Modelling practice: quantify aesthetics

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FP1407 Training School: Service life of modified wood - Understanding Test Methodologies

Senses versus sensors

Visual assesemnet

- semantic differential method Osgood *et al*. (1957).

senses	emotion	evaluation
dark-bright	beautiful-ugly	clean-dirty
warm-cold	desired-unwanted	new-old
regular-rare	pleased-annoying	modern-rustic
gloss-mat	Interesting-boring	complex-simple
smooth-rough	like-dislike	innovative-conservative

Visual assessemnet - grading

- decay assessment according to defined rating scale (prEN 252 2012, EN 330 1993)

| grade "0" | grade "1" | grade "2" | grade "3" | grade "4" | grade "5" | grade "6" |

Grading	Degradation	Characteristics
0	No degradation	No colour changes
1	Small aesthetical changes	Yellow appearance
2	Mild aesthetical changes	Yellow grey appearance
3	Moderate aesthetical changes	Light grey colour
4	More intense changes	Grey colour with warm tonality, no visible cracks
5	Advanced changes	Dark grey colour with cold tonality, some raised fibres, surface erosion, no visible open cracks
6	Very advanced changes	Dark grey, uneven discolouration, surface erosion, presence of cracks, mould, algae

Multi-sensor ND techniques

sensor	human senses	color meter	gloss meter	roughness meter
example				
output data	color pattern roughness impression	colour parameters (L* a* b*) spectrum	glossiness	roughness parameters (R_a, R_z, R_{max})
objectivity	👎	👍	👍	👍

How to measure if we like it…
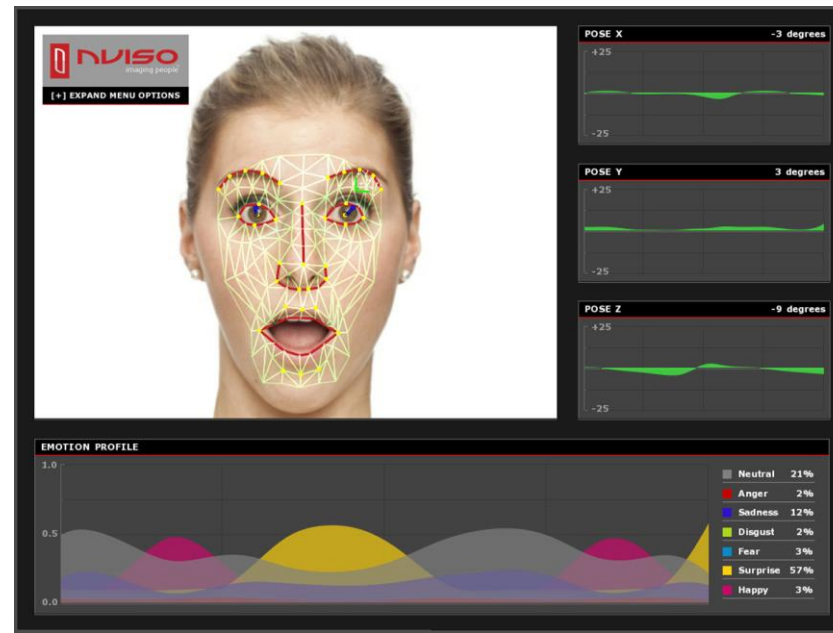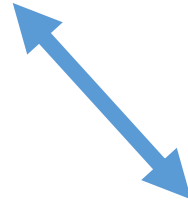
Perception of naturalness

Stand used for verification customers preferences by means of different senses (from up: vision, olfaction, vision and haptic perception, haptic perception, intuition-sixth sense).

Hedonistic tests

- Hedonistic tests can be done with prior training of the responders or without any preparation.

- Selection of materials as well as target groups of respondents must be carefully planned in order to obtain reliable results.

- Tests might be performed by using only visual stimuli, such as dedicated Human Machine Interface or computer-based tests.

- Using of real samples and employing more that only vision during their assessment (hearing, taste, smell and/or touch) is a superior alternative.

Preferences tests

- Selection of a few favorite materials among the set of alternative samples representing the variability range of available choices. It is used to rank the attractiveness of materials/products and identifying the most appreciated.
- The variety of the investigated materials will determine the complexity of the test.
- Respondents might perform:
- Single-attribute comparison - focused on determination of the simple preference without considering the overall contest, for example favorite wood species.
- Multi-attribute comparison - take place when more than one attribute are confronted simultaneously, for example favorable wood species used for façade cladding in a certain assembly form.

Test design

- Tests of preferences might be designed in a more complex way and being combined with other than aesthetics factors influencing the customer choice.

- These may include economic issues (investment cost, maintenance frequency) or environmental awareness (local/imported resources or natural/modified wood).

- Preference test approach can be considered as very useful tool for scheduling of conservation/maintenance. In this case the goal of the test is to define a limits for the customers' tolerance for surface defects due to weathering or other signs of deterioration.
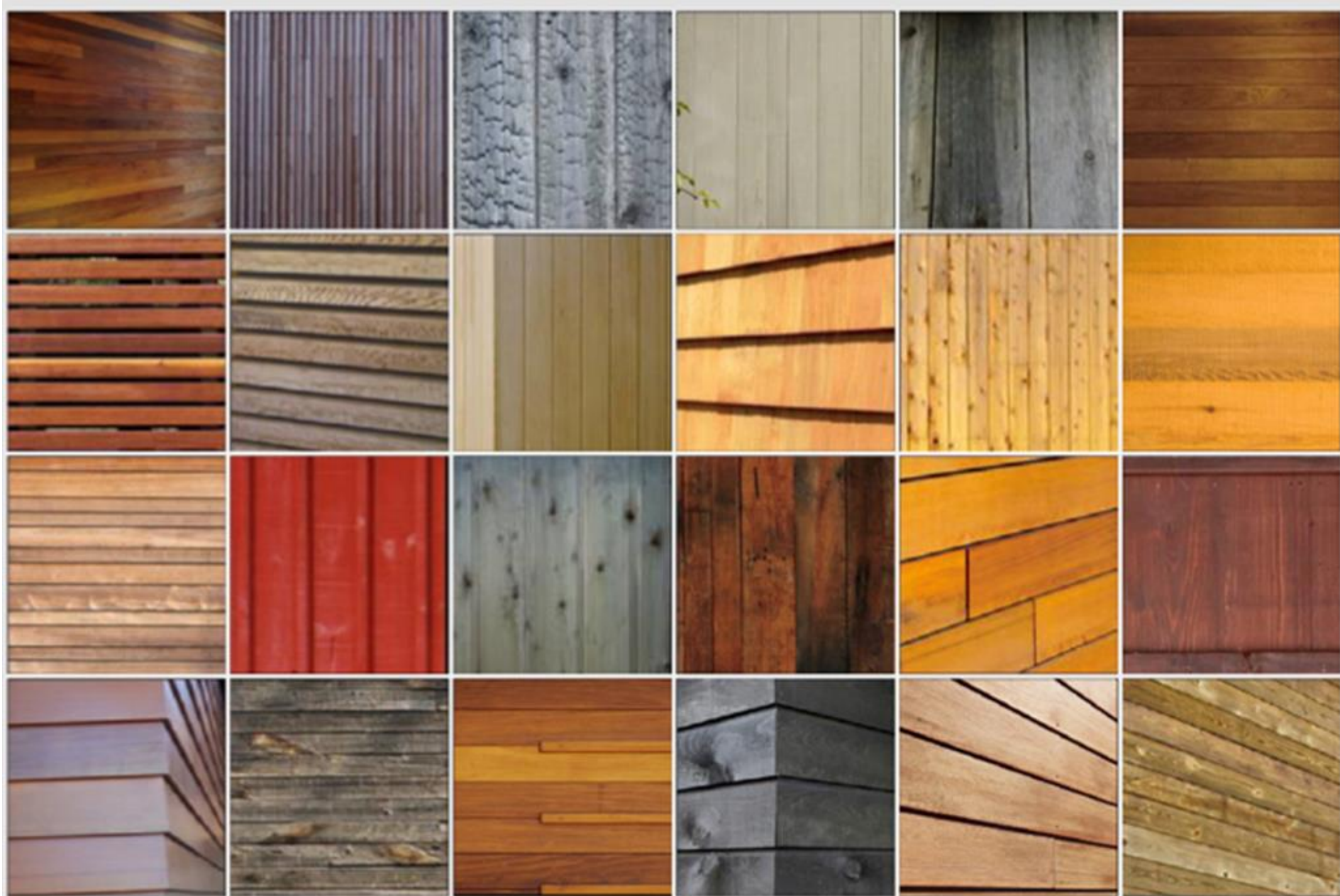
- In this research product-driven stimuli have been used (architectural wooden surfaces)

- set of twenty-four images taken from the web with details of wooden facades. All twenty-four images are shown simultaneously in a mosaic-arranged picture.

- Respondent is asked to select 0 up to 5 images of surfaces, which he/she more appreciates for a wooden façade.

- Responses are related to a number of visible (appearance) attributes, so called descriptors selected by a sensory panel. The choice of descriptors was based on different criteria: design criteria (e.g. composition, layout, etc.), visual grading rules for wooden products (e.g. defectiveness, etc.), technological properties (e.g. treatments) and performance evaluation (e.g. rate of weathering).

