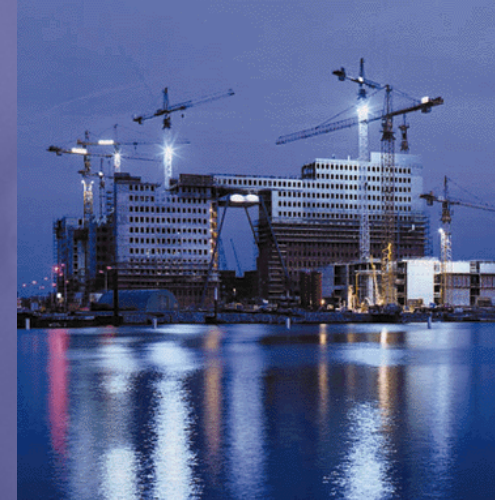


COST E53 Hamburg 14-15 May 2007

Machine strength grading with a flexibility in use and application

TNO Built Environment and Geosciences

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Contents:

- Activities of woodworking companies Netherlands
- Strength grading machines
- Derivation of settings for grading
- Flexible grading in practice
- Conclusions
- Comments to EN 14081

Activities of woodworking companies

Some figures:

- Netherlands:
 - Number of large timber trading companies: 288
 - Import of sawn timber:
 - Softwood : 1.928.000 m³
 - Hardwood: 502.000 m³
 - number of sawmills > 25.000 m³ / year: 5

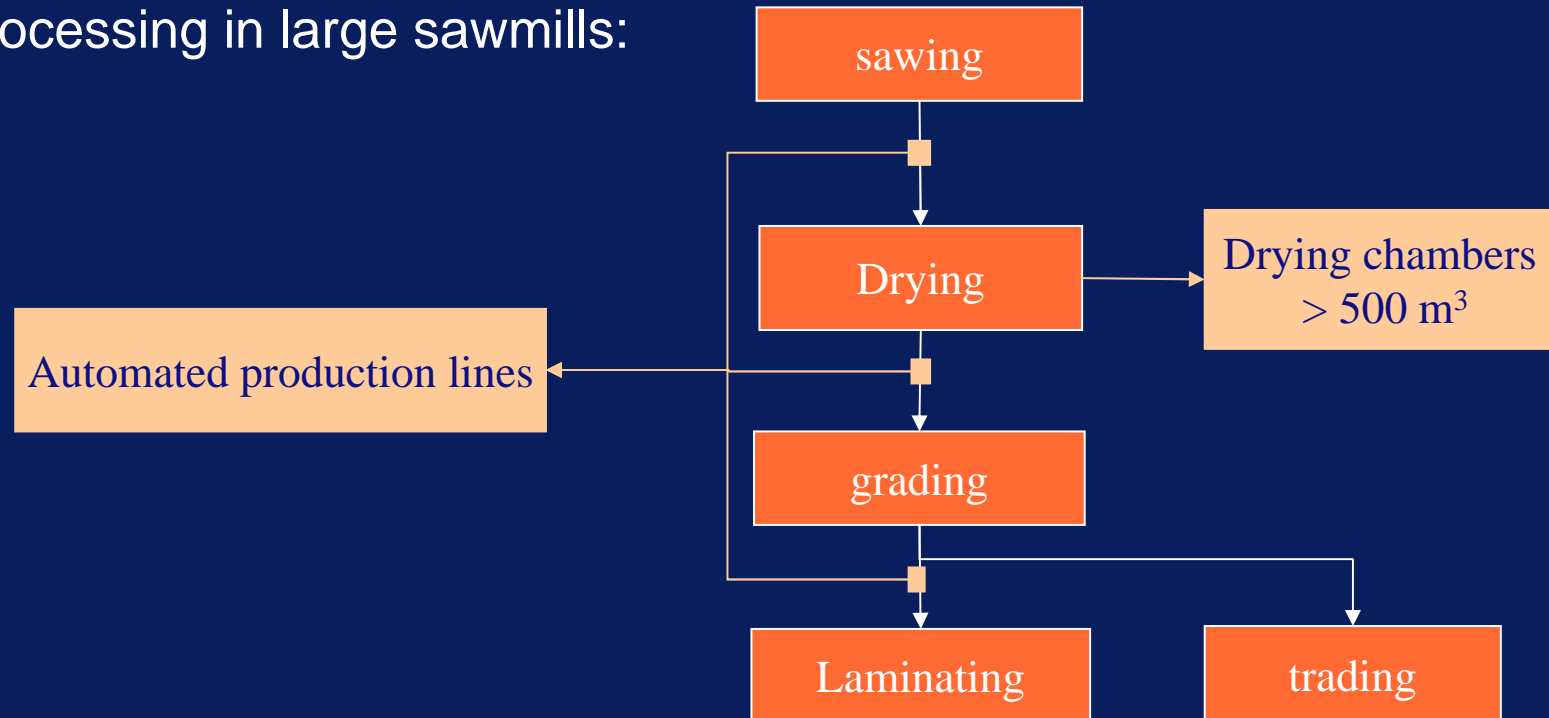
Activities of woodworking companies

Some figures:

- Sweden:
 - number of sawmill companies member of the federation : 150 ?
 - production sawn timber: 18.000.000 m³ ?

