Session 13

[Friday 2nd period 1.5 hours - Main Hall]

Promoting wood culture in the future (continued)

Speakers

Speaker:
Ying Ling Hung

Topic:
Wooden Paths to a Sustainable Future

Speaker:
Criswell Davis

Topic:
Designing with Sustainable US Hardwoods the Future?

Speaker:
Nobuaki Hattori

Topic:
The Present State of Lifecycle and Carbon Footprint Assessment in Japan to Visualize the Eco-friendliness of Products Including Wood

Speaker:
Maria Riala

Topic:
Mapping Customers' Minds with a New Technique: The Case of Housing Needs and Preferences in Finland

Speaker:
T R Manoharan

Topic:
Forest Certification and Wood Based Industries in India

Wooden Paths to a Sustainable Future

Ying Ling Hung[1]

[1] Researcher, IWCS, Taiwan

Wooden Paths to a Sustainable Future

- A Cultural Approach towards 'Wood is Good'

International Wood Culture Society

A Taste on Cultural Perspective

- In terms of Chinese word 'wood' itself:

木　　林　　森

A Chinese Idiom 木本水源

木 (wood) + 一 (ground) = 本 (root or foundation)

水 (water) 源 (source)

BACK

Cultural Perspective (cont.)

- In terms of cosmology

Five phases:

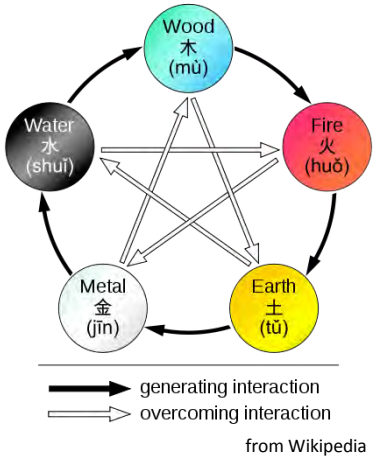
Wood feeds Fire,

Fire creates Earth,

Earth bears Metal,

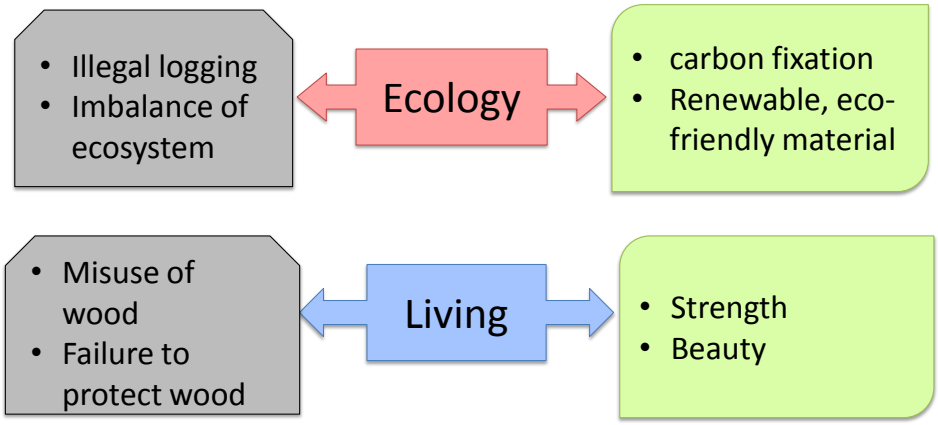
Metal carries Water,

Water nourishes Wood



from Wikipedia

Wood is Good?!



Wood is Good!!

Cultural Approach

- **Culture**
  - Humanity and Civilisation
  - Life style – an integrated pattern of human knowledge, belief and behaviour
  - Set of attitudes and values
- **Wood Culture**
  - Three aspects above regarding wood
- **Cultural approach**

International Wood Culture Society

INFORMATION

- IWCS journal
- IWCS books
- IWCS video

EXPERIENCE

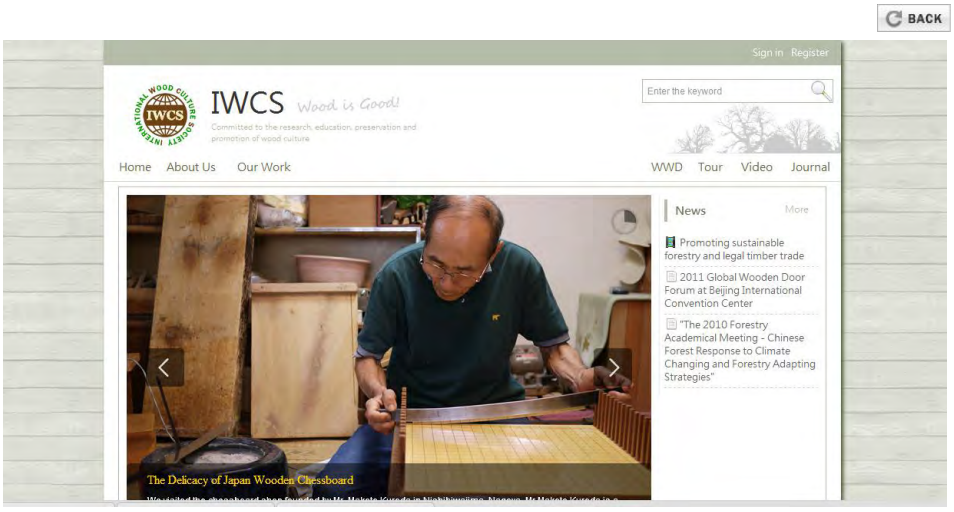
- Wood Culture Tour

http://www.wood.info/100002/

International Conference and Exhibition on
the Art and Joy of Wood

Main page of IWCS

http://www.wood.info/100002/



International Conference and Exhibition on
the Art and Joy of Wood

Webpage of IWCS knowledge

http://www.wood.info/customPage/100002/tab/16/index.html

Webpage of IWCS tour

http://www.wood.info/customPage/100002/tab/10/index.html

Sedan Chair

Chan-Hua, Taiwan

Historically, sedan was one of the means of transport. Even though it is out of date, the concept of gods being seated in the sedan has been deeply printed in people's mind.

Young Shing Craft School

Tainan, Taiwan

Young Shing Craft School provides regular courses for those who want to learn proper wood crafts.

In a exhibition, they also offered a 'hands-on' session for people to experience the joy of wood-crafting (chopsticks).

Master of Chessboard


Master of wooden chessboard, Mr. Makoto Kuroda is the thirteen generation of a wood-crafts family, and dedicates his whole life to preserving traditional craftsmanship.

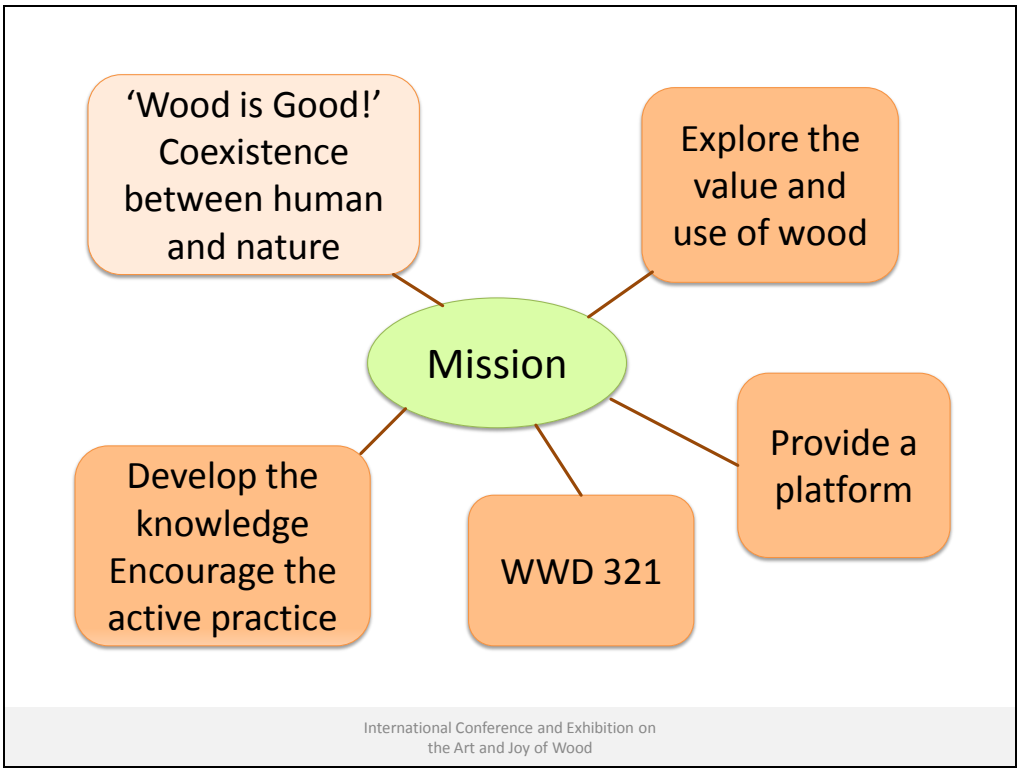
Nagoya, Japan

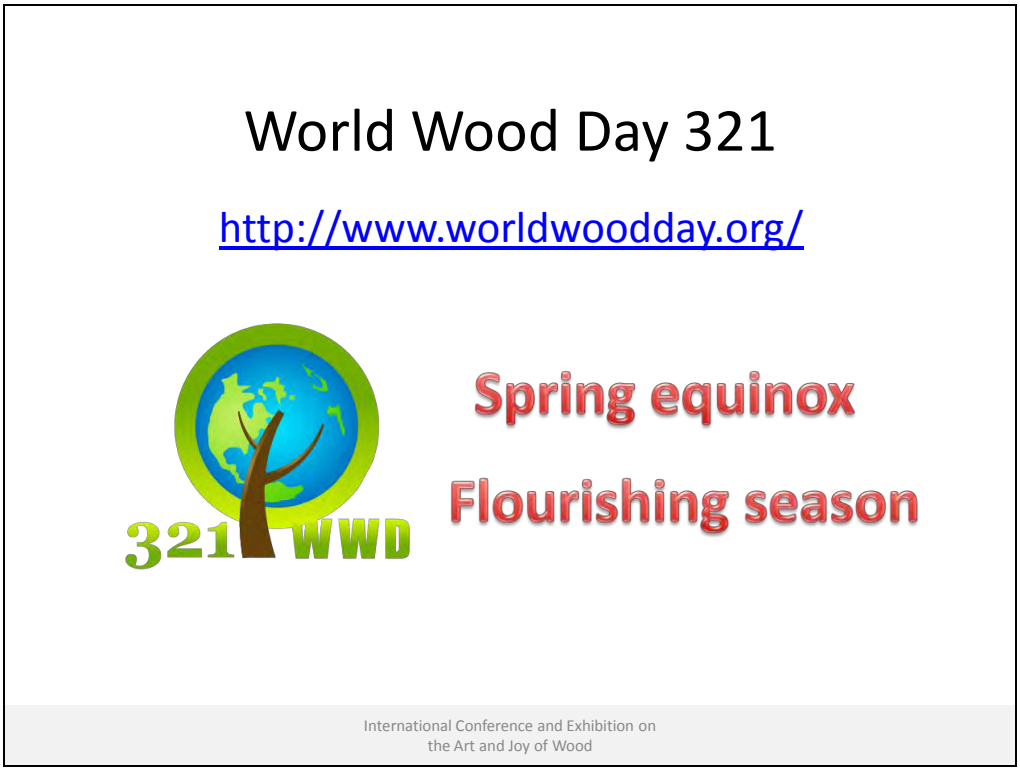
Wood Carving Contest

Exhibition Baham, Wood: Joy, Art and Culture took place in Cameroon in August this year. 36 wood carvers participated.




Baham, Cameroon


'Wood is Good!' Coexistence between human and nature
Explore the value and use of wood
Mission
Provide a platform
Develop the knowledge Encourage the active practice
WWD 321
International Conference and Exhibition on the Art and Joy of Wood


World Wood Day 321
http://www.worldwoodday.org/
321 WWD
Spring equinox
Flourishing season
International Conference and Exhibition on the Art and Joy of Wood

Webpage of WWD

http://www.worldwoodday.org/

World Wood Day 321 (cont.)

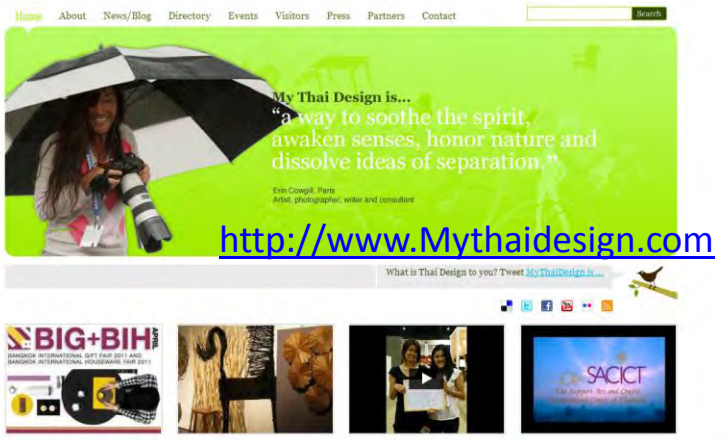
Leave a message/story/
photo/video for us

Your sharing will be
shown here on the Map!

Example 1 – Thai Design

The Way of Wood: Finding Green Pieces in Thailand

by Jirawat Tangkijngamwong



http://www.Mythaidesign.com

Example 2 – Elegant Living

By Mr. Morris Lin

from ELEGANT LIVING OF SAMLING GROUP

Designing with Sustainable US Hardwoods

Criswell Davis[2]

[2] Mighty Oaks Consulting (criswell.davis1@gmail.com)

The Role of US Hardwood in Sustainable Design
A View from The Source
presented by Criswell Davis AHEC

"With his materials the architect can do whatever the masters have done with pigments or with sound – in shadings as subtle, with combinations as expressive – perhaps outlasting himself. Wood is universally beautiful to man.

It is the most humanly intimate of all materials."