Descriptors

Attribute code	Descriptor	Descriptor's class	Definition	Descriptor values
A	Orientation	Design and installation	Orientation of boards in the façade	0-Vertical 1- Horizontal
B	Size of boards	Design and installation	Size of boards in the façade	0- Large 1- Tiny
C	Spacing gaps	Design and installation	Presence and size of gaps between boards	0- Spaced out 1- Tight
D	Effect	Design and installation	Architectonic effect/style	0- Rustic 1- Modern
E	Lightness	Colour	Degree of white/black in the colour	0- Dark 1- Bright
F	Saturation	Colour	Colour saturation	0- Bleached 1- Saturated
G	Natural look	Colour	Natural colour and texture of the material visible or covered by a paint	0- Natural 1- Not natural
H	Treatment	Colour	Painted-coated-impregnated	0- Treated 1- Not treated
I	Homogeneity	Texture	Overall homogeneity of texture	0- Nonhomogeneous 1- Homogeneous
L	Stains	Texture	Presence of stain/mottle/discoloration	0- Stained 1- No stains
M	Knottiness	Texture	Overall presence of knots	0- Knotty 1- Not visible knots
N	Cracks	Texture	Presence of visible cracks in the boards	0- Cracked 1- No cracks
O	Weathering	Condition	Sign of weathering	0- Weathered 1- Fresh

Descriptors value

Block 1

1	2	3	4	5	6
A- horizontal	A- vertical	A- vertical	A- vertical	A- vertical	A- horizontal
B- tiny	B- tiny	B- large	B- tiny	B- large	B- tiny
C- tight	C- spaced out	C- tight	C- tight	C- spaced out	C- tight
D- modern	D- modern	D- rustic	D- N.A.	D- rustic	D- modern
E- dark	E- dark	E- dark	E- light	E- dark	E- dark
F- saturated	F- bleached	F- bleached	F- bleached	F- bleached	F- saturated
G- natural	G- natural	G- natural	G- not natural	G- natural	G- natural
H- treated	H- not treated	H- not treated	H- treated	H- not treated	H- treated
I- not homog.	I- not homog.	I- not homog.	I- homog.	I- not homog.	I- not homog.
L- no stains	L- no stains	L- stained	L- no stains	L- stained	L- no stains
M- no knots	M- no knots	M- knotty	M- no knots	M- knotty	M- no knots
N- no cracks	N- cracked	N- no cracks	N- no cracks	N- no cracks	N- no cracks
O- fresh	O- weathered	O- weathered	O- fresh	O- weathered	O- fresh

Block 2

1	2	3	4	5	6
A- horizontal	A- horizontal	A- vertical	A- horizontal	A- vertical	A- horizontal
B- tiny	B- tiny	B- tiny	B- large	B- tiny	B- large C
C- spaced out	C- spaced out	C- tight	C- spaced out	C- tight	C- tight
D- modern	D- modern	D- modern	D- modern	D- rustic	D- rustic
E- dark	E- light	E- light	E- light	E- light	E- light
F- saturated	F- bleached	F- bleached	F- saturated	F- saturated	F- saturated
G- natural	G- natural	G- natural	G- natural	G- natural	G- natural
H- treated	H- not treated	H- treated	H- not treated	H- not treated	H- treated
I- homog.	I- not homog.	I- homog.	I- homog.	I- not homog.	I- not homog.
L- no stains	L- stained	L- no stains	L- no stains	L- stained	L- no stains
M- no knots	M- no knots	M- no knots	M- no knots	M- knotty	M- knotty
N- no cracks	N- no cracks	N- no cracks	N- no cracks	N- no cracks	N- no cracks
O- fresh	O- weathered	O- fresh	O- fresh	O- fresh	O- fresh

Block 3

1	2	3	4	5	6
A- horizontal	A- vertical	A- vertical	A- vertical	A- horizontal	A- horizontal
B- tiny	B- large	B- large	B- large	B- large	B- large
C- spaced out	C- tight	C- tight	C- tight	C- spaced out	C- tight
D- modern	D- rustic	D- rustic	D- rustic	D- modern	D- rustic
E- light	E- dark	E- light	E- dark	E- light	E- dark
F- bleached	F- saturated	F- bleached	F- saturated	F- saturated	F- saturated
G- natural	G- not natural	G- natural	G- not natural	G- natural	G- natural
H- not treated	H- treated	H- not treated	H- treated	H- treated	H- treated
I- not homog	I- homog.	I- not homog.	I- not homog.	I- homog.	I- homog.
L- no stains	L- stained	L- no stains	L- stained	L- no stains	L- no stains
M- no knots	M- no knots	M- knotty	M- no knots	M- no knots	M- no knots
N- no cracks	N- no cracks	N- no cracks	N- no cracks	N- no cracks	N- no cracks
O- fresh	O- fresh	O- weathered	O- fresh	O- fresh	O- fresh

Block 4

1	2	3	4	5	6
A- horizontal	A- horizontal	A- horizontal	A- horizontal	A- horizontal	A- horizontal
B- large	B- tiny	B- N.A.	B- large	B- large	B- tiny
C- spaced out	C- tight	C- tight	C- spaced out	C- spaced out	C- tight
D- modern	D- rustic	D- modern	D- rustic	D- modern	D- rustic
E- dark	E- dark	E- N.A.	E- dark	E- light	E- light
F- bleached	F- bleached	F- saturated	F- bleached	F- saturated	F- saturated
G- not natural	G- natural	G- natural	G- natural	G- natural	G- natural
H- treated	H- not treated	H- treated	H- not treated	H- treated	H- treated
I- homog.	I- not homog.	I- not homog.	I- not homog.	I- homog.	I- not homog.
L- no stains	L- stained	L- no stains	L- no stains	L- no stains	L- stained
M- no knots	M- knotty	M- no knots	M- knotty	M- no knots	M- knotty
N- no cracks	N- no cracks	N- no cracks	N- no cracks	N- no cracks	N- no cracks
O- fresh	O- weathered	O- fresh	O- weathered	O- fresh	O- fresh

Numerical descriptors value

Descriptors	A	B	C	D	E	F	G	H	I	L	M	N	O
Profiles													
11	1	1	1	1	0	1	0	0	0	1	1	1	1
12	0	1	0	1	0	0	0	1	0	1	1	1	0
13	0	0	1	0	0	0	0	1	0	1	0	0	0
14	0	1	1	1	1	0	1	0	1	1	1	1	1
15	0	0	0	0	0	0	0	1	0	1	0	1	0
16	1	1	1	1	0	1	0	0	0	1	1	1	1
21	1	1	0	1	0	1	0	0	1	1	1	1	1
22	1	1	0	1	1	0	0	1	0	1	1	1	0
23	0	1	1	1	1	0	0	0	1	1	1	1	1
24	1	0	0	1	1	1	0	1	1	1	1	1	1
25	0	1	1	0	1	1	0	1	0	1	0	1	1
26	1	0	1	0	1	1	0	0	0	1	0	1	1
31	1	1	0	1	1	0	0	1	0	1	1	1	1
32	0	0	1	0	0	1	1	0	1	1	1	1	1
33	0	0	1	0	1	0	0	1	0	1	0	1	0
34	0	0	1	0	0	1	1	0	0	1	1	1	1
35	1	0	0	1	1	1	0	0	1	1	1	1	1
36	1	0	1	0	0	1	0	0	1	1	1	1	1
41	1	0	0	1	0	0	1	0	1	1	1	1	1
42	1	1	1	0	0	0	0	1	0	1	0	1	0
43	1	1	1	1	0	1	0	0	0	1	1	1	1
44	1	0	0	0	0	0	0	1	0	1	0	1	0
45	1	0	0	1	1	1	0	1	1	1	1	1	1
46	1	1	1	0	1	1	0	0	0	1	0	1	1

