WoodWisdom-Net

Gradewood: Grading of timber for engineered wood products

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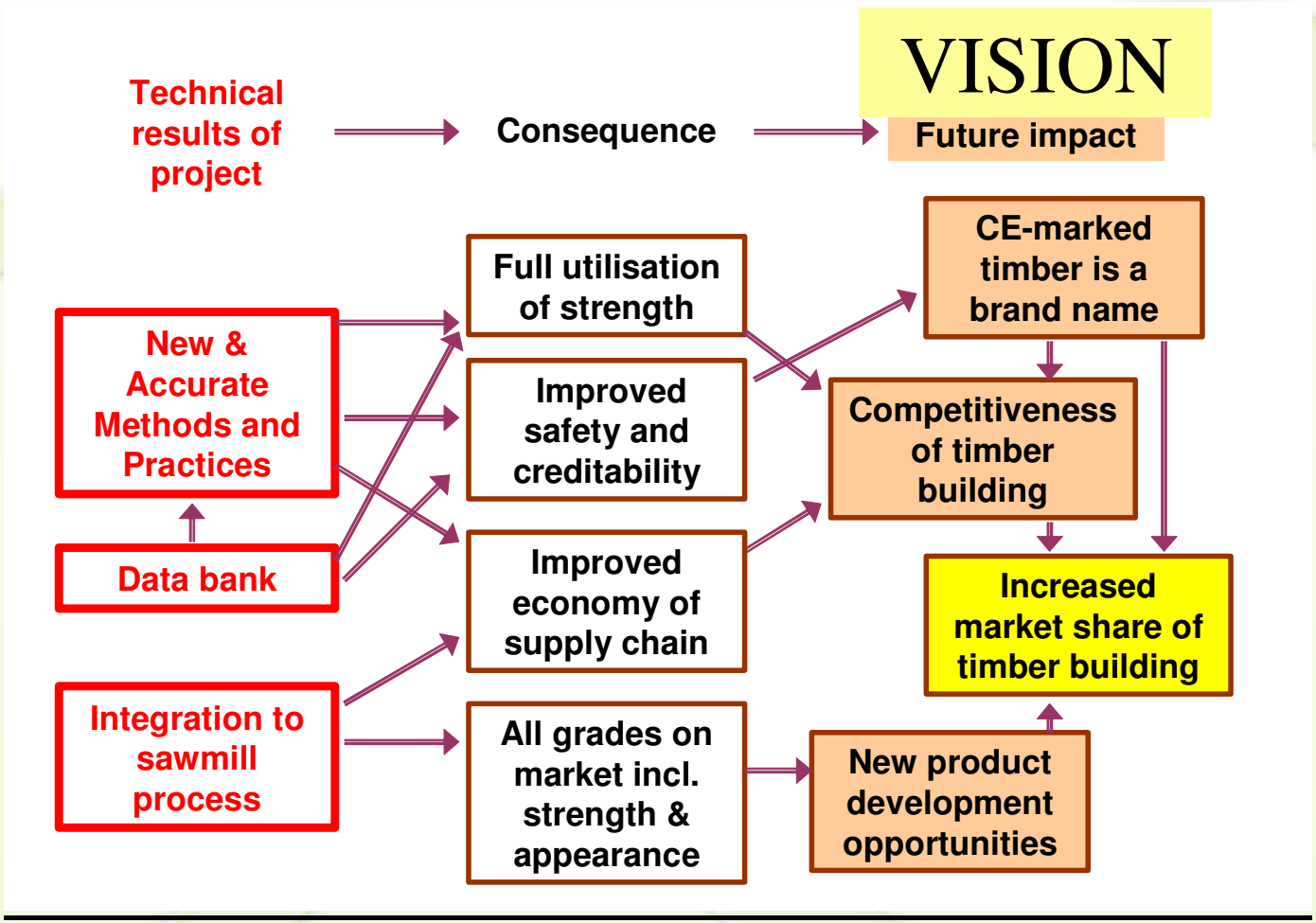
VTT Finland