Activities of woodworking companies

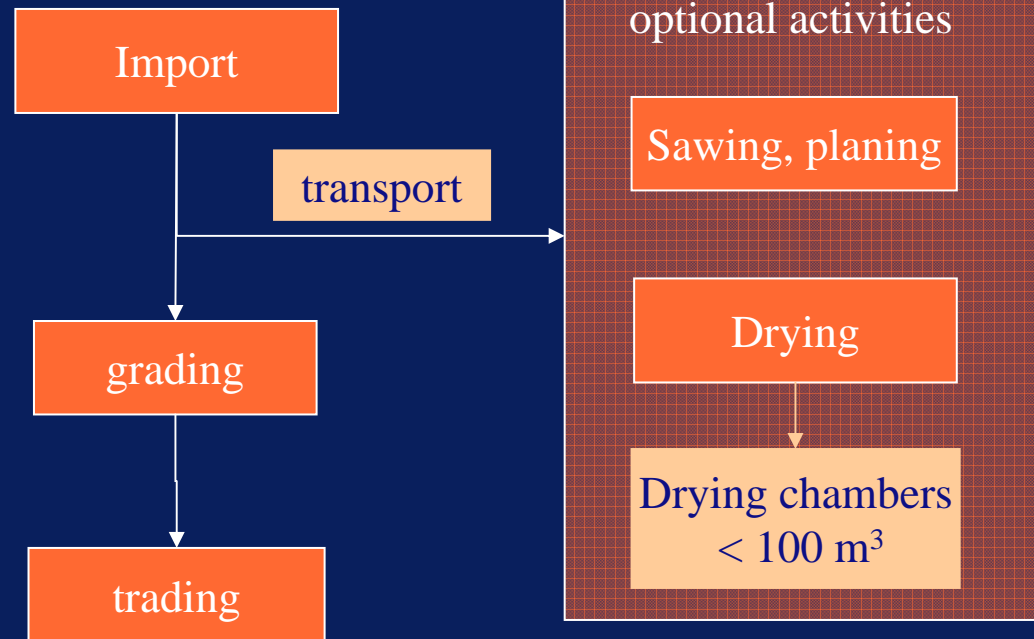
- processing in large sawmills:



- Mainly softwood, small number of species
- large amount standardised material

Activities of woodworking companies

- processing for (Dutch) Timber Trader:



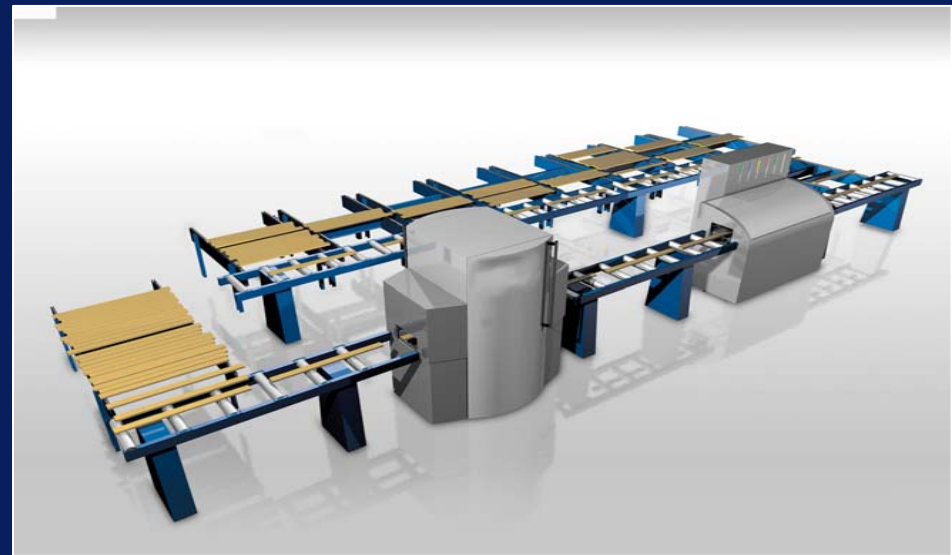
- batches with small number of beams
- different species (hard- and softwood), different sizes
- no automated production lines

Activities of woodworking companies

- Large sawmills :
 - automated processing lines for sawing and drying
 - Mainly softwood, small number of species
 - large amount standardised material
- (Dutch) Timber trader:
 - no automated production lines, contract sawing and drying
 - different species, different sizes, small batches
- Small sawmill: ?

Strength grading machines

- EN 14081: written with in-line machines in mind
- Number of grading machines Europe: approx. 150:
 - in-line machines at large sawmills with production lines where these can easily be incorporated :
 - Microtec
 - Dynagrade
 - Computermatic
 -



Strength grading machines

- The largest amount (80% ?) of companies in the woodworking industry have no infrastructure for in-line machines.



- There is a demand for flexibility in grading machines for companies with:
 - no automated production lines
 - different species, different sizes, small batches