Results

11	12	13	14	15	16
21	22	23	24	25	26
31	32	33	34	35	36
41	42	43	44	45	46

Total number of responses
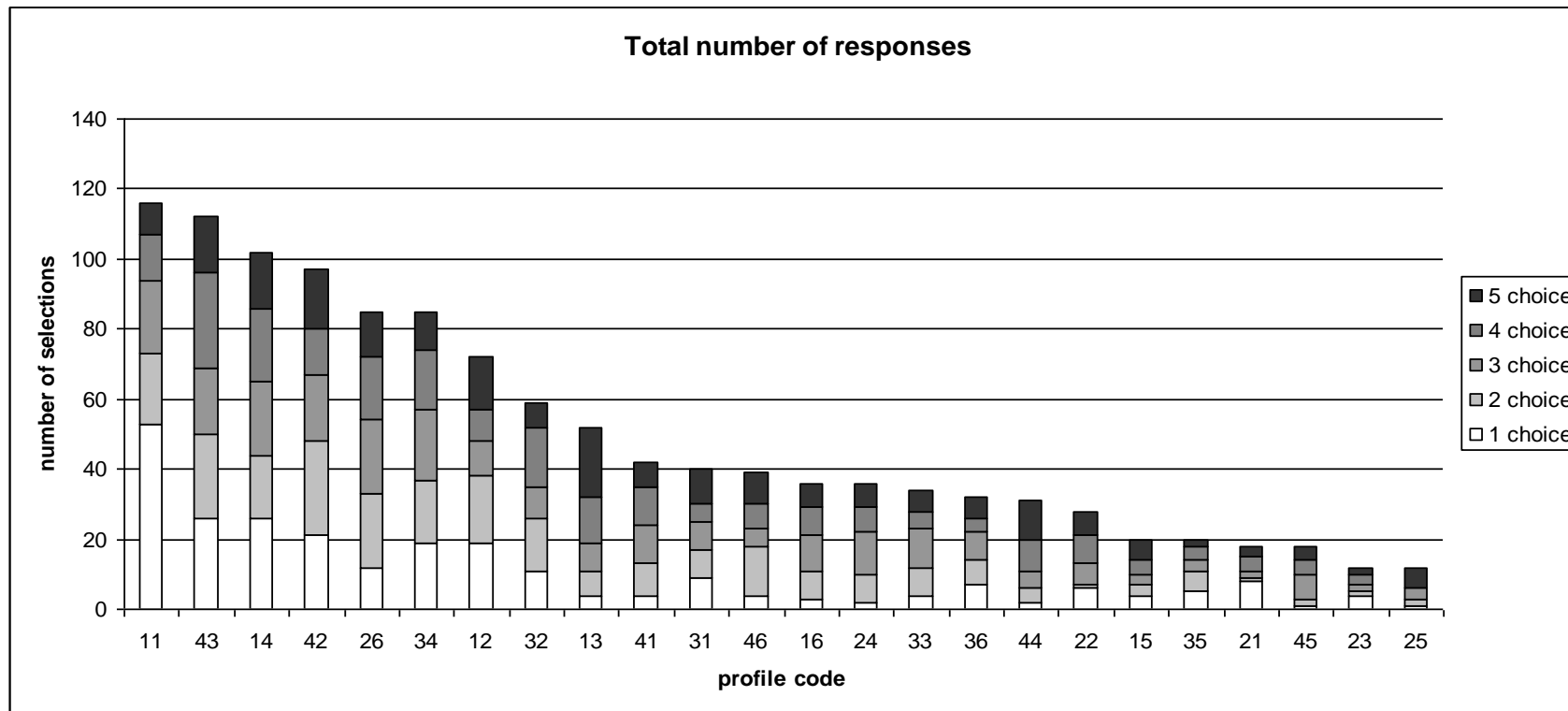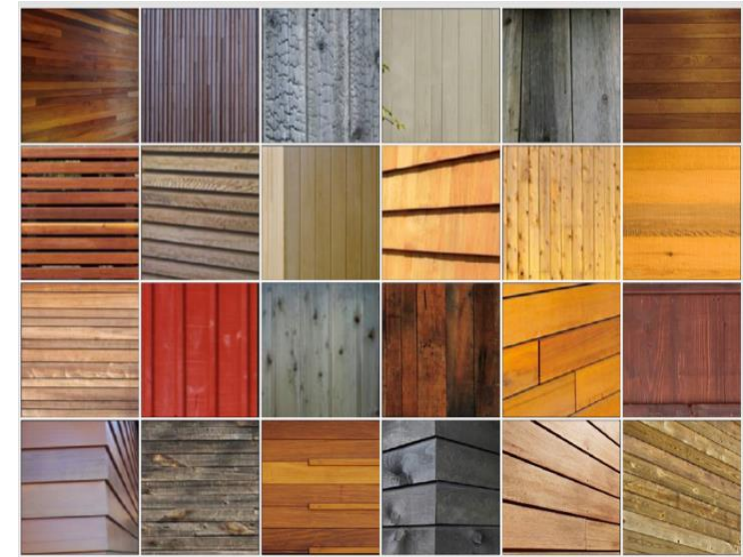
Number of choices for each image. Expert respondents

Expert responses

number of selections

Legend:
- 5 choice
- 4 choice
- 3 choice
- 2 choice
- 1 choice

profile code: 43, 14, 42, 11, 26, 34, 12, 32, 13, 16, 46, 24, 33, 22, 31, 41, 44, 35, 36, 15, 23, 45, 21, 25
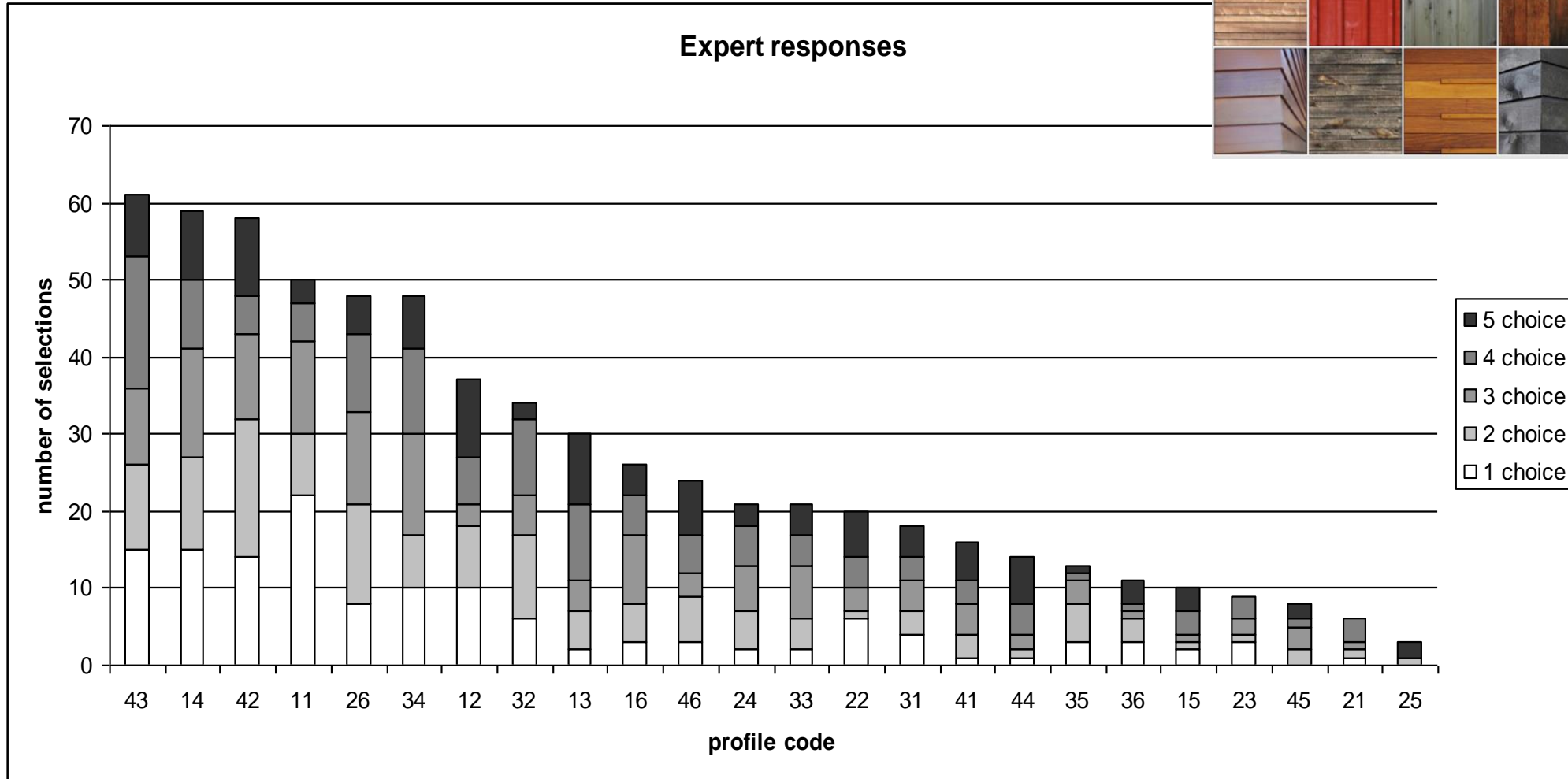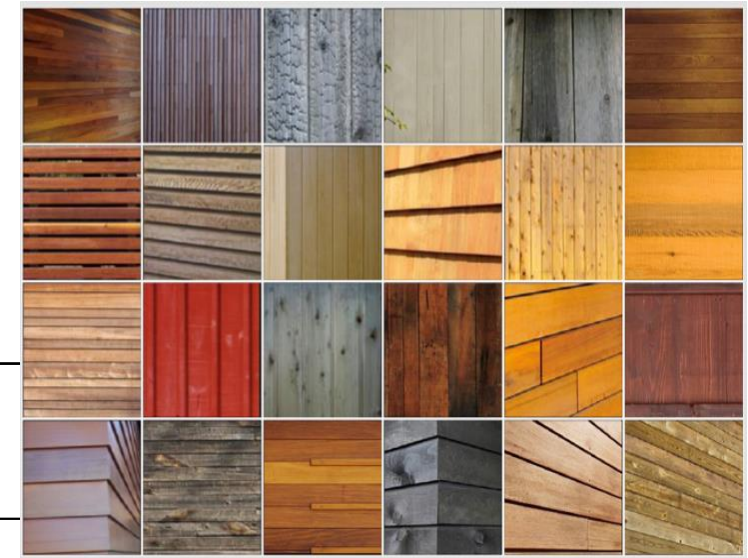
Number of choices for each image. Not expert respondents