SIXTH FRAMEWORK PROGRAMME

COST E53 in Oslo, 19 May 2008

Project Objectives and Main Tasks



Project Partners and their Roles

VTT, Finland, Project Coordinator

BRE, UK, Dissemination of results

FCBA, France, Statistical analysis

TUM, Germany, Experimental research

SP, Sweden, Input for standards

HFA, Austria, Experimental research

TUW, Austria, Modelling of effect of defects

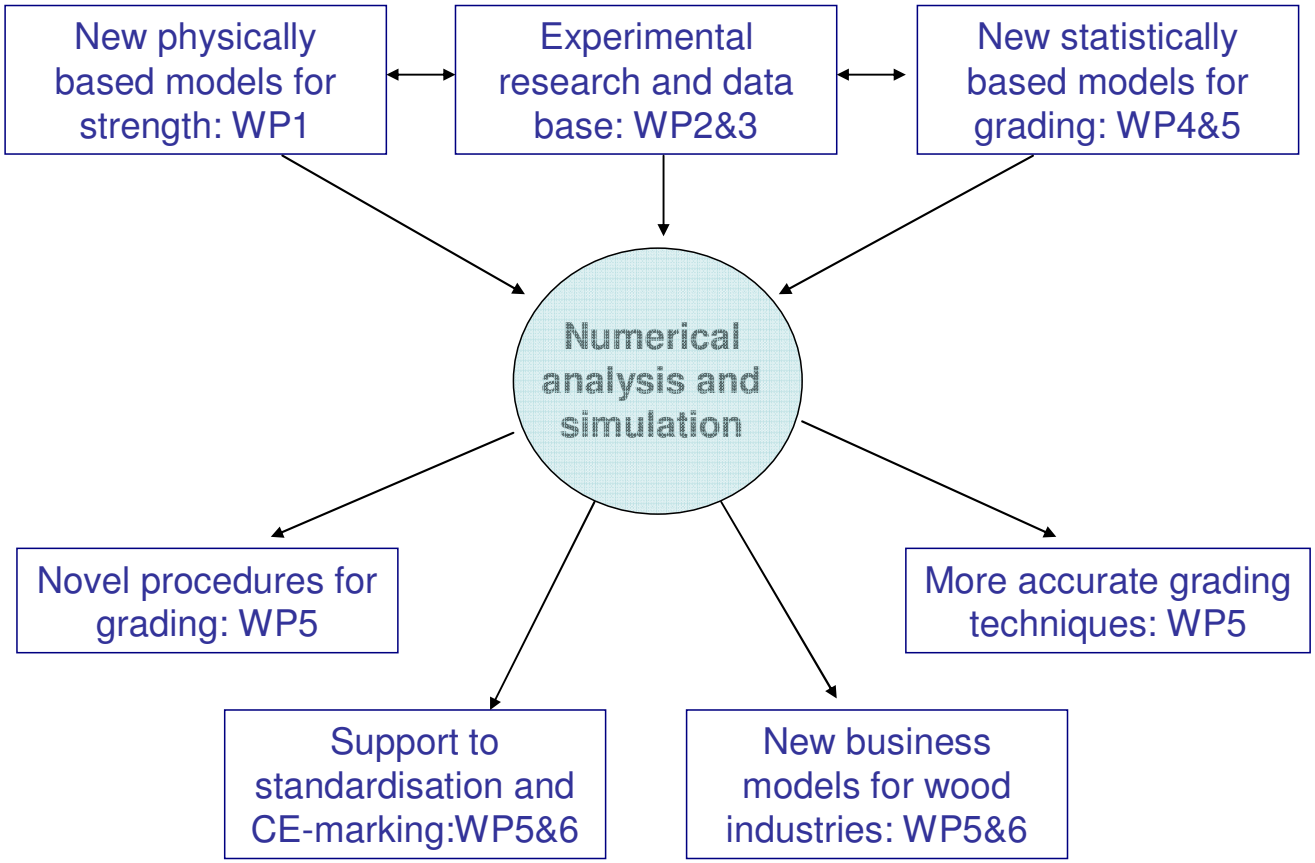
UL, Slovenia, Simulation of grading

Grading equipment developing industries

Building With Wood (CEI-Bois), Funding

National funding organisations/Wood Wisdom.Net

Project Highlights



Time table and milestones

Table 1

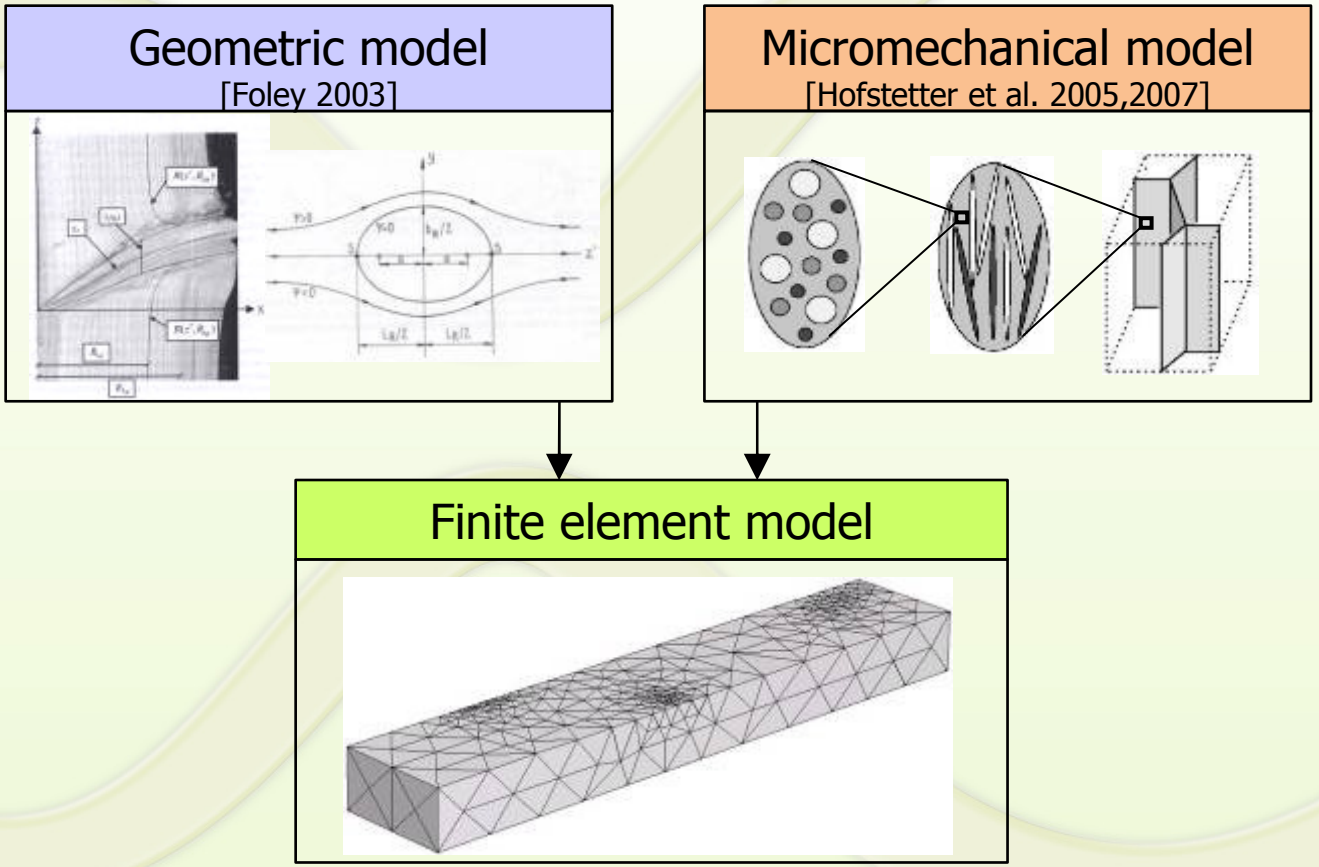
Workpackage \ Month	0	3	6	9	12	15	18	21	24	27	30	33	36
WP1. Theoretical basis									M4				
WP2. Prior analysis			M1										
WP3. Experimental research					M2			M3					
WP4. Statistical analysis									M4				
WP5. Modelling and devel. …												M5	
WP6. Dissemination of results			C			C			C	P		C	F

Milestones:
M1. month 6, Plan for sampling and testing based on analysis of existing results
M2. month 12, Industrial grading of test material complete, material transfer to laboratories
M3. month 21, Laboratory testing complete, data transferred to joint data file
M4. month 24, Workshop on the results, manuscripts for publications
M5. month 34, New industrial grading methods drafted
C communication with scientific community and industries in conferences
P scientific results published
F month 36, final conference: European conference on strength grading