Frank Lloyd Wright

Humans are like US
Hardwood trees in three
significant and profound ways

They are mostly water

They have a peak life span of about 80 years

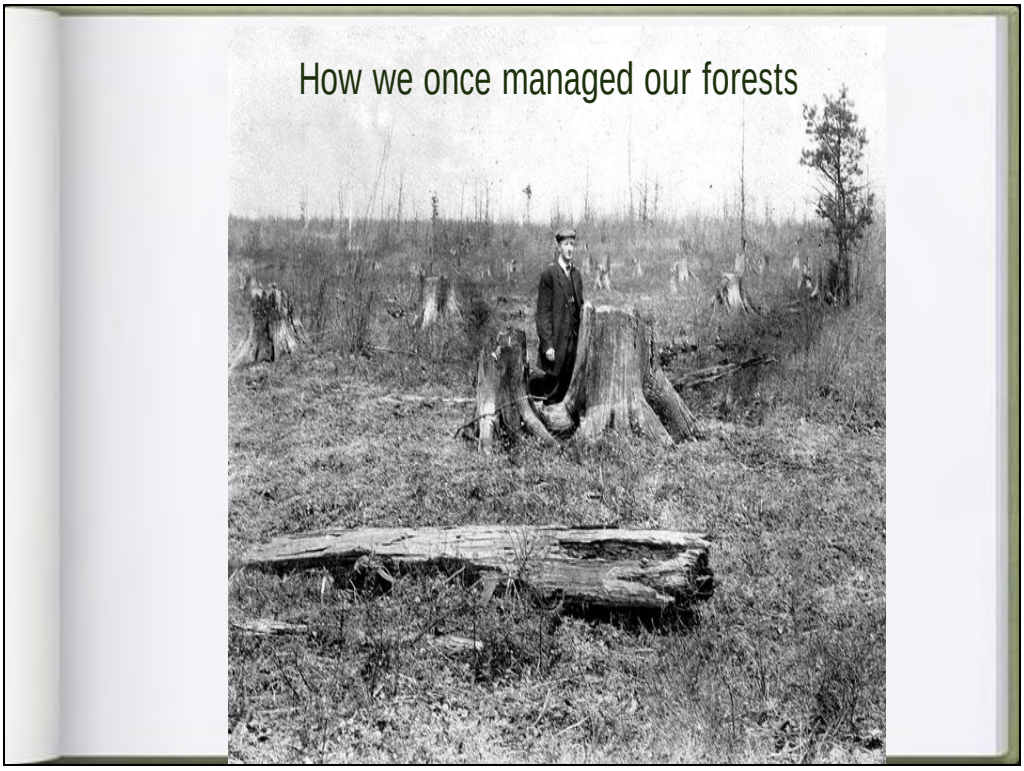
THEY ARE ALL UNIQUE

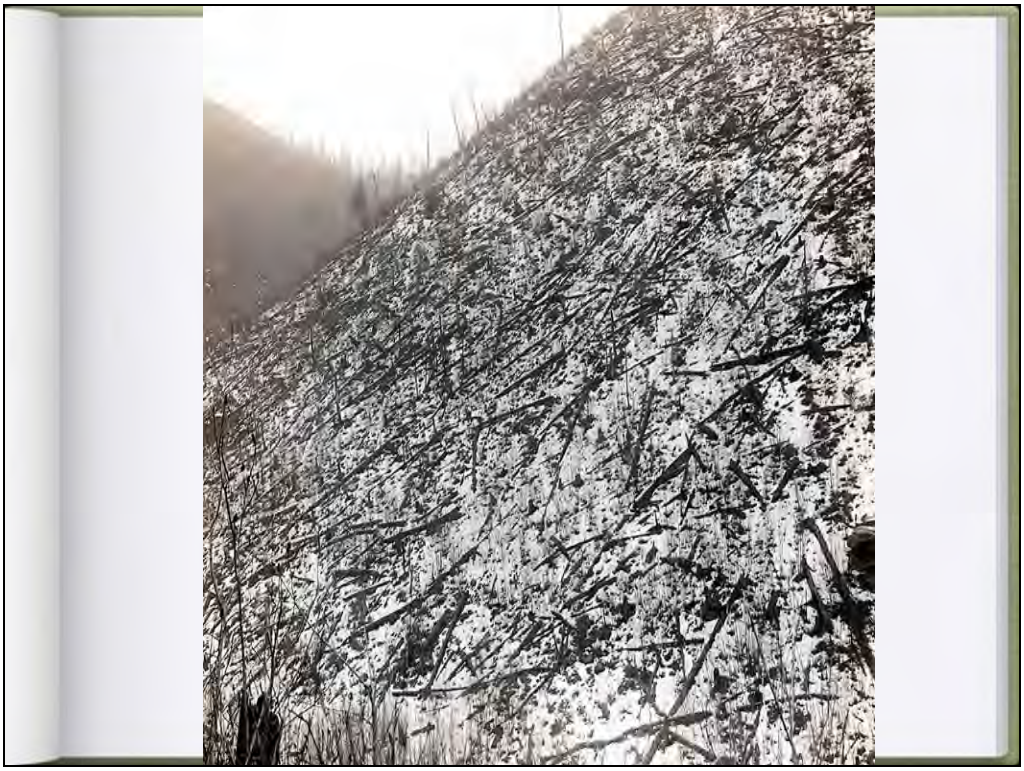
Hardwoods

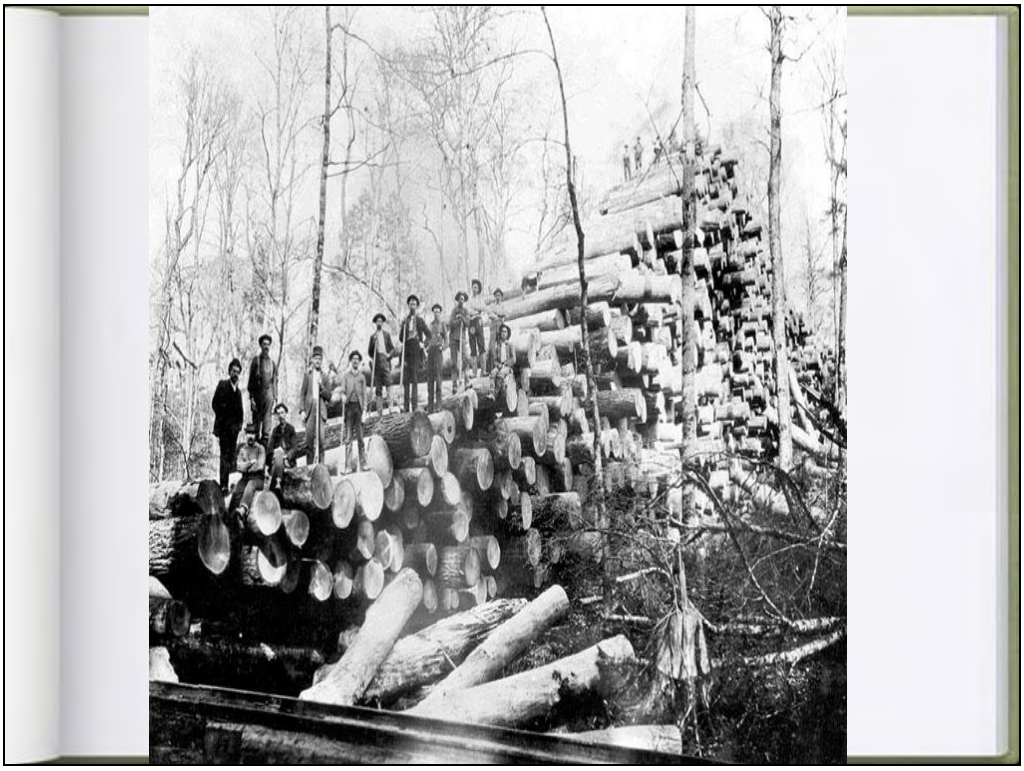
- Hardwoods are woods produced by broadleaf trees known as angiosperms. They lose their leaves in winter. This is a White Oak, quercus alba.

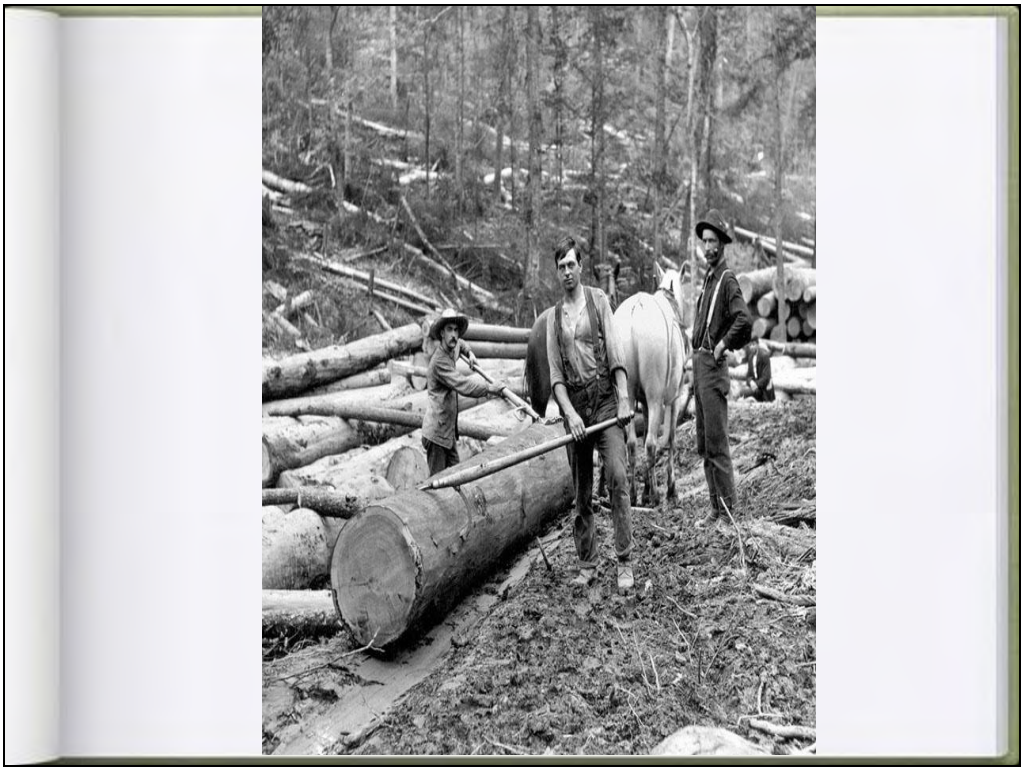
Softwoods

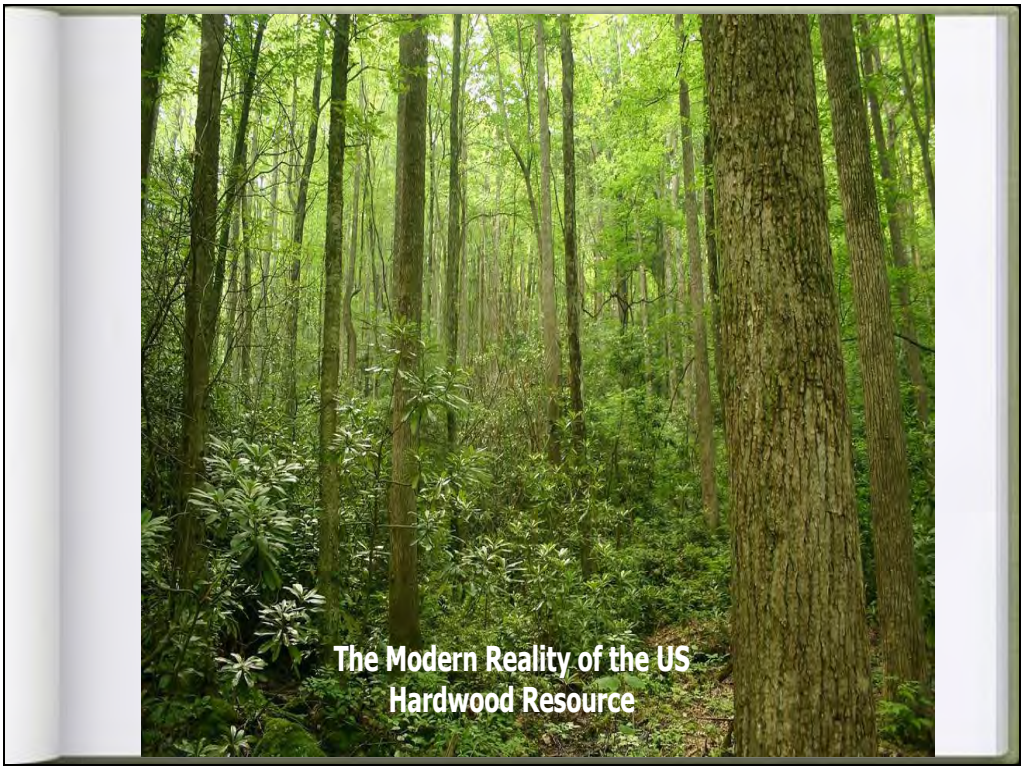
- Softwood is wood produced by coniferous trees (cone bearing), referred to as gymnosperms. Softwood does not necessarily refer to the hardness of the lumber. These trees are known as "evergreens"


How we once managed our forests








The Modern Reality of the US
Hardwood Resource


Those same forests today

US Hardwoods – a genuinely sustainable resource

The volume of US hardwoods over the past 50 years has *more than doubled* and the area of forest has increased by 18%. This is due to the diligent practice of sustainable forestry and selection harvesting.

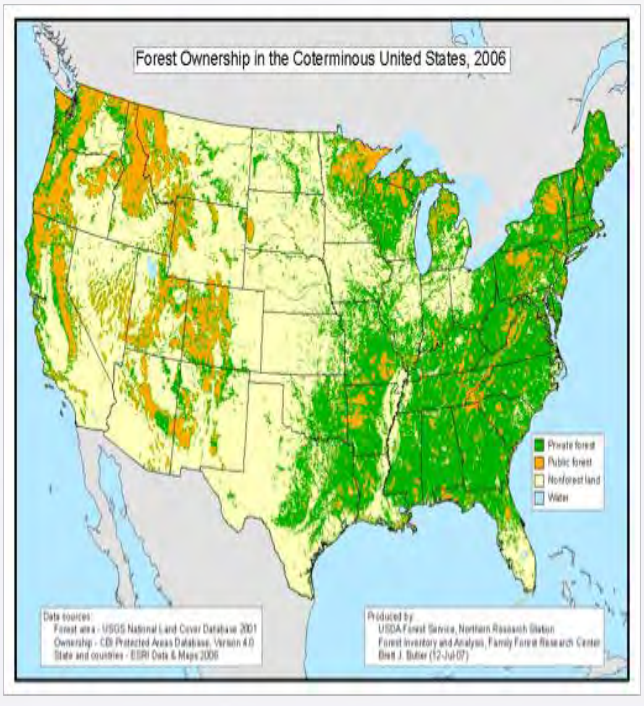
Approximately 90% of the hardwood producing land in the US is owned by over 4 million private land owners. It is usual for a sale of hardwood logs to occur only once or twice in an owners' lifetime.

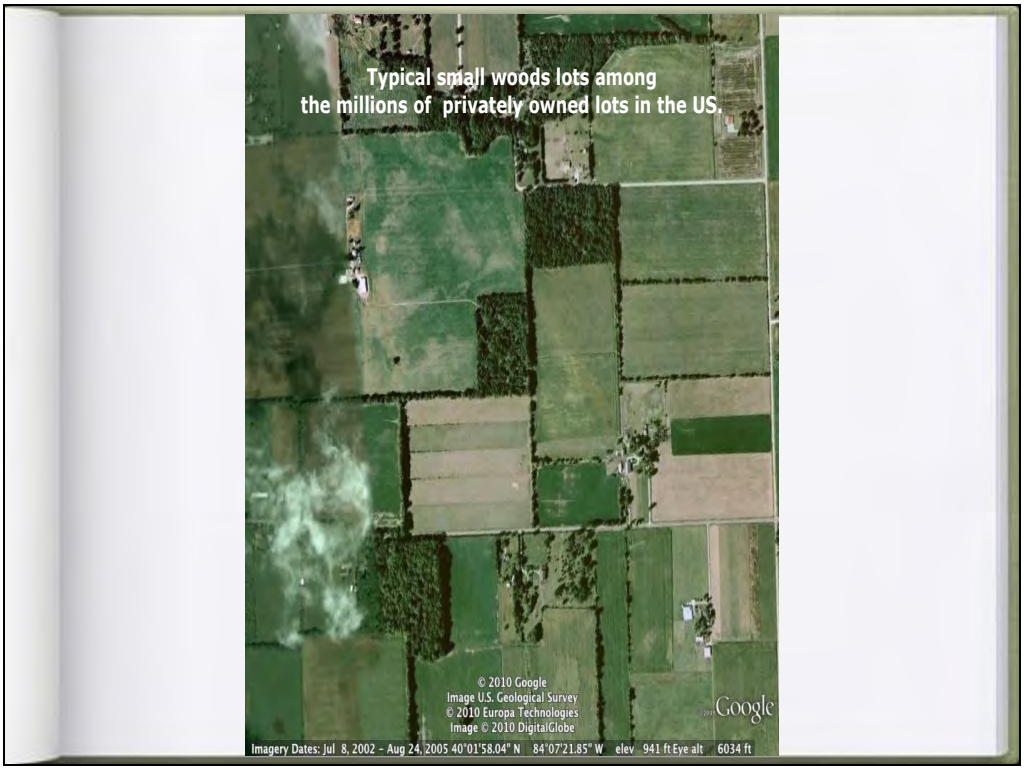
If US Hardwoods are sustainably managed, why aren't all of the US Hardwood Certified?

1. Many of the more than 4 million private landowners who control most of the resource are unaware of certification.

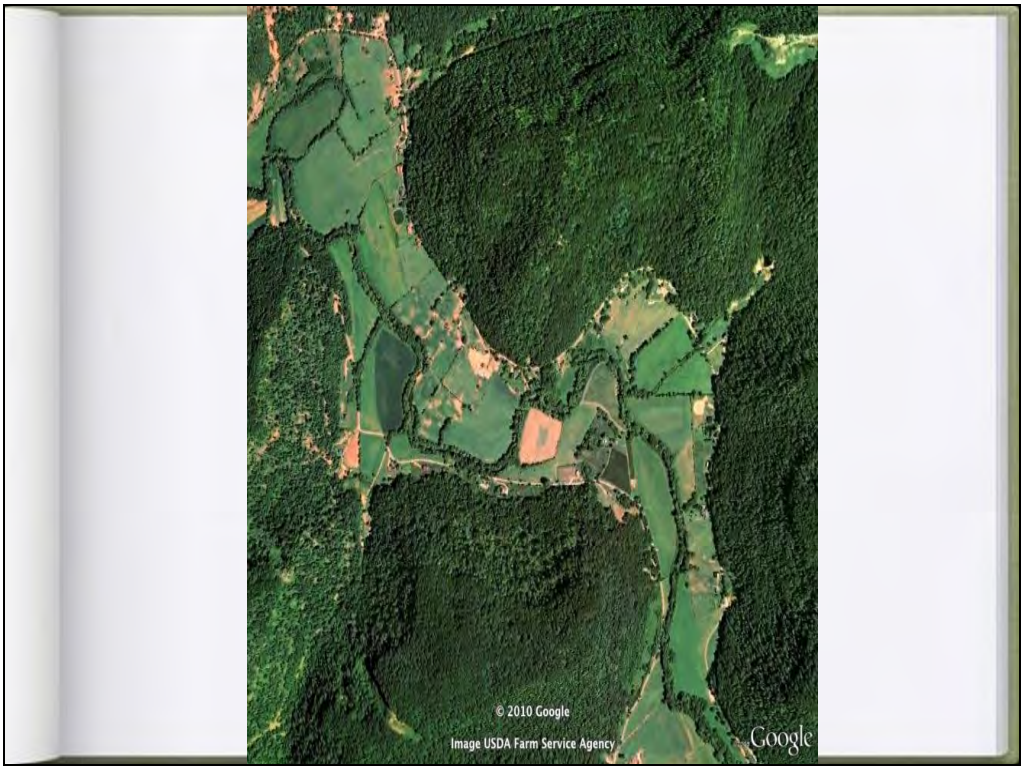
2. Those who are aware of certification perceive it to be expensive, complicated and not necessarily of benefit.

3. There is relatively low demand for certified wood in the US and approximately 75% of all US hardwood lumber produced is for US domestic consumption.