Not expert responses

Legend:
- 5 choice
- 4 choice
- 3 choice
- 2 choice
- 1 choice

y-axis: number of selections (0, 10, 20, 30, 40, 50, 60, 70)

x-axis: profile code (11, 43, 14, 42, 26, 34, 12, 41, 32, 13, 31, 36, 24, 44, 46, 33, 21, 15, 16, 45, 25, 22, 35, 23)
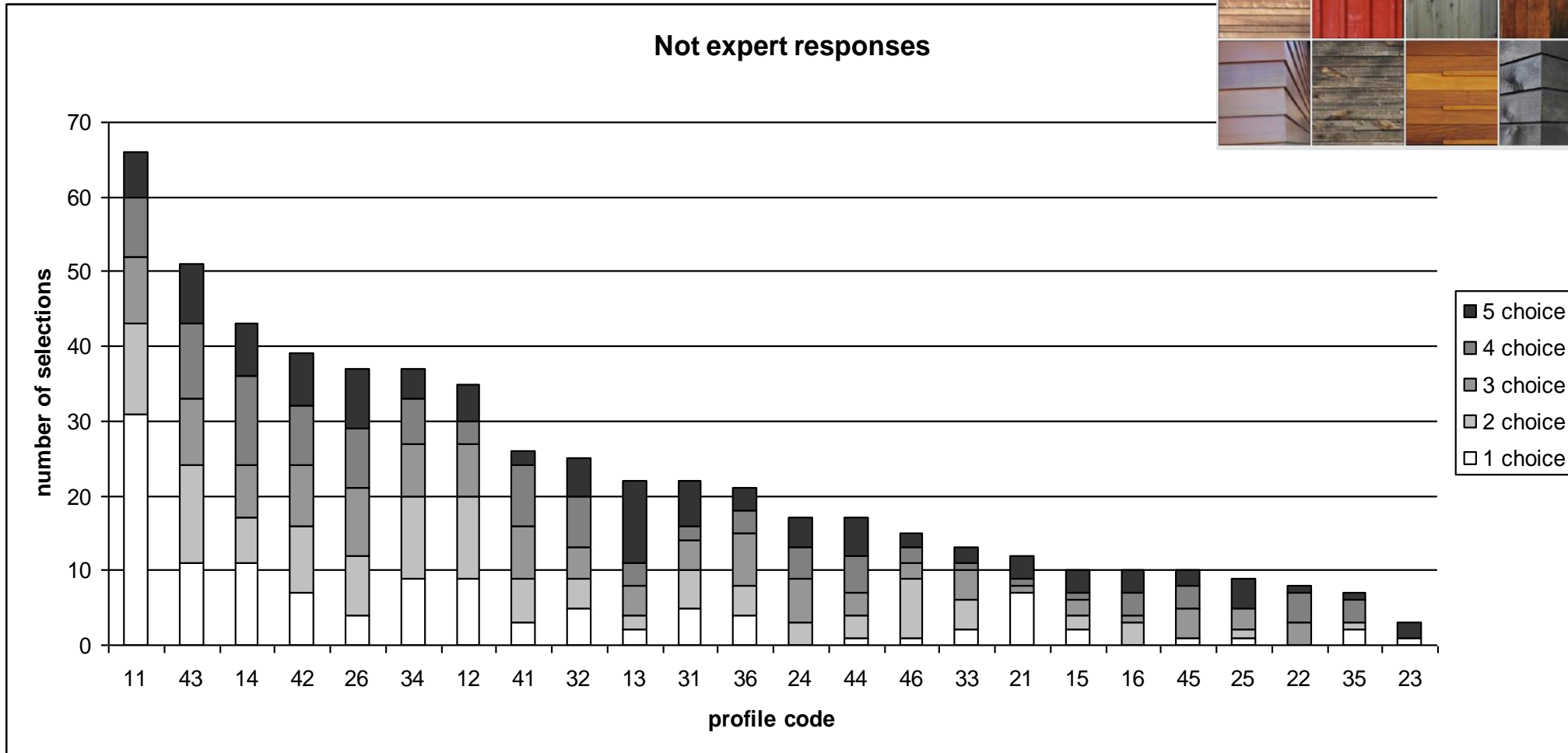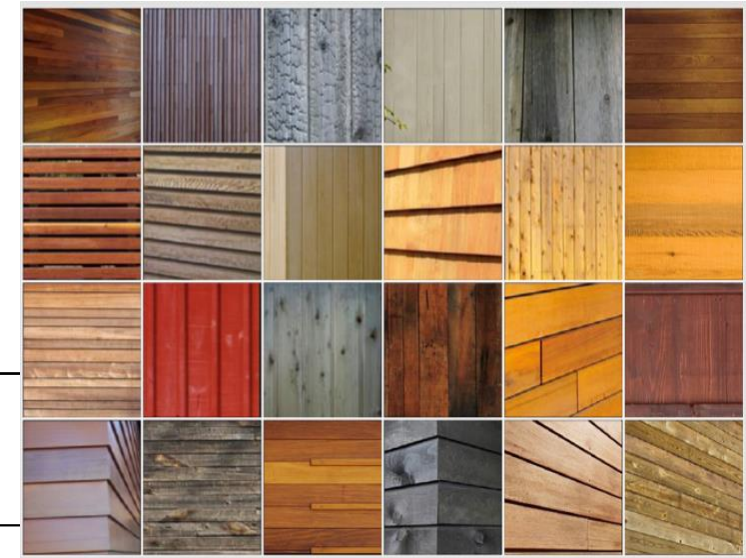
Differential method
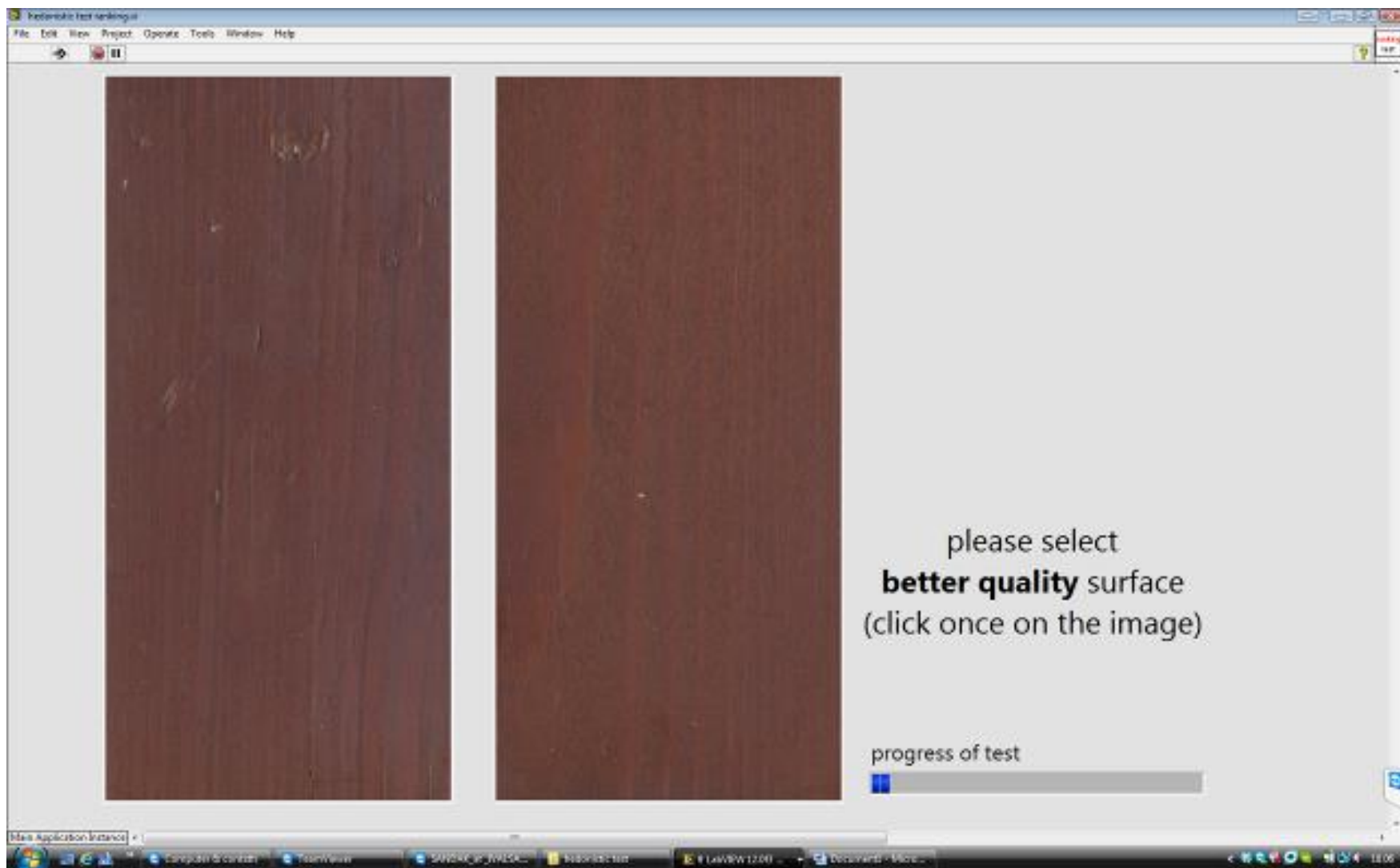
Maintenance preferences
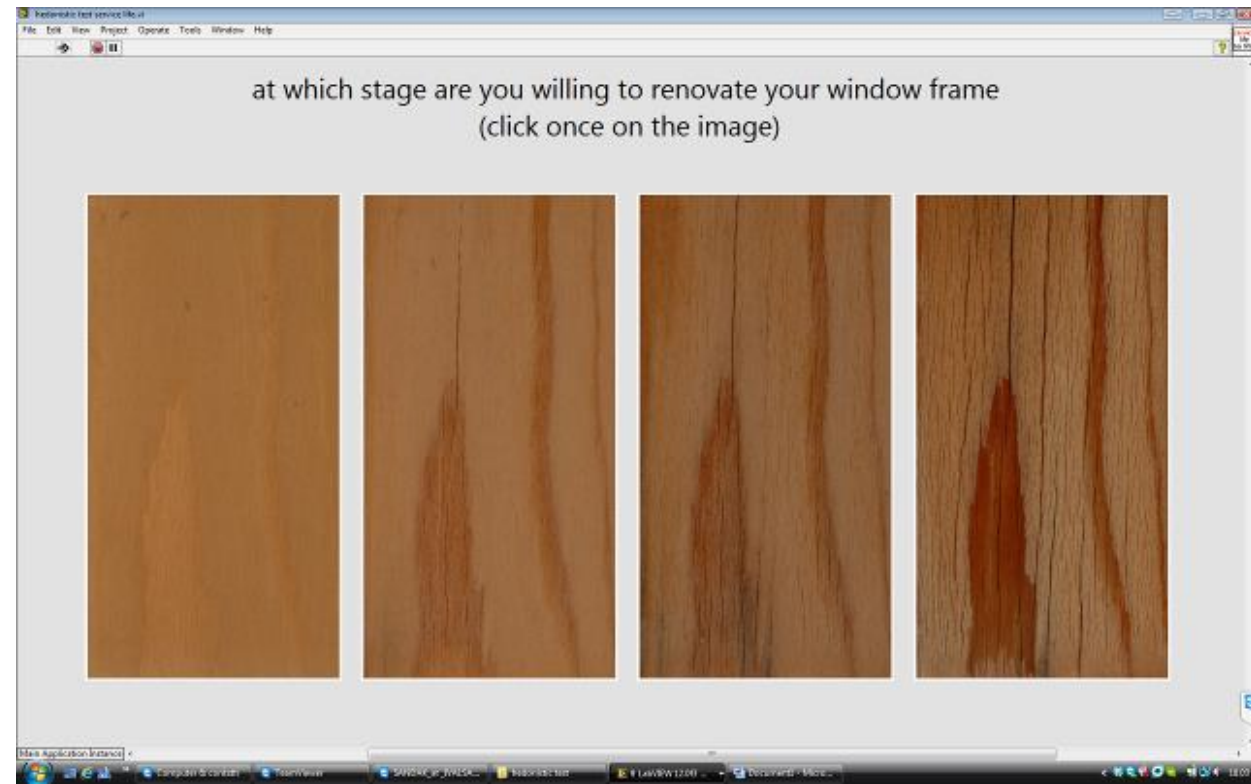
The test