WP 1 – Physical Modelling of the Effects of Defects

WP Leader: Vienna University of Technology, K. Hofstetter

Numerical simulation of mechanical behavior of **timber with knots** by combining micromechanical model and model for fiber course within an FE simulation



WP1 - Work programme

Task 1.1: Development of a geometric model for the grain course in the vicinity of knots for typical knot configurations using the Foley model; implementation into FE software

Task 1.2: Adaptation and further development of micromechanical model for consideration of variation of the morphological and mechanical properties of the wood tissue and its mechanical properties

- in the vicinity of knots (variation within log),
- across different vegetation zones / growth conditions,
- across different log positions in the stem;

implementation into FE software

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Task 1.3: Experimental validation of FE simulation tool by comparison of numerical results with test data from WP2 and WP3 as well as from own investigations;

required test data:

- board stiffness and strength,
- morphological characteristics of knots ('3D', not only surface data)

Task 1.4: Performance of FE simulations of selected boards, parameter studies in relation to

- morphological characteristics of knots,
- influence of vegetation zone / growth conditions,
- influence of log position in the stem;

derivation of simplified relations for mechanical properties of boards based on simulation results

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WP2 - Analysis of existing data

WP leader: VTT, A. Ranta-Maunus

Specific goal: New definition of "growth area" based on relation of measured grade indicating properties and strength in different regions for different species

Objectives:

1. Conclusions on growth areas based on existing data

2. Which new experiments are most beneficial to be done in WP3.

FCBA Data bank (Douglas fir, European spruce, Sitka spruce, Scots pine)
Data from ACCESS software

			Strength properties (number of sawn timber)		Woods characteristics					Grading method with machines (names and tech			
Species	Number	French growth area	Bending	Tension	Density	E-modulus	Knots	KAR	MC 10 to 15%	Cook bolinder SG-AF 100	Prototype (Bing)	Prototype (CTBA)	Sylvatest
										dynamic modulus	portable vibratory device	X ray	portable ultrasonic device
Douglas-fir	1	Auvergne	427		X	X	X	X	X	X	X	X	X
	2	Bourgogne	478		X	X	X	X	X				
	3	Bretagne	179		X	X	X	X	X				
	4	Centre	109		X	X	X	X	X				
	5	Haute et Basse Normandie	347		X	X	X	X	X				
	6	Limousin	357		X	X	X	X	X				
	7	Limousin	514		X	X	X	X	X	X	X	X	X
	8	Midi Pyrénées	424		X	X	X	X	X				
	9	Rhône Alpes	135		X	X	X	X	X	X		X	X
	10	Rhône Alpes	867		X	X	X	X	X	X	X	X	X
	11		248		X	X	X		X		X		X
	12	Limousin	564	564	X	X			X				
	13	Auvergne	78	78	X	X			X				
	14	Rhône Alpes	140	140	X	X			X	X for MC>30%			
	15	Bourgogne	179	179	X	X			X				
Total			**5046**	**961**									
European spruce	16	Alsace	101	109	X	X	X	X	X				
	17	Auvergne	169		X	X	X	X	X				
	18	Bourgogne	88		X	X	X	X	X				
	19	Champagne Ardenne	79		X	X	X	X	X				
	20	Franche-comté	325		X	X	X	X	X				
	21	Languedoc Roussillon	58		X	X	X	X	X				
	22	Limousin	146		X	X	X	X	X				
	23	Lorraine	347		X	X	X	X	X	X	X	X	
	24	Lorraine	185		X	X	X	X	X				
	25	Midi Pyrénées	47		X	X	X	X	X				
	26	Rhône Alpes	544		X	X	X	X	X				
	27	Rhône Alpes	449		X	X	X	X	X		X		
	28	*Outside France ("Scandinavie")*	1460	660	X	X	X	X	X	X		X	X
Total			**3998**	**769**									
Sitka spruce	29	Bretagne	532		X	X	X	X	X	X		X	X
	30	Bretagne	185		X	X	X	X	X				
Total			**717**	**0**									
Scots pine	31	Alsace	412	97	X	X	X	X	X	X		X	X
	32	Auvergne	640		X	X	X	X	X	X		X	X
	33	Centre	615	143	X	X	X	X	X	X		X	X
	34	Limousin	171	174	X	X	X	X	X	X		X	X
	35	Provence Alpes cote d'azur	298		X	X	X	X	X	X		X	X
Total			**2136**	**414**									

