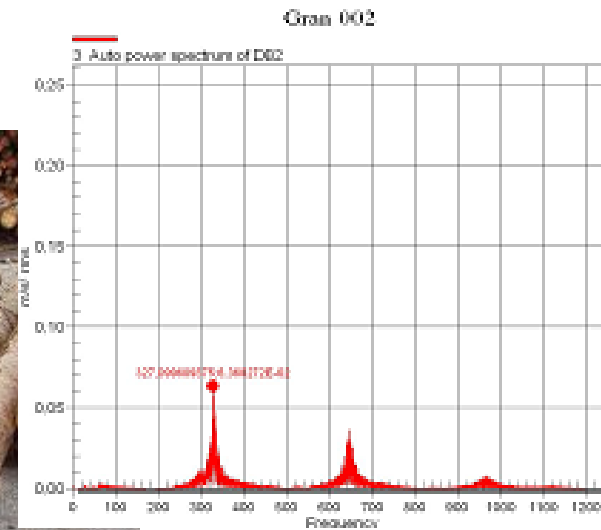
## Material

Approx 170 logs of pine, 177-186 mm

Approx 180 logs of spruce, 176-187 mm



# Acoustic measurements



## 3 different systems

- Fibre-Gen
- Grindosonic
- CatMan

**Both unfrozen and frozen logs**

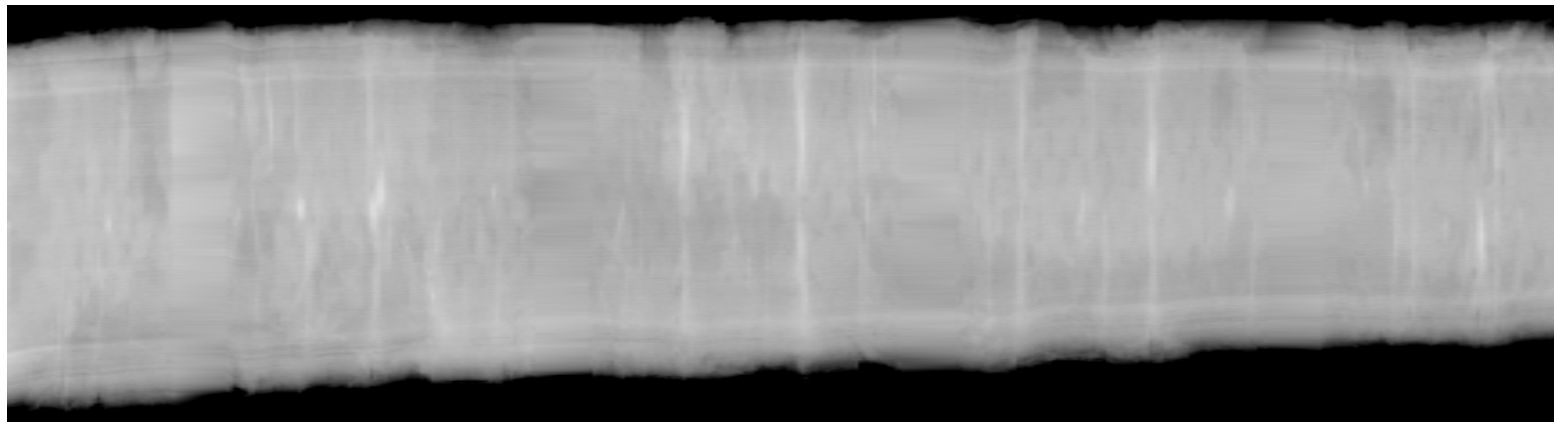


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# Heartwood measurement