- **Simple approach**:
  - read the question (in native language)
  - look at set of images
  - decide & click

- **Seven questions** in total (only 2 presented here)

- Focus (of this selected questions) on **wooden facades exposed to weathering**:
  - various bio-materials
  - natural weathering for 3 years, south exposition, no protection from rain

- Data analysis related to **age, gender, nationality, education & expertise in wood**

- average **time needed for answer** all questions in the test: ~226 seconds

- dedicated **software tool** has been developed in LabView 2013

- only **one portable computer** has been used for visualization of the sample images during whole experiment (HP Pavilion HDX, 20' display size, resolution 1680x1050 pixels)

The test: **user info**

The test: **question 1**

The test: **question 2**

material indexes

aesthetics: change to surface

3	3	3
1	2	3

1 – no change
2 – little change
3 – a lot of change

aesthetics: uniformity of the surface

2	2	2
1	1	2

1 – uniform
2 – pattern

function: maintenance

2	2	1
3	1	1

1 – not need
2 – occasionally
3 – intensive

function: durability (perception)

1	2	3
2	3	3

1 – not durable
2 – average
3 – very durable

environment: provenance

1	2	3
1	3	1

1 – close
2 – distant
3 – very faraway

environment: "recyclability"

1	1	2
3	1	2

1 – easy
2 – difficult (?)
3 – problematic

respondents

- COST Action FP1006 (and FP0904) members
- University of Life Sciences in Poznan (Poland) staff
- University of Trento Structure Enginering students/staff
- professional secondary school for carpenters in Trento
- carpenters from association SanPatrignano (Italy)
- staff/visitors from IVALSA/CNR San Michele & Florence
- students/teachers from Scuola Media di Mezzocorona
- others; friends

Respondents: country
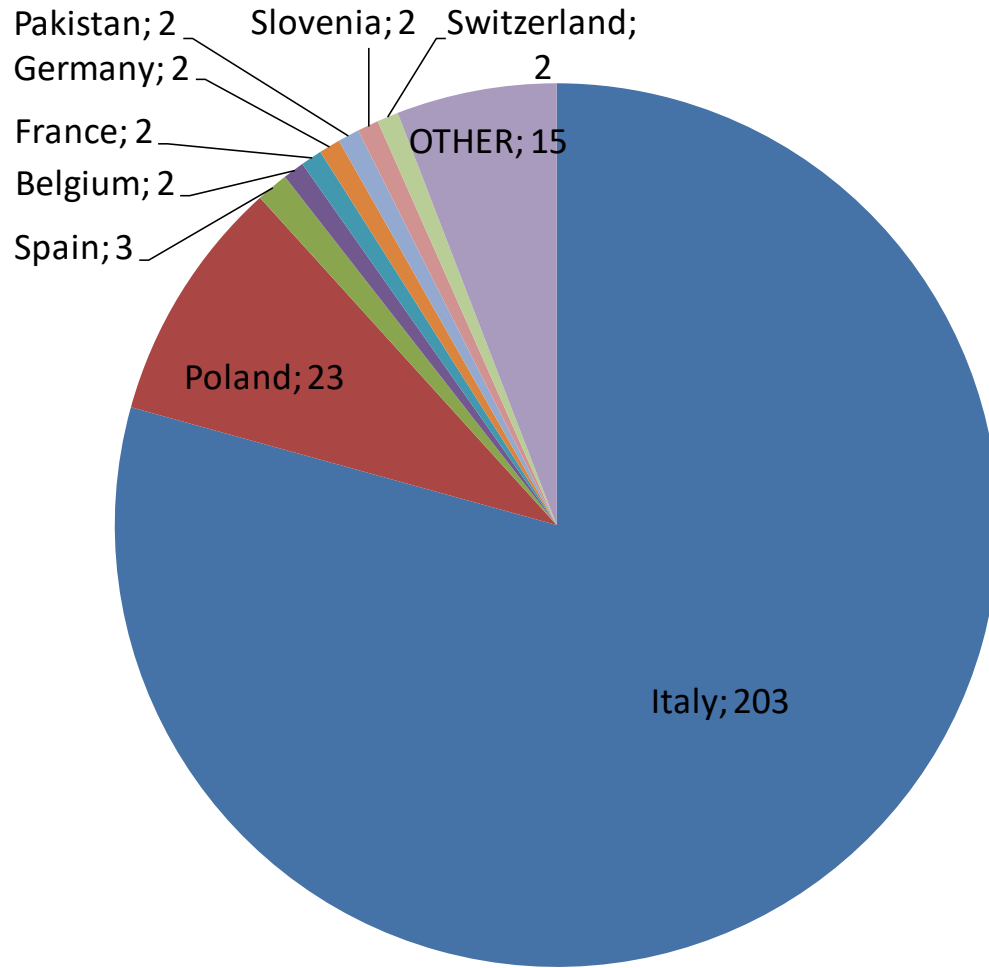
country	number of responses
Italy	203
Poland	23
Spain	3
Belgium	2
France	2
Germany	2
Pakistan	2
Slovenia	2
Switzerland	2
Ghana	1
Austria	1
Canada	1
Croatia	1
Egypt	1
Eritrea	1
Finland	1
Macedonia	1
Marocchina	1
Netherlands	1
Norway	1
Portugal	1
Romania	1
Serbia	1
Thailand	1
TOTAL:	**256**