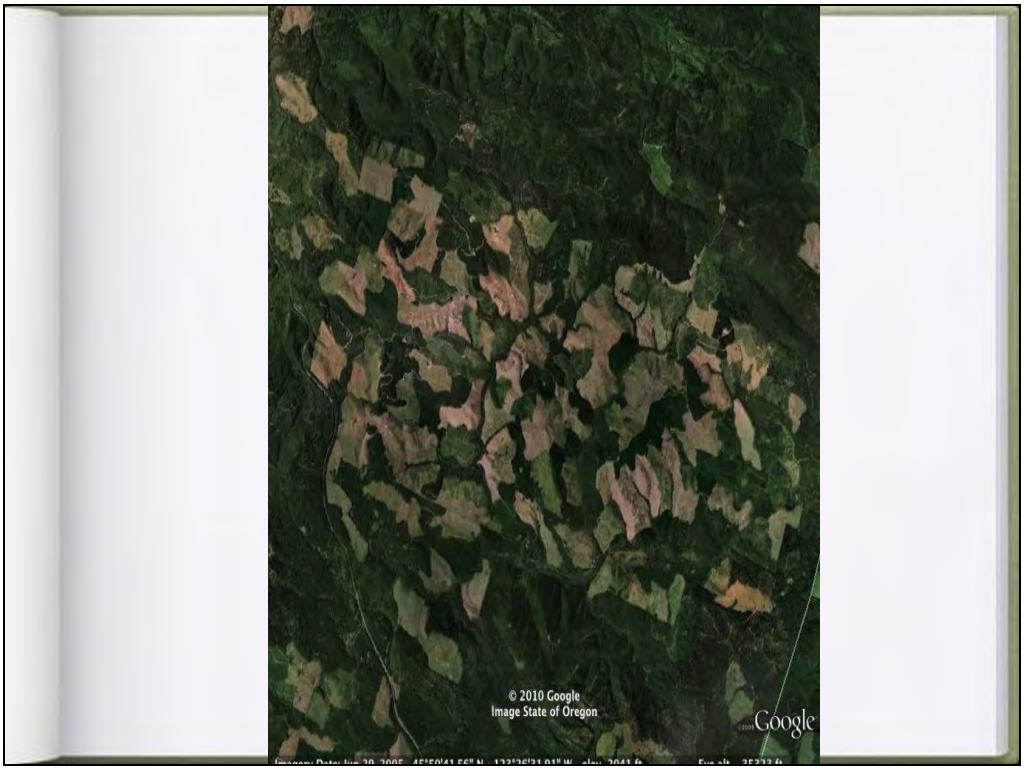



Typical small woods lots among
the millions of privately owned lots in the US.
© 2010 Google
Image U.S. Geological Survey
© 2010 Europa Technologies
Image © 2010 DigitalGlobe
Google
Imagery Dates: Jul 8, 2002 – Aug 24, 2005 40°01'58.04" N 84°07'21.85" W elev 941 ft Eye alt 6034 ft


© 2010 Google
Image USDA Farm Service Agency
Google
Imagery Date: Jun 1, 2005 43°21'18.94" N 84°54'20.71" W elev 933 ft Eye alt 15180 ft

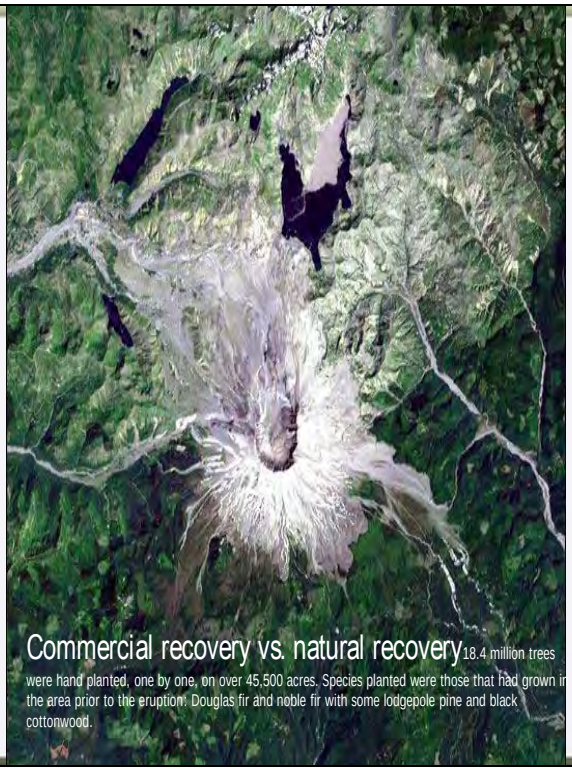


Softwood management is different

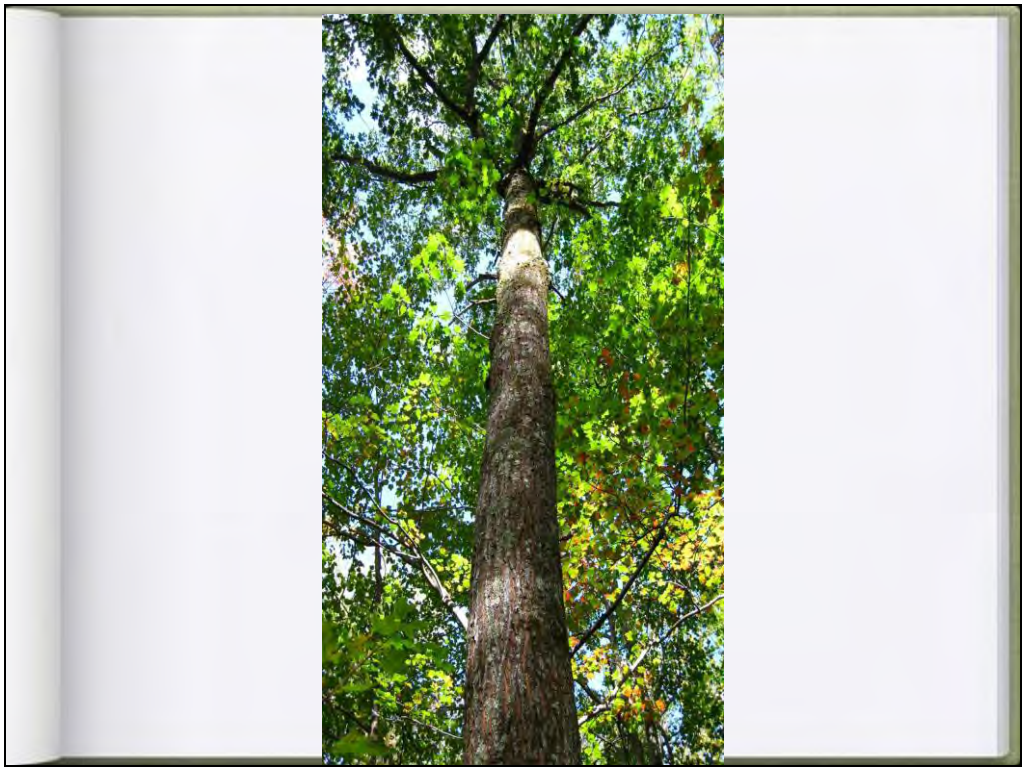

© 2010 Google
Image State of Oregon
Google


Mt. St. Helens before the eruption


NASA


Commercial recovery vs. natural recovery 18.4 million trees were hand planted, one by one, on over 45,500 acres. Species planted were those that had grown in the area prior to the eruption: Douglas fir and noble fir with some lodgepole pine and black cottonwood.


Selection Harvesting
and Natural Regeneration



Horses are still used in logging

An independent Risk Assessment carried out by Seneca Creek in 2008 concluded that less than 1% of the US Hardwood entering the American hardwood pipeline could be classified as illegally harvested.

Life Cycle Assessment is the best framework currently available to assess and compare the environmental impacts of products.

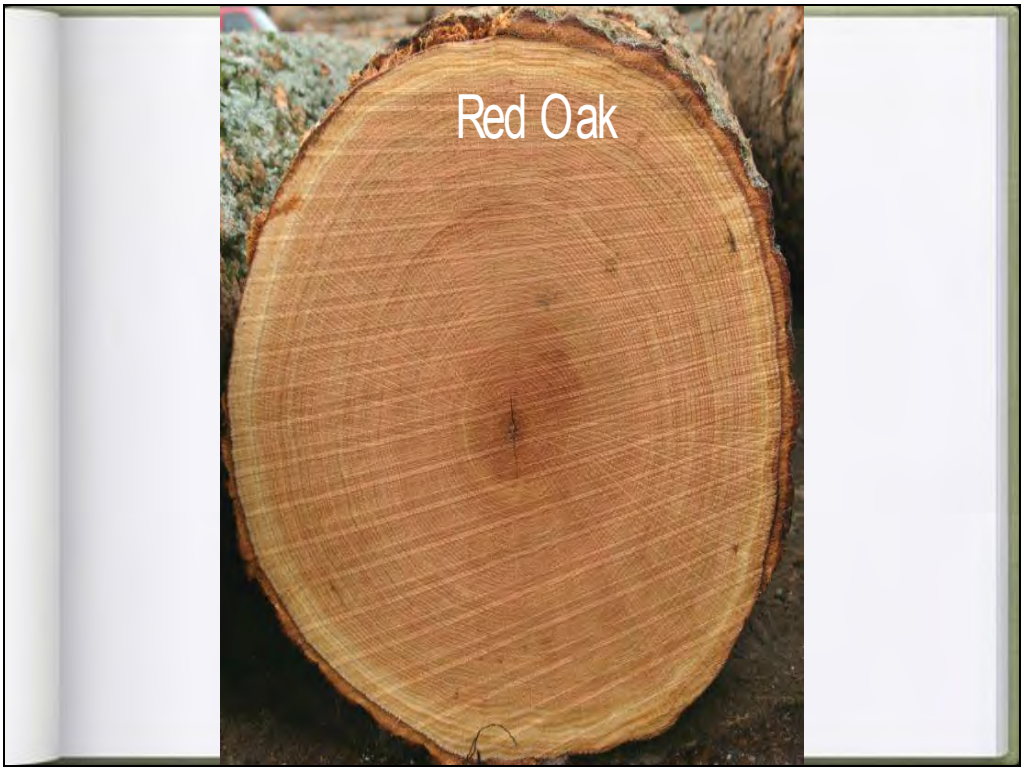
AHEC is investing in the largest Life Cycle Assessment ever undertaken in the international hardwood sector.

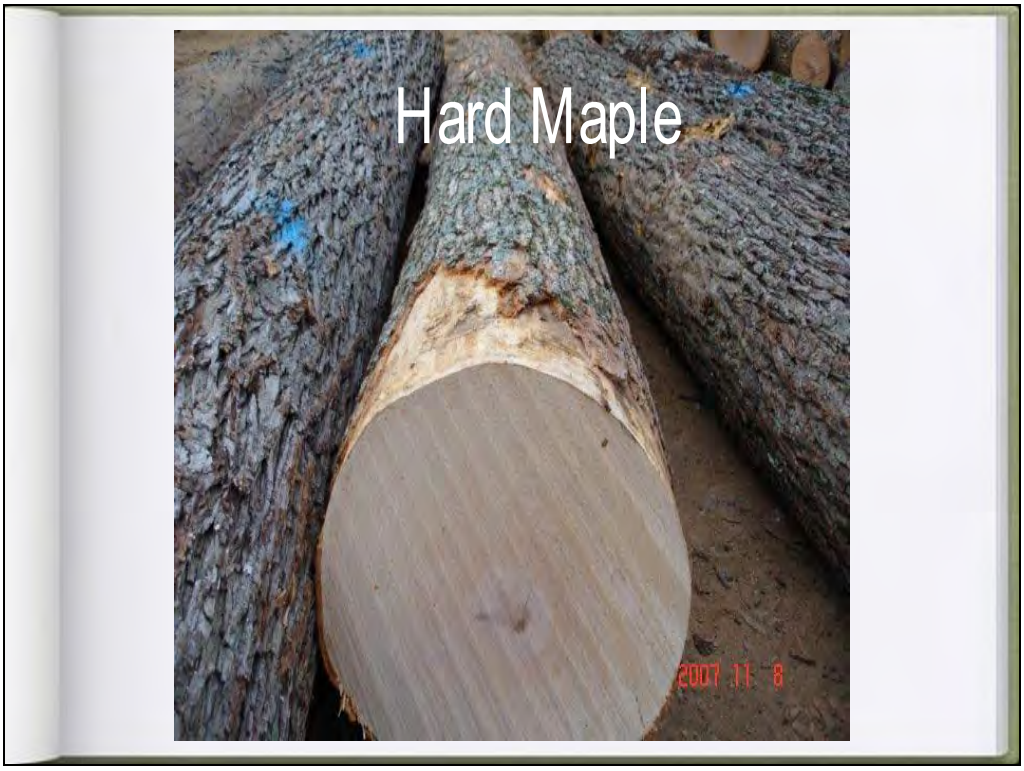
The assessment will be completed by PE International, a leader in the field of LCA
The LCA will provide comprehensive information about the environmental impacts of the processes used to extract, process, fabricate, transport, install, maintain, replace and dispose of American Hardwoods and their competitors.

The study will include an assessment of the "Carbon Footprint" of American Hardwoods

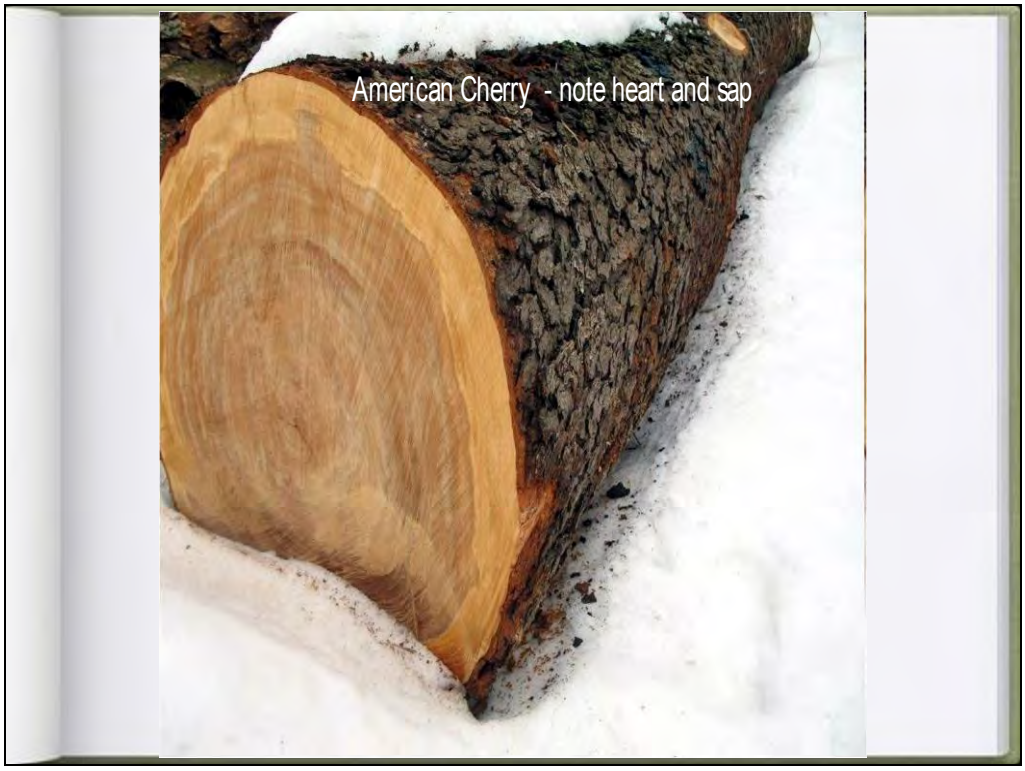
The US only has approximately 8% of the world's hardwood forests, but is the largest hardwood lumber producer in the world @ nearly 24%

