



BRANCH MODELS TO PREDICT THE EFFECT  
OF COMMON SILVICULTURAL TREATMENTS  
ON *PINUS BANKSIANA* VISUAL LUMBER  
DOWNGRADE BY KNOTS

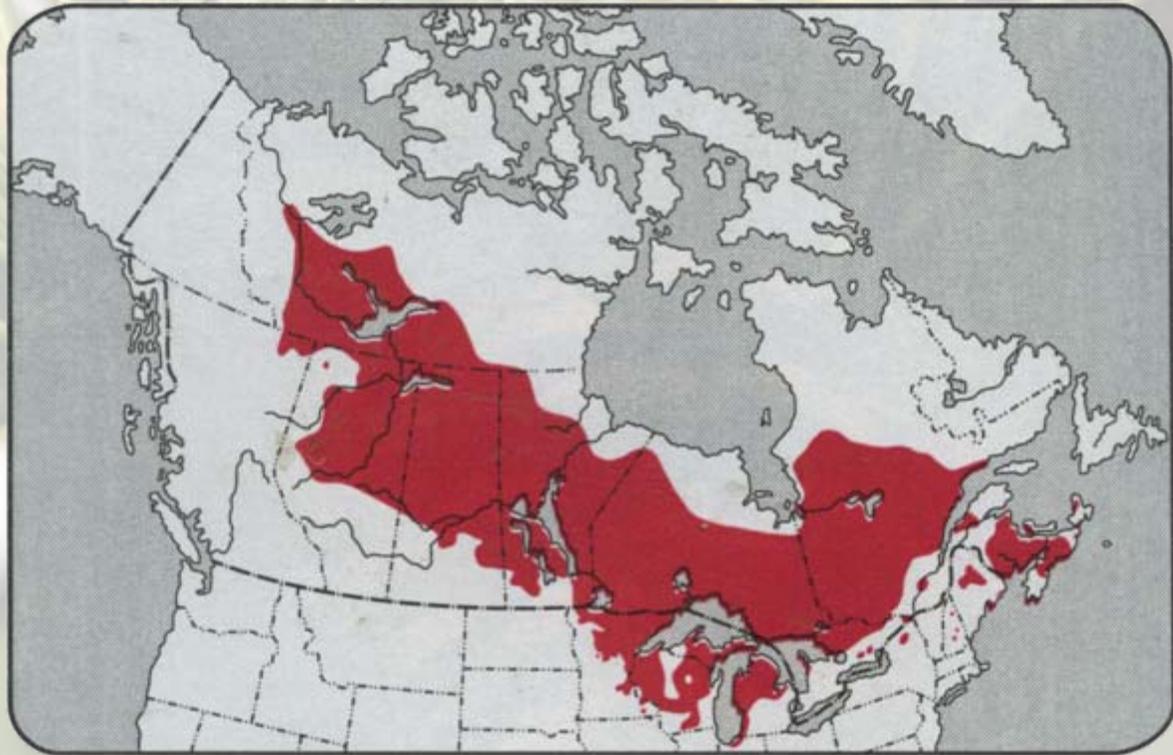
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# CONTEXT

- Short supply of sawlogs in Eastern Canada
- Jack pine (*Pinus banksiana*)
  - large distribution area
  - 20% of softwood volume
  - Second fastest-growing conifer
- Industry moving toward intensified practices



