

Using Acoustic Velocity to Predict Hemlock Wood Quality

(Hope for Hemlock)

Jeff Sandford, J.S. Sandford & Associates Ltd.



Forestry Canada
Natural Resources Canada
Canadian Forest Service (CFS)

Canadian Wood Fibre Centre

Al Mitchell, Tom Bown, Graeme Goodmanson, Ross Koppenaal

FERIC – harvesting – getting wood to the mill
Forintek – solid wood products
Paprican – pulp and paper products

FPInnovations

Bjorn Anderson, Tim Caldercot



Industry Challenges

- Large second growth Hw/Ba resource
- Coastal advantage is variability and diversity
- Diversity is difficult in the mill environment
- Can we manage that variability at the resource end
- How do we identify stands that meet customer demands?
- Available tools and technology?

→ “Coastal Forest Project”

AV = Acoustic Velocity

Trees



\$12,000



\$12,000



Logs



Can we use AV devices to”

1. Increase profit margin of western hemlock?
2. Help meet customer demands?

Trees

Logs

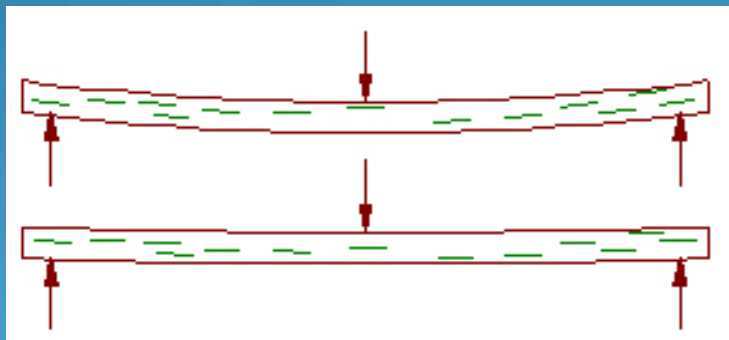
Sort Logs at Mill

Predict MSR

Wood Stiffness is the ability to resist bending under load and is typically expressed as Modulus of Elasticity (MOE)

Comparison of two 2x4s of the exact same density might show one to have double the stiffness. Machine-stress Rated (MSR) testing is currently being used to identify wood with increased stiffness. MSR wood brings a higher economic return and is used in higher value products that require increased stiffness.

In New Zealand log/board? acoustic velocity has been shown to correlate well with mechanical tests of veneer stiffness.



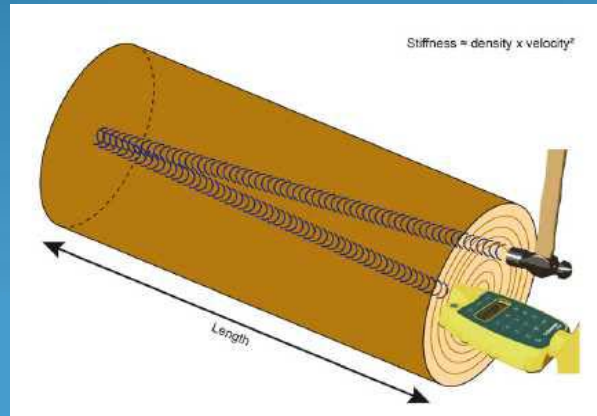
MoE

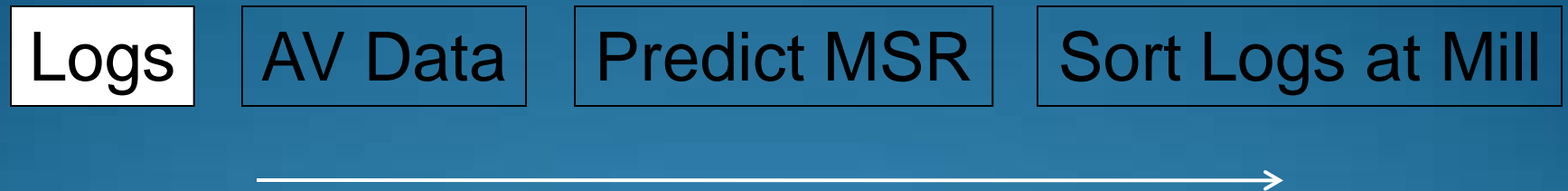
MoR



Resonance - Logs

This method measures the speed of sound as it reverberates through the entire log from one end to the other. Once the log length is known a single operator can sample a log in under 10 seconds by using a hammer to strike the end of the log.