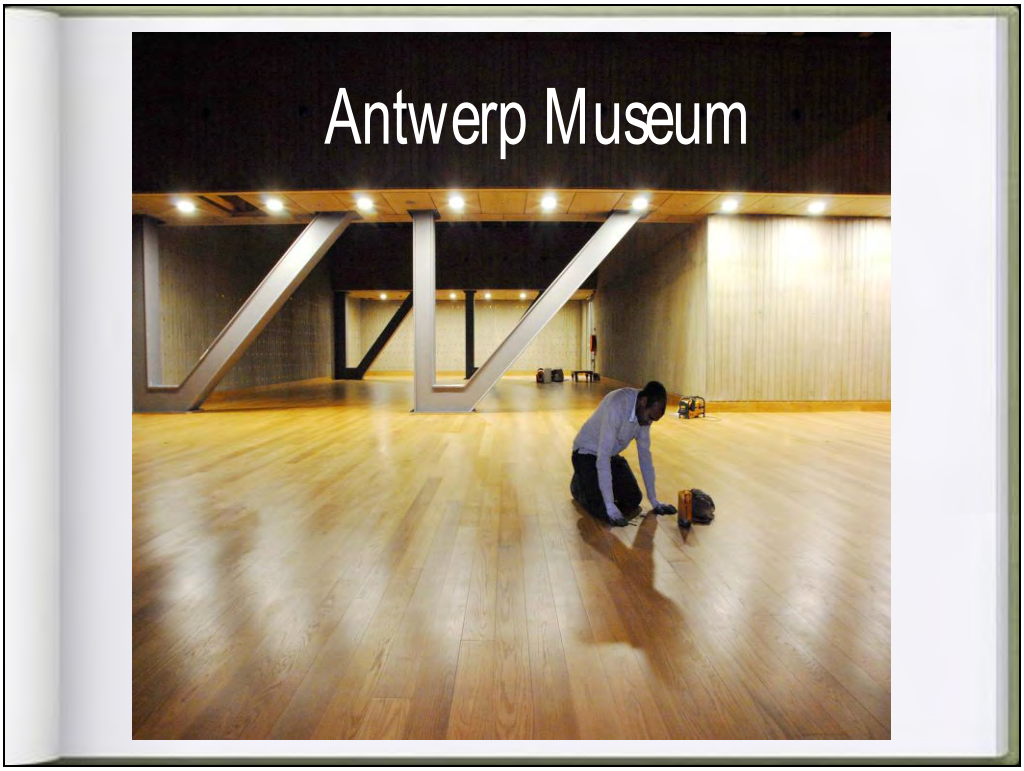

Veneer logs
leveraging the beauty of perfect logs

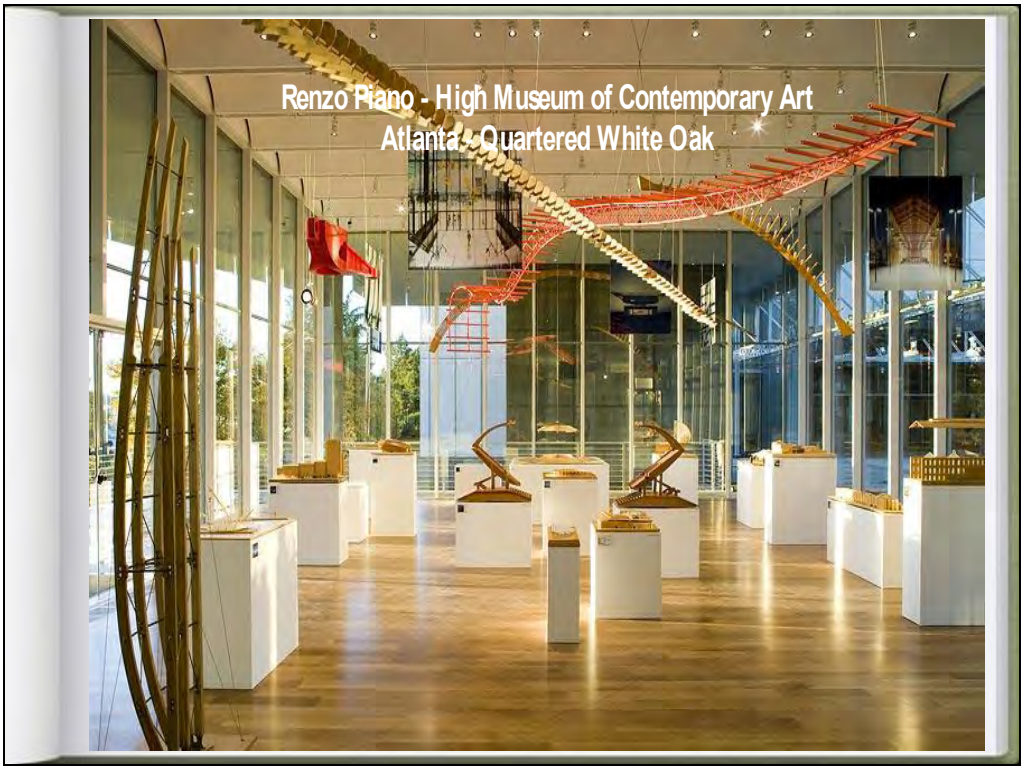

Red Oak

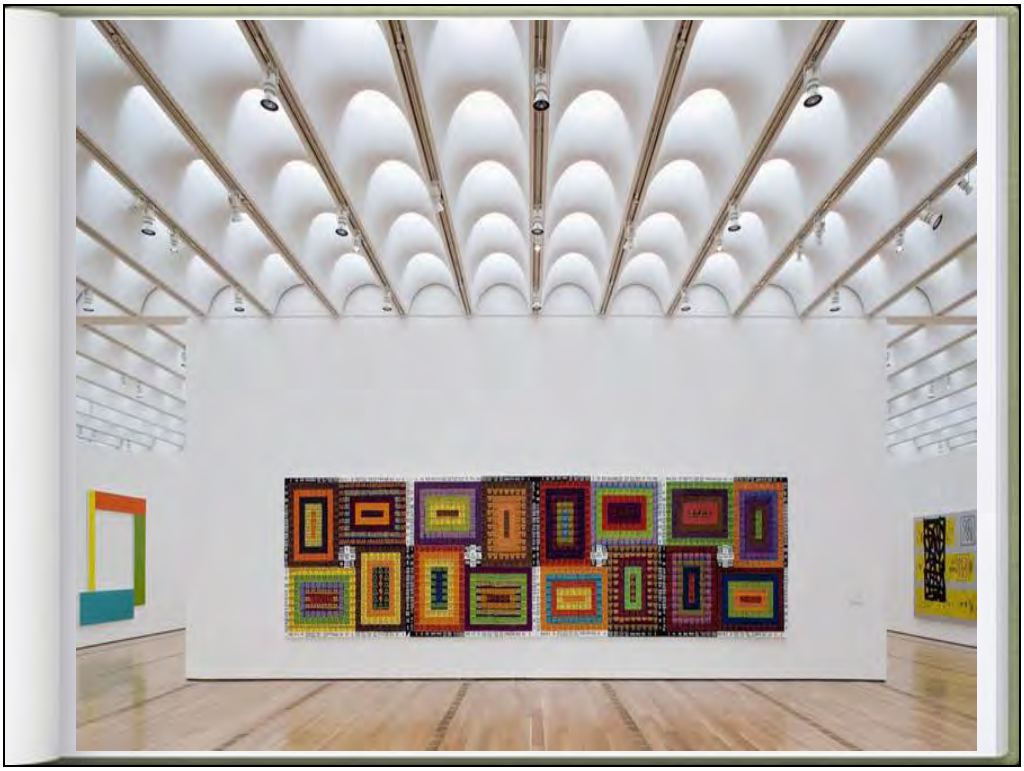

Hard Maple
2007 11 8


American Black Walnut


American Cherry - note heart and sap


Antwerp Museum

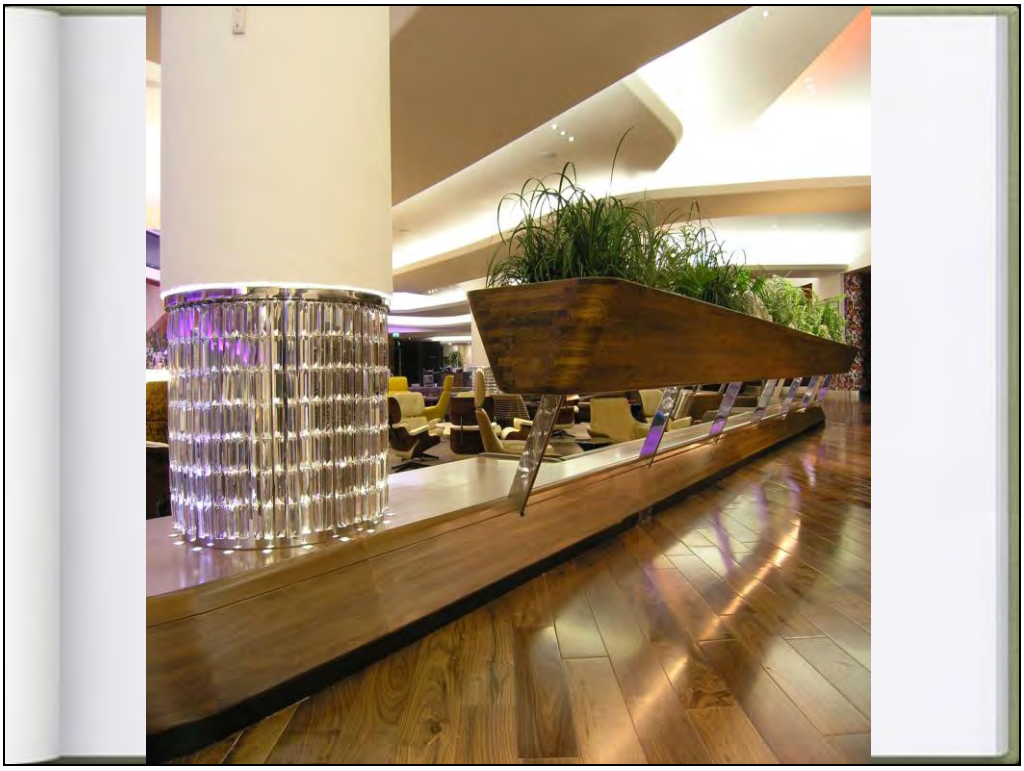

Renzo Piano - High Museum of Contemporary Art
Atlanta - Quartered White Oak

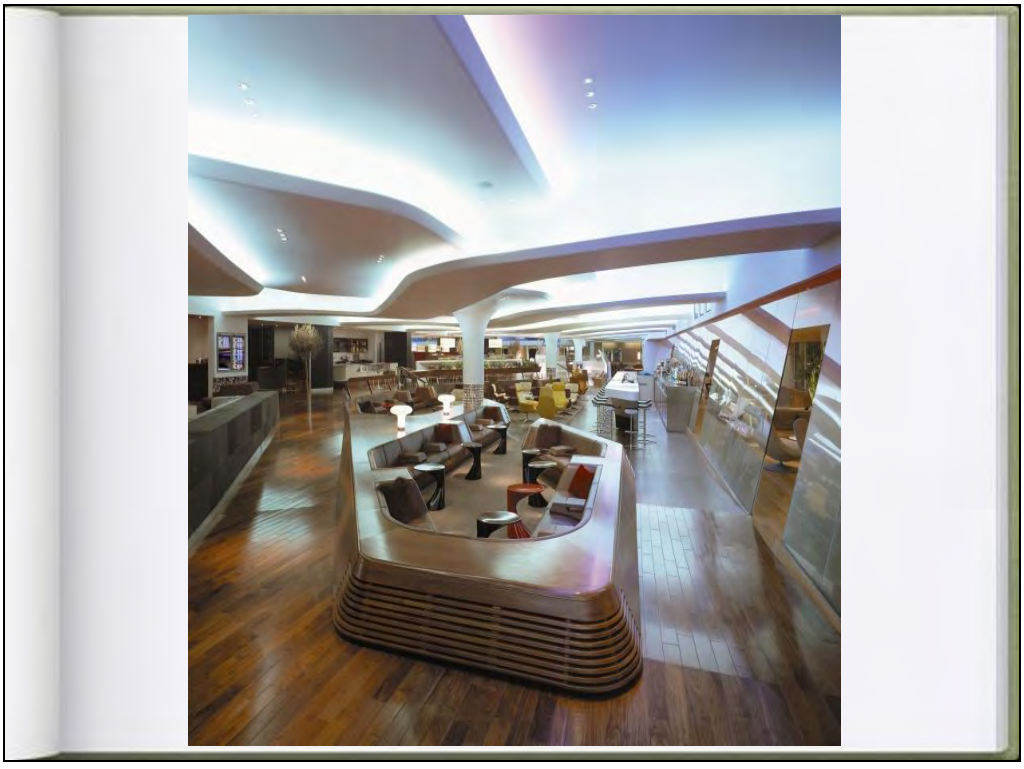


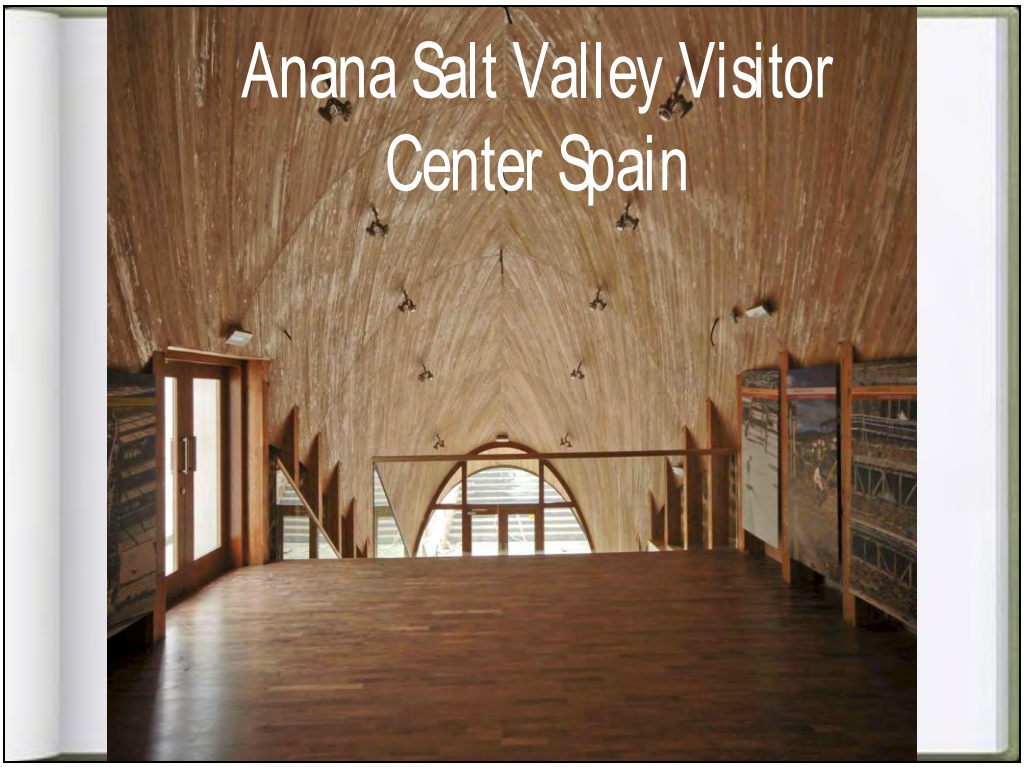
Interiors


Oslo Opera House
American White Oak

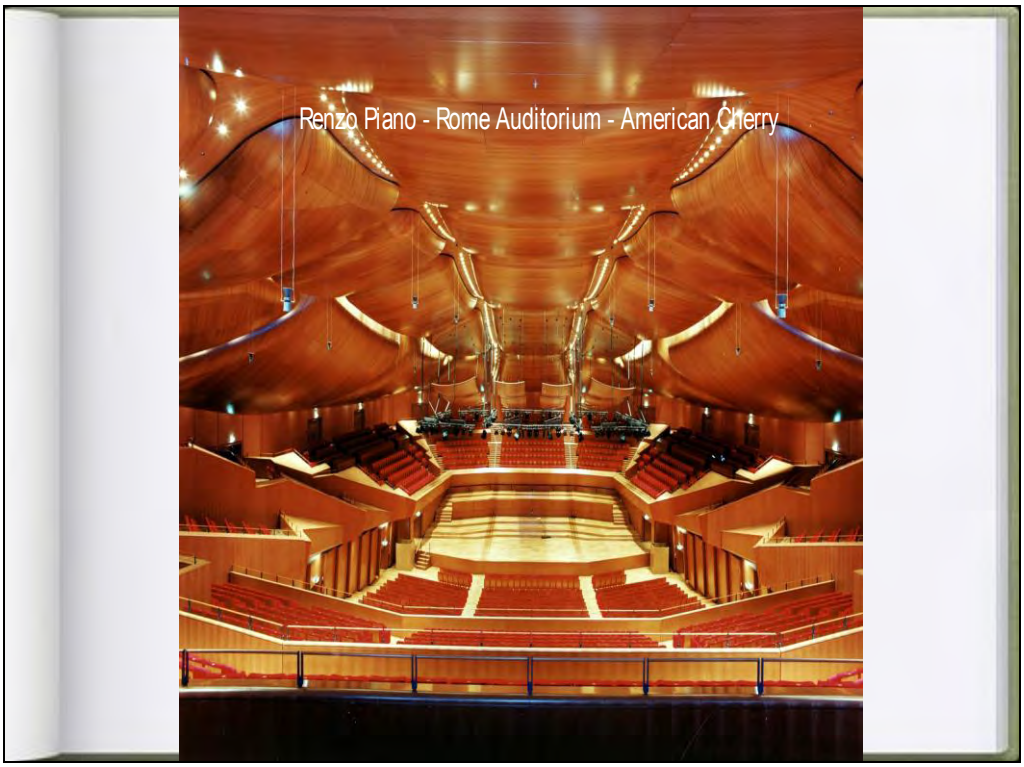

Virgin Atlantic Lounge
American Walnut

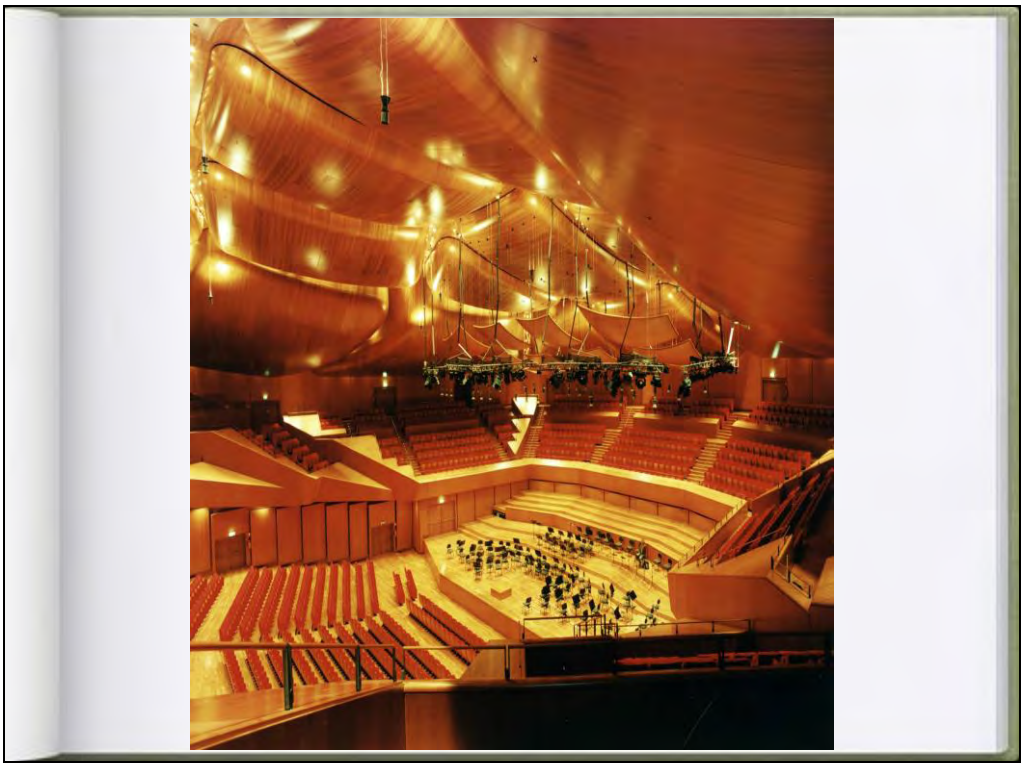


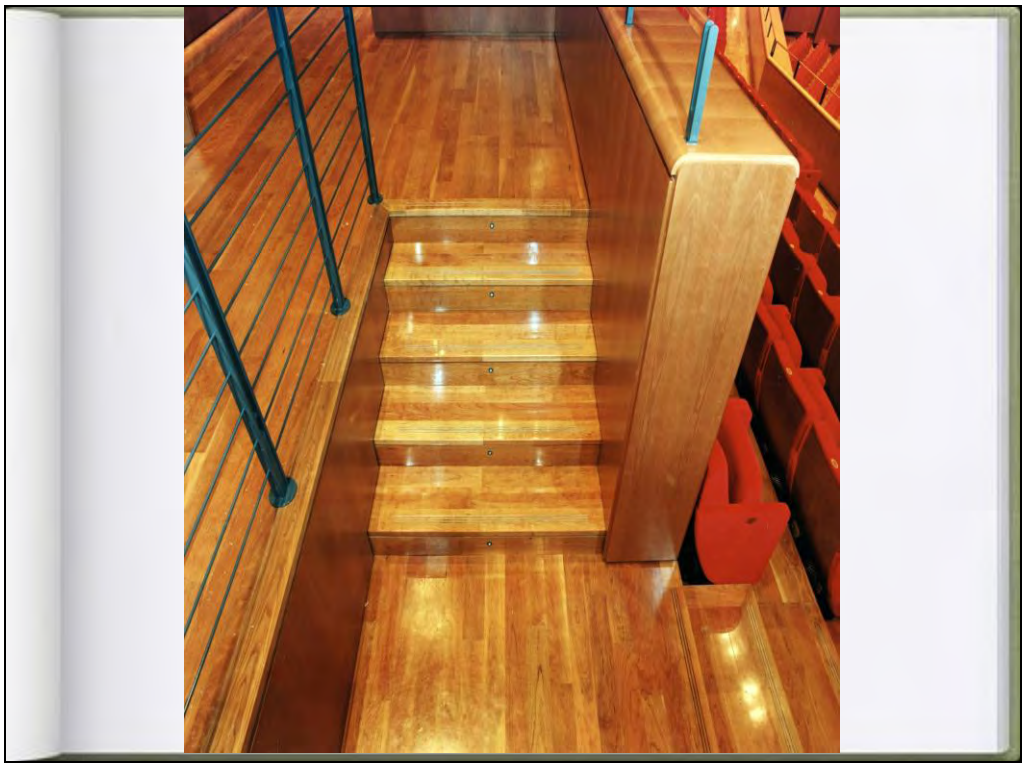


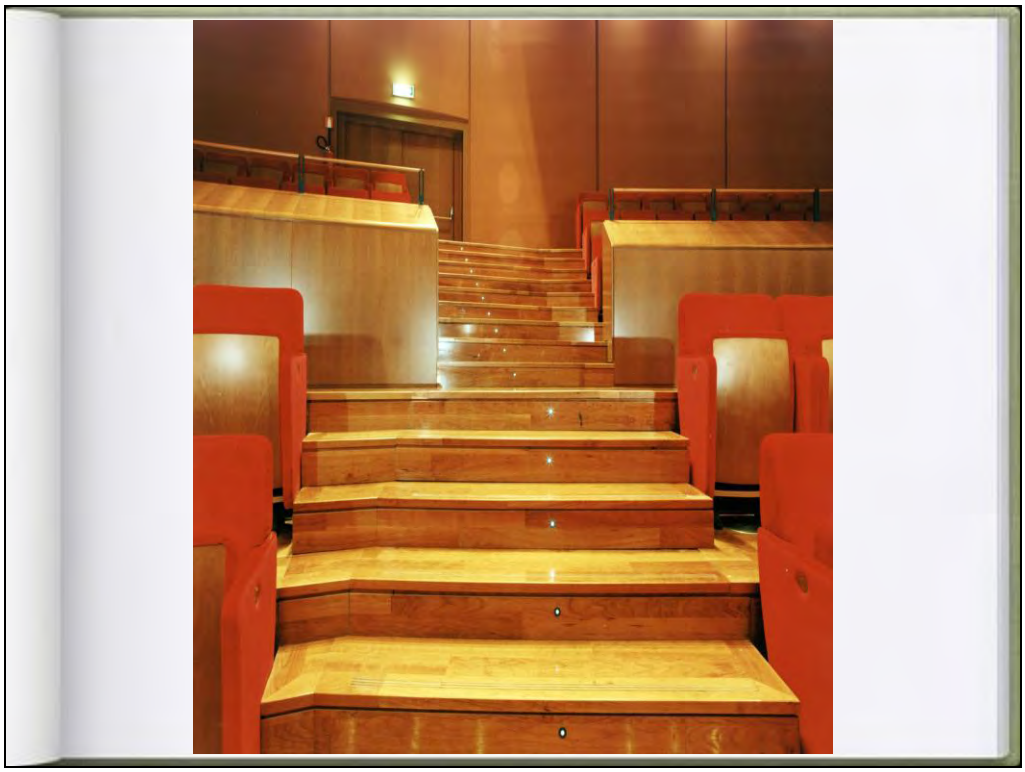

Anana Salt Valley Visitor
Center Spain

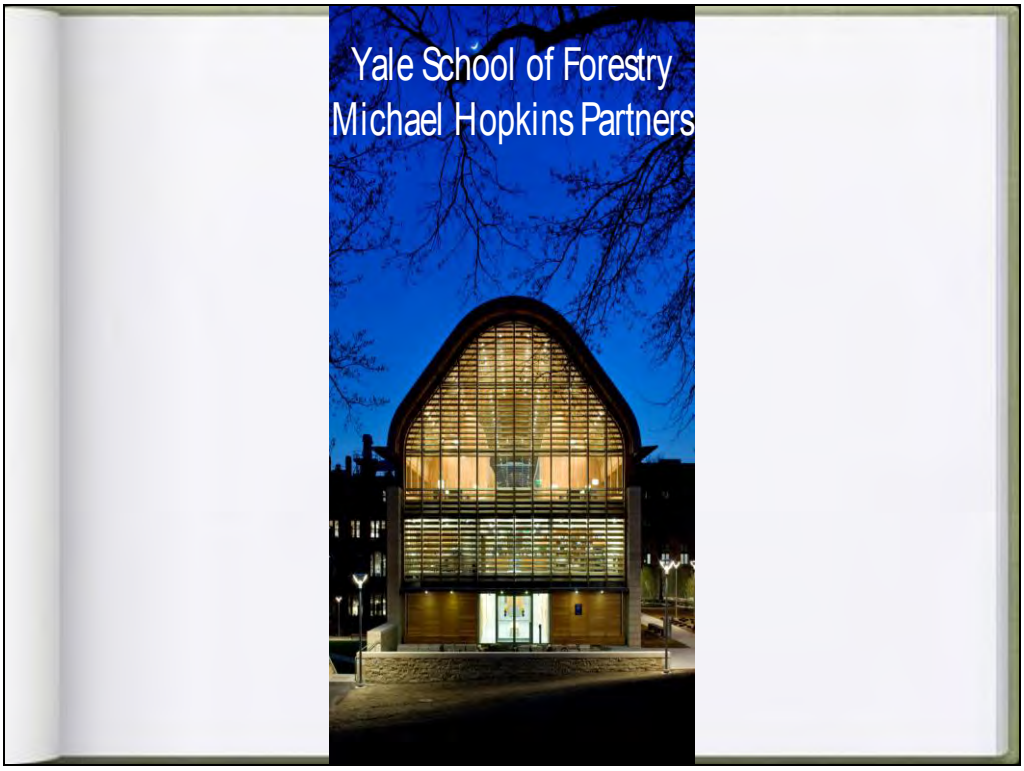

Anana Salt Valley Visitor Center Spain
American Ash
Mikel Landa

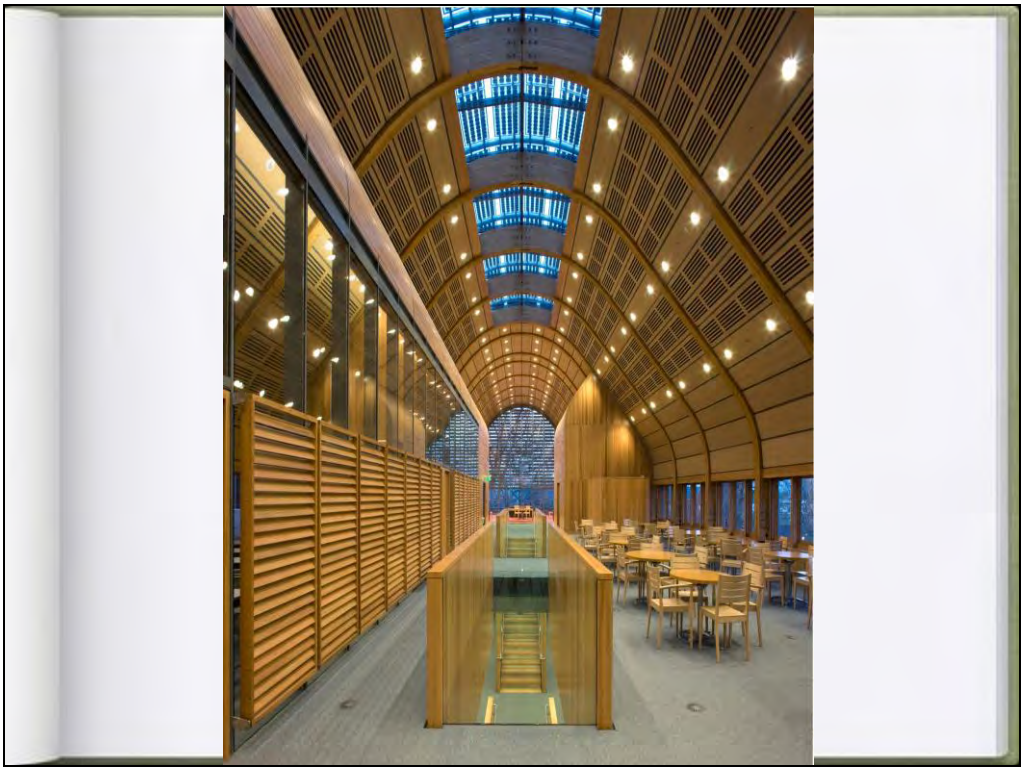

Renzo Piano - Rome Auditorium - American Cherry

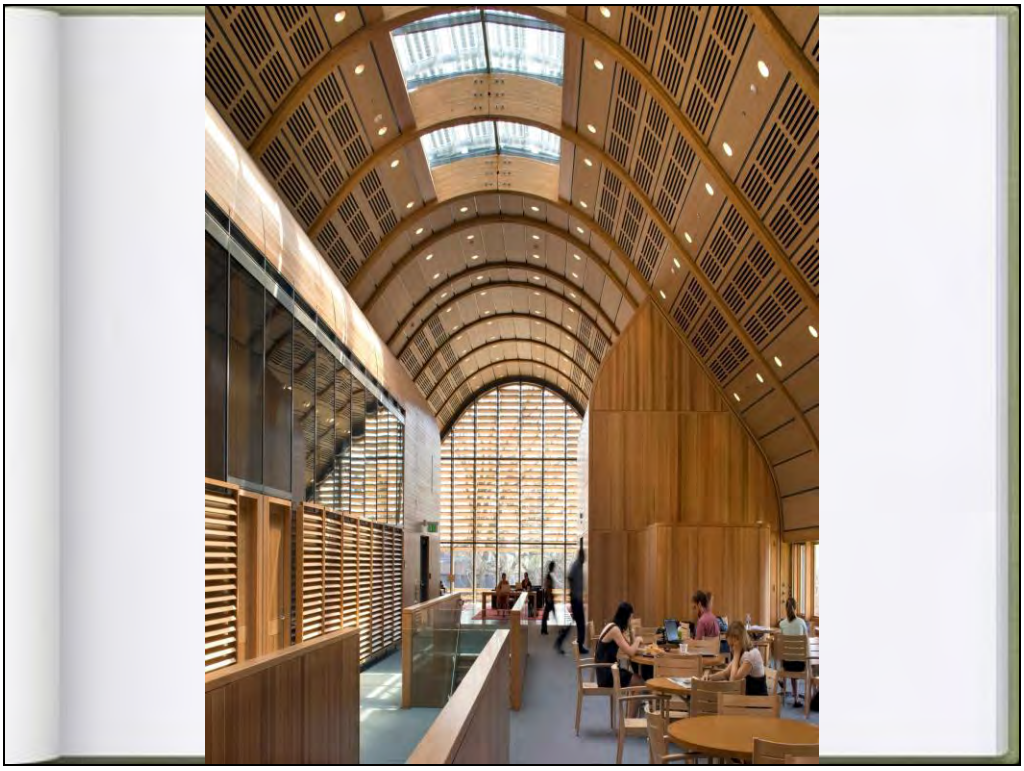


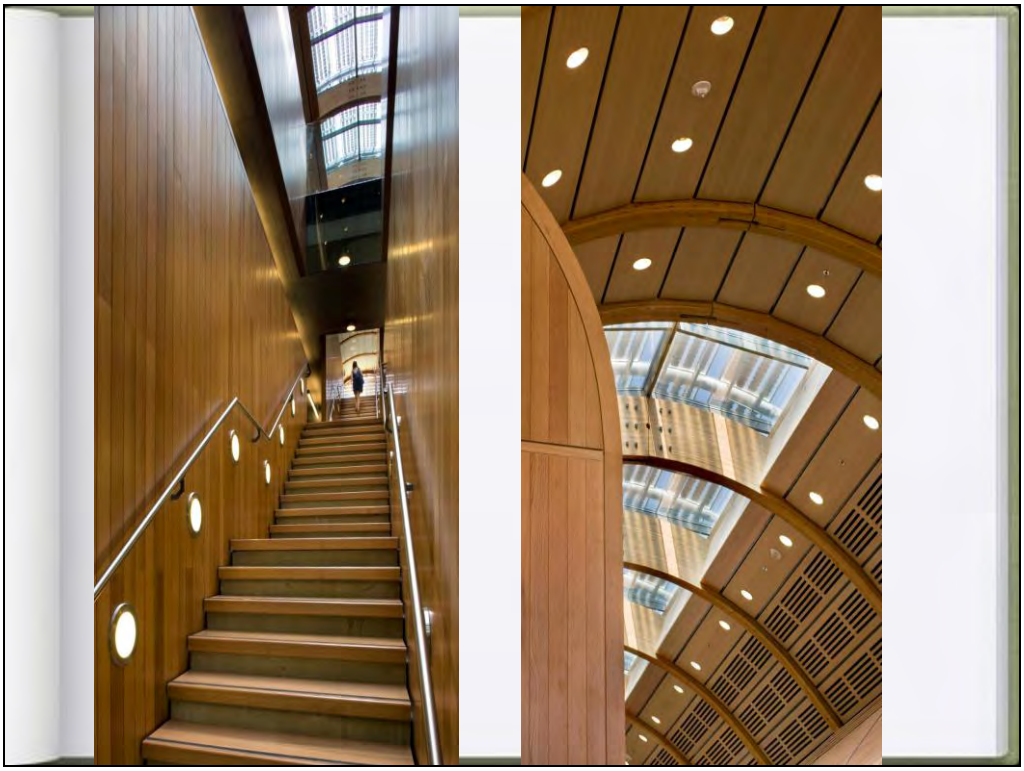




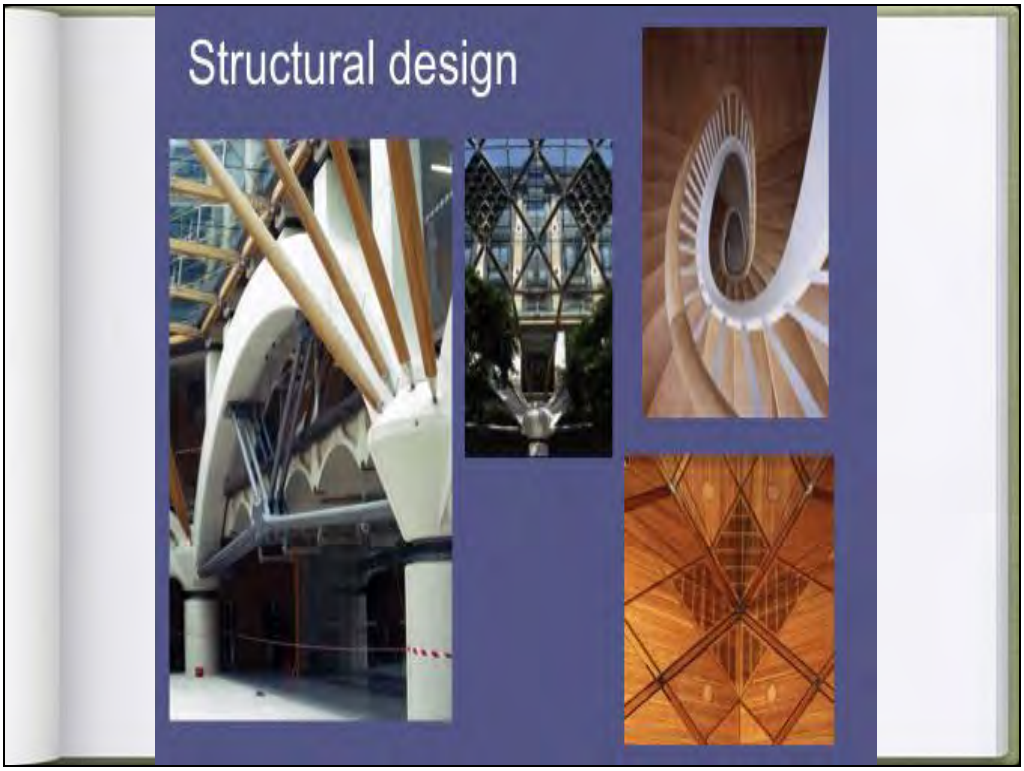

Yale School of Forestry
Michael Hopkins Partners

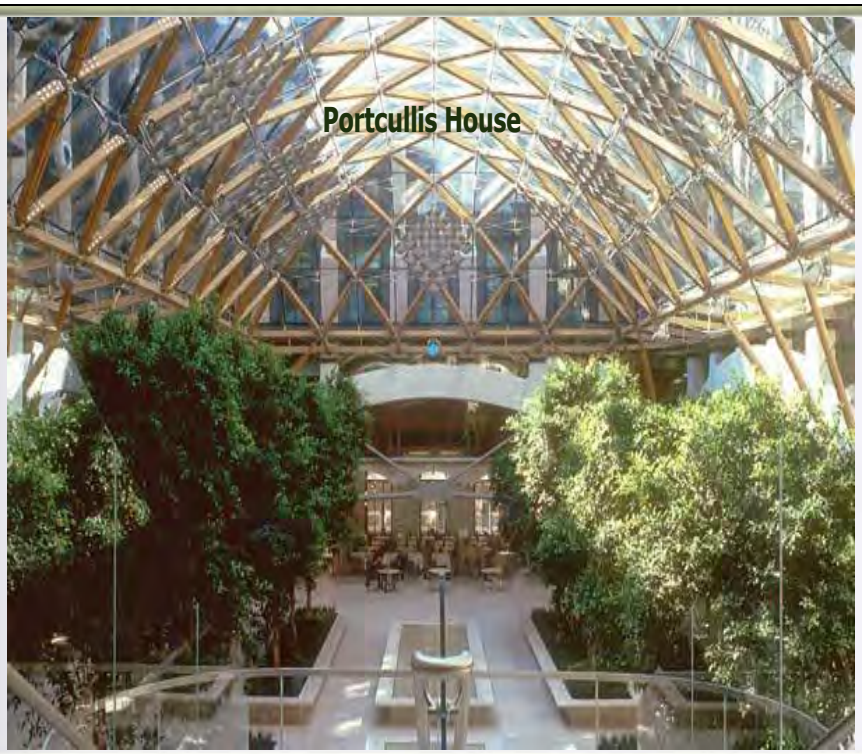






Historical Perspective - McKim, Meade and White 1862


Structural design


Portcullis House

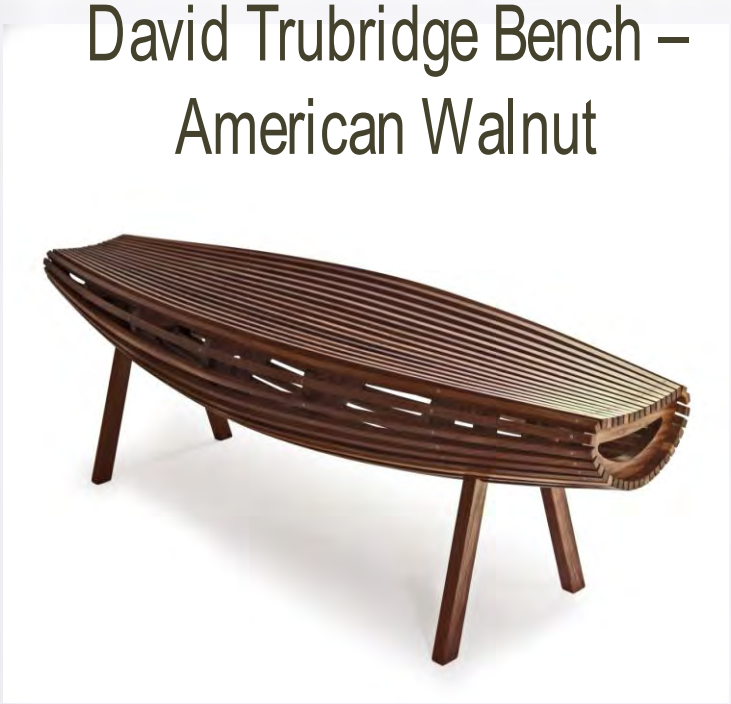

Timber Wave London – Red Oak


Zayed University UAE
Walnut floor

Furniture


Nakashima inspired Walnut Table

David Trubridge Bench – American Walnut

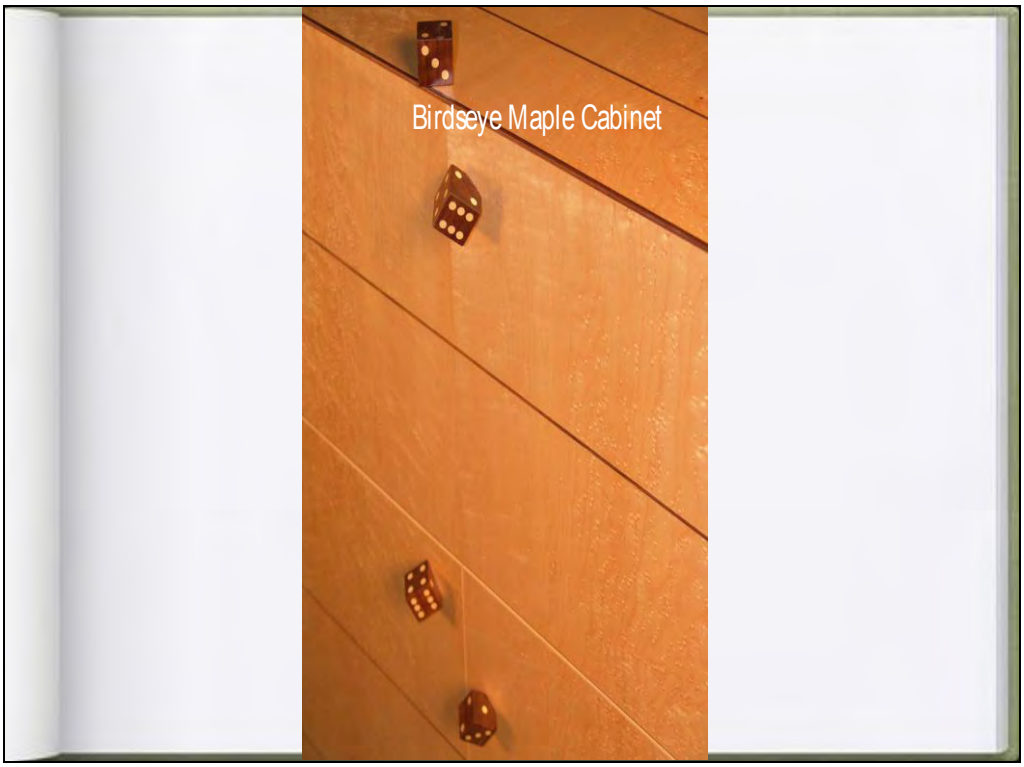


Thomas Moser American Cherry


John Galvin Lounge Chair
American Walnut


Red Oak and Walnut Table


American Hard Maple table


Birdseye Maple Cabinet


Curly Maple Cabinet


Sculpted Cherry

Remember that wood is a natural product, subject to variations in color within each species

For More Information:

www.americanhardwood.org

AMERICAN HARDWOOD EXPORT COUNCIL

The Present State of Lifecycle and Carbon Footprint Assessment in Japan to Visualize the Eco-friendliness of Products Including Wood

Nobuaki Hattori[3]

Abstract

To reduce environmental loads of products or services for an environment-friendly society, it is necessary to know them quantitatively. At present, life cycle assessment (abb. to LCA) is the only tool to assess the environmental loads quantitatively. In order to reduce greenhouse gases emitted from a product over its life cycle, carbon footprint (abb. to CFP) is the only tool to assess the total emissions of greenhouse gases quantitatively. CFP is defined as the total amount of greenhouse gases emitted from a product throughout its life and expressed in functional equivalent amounts of carbon dioxide. Therefore, CFP can be obtained by inventory analysis of LCA and the global warming potential among many potentials used in LCA.