# DISTRIBUTION AREA

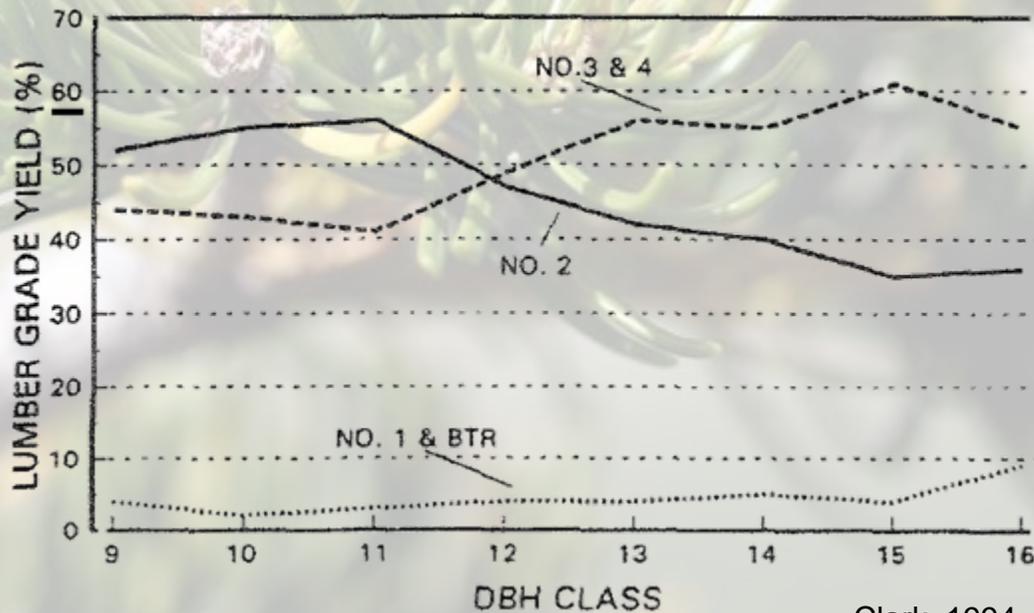


Farrar, 1996



# PROBLEM

- ↓ plantation density 70's Vs 90's (Quebec)
- Scarce knowledge on wood quality (*define*) impacts



Clark, 1994

# THEORIES

- da Vinci (1452-1519)  
« all the branches of a tree at every stage of its height when put together are equal in thickness to the trunk »
- Shinozaki (1964)  
Pipe model theory
- Mäkelä (1997)  
« A Carbon Balance Model of Growth And Self-Pruning in Trees Based on Structural Relationships »



Aratsu, 1998



# HYPOTHESES

- Competition effect on resources availability
- Competition dynamics depend on silvicultural treatments
  - annual growth increase with spacing ( $\uparrow$  volume,  $\downarrow$  quality)
  - natural pruning increase with competition ( $\uparrow$  quality,  $\downarrow$  volume)



# SILVICULTURAL TREATMENTS

- Earlier interventions ↑ knot effect on wood quality
- Thinning (*Timing and intensity*)
  - + proportion of large DBHs, ± stand volume
  - + range of products, + large knots, + downgrading
- **Trade-off between volume and wood quality**

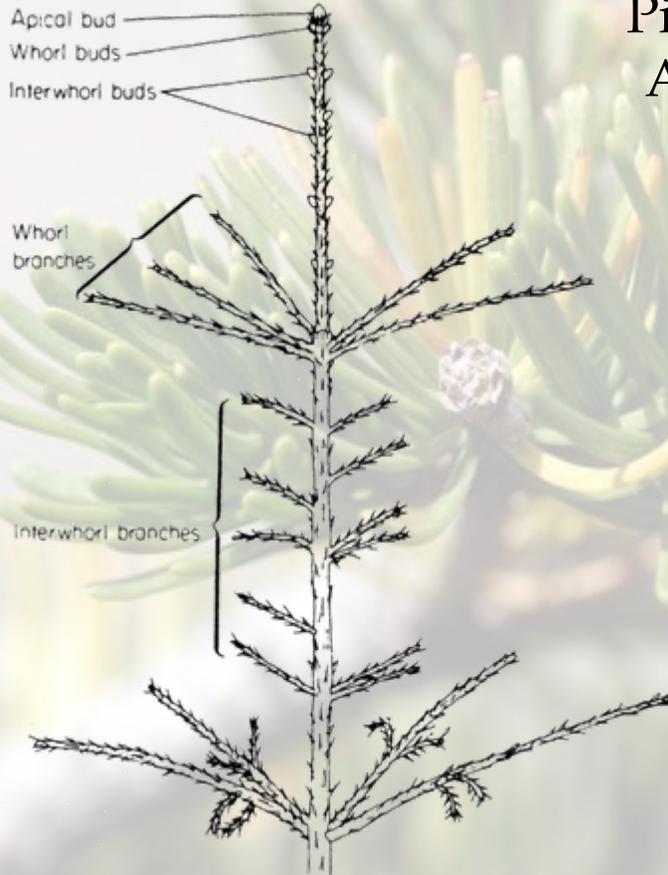
# METHODS

- Sawing studies
- Peeling method
- Modeling knots
- Modeling tree growth + branches  
(*numerous advantages*)
  - Efficient
  - Non-destructive
  - Silvicultural treatments exploration
  - Dynamic image of stand