New Zealand – have related HM200 data to wood quality.

Automated at green chain -> hit -> directs log to sawyer

Hit again at planer to filter.

Weyerhaeuser is using HM200 to sort Fd in Washington and Oregon

Can we use these devices successfully with Hw?

Time of Flight – Live Trees

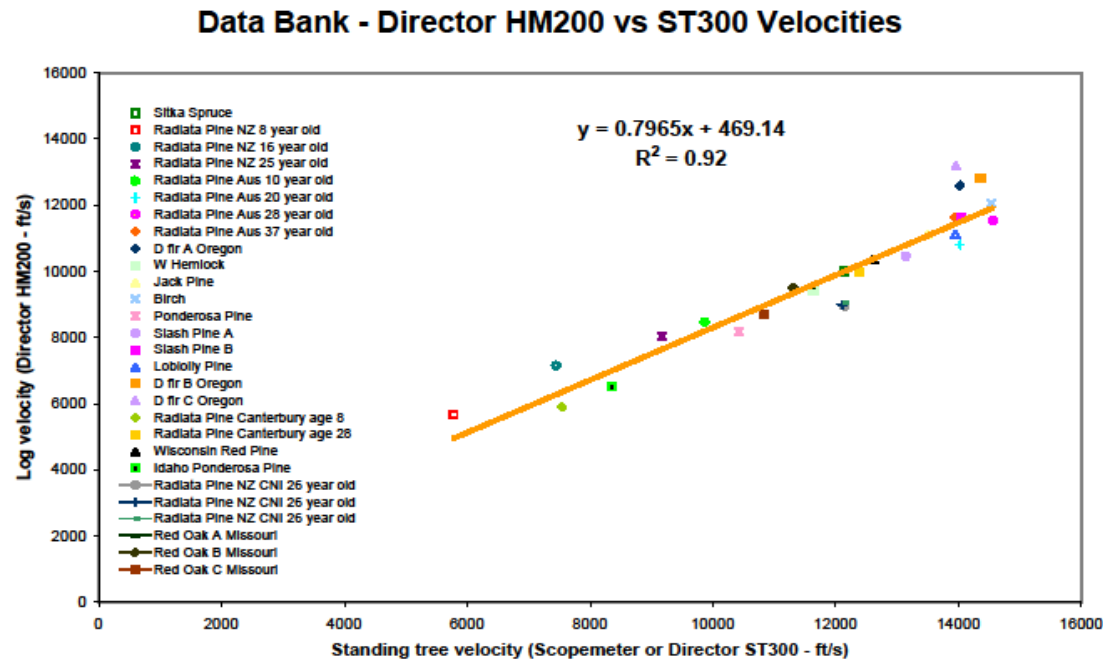
Used for standing trees.

A transmitter and receiver probe are tapped into the tree about a meter apart and the speed the sound between the two probes is measured.

A single operator can use the instrument and sample a tree in a few minutes.



Research in New Zealand, the US, and elsewhere has resulted in a databank that can be used as a model for Canadian species



Standing Trees	Logs
Time of Flight	Resonance
Fast and easy (3 mins./tree)	Seconds per tree
	More data in signal can be extracted to infer other wood properties
	Signal from entire length
Non-destructive	Non-destructive
Both methods are measured – not subjective like visual grading	

Both signals are closely correlated

Can we use AV data collected from standing trees to predict wood quality?

Can we use AV data to determine where that wood is before it's felled?