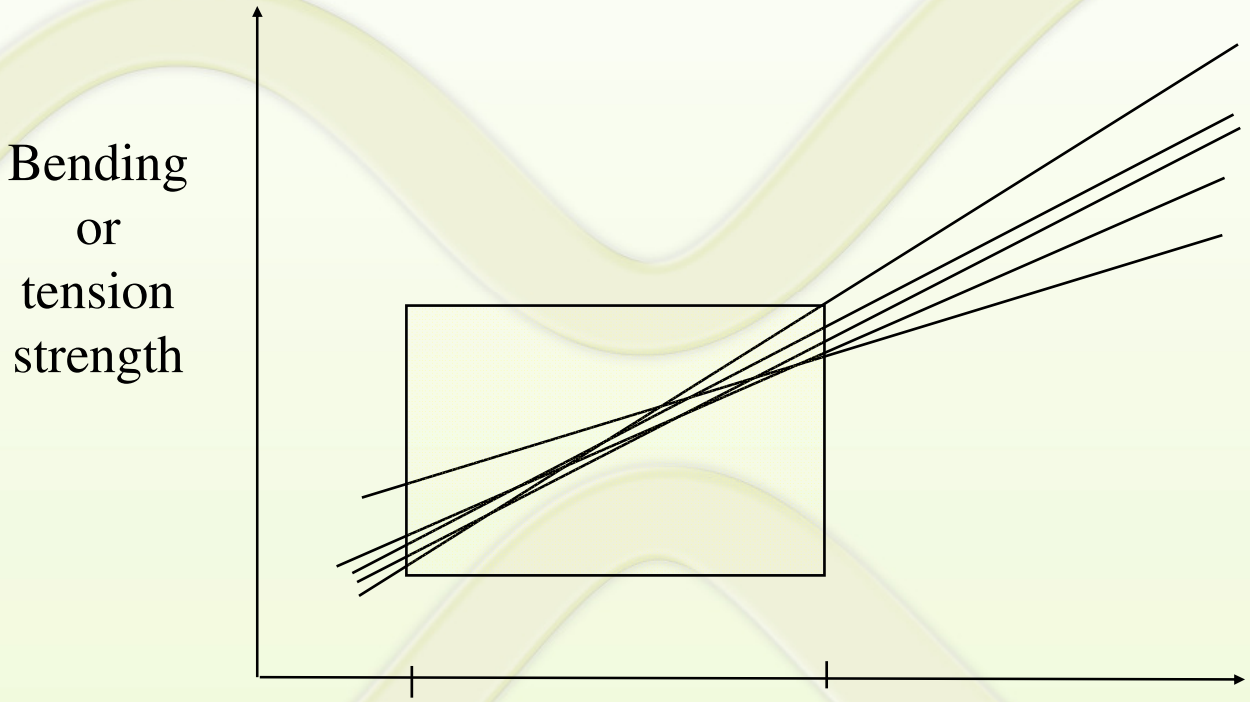
X = Present data

Test data available, to be completed

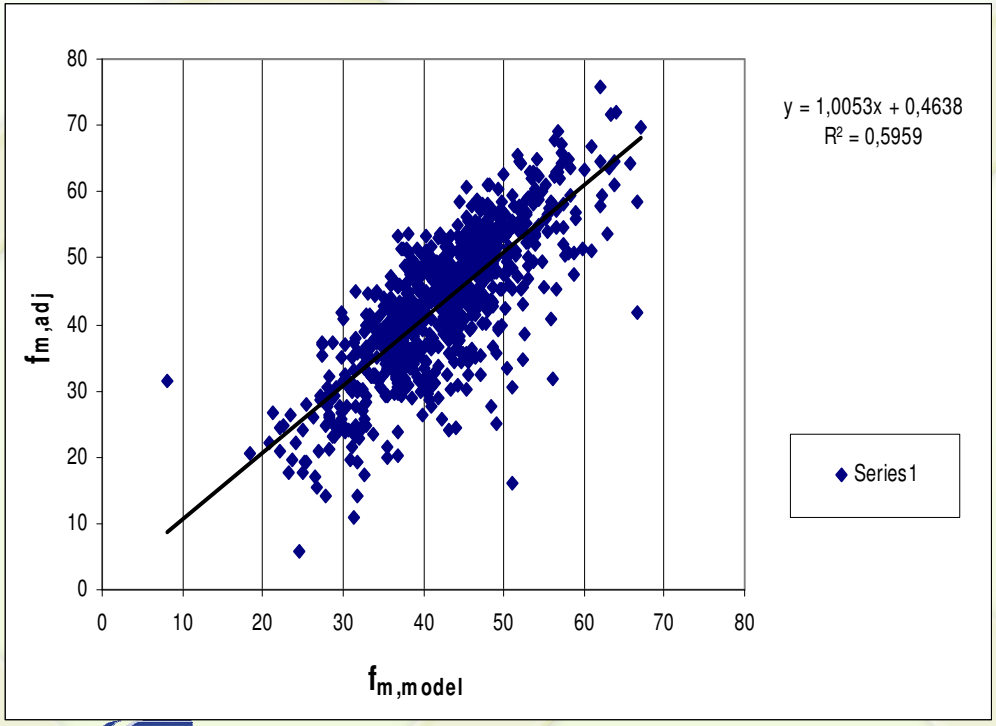
Bending Tension	Strength indicating variable	Spruce & fir	Scots pine	Douglas fir	Sitka Spruce
B	MOE	10 000	5 000		
T		5 000	800		
B	Density	10 000	5 000		
T		5 000	800		
B	KAR	5 000	4 000		
T		2 000	800		
B	Edyn	5 000	4 000		
T		2 000	800		

Basic question:

What is result of random variation and what is effect of growth area ?



Method of analysis, Phase1a
Observed vs. modelled strength



	MEAN	COV [%]
MOE	12190	20,1

range of f_{model} N/mm²	$f_{adj,mean}$ N/mm²	COV %	$f_{adj,0,05}$ by ranking
0-10			
10-20	13,9	22,8	
20-30	24,1	25,7	
30-40	35,7	20,8	24,0
40-50	45,5	15,5	33,2
50-60	53,2	17,0	35,8
60-70	62,5	11,2	
70-	57,6		
all	43,7	25,7	24,8

WP3 - Experimental research

WP leader: TUM, P. Stapel

Objectives: to fill the gaps in present knowledge needed for improved strength grading of commercially important softwood species

Present plan:
Step 1: 2,000 bending tests, 2,000 tension tests; species: European spruce, Scots pine, Douglas fir.
Step 2: 500 bending tests, 500 tension tests for verification of new findings.

Participants: FCBA, BRE, VTT, SP, HfA as well as grading equipment developing industries.

WP4 - Statistical analysis

WP leader: FCBA, D. Reuling

The complete data including prior existing data and new data from WP 3 will be analysed in order to find grounds for better settings of grading machines, new and more efficient combinations of grading techniques and new possible determination of larger growth areas to be used in standards.