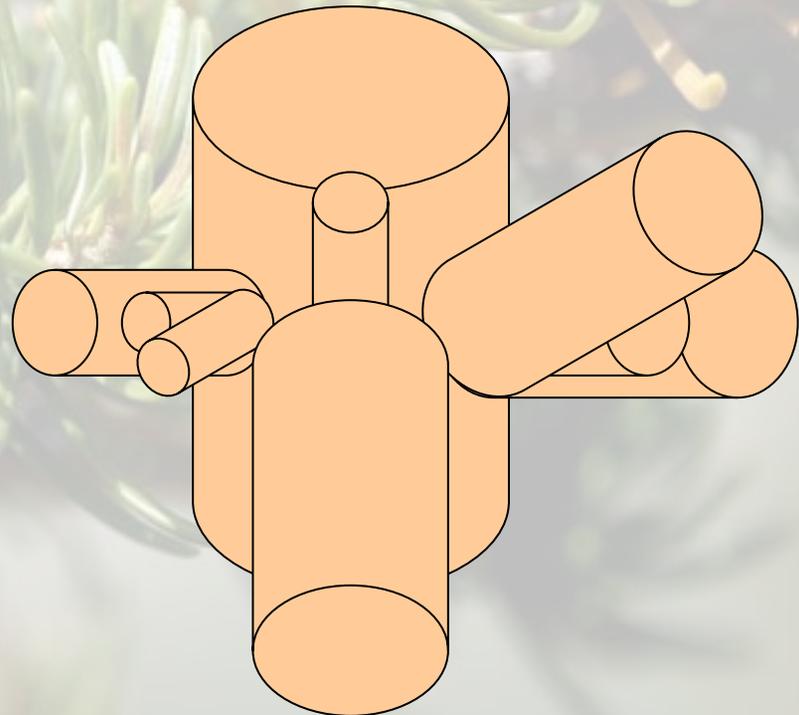
# 1. BRANCH RELATIONSHIPS

- **Aim 1** : Develop models of branch characteristics integrating the impact of silvicultural treatments
  - Number of Branches by Annual Shoot Length
  - Azimuth by Even Spacing
  - Diameter Distribution by Whorl Number from Apex
  - Insertion Angle by Whorl Distance from Apex
  - Status by Relative Diameter within Whorl
  - Self-Pruning by Tree Age

# 1. BRANCH RELATIONSHIPS



PipeQual (Mäkelä and Mäkinen 2003)  
ARBRE - VERTICILLE - BRANCHE



Cochrane, 1978

## 2. WOOD QUALITY

- **Aim 2** : Simulate sawing with Optitek© and assess visual lumber downgrading by knots

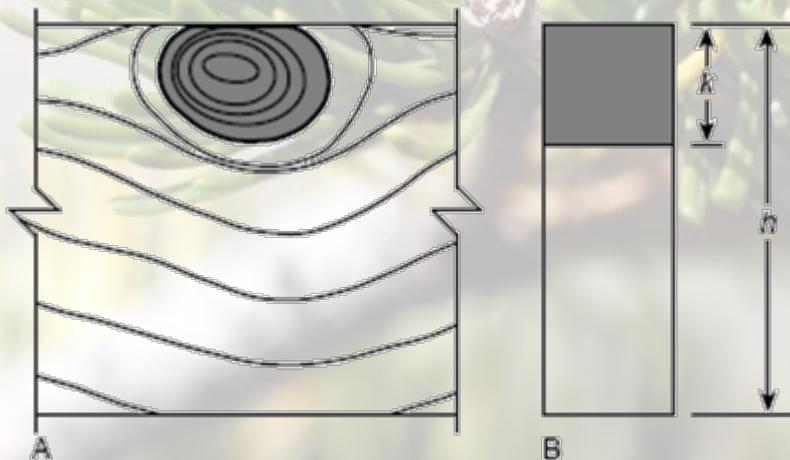


Figure 6-2. Effect of edge knot: A, edge knot in lumber and B, assumed loss of cross section (cross-hatched area).