OTHER

Respondents: **gender**
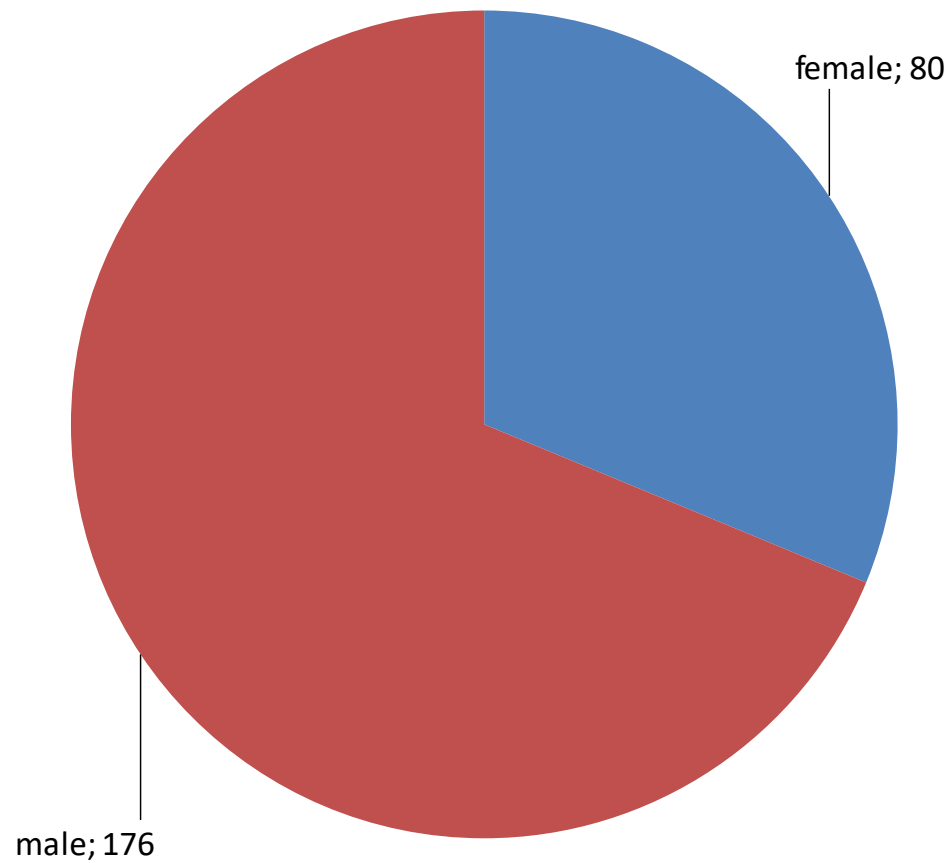
female; 80

male; 176

gender	number of responses
female	80
male	176
TOTAL:	**256**

Respondents: **education**
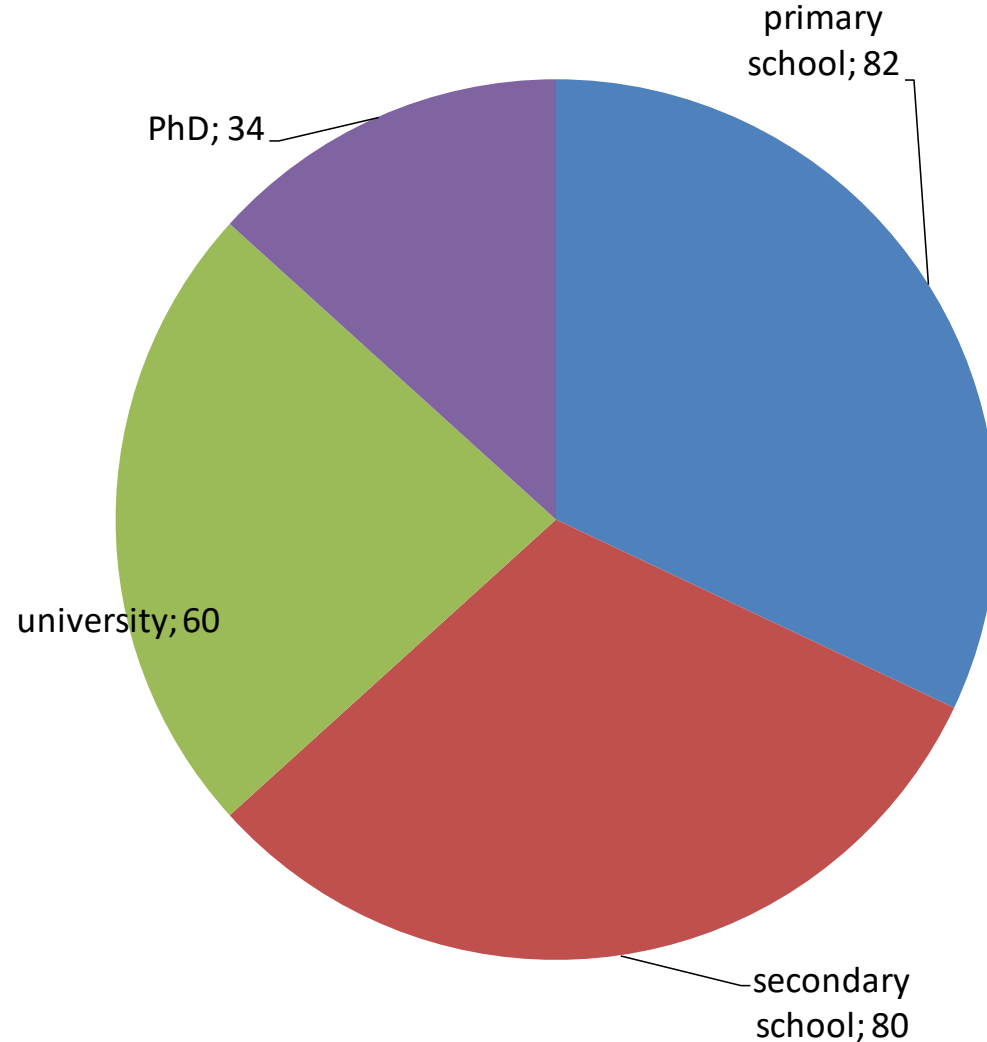
education	number of responses
primary school	82
secondary scho	80
university	60
PhD	34
TOTAL:	**256**

Respondents: **expertise in wood**
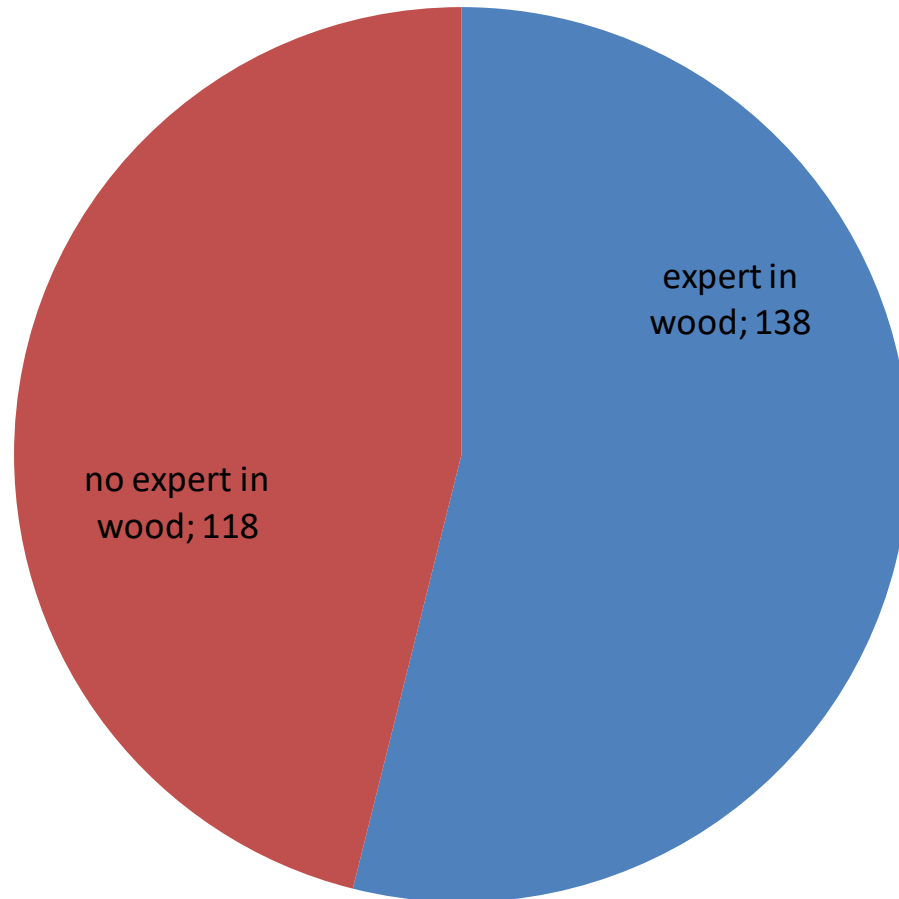
expertise	number of responses
expert	138
no expert	118
TOTAL:	**256**

some results…

all responses (n = 256)

1 - Italian spruce   2 - coated spruce   3 - Siberian larch

4 - African teak   5 – TMW-hardwood   6 – TMW-softwood   % of respondents changing selection = 42,4
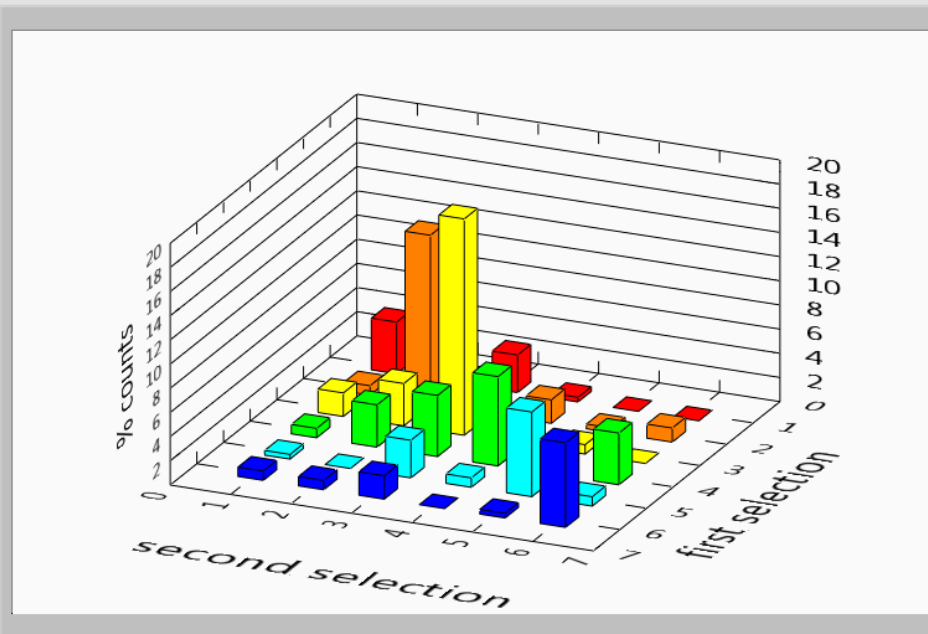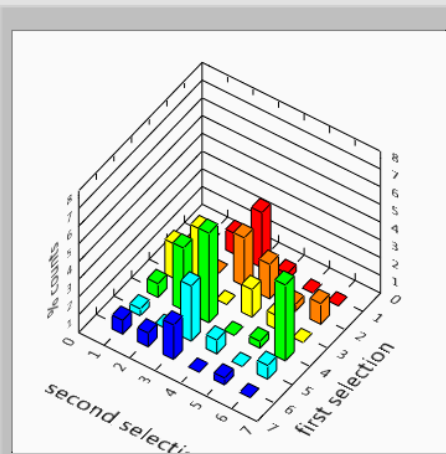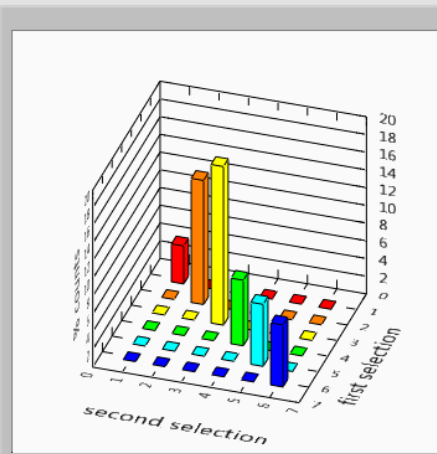
female ⟺ male (n_{female} = 80)