The comparison between the growth areas includes at least the study of how stiffness and knot characteristics predict strength in different growth areas. Also the occurrence and frequency of specific defects is to be analysed in different growth areas.

WP 5 - Modelling and development of grading procedures

WP Leader: SP Trätek, Charlotte Bengtsson

Content:

Improvement of existing grading procedures and development of scientifically sound new grading procedures to fit the industrial needs in a better way than today.

- Out-put control
- New methods for measuring severe defects
- Evaluation and improvement of the present machine control method
- Relevance of density as grade determining property

WP 5 - Modelling and development of grading procedures

Planned deliverables are:

- Description for implementation of out-put control
- Draft of new standardised procedures
- Report on the machine control method
- Report on simulation of yields
- Report on tailored grades for building products
- Report on grading by inclusion of new defect measurements

Partcipants: SP Trätek (WP leader), FCBA, UL, VTT and TUM

WP6 - Dissemination of results

WP leader: BRE, C. Holland

- scientific publications,
- target information and education for industry (incl. supply chain, designers) and regulators
- communication with standardisation bodies
- Building With Wood Web Site
- European conference on strength grading

Gradewood project is willing to collaborate with other experts

- data of other researchers can be combined in joint European analysis, especially large data files including measurement of E_{dyn} and KAR would be valuable

- collaboration with COST E53 will continue