# X-ray LogScanner



## New marking

A new marking is needed to be able to keep track of the boards after sawing



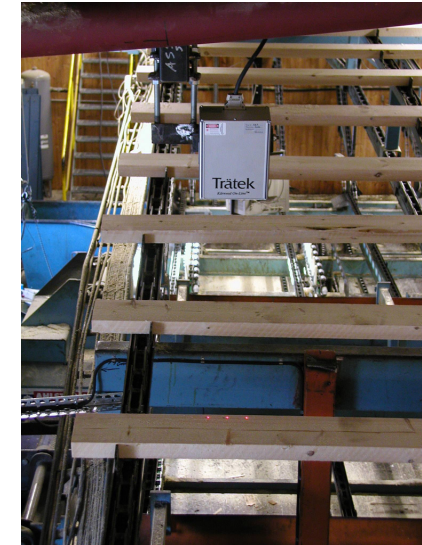
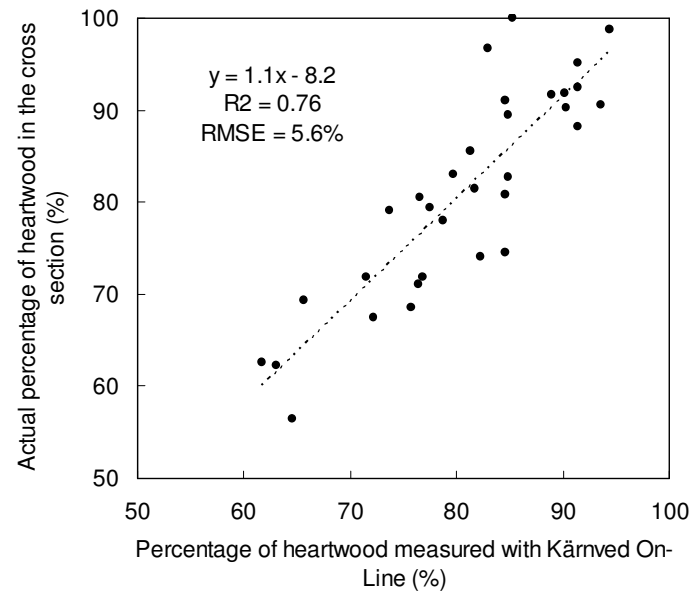


# Sawing, measurement of grain angle and heart wood content, board marking

Saw set up

Pine: 2x 50\*125

Spruce: 2x 51\*125



## Further on in the chain

Drying to 11%

Grading

Dynagrade

Manual grading, similar to Nordic Wood (Nordiskt Trä)