The activities of CFP have become known in Japan from the year of 2009 thanks to a subsidized three year CFP pilot project funded by the Ministry of Economy, Trade and Industry. In this paper, the concept and procedure of LCA and the present state of products category rule (abb. to PCR) and the CFP system in Japan were introduced, though PCR for wood materials was just applied to the carbon footprint office.

A few case studies of LCA and CFP about wood materials were also introduced for particleboard, hardboard and insulation fiberboard.

Key words: Inventory analysis, Impact assessment, LCA, Greenhouse gas, carbon footprint

[3] Tokyo University of Agriculture and Technology, Faculty of Agriculture, 3-5-8 Saiwai-cho, Fuchu-shi, Tokyo 183-850, JAPAN (hattori@cc.tuat.ac.jp)

1. INTRODUCTION

In Japan, the emission of greenhouse gases (GHG), such as CO_2, due to energy consumption increases year by year for all sectors except industries. To halt global warming, the first step is to identify how a sector or a product emits GHG. A visual demonstration of GHG emissions would be very useful. Recently, the carbon footprint (CFP) system has been introduced to do this. CFP is usually calculated based on the methodology of life cycle assessment (LCA). Therefore, we first have to understand LCA. If we could implement the recommendations by LCA in the development of a new product or reflect it in government policy, the secondary effect will be expected for life prolongation of depleted resources.

2. WHAT IS LIFE-CYCLE ASSESSMENT?

2.1 Concept and procedure of LCA

LCA is the abbreviation of Life Cycle Assessment and it is used as a tool to evaluate the environmental burdens of a product or service by identifying and quantifying energy and materials used and wastes released to the environment, and to assess the impact of the product or service to the environment across its life cycle from extraction and processing of raw materials, manufacturing, transportation, distribution, use, recycling and to final disposal (from cradle to grave) as shown in Fig. 1. LCA is also a tool to used visualize mass balance between natural area and artificial one.

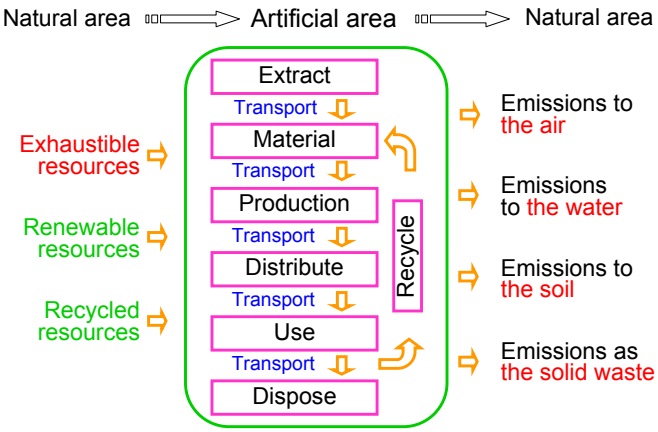


Fig. 1 Outline of LCI.

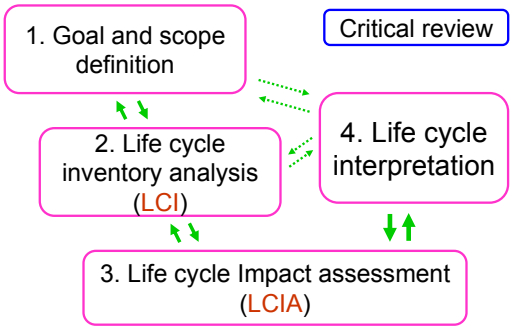


Fig. 2 Phase of LCA.

LCA consists of 1. Goal and Scope definition, 2. Life Cycle Inventory (LCI), 3. Life Cycle Impact Assessment (LCIA) and 4. Interpretation as specified by ISO (ISO 14040), as in Fig.2. The LCI phase is designed to capture all processes across the life cycle of a product assessed (Preparing for data collection), capture the amount of input and output materials in each process (Collection of foreground data), calculate environmental loads by multiplying background data and foreground data for each material (Data aggregation). The LCIA phase assigns the inventory results of CO2, NOx ・・ to impact categories such as global warming, ozone depletion and so on (Classification), calculates a category indicator within each impact category by multiplying environmental load by characterization indicator (Characterization), calculates modified category indicator according to an indicator list (Weighting) and