1 - Italian spruce   2 - coated spruce   3 - Siberian larch
4 - African teak   5 – TMW-hardwood   6 – TMW-softwood   % of respondents changing selection = 43,8
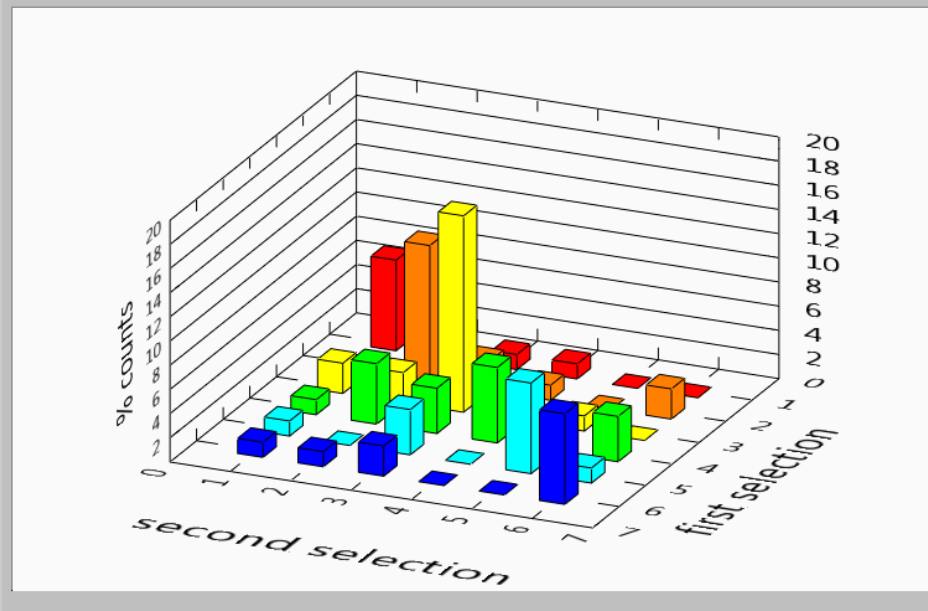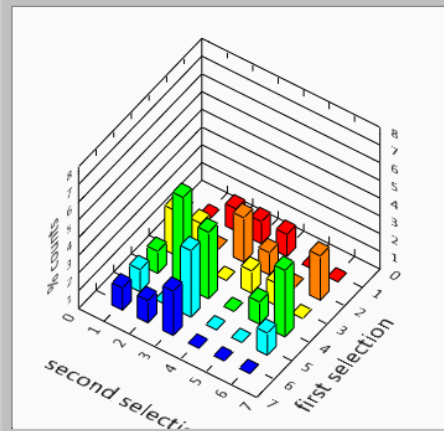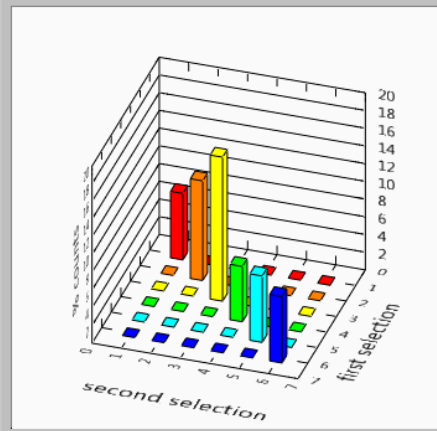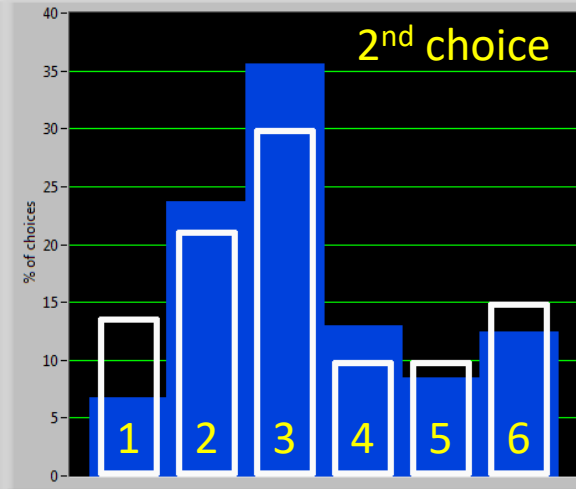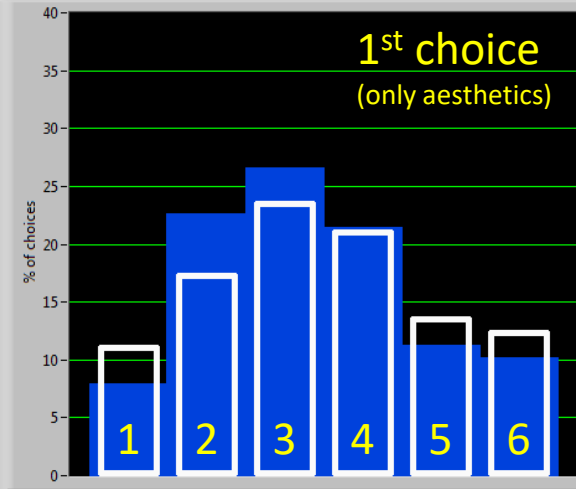
experts in wood (n$_{experts}$ = 137)

1 - Italian spruce   2 - coated spruce   3 - Siberian larch

4 - African teak   5 – TMW-hardwood   6 – TMW-softwood   % of respondents changing selection = 40,9
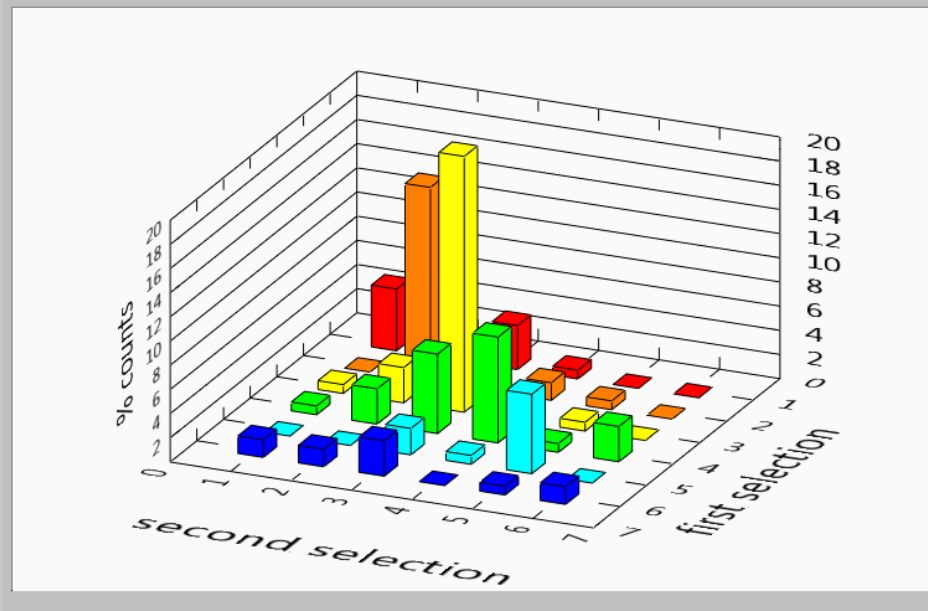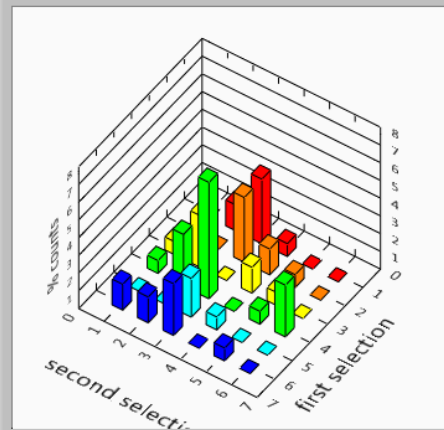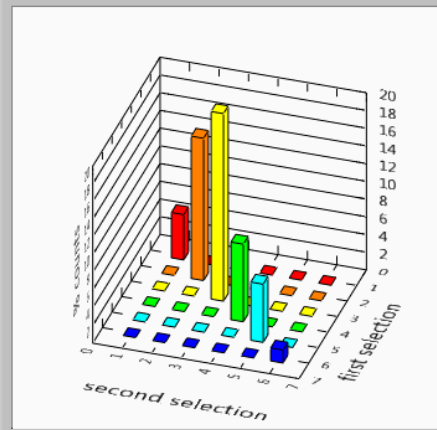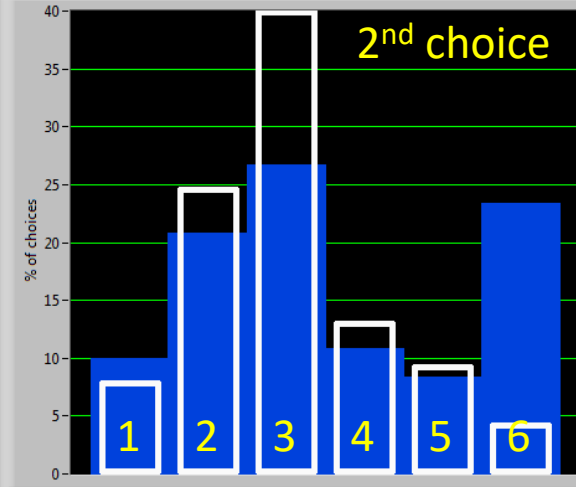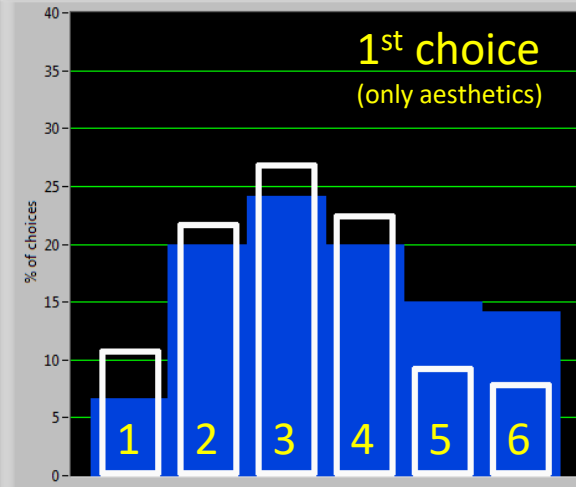
junior high school students (n = 79)