Bending

Flatways

Edgeways

Density

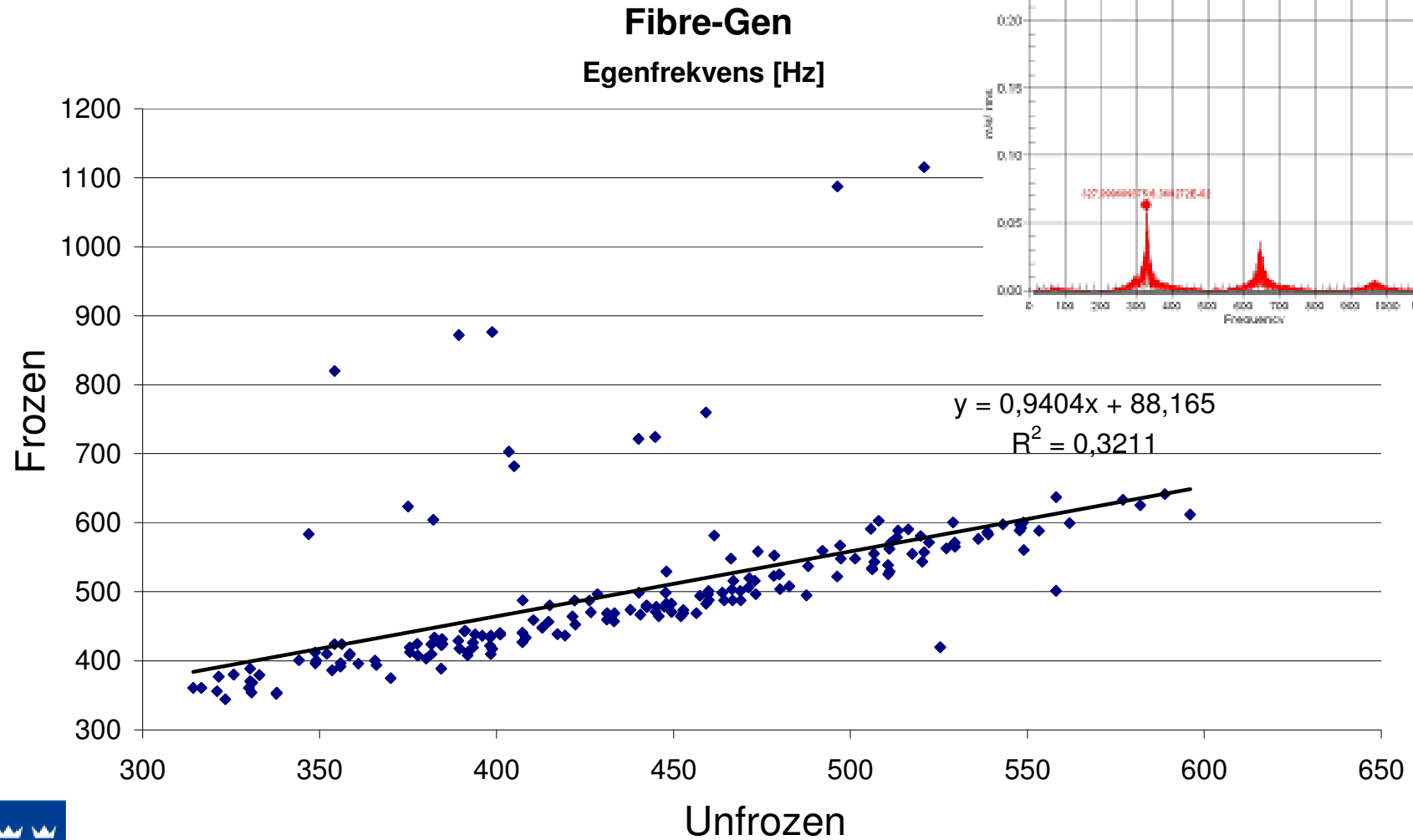
$u=11\%$

dry

Frequency

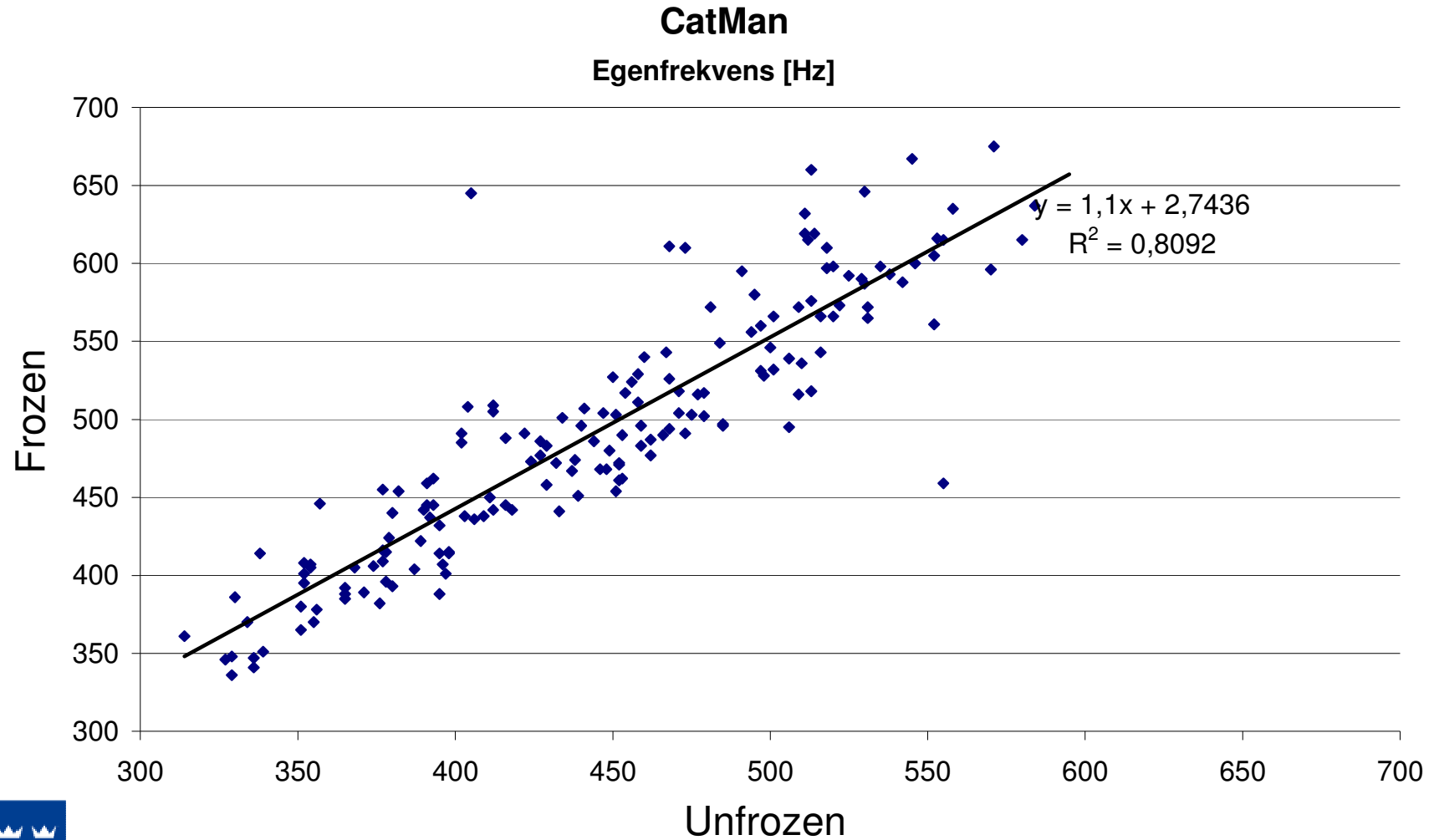


# Results, acoustic log measurement





# Results, acoustic log measurement



# Output control

Hypothesis:

It is possible to use X-ray logscanner to strength grade structural timber and use output control to secure the quality

How?