Strength grading machines

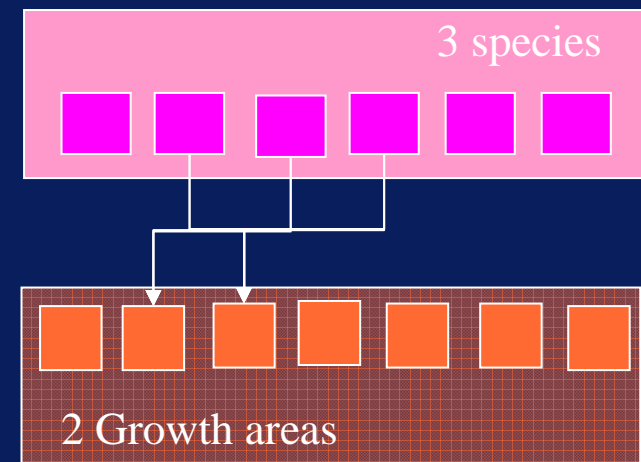
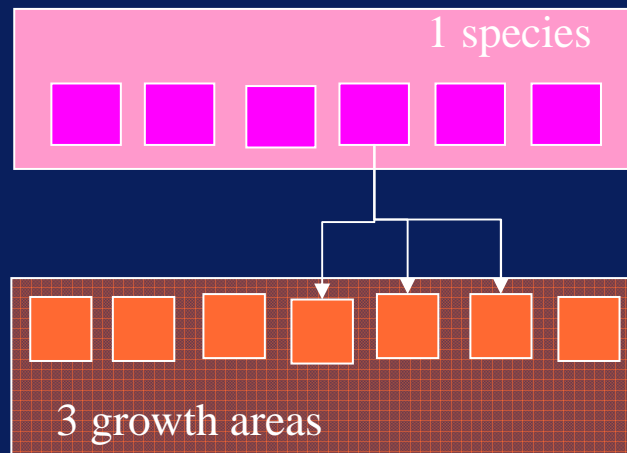
- Development of Brookhuis Micro-Electronics: Timber Grader MTG, a hand grading device: based on stress wave measurements, accepted for EN 14081-4 for Northern and Middle European spruce. For flexible use in woodworking companies



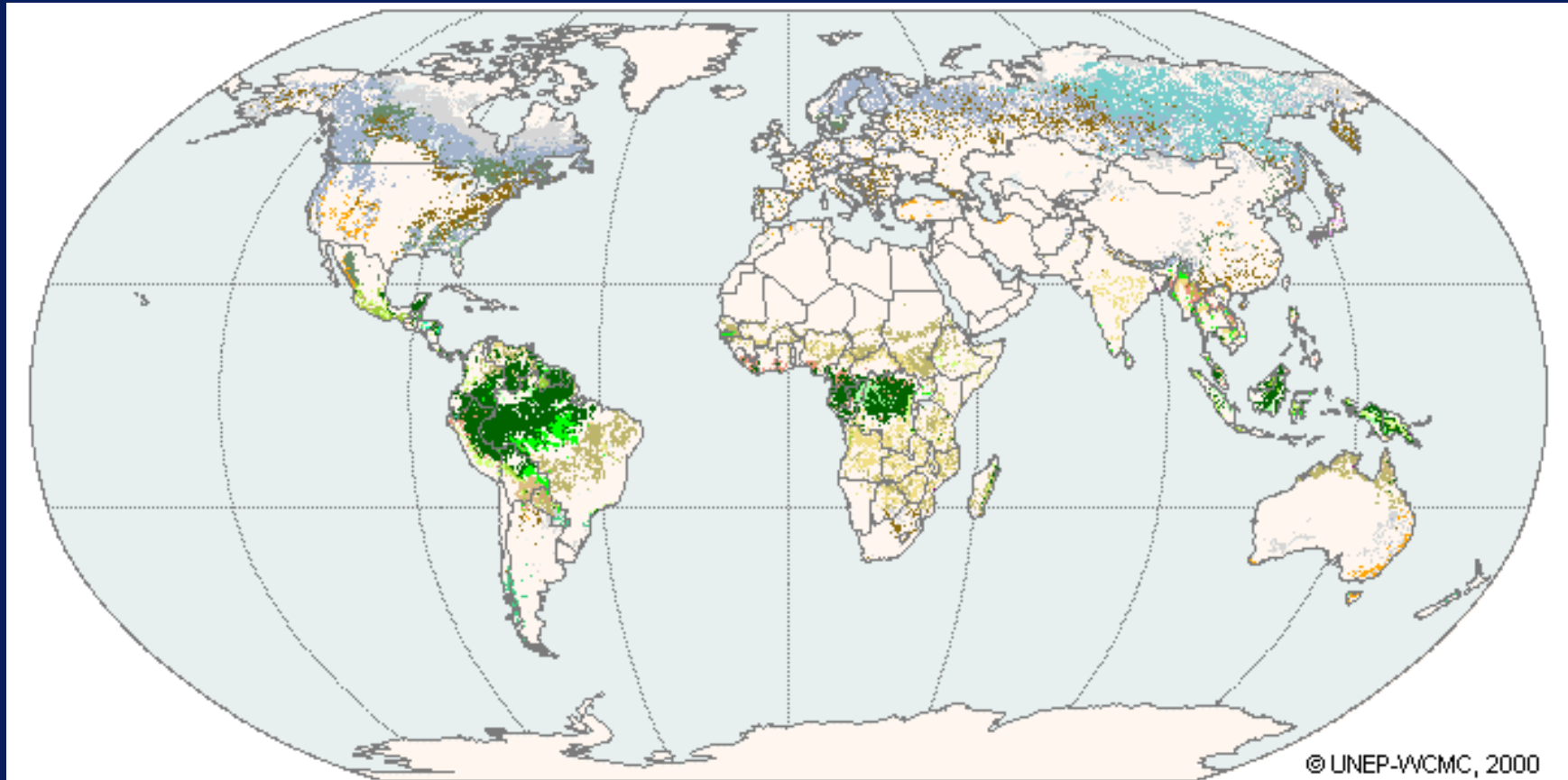
Derivation of settings for grading:

- Parameters for derivation of grading settings:
 1. botanical species
 2. growth areas
- Settings depend on:
 1. the quality of the model
 2. a representative distribution of growth areas

Possibilities:



Derivation of settings for grading:



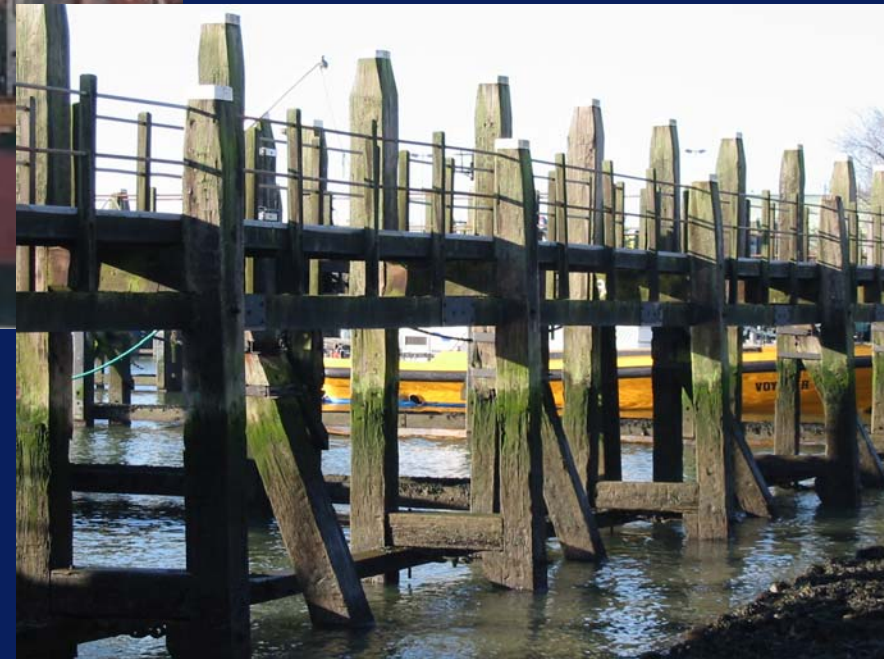
The world's forests: origin of species used

Derivation of settings for grading:

- Number of species used for structural uses in Europe:
 - Softwoods: 5 ? (mainly spruce and pine)
 - (tropical) Hardwoods in the Netherlands: 30 and more to come (also due to the FSC).
- Characteristics of tropical hardwoods:
 - Hard to identify in practice
 - Changing quality.
 - Tropical hardwoods have little visual distinctions

Derivation of settings for grading:

- Structural hardwoods in the Netherlands



Derivation of settings for grading:

- **Case 1: Combining growth areas and hardwood species.**

At TNO and TU Delft there has been research on hardwood timber for more than 40 years, with azobé (*lophira alata*) as the most important

The research goal was to determine if machine grading for tropical hardwoods is possible and economical.

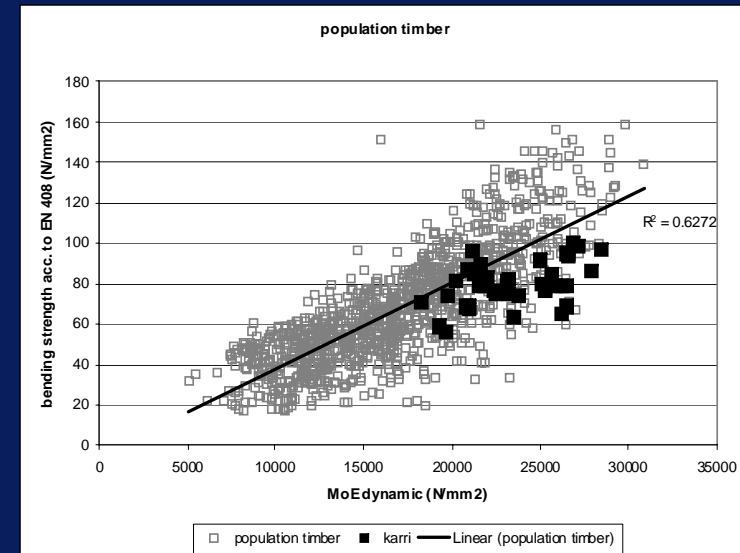
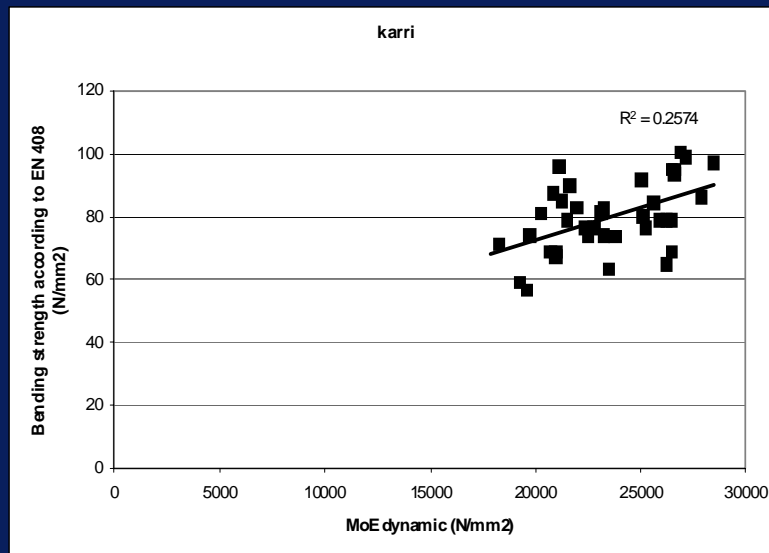
More than 20 species were tested:

- non-destructive
 - natural eigenfrequency (longitudinal)
 - density
 - visual (growth features)
- destructive (EN 408)
 - minimum of 40 beams to allow strength class assignment

Derivation of settings for grading:

Research results:

- For individual wood species not always clear relationships between MoE and MOR were found.
- When all beams were regarded as 'one' population hardwood good correlations between MoE and MOR were found.