integrates modified category indicators according to an indicator list to a single indicator like Japanese Yen when LIME was used (Integration).

When LCA is carried out, you have to pay attention to use high quality background data, collect foreground data as much as possible to get reliable average environmental impact and to check miscalculation by a peer reviewer.

Therefore, JEMAI-LCA Pro Ver. 2.1.2 and LIME (Life cycle Impact assessment Method based on Endpoint modeling) developed by LCA Center of AIST has been used as a reliable background database and an integration one in Japan. Furthermore, recently MiLCA (JEMAI, 2010) and LIME2 (Itsubo, 2010) have started to come into use.

2.2 Present state of LCA in Japan

The activities of LCA were initiated by the Life Cycle Assessment Society of Japan (JLCA) in 1995. The ILCAJ was established in 2004 as an academic society. Membership and numbers present at annual meeting have increased in Fig. 3.

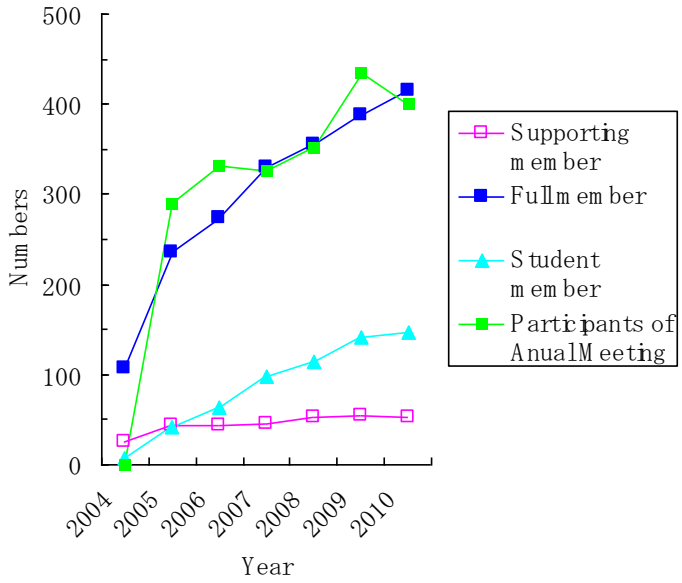


Fig. 3 Trends about ILCAJ.

Some of leading research groups are as follows: Genchi Lab. and Tahara Lab., The Research Institute of Science for Safety and Sustainability (RISS) at the National Institute of Advanced Industrial Science and Technology (AIST) have worked on LCAs and methodology. Harada Lab., Innovative Materials Engineering Laboratory at National Institute for Materials Science has worked on LCA of metals. Matsuno Lab., Faculty of Engineering, The University of Tokyo has studied LCA of steel. Inaba Lab., Faculty of Engineering, Kogakuin University has studied various types of LCA. Itsubo Lab., Faculty of Environmental and Information Studies, Tokyo City University has developed LIME and studied various types of LCA. Ikaga Lab., Faculty of Science and Technology, Keio University has studied LCA of architecture. Hondo Lab., Graduate School of Environment and Information Sciences, Yokohama National University has studied LCA of energy and methodology.

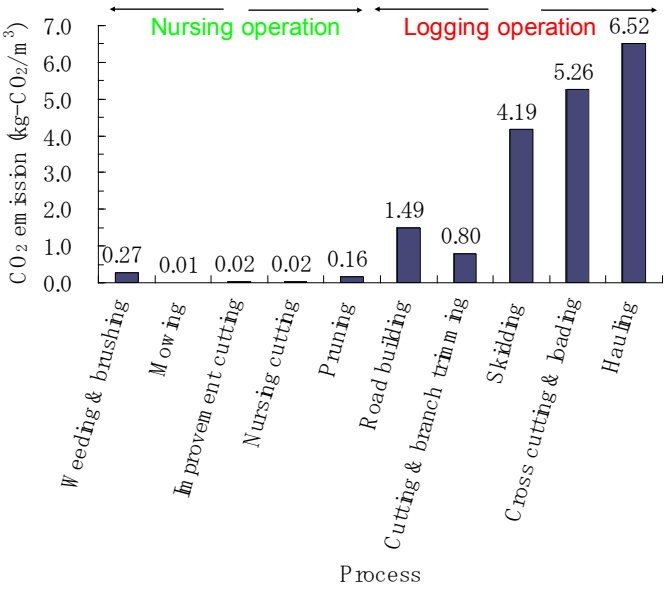


Fig. 4 CO_2 emissions of log production

2.3 Case study of LCA

Many LCA surveys about wood or wood materials have been conducted by my laboratory in which the results of logs are indicated here.

CO2 emission from 1 m3 of log production was shown in Fig. 4 for major processes (Tahara, 2004). The total CO2 emission for production of 1 m3 log was 18.7 kg-CO2/m3 in which major emission processes were hauling, cross cutting & loading and skidding in this case.

Other major published case studies about wood products concern domestic larch logs in Hokkaido (Komata, 2006), five types of adhesives for wooden panels (Sawada, 2006) and allocation concept of domestic lumber (Hitoe, 2009).