Use the X-ray logscanner data

...together with other measurements

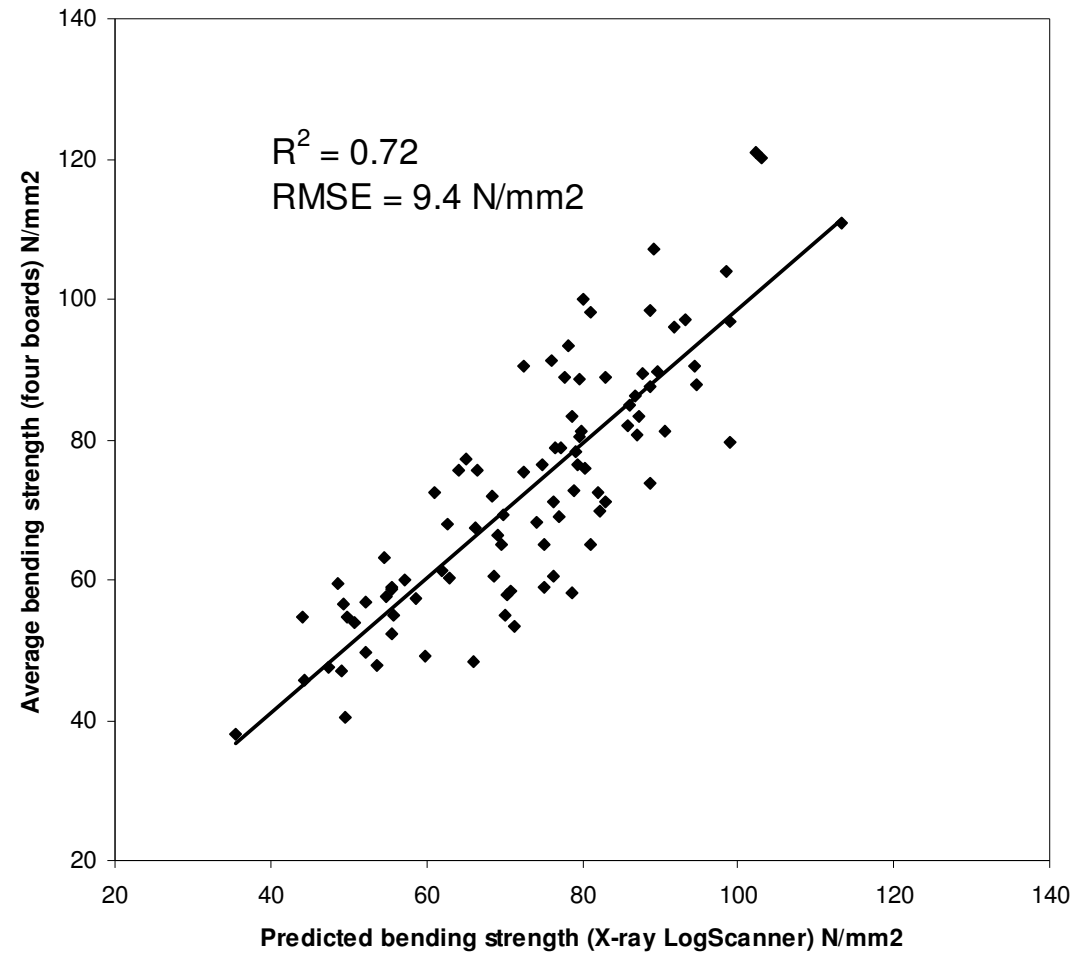
Use multivariate methods on all the data to find models for strength grading