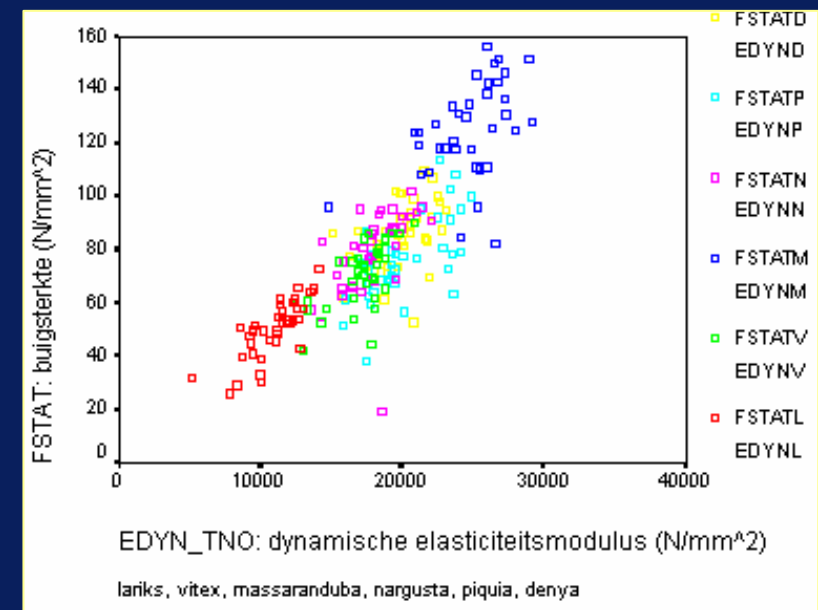
Derivation of settings for grading:

- When tropical hardwood regarded as 'one' population non-destructive measurements (density and $MoE_{dynamic}$) give good correlations for the strength.

- Growth area: South-America + Africa



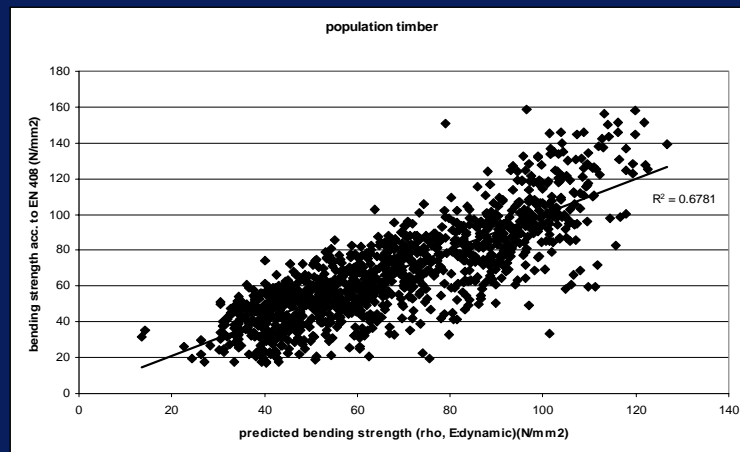
- Species: 20 tropical hardwood species with little visual distinctions