Popular types of detached houses are made of concrete, steel and lumber in Japan. As it is very difficult to compare the results of their LCA because of a lack of back ground data, I calculated single indexes whose environmental loads were in the database (Ikaga, 2003) using LIME2 and showed in Fig. 5.

It is clear that the most eco-friendly detached houses are made of wood, with steel built houses representing the lowest level of eco-friendliness. Potential damage cost due to urban air pollution was nearly the same as the one by global warming.

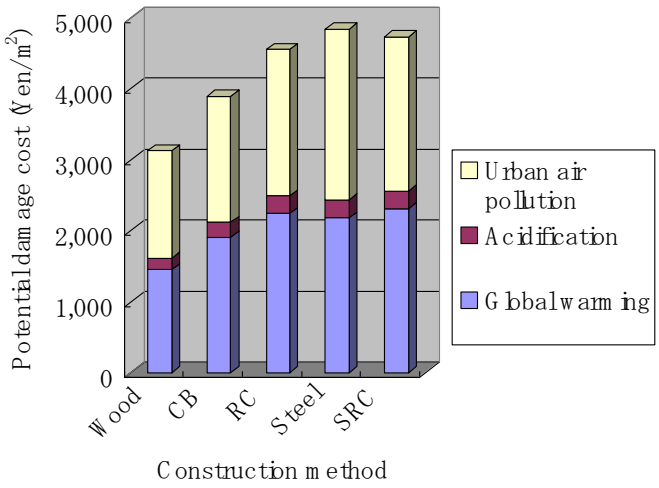


Fig. 5 Comparison of potential damage cost for types of detached house.

3. WHAT IS CARBON FOOTPRINT?

3.1 Concept of CFP

Carbon Footprint, abbreviated to CFP or CF, is a term used to describe the total amount of greenhouse gas (GHG) emissions caused by a particular activity or entity, and is thus a way for organizations and individuals to assess their contribution to the prevention of global warming. CFP refers only to GHG emissions of a product or service provision across its life cycle among all environmental categories assessed by LCA.

CFP is expressed in equivalent weights of carbon dioxide equivalent (CO2e) in which carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF6) are included. CFP includes not only GHG from artificial sources but also natural sources, such as rice paddies, livestock and so on. CFP is calculated with global warming potential for 100-year time horizon brought up by IPCC.

CFP can be used for Business-to-Consumer (B2C) goods, where the customer is the end user; and for Business-to-Business (B2B) goods, where the customer is another business using the product as an input to its own activities.

CFP system has been developed as part of the pilot project for three years from 2009 supported by the Ministry of Economy, Trade and Industry. The secretariat division is in JEMAI who has managed dedicated web site about CFP (Web site of CFP).

3.2 How to calculate and indicate CFP in Japan?

The equation is the sum of all activities in a product's life cycle multiplied by their emission factors as follows.

CFP of a given activity＝∑(Activity data i×CO_2 equivalent emission of factor i)
where i means a process

Steps to calculate CFP are, 1. Build process map of product's life cycle, from raw materials to disposal, including all material, energy and waste flows. 2. Confirm boundaries and perform high-level footprint calculation to help priorities efforts. 3. Collect data on material amounts, activities and emission factors across all life cycle stages. 4. Calculate the product carbon footprint. 5. Assess precision of the footprint analysis.

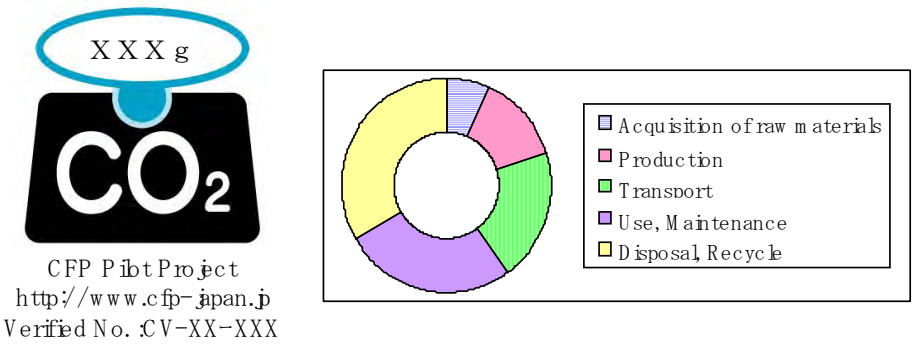


Fig. 6 Image of a recommended CFP label with the official mark. Basic indication area (Left) and additional indication area (Right)

The indication of a CFP consists of basic indication and additional indication on a label as shown in Fig. 6. The basic indication is required to state the absolute total CO2 equivalent value of the product or service across its life cycle on the authorized label. CFP values should be states in grams, kilograms or tons, although the correct expression is CO2 equivalent. The label must be on the body of the package itself. Detailed CFP information should be disclosed on the website of the CFP office.

Additional information such percentage of total GHG, cut down percentage against the current model or default value in the industry sector and amount of carbon stock in biomass are permitted to indicate on the additional area of the label. Differences in regions, seasonal changes of climate and suppliers should be indicated if significant. Verification of CFP by a third-party is recommended.

The advantages of CFP include: reduction of GHG emissions, identification of cost savings opportunities, incorporating emissions impact into decision making on suppliers, materials, product design, manufacturing processes, etc., demonstrating environmental/corporate responsibility leadership, meeting customer demands for information on product carbon footprints and meeting demands from 'green' consumers, for companies.

Customers are expected to use products in a low-carbon manner and choose recycled products with less environmental impact and take voluntary actions to reduce GHG emissions, such as selecting products with fewer GHG emissions when shopping.

3.3 What is PCR?

When a manufacturer calculates a CFP of his own product, there is always a possibility of willfully underestimating the value. If a customer realizes this fact, the CFP system may immediately lose the trust of its users. This is why the PCR (Products Category Rule) system was introduced to CFP system.

PCR is a rule to calculate CFP of a product and approved by PCR committee after strict review. As there is only one usable PCR for a product, all manufacturer have to use the same PCR if they produce the same products. CFP of a product is reviewed and verified by the CFP panel whether it was calculated in accordance with the PCR or not in this pilot project.

As the possession and licensing of PCR belongs to the Japanese government, persons in charge of PCR and CFP always watch and offer comments to promote this system for prevention of global warming.

3.4 Case studies of CFP

The well-known brand IEON produces a rice product “Akitakomachi” weighing 5 kg with CFP on market this January at their ten stores as shown in Fig. 7. The CFP of this package shows that the total CFP is 7,730 g and the largest step is cultivation in which natural emission from paddy was 3,119 g. Can you imagine that 7.7 kg of CO2 emitted from 5 kg rice during the life cycle and 40 % of CFP came from paddy?

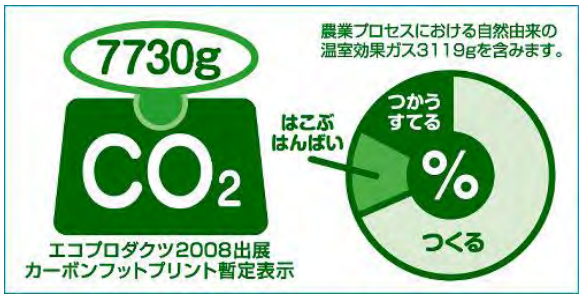


Fig. 7 Test marketing of rice with CFP.

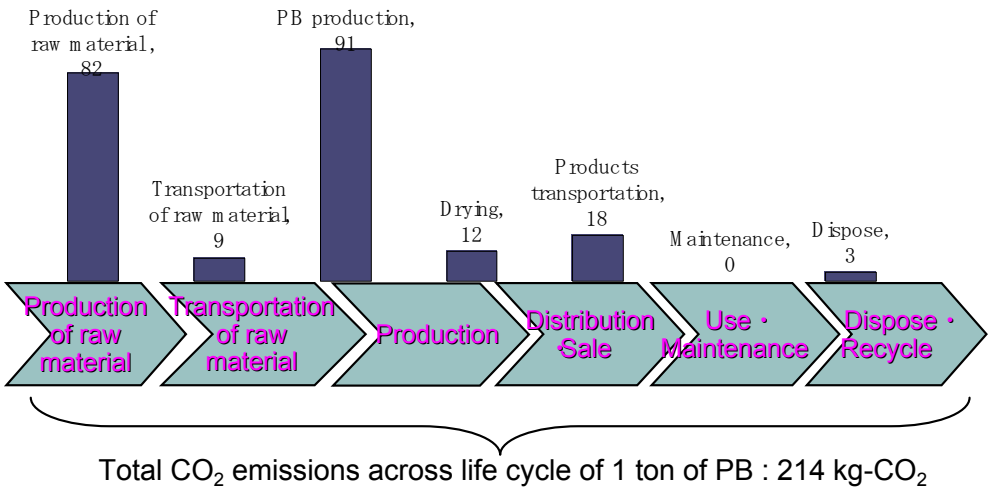


Fig. 8 Case study of CFP of particle board for sub-floor.

A CFP of 1 ton of particle board was estimated by Hattori Lab. in cooperation with a manufacturer in Tokyo and resulted in Fig. 8, which illustrates GHG emitted mainly from the stages of the production of chips and board among its life cycle stages. The CFP of a board for sub-floor whose size and density are 20 by 600 by 1800 mm and 0.75 g/cm3 respectively was 3.47 kg referring to the main result. This estimation carried out in 2008 and not verified.

3.5 The present state of PCR and CFP in Japan

PCR planning has been adjusted at first to avoid definition of a product in more than one PCR before PCR review. This adjustment is sometimes done in ministerial talks.

Products with verified CFP label are displayed at the Eco-Products Exposition from 2008 as shown in Fig. 9.

Fig. 9 Test marketing of products with CFP from 2008.

You can see products with CFP label include not only daily necessities but also foods and beverages.

Statistics of PCR and CFP from 2008 are indicated in Fig. 10.

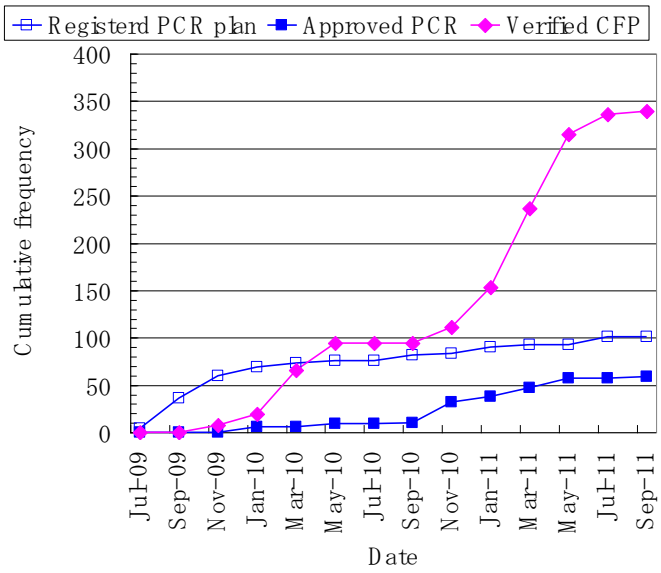


Fig. 10 Statistics of registered PCR plan, approved PCR and verified CFP.

About 60 % of planned PCR have been approved in which some of them were already revised for completion. Numbers of verified CFP in this year, through the PCR plan, increased in the first year of this project.

ACKNOWLEDGMENTS

I wish to express many thanks to IWCS for the invitation and provision of accommodation.

REFERENCES

ISO 14040: 2006, Environmental management -- Life cycle assessment -- Principles and framework, pp.20.

MiLCA (Multiple Interface of Life Cycle Assessment), Japan Environmental Management Association for Industry, URL: http://www.milca-milca.net/index.php, Dec. 2010.

Itsubo, N., Inaba, A., 2010, LIME 2 Method to Support Decision-Making, JEMAI, pp.666. (in Japanese)

Tahara K., Inaba A., Yamanaka K., Hattori N., Noguchi T., Terazawa K., Kutani M., 2004, Life Cycle Inventory Analysis of Log Production of Japanese Cedar and Cypress, SETAC 25th Annual Meeting in North America, PW088, 14-18 November, Portland, Oregon, USA.

Komata, H., Yoshida, S., Kato, Y., Takayama, M., 2006, Inventory Analysis of CO2 Emission for Log Production of Japanese Larch, Journal of Life Cycle Assessment, Japan, 5(1), 131-137. (in Japanese)

Sawada, Y., Ando, K., Hattori, N., Tamura, Y., 2006, Inventory Analysis of Adhesives Used for Wood Based Materials, Mokuzai Gakkaishi, 52(4), 235-240. (in Japanese)

Hitoe, K., Habuto, M., Nishimura, Y., Nishimura, H., Hattori, N., 2009, On the Trial Allocation in Life Cycle Inventory of Structural Domestic Lumber, Journal of Life Cycle Assessment, Japan, 5(4), 456-461. (in Japanese)

Ikaga, T et all, 2003, LCA Indicator for Buildings, Architectural Institute of Japan, AIJDATA95_v3.1.xls. (in Japanese)

Web site of CFP by JEMAI, http://www.cfp-japan.jp/english/

To visualize eco-friendliness of a product – The present state of life cycle assessment and carbon footprint in Japan –

11:36 – 11:54, October 21, 2011

Room: Main auditorium

by
Nobuaki HATTORI, Dr. of Agr.
Professor, Graduate School of Agriculture,
Tokyo University of Agriculture and Technology
E-mail: hattori@cc.tuat.ac.jp

Wood is good?

- Visualization of environmental loads and GHG emissions.
- The emission of GHG by energy consumption increases year by year for all sectors except industries in Japan.
- To stop global warming, we have to know how a sector or a product exhausts GHG.
- Carbon footprint (CFP) system has been used to visualize GHG emissions for this purpose.
- CFP must be calculated by life cycle assessment (LCA).
- Expected secondary effect is to prolong the life of depleted resources.

2

Contents

- Part 1：What is Life Cycle Assessment (LCA)? and present state of LCA in Japan
- Part 2：What is carbon footprint (CFP)? and present state of CFP in Japan

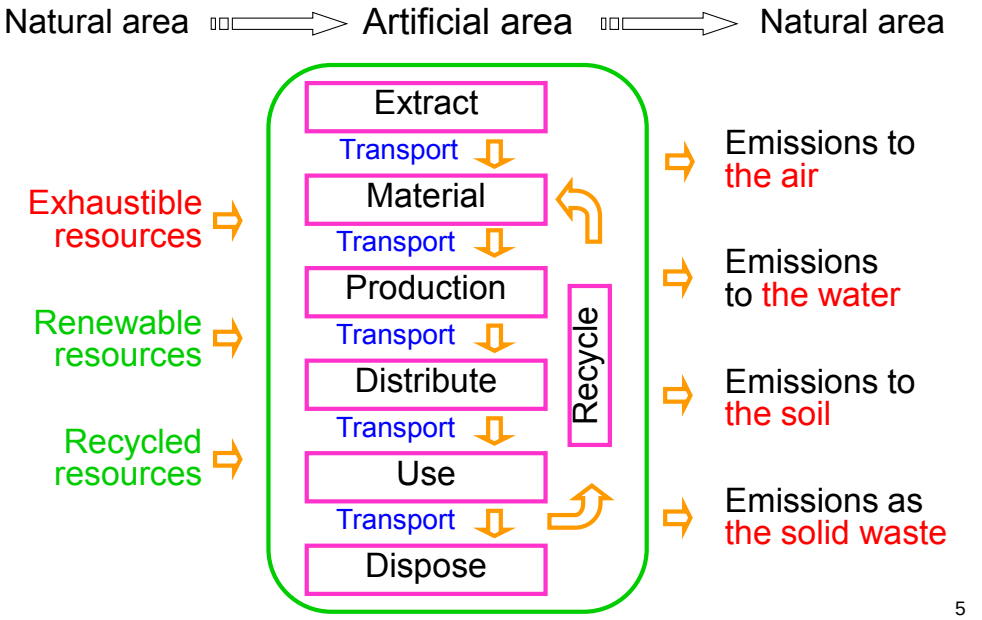
3

What is LCA?

- Abbr. of Life Cycle Assessment.
- Tool to assess environmental impacts associated with all stages of a product or service by identifying and quantifying energy, materials used and wastes released to the environment.
- Stages are from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling (from cradle to grave).
- LCA can cover many environmental categories.
- Impacts can be integrated to one value such as Japanese Yen, if you use LIME.