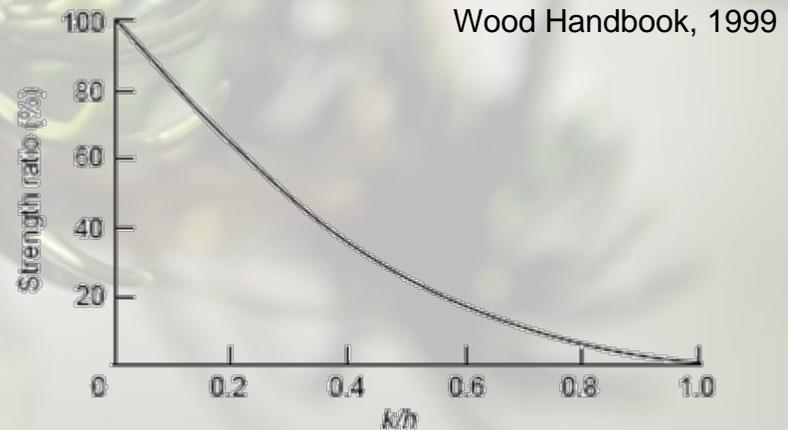


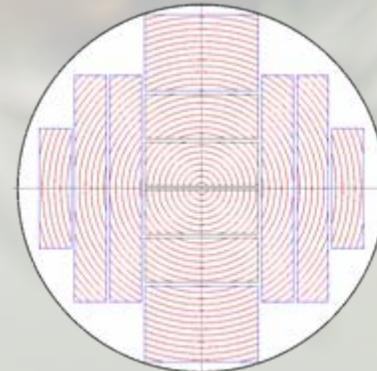
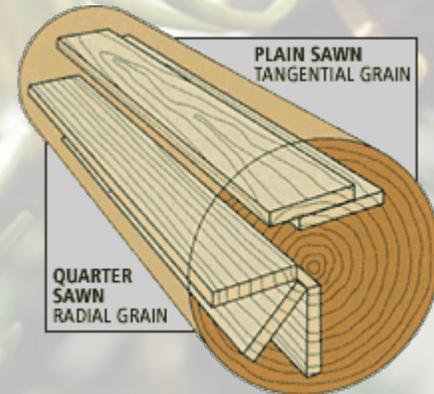
Figure 6-3. Relation between bending strength ratio and size of edge knot expressed as fraction of face width.  $k$  is knot size;  $h$ , width of face containing the knot.

# SAWING SIMULATION

- Knot properties



- Stud mill Vs random length
- Optimized sawing pattern



# GRADING

- knot shape + size
- location
- shape
- state

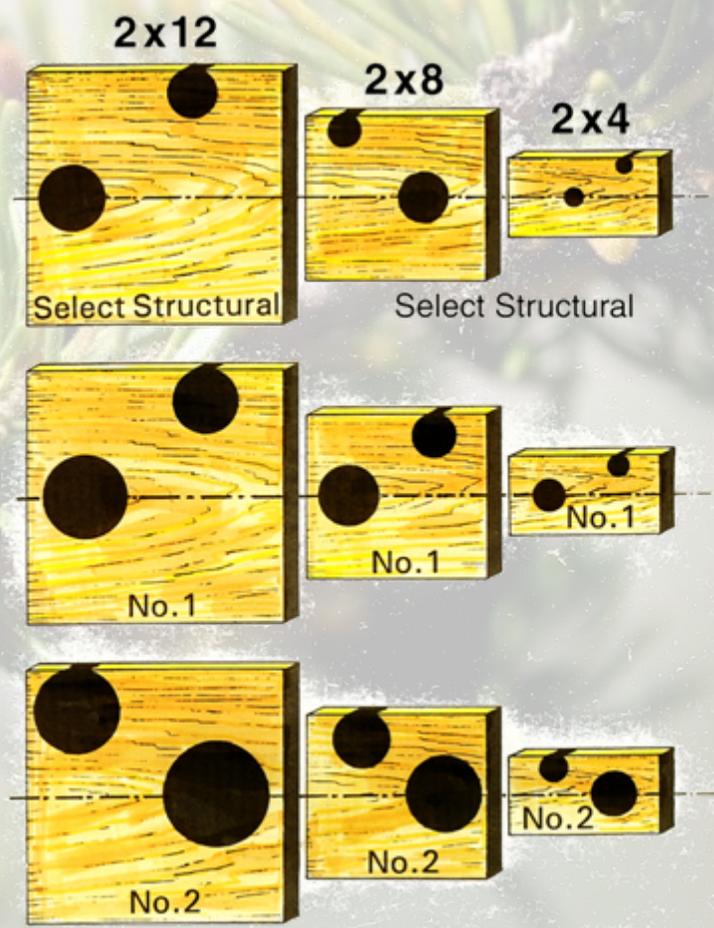


Knots on the 4 faces of a board



Esthetic aspect

Wood Handbook, 1999



Jozsa, 1994

Scale: 0 5 10 15 (cm)

# SILVICULTURAL TREATMENTS SIMULATIONS

- Initial spacing, (pre)commercial thinning, pruning?, rotation age
- Dynamic assessment of wood volume and quality, and value through grading
- Are we doing the right thing ?

# TURN SAWING...



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# INTO ART