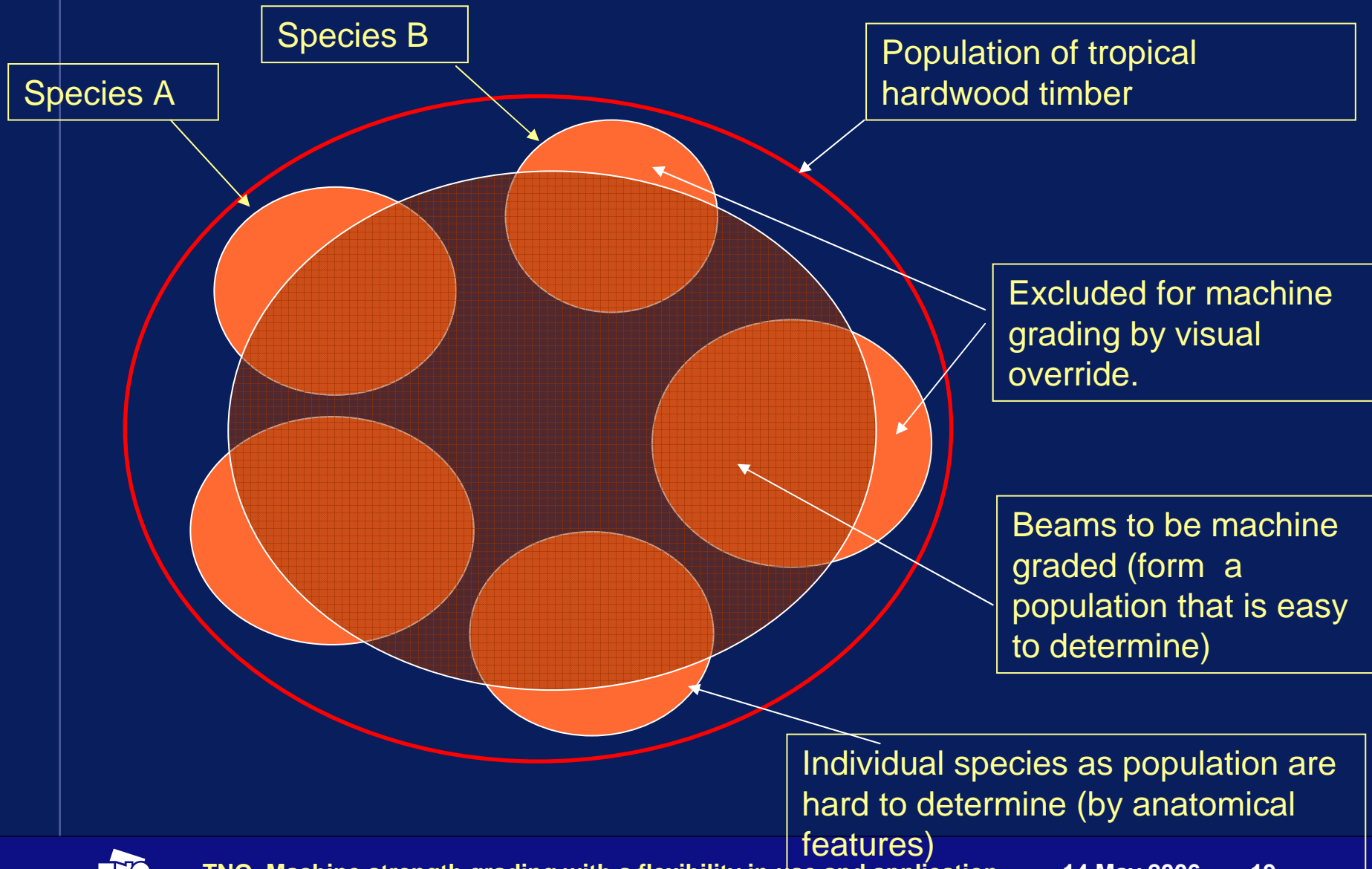
Flexible grading in practice

- Grading set-up: Timber trader with no automated production lines.
- Grading material: South-American hardwood species, different sizes, small batches

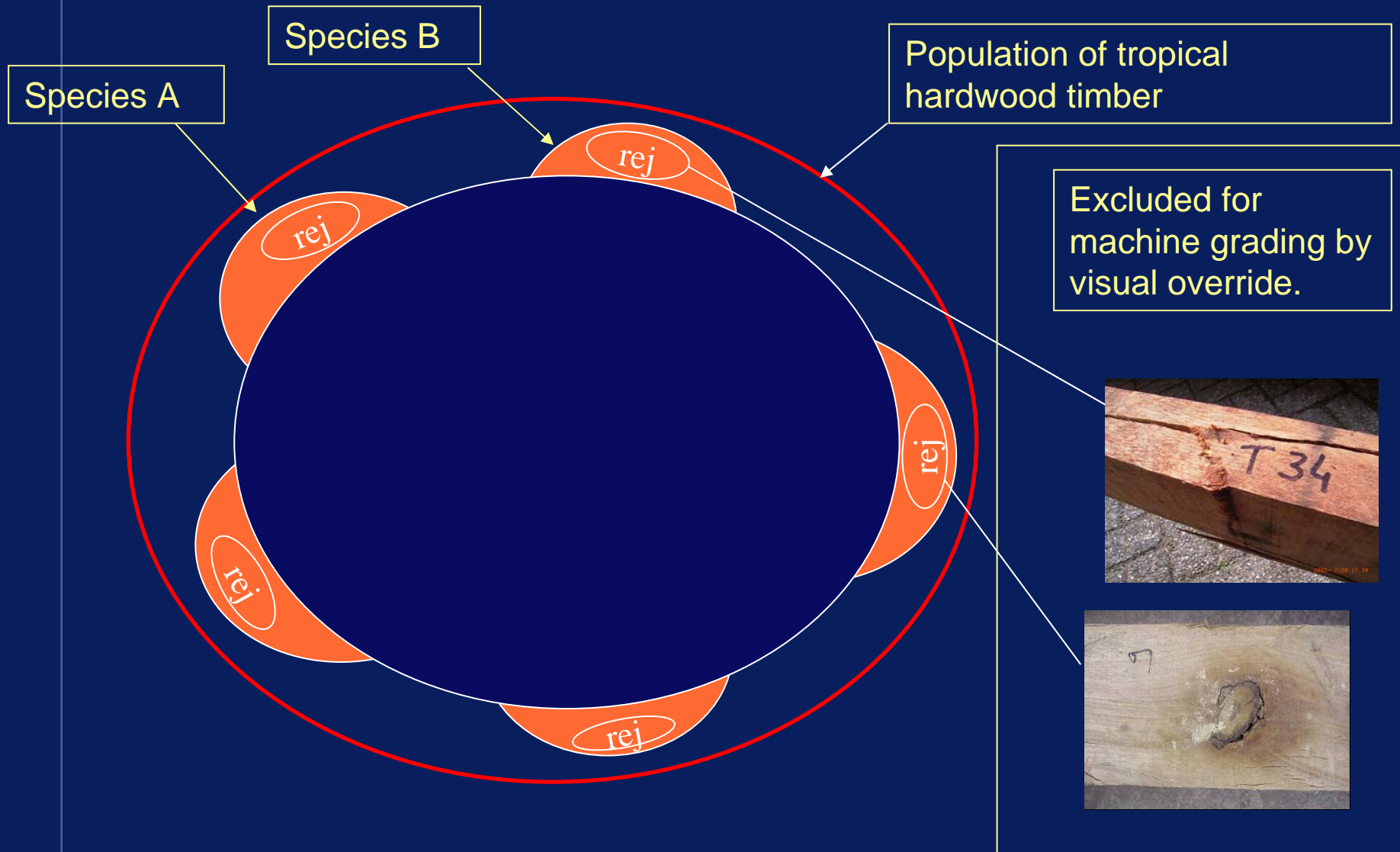
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Hardwood grading models incorporated
in the Timber Grader MTG.