Logs



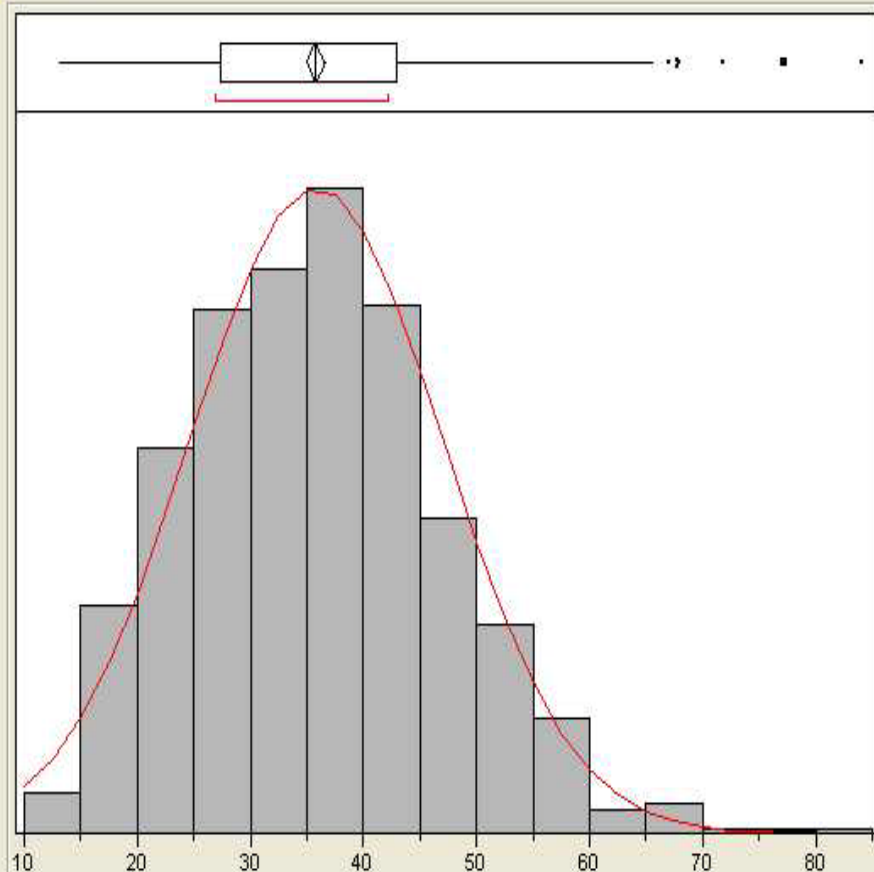
Need Data to Relate Site Characteristics to Wood Quality

- BEC, elevation, slope, aspect, density, age, etc.
- Where can I get fibre of meet specific specifications?

Location	Plots	Trees
Jordan River	3	153
Port Alberni	3	153
Campbell River	4	204
Adam River	4	204

Distributions

DBH



Quantiles

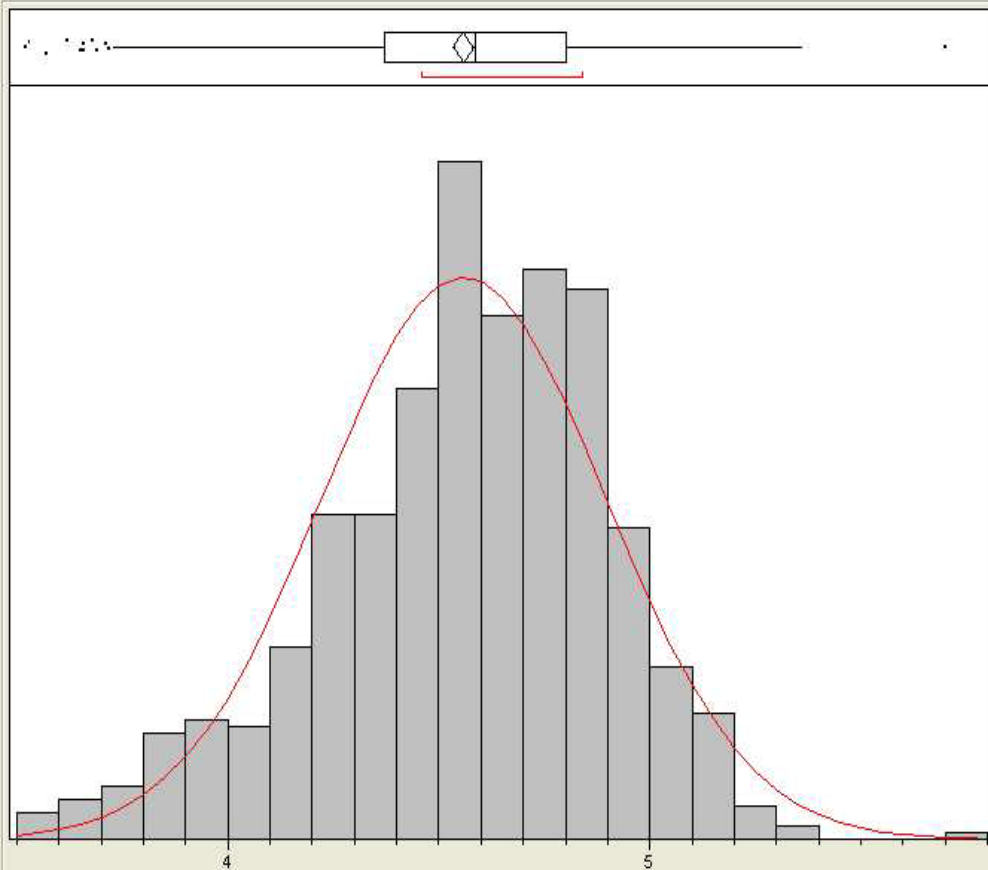
100.0%	maximum	84.1
99.5%		69.7
97.5%		58.9
90.0%		50.6
75.0%	quartile	42.9
50.0%	median	35.7
25.0%	quartile	27.3
10.0%		21.4
2.5%		16.9
0.5%		14.1
0.0%	minimum	13.2