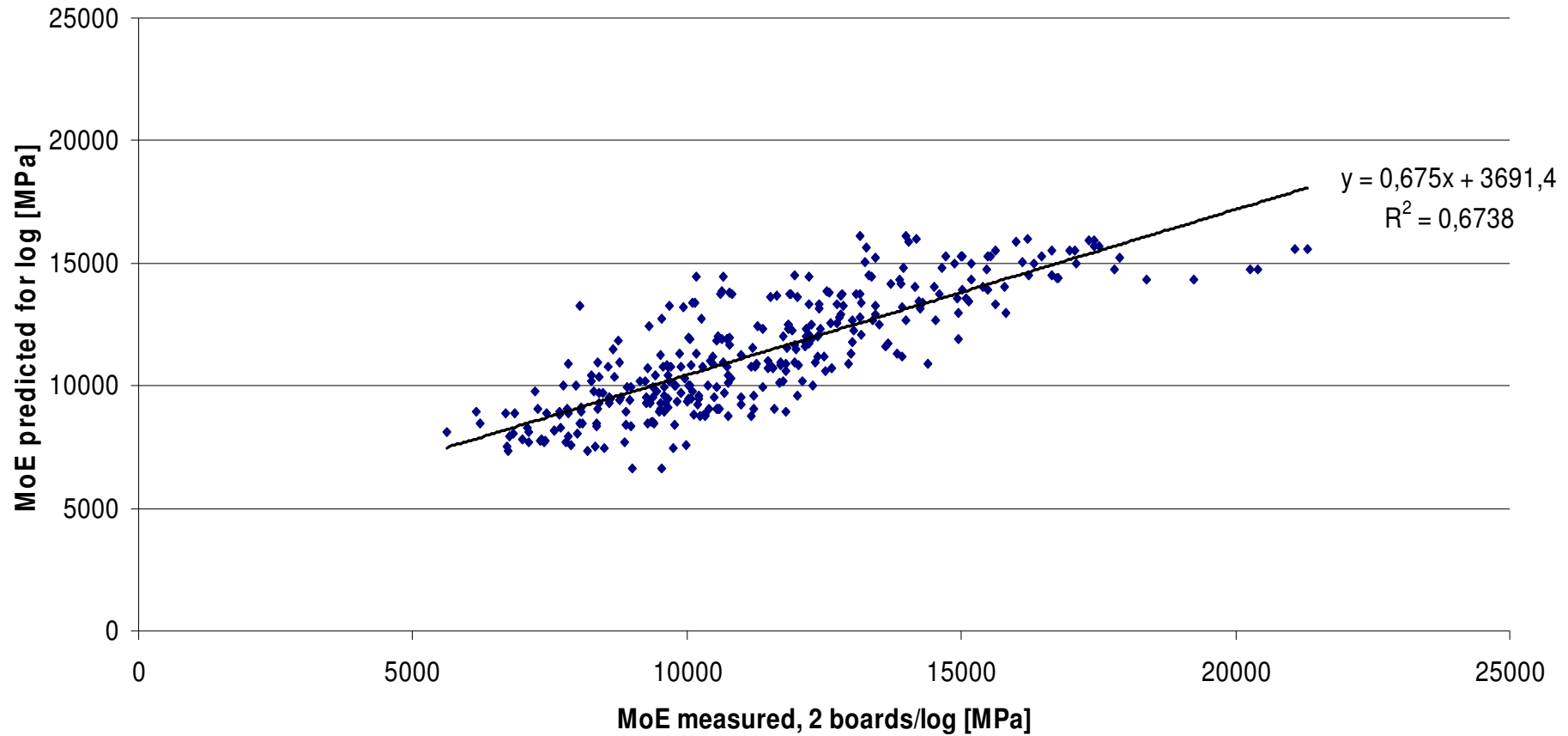
# Results

Strength grading of boards  
based on X-ray of logs

Pine 4X 34x112mm



# Prediction MoE of X-Ray logscanner Pine, 2x 50x125mm





## Results with different measuring devices

### Predictions for Pine

<b>MoR</b>	<b>R<sup>2</sup></b>	<b>Q<sup>2</sup></b>
Frequency	0,392	0,391
Freq, density	0,495	0,495
X-ray	0,647	0,634
X-ray, freq, dens	0,714	0,678

<b>MoE</b>	<b>R<sup>2</sup></b>	<b>Q<sup>2</sup></b>
Frequency	0,605	0,603
Freq, density	0,714	0,712
X-ray	0,674	0,659
X-ray, freq, dens	0,831	0,793



## Results with different measuring devices

### Predictions for Spruce

MoR	R <sup>2</sup>	Q <sup>2</sup>
Frequency	0,078	0,072
Freq, density	0,157	0,145
X-ray	0,286	0,269
X-ray, freq, dens	0,389	0,330
X-ray, freq, dens, grain angle	0,533	0,454

MoE	R <sup>2</sup>	Q <sup>2</sup>
Frequency	0,288	0,284
Freq, density	0,422	0,417
X-ray	0,346	0,285
X-ray, freq, dens	0,548	0,509



## Conclusion, so far

It is easier to strength grade logs of pine than of spruce

It is possible to strength grade boards already as logs, when using X-ray logscanner for pine

As much can happen down the chain at the sawmill, it is difficult to certify log scanners for board grading.

Output control is a way to solve that problem.



## Continuing work

Improve the methods for spruce logs

Simulations of output control of boards graded with different methods