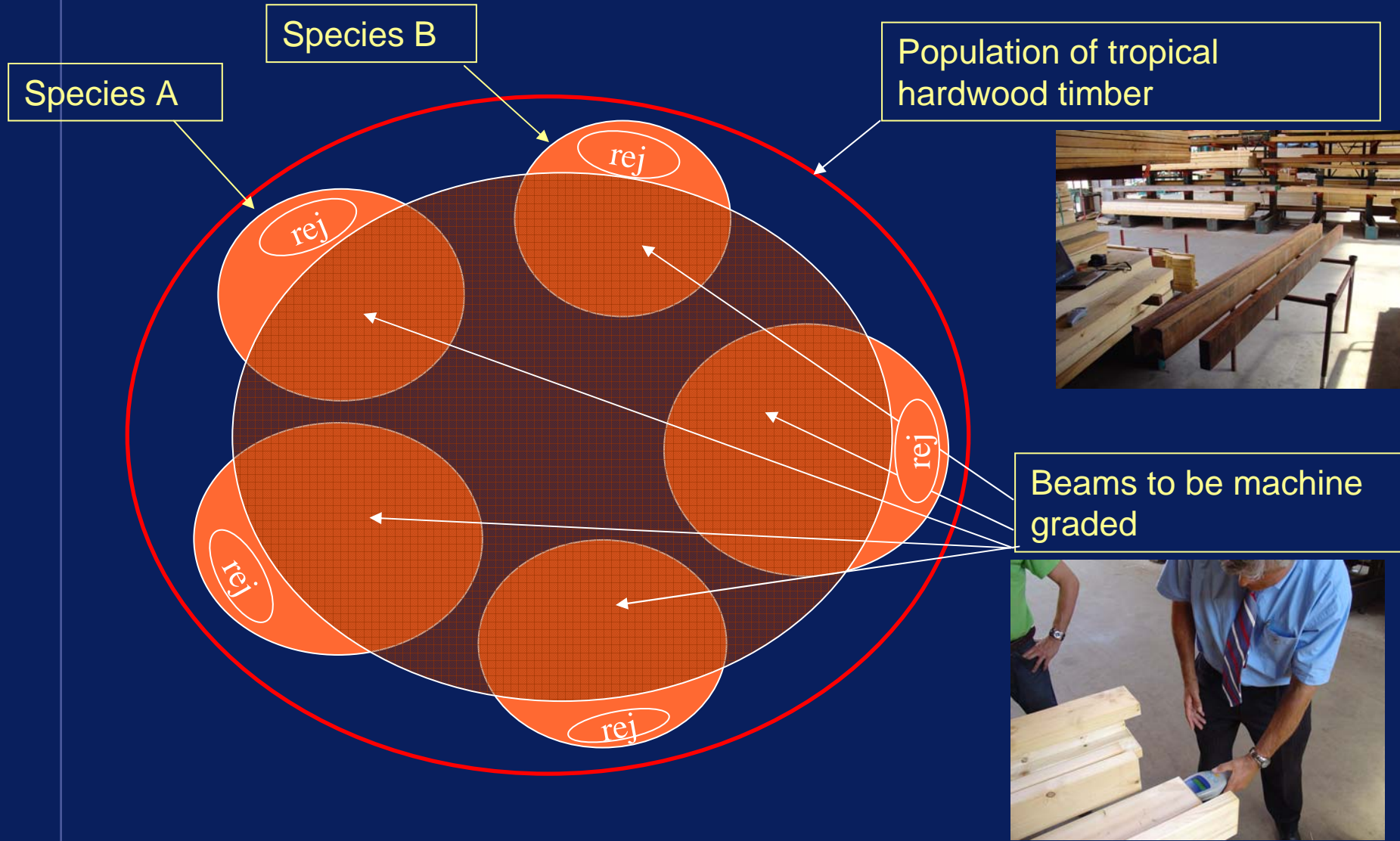
Flexible grading in practice



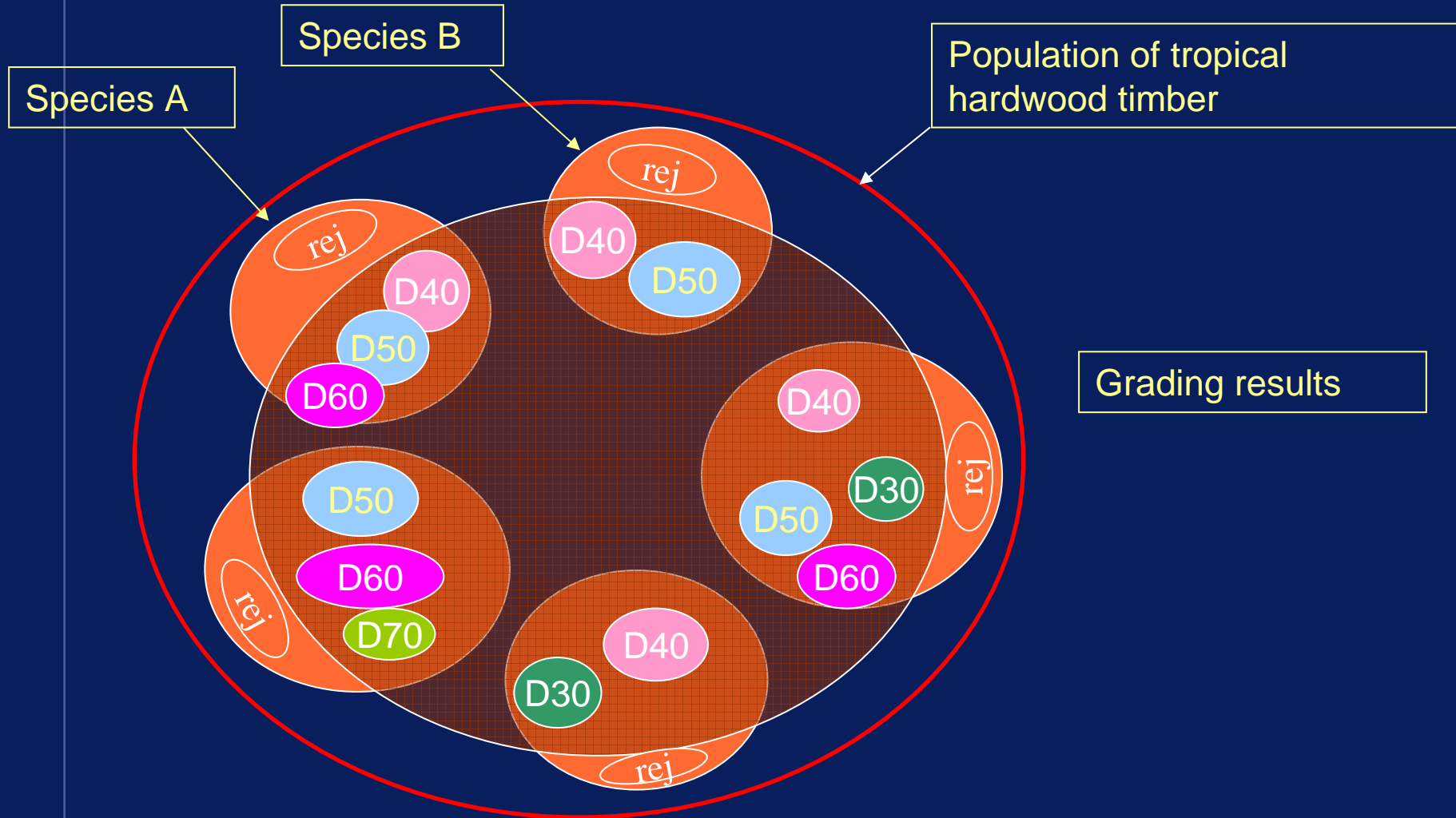
Flexible grading in practice



Flexible grading in practice



Flexible grading in practice



Flexible grading in practice

D Class according to EN 338

D50



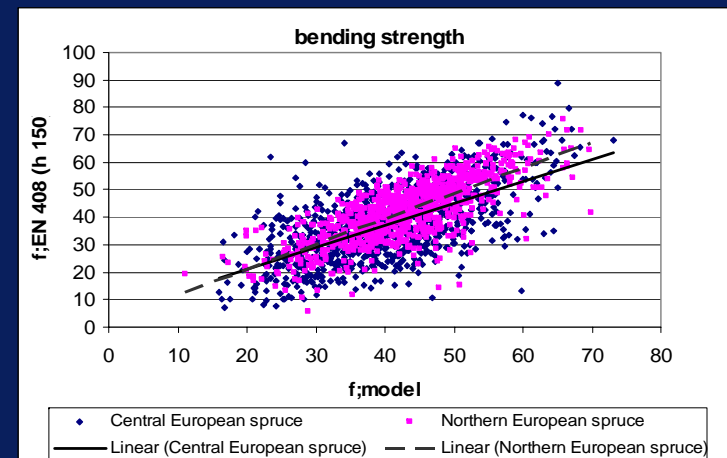
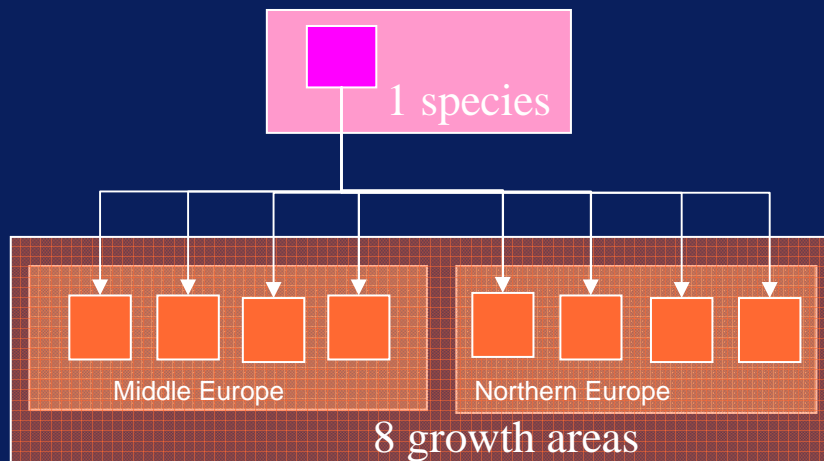
D Class according to EN 338

D70

Flexible grading in practice

- **Case 2: Combining growth areas Middle and Northern Europe and species spruce.**

Settings derived for the Timber Grader MTG accepted to be listed in EN 14081- 4: Middle and Northern European spruce.



- settings were derived for spruce for Timber Grader MTG because of market demand for flexible grading for softwoods
- Deriving settings for restricted growth areas (like only Northern European spruce) can give higher yields

Conclusions

- Flexibility in grading machines;
 - In-line grading machines are suited for companies with automated processing lines.
 - For the majority of companies (timber traders, small sawmills) more flexible machine grading solutions are demanded.
- Flexibility in grading applications:
 - combining growth areas and species combinations can make machine grading possible for species brought the market in small amounts.

Comments to EN 14081

- Machine installation check:
 - What is the goal: the machine in the company must give the same results as the master machine for which the settings were derived ?
 - Is this achieved by the present requirements ?