Moments

Mean	35.8
Std Dev	11.2
Std Err Mean	0.42
upper 95% Mean	36.6
lower 95% Mean	35
N	714

Distributions

AV



Quantiles

100.0%	maximum	5.7
99.5%		5.3
97.5%		5.1
90.0%		5.0
75.0%	quartile	4.8
50.0%	median	4.6
25.0%	quartile	4.4
10.0%		4.1
2.5%		3.8
0.5%		3.6
0.0%	minimum	3.5

Moments

Mean	4.6
Std Dev	0.3
Std Err Mean	0
upper 95% Mean	4.6
lower 95% Mean	4.5
N	714

Lower Adam River Study

102-year old western hemlock

4 plots x 51 trees per plot

Standing tree data collected in 4 plots x
51 trees/plot

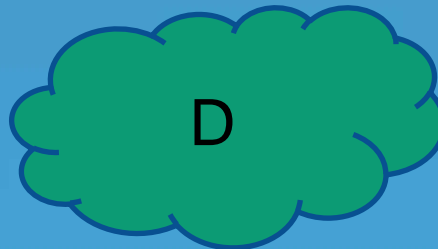
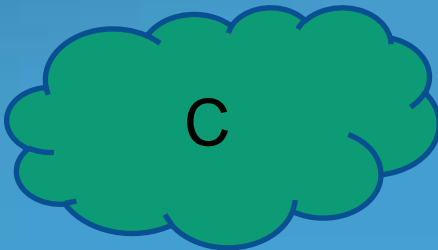
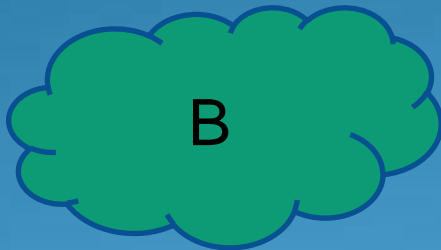
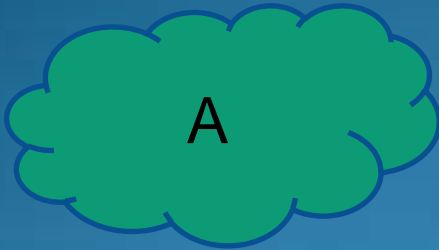
FPIinnovations measuring AV on 89 logs

Follow logs to the mill and sample
lumber for MSR

1. Customer Order

2. Sample Stands

3. Target Harvest



AV 4.5 or
higher

120m

180m

450m

380m

Who can benefit from Acoustic Velocity ?

- Anyone managing forest land and has an interest in the inventory information and the potential value of the trees.
- Mills that want to maximize the value of the logs being utilized
- Companies already producing MSR lumber or specialty products that want to increase the likelihood that the logs being utilized will produce lumber or the expected quality
- Forest managers requiring feedback on the influence of silvicultural practices and genetics on fiber quality



Hope for Hemlock

Have to look to learn ...

Research is on-going

Acknowledgements

Western Forest Products Inc.

Pat Bryant, Lisa Davidson, Bill Beese