1 - Italian spruce   2 - coated spruce   3 - Siberian larch
4 - African teak   5 – TMW-hardwood   6 – TMW-softwood   % of respondents changing selection = 50,6
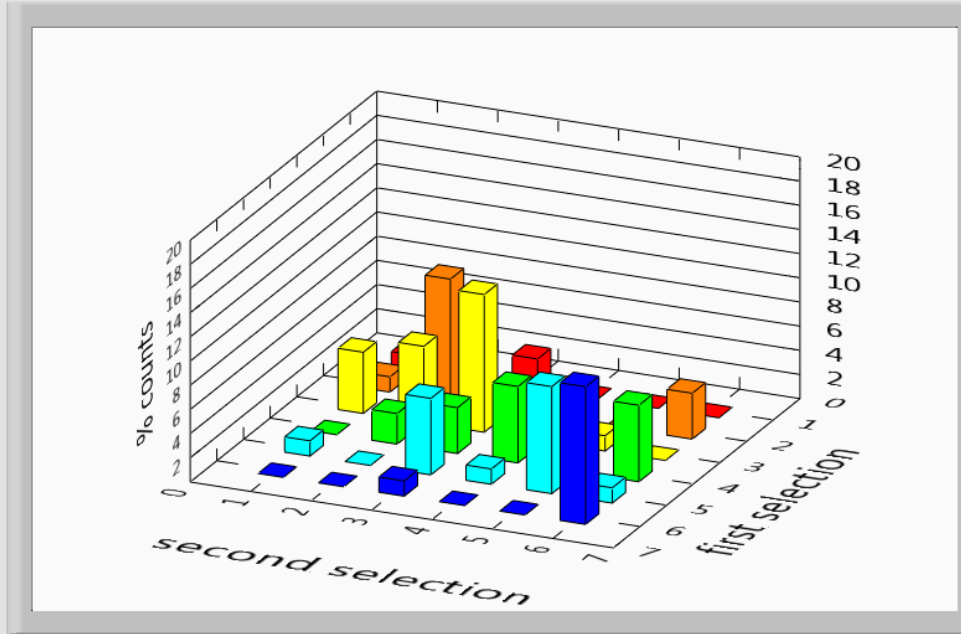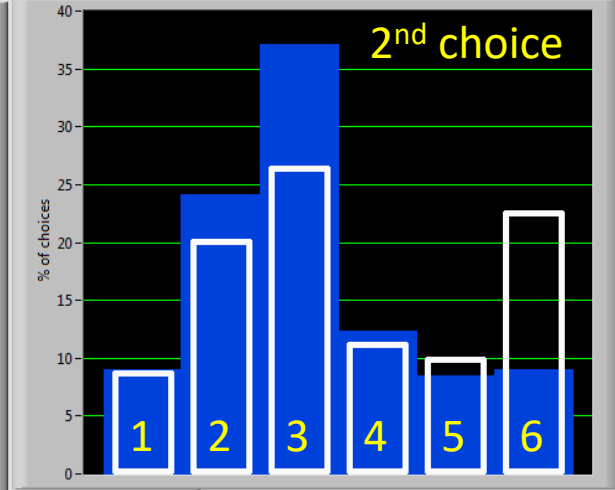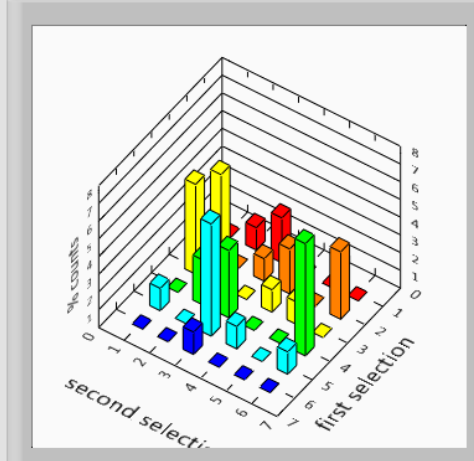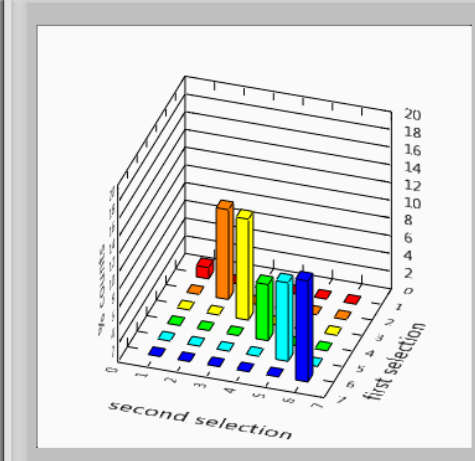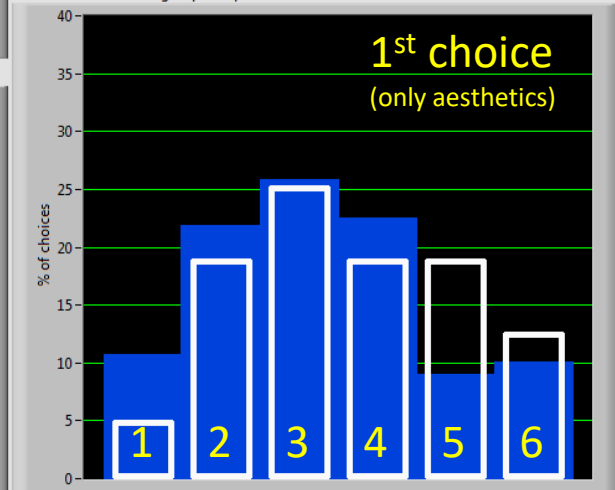
criteria for economic advantage:
"new choice is less expensive"

	Italian spruce 50€/m²	coated spruce 85€/m²	Siberian larch 75€/m²	African teak 250€/m²	TMW softwood 100€/m²	TMW 2 hardwood 100€/m²
Italian spruce 50€/m²	0	**1**	**1**	**1**	**1**	**1**
coated spruce 85€/m²	0	0	0	**1**	**1**	**1**
Siberian larch 75€/m²	0	**1**	0	**1**	**1**	**1**
African teak 250€/m²	0	0	0	0	0	0
TMW softwood 100€/m²	0	0	0	**1**	0	0
TMW hardwood 100€/m²	0	0	0	**1**	0	0

second selection

criteria for environmental improve:

"new choice is more eco-friendly"

first selection

	Italian spruce #1	coated spruce #3	Siberian larch #4	African teak #5	TMW softwood #2	TMW hardwood #2
Italian spruce #1	0	1	1	1	1	1
coated spruce #3	0	0	1	1	0	0
Siberian larch #4	0	0	0	1	0	0
African teak, #5	0	0	0	0	0	0
TMW softwood #2	0	1	1	1	0	0
TMW hardwood #2	0	1	1	1	0	0

second selection

interpretation of changes: **all data**

(n >5 respondents)

interpretation of changes: **all data**

(n >5 respondents)

gender	male	male	male	male	female	female	female
education	university	university	primary school	secondary school	university	university	primary school
expertise in wood	yes	no	no	yes	yes	no	no
number of respondents	*36*	*18*	*45*	*68*	*25*	*15*	*34*

Legend:
- % of respondents who changed selection
- % of respondents who changed idea due to economy
- % of respondents who changed idea due to environment

interpretation of changes: **Italy**

(n >5 respondents)

gender	male	male	male	male	female	female	female
education	university	university	primary school	secondary school	university	university	primary school
expertise in wood	yes	no	no	yes	yes	no	no
number of respondents	*17*	*15*	*41*	*67*	*12*	*10*	*29*

Legend:
- % of respondents who changed selection
- % of respondents who changed idea due to economy
- % of respondents who changed idea due to environment

conclusions

- the test is a preliminary approach: therefore **"the statistical significance" is questionable**
- however, some clear trends in responses can be found;
  - **aesthetics** is not the only criteria for selection of biomaterial!
  - at least 40% of respondents has **changed their selection** after knowing additional information as reading the bio-material
  - not really clear **pattern of change** can be noticeable, even if material traditionally perceived as most durable (larch) was frequently chosen at the second time
  - the most **changing opinion (64%)** was a group of Italian males with university degree and expertise in wood
  - 20% of high school students changed their choice and opted for **less expensive bio-materials**
  - highly educated people were more **aware of environmental aspects** when choosing bio-materials
  - problematic (due to limited number of responses) to interpret **variations between nations**, even if Italian group of respondents differed from other countries
- **the economic and environmental advantage of TMW are not known to the users (yet)…**

To be continued within COST FP1407… (???)