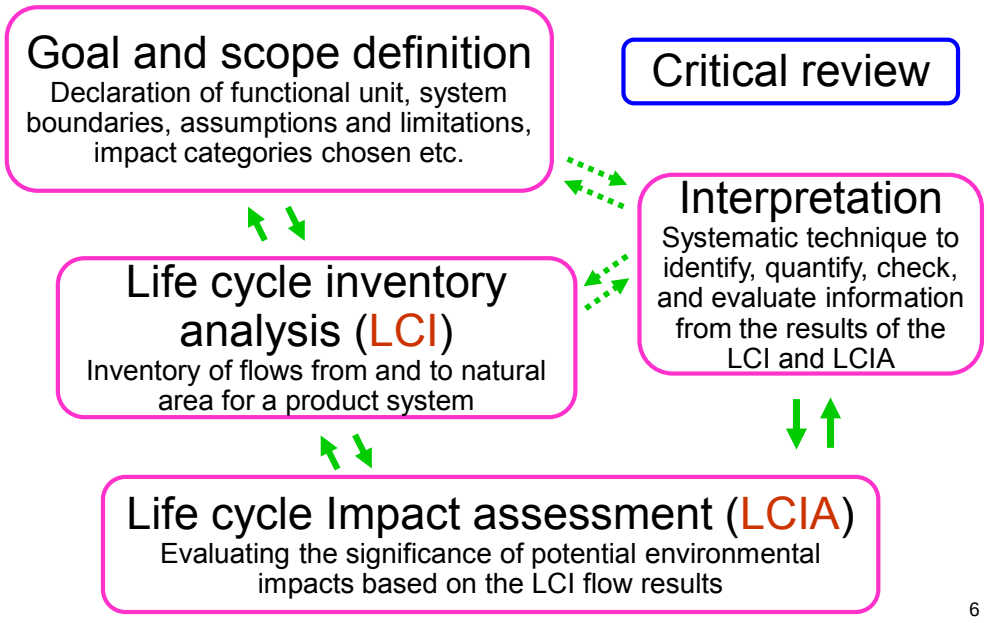
4

Concept of LCA



5

Procedure of LCA



6

Reliable tools have to be used to do LCA

- Software
  JEMAI-LCA Pro Ver. 2.1.2 developed by LCA Center of AIST and sold by JEMAI (Japan Environmental Management Association for Industry, 105,000 yen), MiLCA by JEMAI (usable under license key), Simple LCA (free from Web site)
- Background data
  JLCA, NIRE in LCA-Pro, MiLCA, Simple LCA
- Integration tool
  LIME (Life cycle Impact assessment Method based on Endpoint modeling) applicable in Tokyo and LIME2 applicable in Japan by LCA Center, and LIME3 applicable in Asia comes up soon.

7

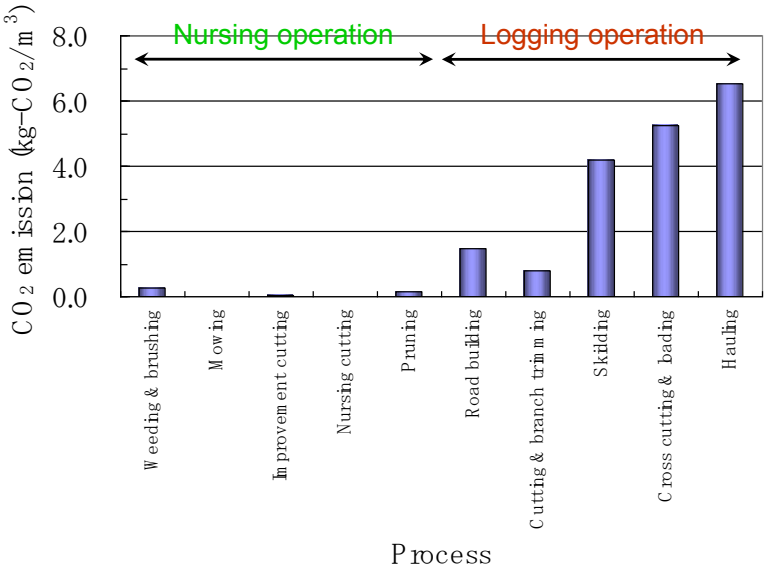
LIME can be used for

- calculation of a potential damage cost for all environmental loads assessed by LCA.
- getting the damage cost in Japanese Yen.
- full cost assessment consists of internal cost (direct cost) and external cost (potential damage cost) in which the assessment of direct costs is well known as life cycle costing.
- eco-efficiency of various levels.

8

Case 1: Inventory of logs

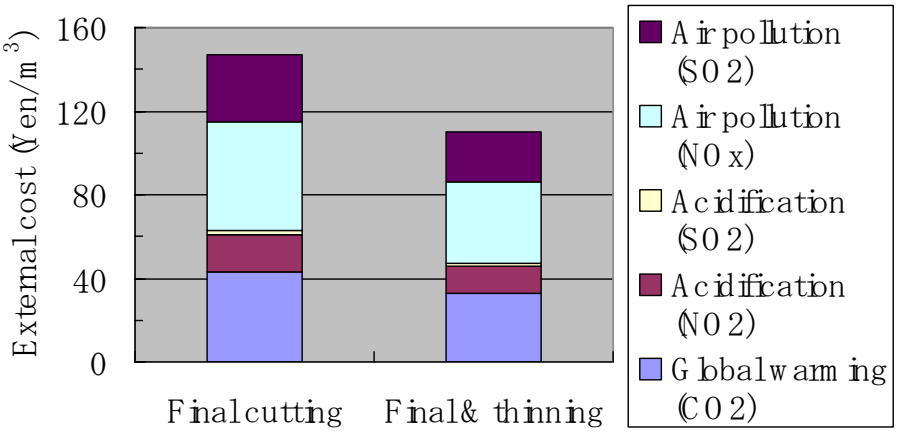
- CO_2 emissions of log production assessed by LCA.



9

Case 1: Impact of log

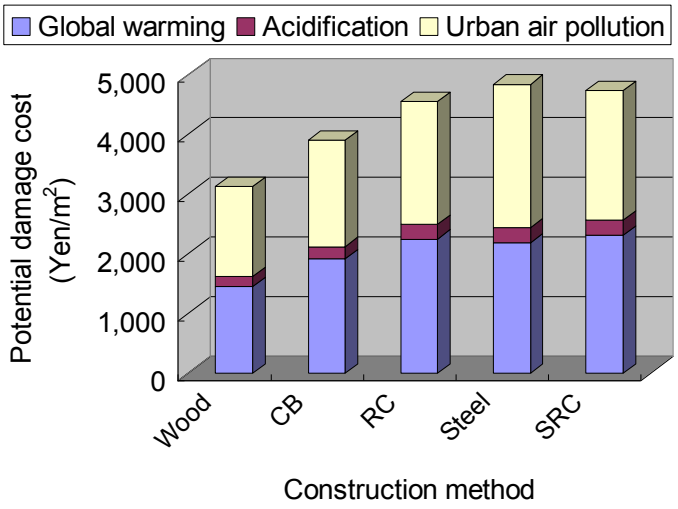
- Potential damage cost of log production



10

Case 2: Impact of house

- Potential damage costs for types of house assessed by economic input-output LCA.



11

Contents

- Part 1：What is Life Cycle Assessment (LCA)? and present state of LCA in Japan

- Part 2：What is carbon footprint (CFP)? and present state of CFP in Japan

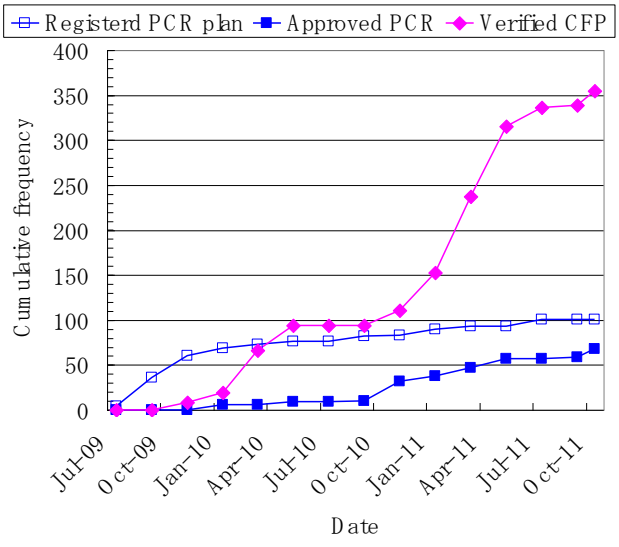
12

How to calculate CFP?

- The same as process based LCA.
- Greenhouse gas (GHG) emissions can be only assessed.
- PCR (Products Category Rule) must be planned and made at first.
- CFP must be verified by the authorized committee in Japan.
- This system has been developed in three years from 2009 on the CFP Pilot Project by the Ministry of Economy, Trade and Industry.
- The system is managed by JEMAI whose web site is http://www.cfp-japan.jp/english/ .

13

Outline of PCRs and CFP in the project



14

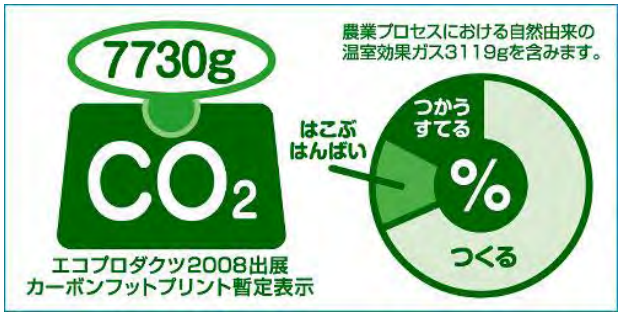
Eco-Products Exhibition

- Eco-Products Exhibition is held every year at Tokyo Big Sight to let people know the CFP system.

15

Test marketing about rice

- Famous supply chain IEON put a brand rice “Akitakomachi ” of 5 kg with CFP on market from January, 2009 at their ten stores.



- The CFP of this package shows that the total CFP is 7,730 g and the largest step is cultivation in which gas emission from paddy field was 3,119 g.

16

Test marketing of goods with CFP in England ?

Tesco, Coca-Cola, and some others have started to show CFP in a label.

Required indication :
①Work with the Carbon Trust
②Label and CFP
③Promise of CFP reduction within two years
Additional indication :
④Additional information etc.

17

Test marketing in France ?

- LECLERC in France started to print CFP on a tag of 20,000 items.
- You can recognize CFP when you get the receipt.

A receipt with CFP issued at cash register by LECLERC (URL :

18

The present state of PCRs for wooden products in Japan

- PA-CC-02 “Wood and wood materials” for lumber, glulam, plywood, PB, FB and preservative impregnated lumber made by NPO Sainoki and me.
- PA-CD-01 “Wooden products” for flooring and small wooden products by Flooring Industries Association and me.
- PA-CB-01 “Wood plastic combination” by WPC group and me.
- PA-BB-02 “Paper containers, packaging and wrapping” by Japan Printed Papers Association.
- PA-CJ-01 “Publication” by Japan Publishing Association.
- PA-AK-03 “Office furniture” by Japan Office Furnitures Association.

19

Thank you for your attention!

20

Mapping Customers' Minds with a New Technique: The Case of Housing Needs and Preferences in Finland

Maria Riala[4] and Tuomas Nummelin[5]

Abstract

This study tests a novel method for studying customer preferences in housing and explores Finnish customers' housing needs and wants. The approach is based on the means-end theory of consumer research. Traditionally studies grounded in this theory have used laddering interviews to uncover chains linking product attributes to their psychological consequences, and to a person's values. The method used in this study, by contrast, utilises the concept of a mind map. As a visual representation of a complex reality, it offers the respondents a more natural way to think about their preferences than the laddering interviews.

The mind map tool needs to be developed further, but we still received interesting mind maps from respondents. The resulting networks were analysed with quantitative tools, as well as interpreted qualitatively. The data was also compared with results of previous studies on housing in Finland. The respondents looked for functional apartments in good locations, which is mostly in line with previous research. There were also some interesting differences, e.g. the emphasis on families and children. It seems that building materials are not on top of the list when people look for apartments, and thus timber construction promotion activities should focus on the quality of construction.

Keywords mind map, housing, consumer research, means-end chain theory, Finland

[4] Finnish Forest Research Institute, Jokiniemenkuja 1, 01301 Vantaa, Finland, maria.riala@metla.fi
[5] Finnish Forest Research Institute, Jokiniemenkuja 1, 01301 Vantaa, Finland, tuomas.nummelin@metla.fi

1. INTRODUCTION

Housing is an interesting and complex area of consumer research. In Finland, most of the previous studies have focused on the living environment, and thus we wanted to shift the focus to apartments. Knowing what people look for in apartments and why those aspects matter to them might offer pathways to promoting timber construction, and thus lead to more environmentally sustainable housing stock.

The study is based on the means-end chain theory of consumer research. We wanted to develop a new, easier method of uncovering means-ends networks, which would give respondents opportunities for expressing themselves freely, while reducing the reliance on interpretations by researchers. This article first outlines the means-end chain theory, and then explains how our new method applies the theory. Our results are presented and compared with those of previous housing research, with a particular focus on timber construction. Due to the small number of valid responses, the conclusions offered are tentative, but suggest that the mind map tool is useful and can help people consider their preferences related to complex products.

2. MEANS-END CHAIN THEORY

The core assumption of means-end chain theory is that consumers do not choose products only because of product attributes e.g. surface colour. Instead, consumers have certain values, which consciously or subconsciously influence their decision-making. However, the values are not directly observable on a product. The observable attributes of a product and the underlying values of the consumer are linked by 'consequences', i.e., what the consumer hopes to achieve with a specific mix of attributes. Consequences are a tool to fulfil the values. An example of an attribute-consequence-value chain for salty snacks is 'flavoured chip' (attribute) – 'strong taste' (attribute) – 'eat less' (consequence) – 'don't get fat' (consequence) – 'better figure' (consequence) – 'self-esteem' (value) (Reynolds and Gutman, 1988).

The most common method to uncover means-end chains has been laddering. Laddering is a structured form of interviewing for gathering data about consumer preferences and values. The various laddering techniques differ in terms of how structured they are. The first stage is finding out which attributes are relevant to the respondent, and this can be achieved in a structured manner (e.g. giving the respondent a list of attributes, or a couple of alternatives), or by allowing the respondent to introduce the relevant attributes themselves in an interview. In the stage of constructing the means-end chains there are two main techniques, hard and soft laddering. In hard laddering the respondent is asked a series of questions, which guides them to generate value chains. In soft laddering, the respondents discuss the issue at hand in a less structured manner, and the researcher then forms the chains based on the data and their interpretations (Miles and Rowe, 2004).

2.1 Previous applications of means-end chain theory in housing research

The applications of means-end chain theory have generally been in consumer products, e.g. exploring cross-cultural differences in relation to particular products (Miles and Rowe, 2004). However, means-end chain theory has also been applied to housing (Arvola et al, 2010) studied consumer perceptions of residential environments in Finland. Their respondents walked independently in a residential neighbourhood along a guided route, and stopped at set

points to evaluate the surroundings, and rank attributes. Afterwards, relatively structured laddering interviews were conducted by phone. The researchers then coded and categorized the data into hierarchical value maps, i.e. groups of means-end chains.

Schauerte (2009) studied consumer perceptions of wooden multi-storey houses in Sweden and Germany. He started by conducting laddering interviews in person in both Germany and Sweden. He focused on positive value chains, and kept the data for the two countries separate throughout the process. The results of the laddering interviews were used to create structured matrix questionnaires. Matrices represented linkages between attributes and consequences, consequences and consequences, and consequences and values. The questionnaires were delivered to residents of multi-storey houses in the two countries and returned by post.

2.2 Methodological difficulties

The main observed difficulty with studies based on means-ends chain theory is to orientate consumers to discuss their preferences in a clear, linear manner. Preferences about products are not always that obvious, and it is even more difficult to connect product preferences to underlying consequences or values. Both hard and soft laddering attempt to deal with this issue, but have their own problems. If the interview is too structured, it may force the interviewee into a mould they feel uncomfortable in. In soft laddering, by contrast, the role of interpretation by the researcher might be too great (Grunert and Grunert, 1995).

One challenge in interpreting laddering data is determining the difference between attributes, consequences and values. This problem has been highlighted e.g. by Grunert and Grunert (1995), who point out that these terms have not really been defined in laddering literature. There are many borderline cases, where a concept could fall into more than one of the categories. They also state that the interpretation of data is prone to inaccuracies. This derives from the different understanding of attributes, consequences, and values by the respondents and the researcher, which is a result of different backgrounds.

Another challenge is finding the ‘right’ level of abstraction. If you combine two terms under the same heading, the level of abstraction rises. This process is common in laddering because respondents tend to use different terms even if they mean the same thing. The problem is deciding when several terms can rightfully be combined under the same heading. For example, Arvola et al. (2010) have an attribute ‘surroundings’, which includes statements such as ‘pleasant surroundings’, ‘no restaurants very close by’, ‘urban view’, and ‘nature close-by’. Thus, an attribute in a hierarchical value map can contain a large variety of attributes within it. Similar groupings are found in Schauerte (2009). While grouping variables might be necessary in analysing means-end chains, it is nevertheless challenging to come up with the ‘right’ groups.

In addition to these general problems with laddering, the studies on housing that used laddering have their own issues. In Schauerte (2009), the questionnaire was far too difficult for the respondents, which is reflected in the extremely low response rates. This was probably mainly due to unclear and ambiguous instructions. The matrixes also contained a very restricted set of alternatives. In Arvola et al. (2010), the main problem seems to be in coding the results of the interviews. Their decision to use six categories (two each for attributes, consequences and values) resulted high levels of overlap between the categories. Thus, there is a lot of dependency on coding by the research team, which might be too subjective.

3. MAP OF CUSTOMERS' MIND

In the light of difficulties faced by previous applications of means-end chain theory in consumer research, we decided to try a different, visual approach to the complex issue of housing preferences. We decided to use the mind map as a graphic tool to help understand housing preferences. The mind map approach also makes it possible for the respondent to create networks of variables affecting housing.

3.1 The principle

Our goal was to find a less structured and easy to use tool to model complex issues in a visual manner. In essence, the goal was to combine the best features of hard and soft laddering techniques and to remove the challenges encountered in them. The attempt was to find a balance between avoiding excessive structuring to guide the respondent, and reducing the need for interpretations by the researchers. It was also important for us to allow free associations by the respondents.

The previous studies have shown problems in formulating questionnaires for laddering. We thought the visual tool would make it easier for the respondents to make connections between different levels of abstraction. There might still be a need for some interpretation of the replies (e.g. if the respondent had used a slightly different expression for the same feature), but hopefully less than in laddering interviews. It would also be possible to analyse the networks using quantitative methods.

In order to create some structure for the tool and to give the respondents a starting point we decided to give each respondent a few variables at the start. This would help getting them in the right frame of mind. All starting 'maps' included an apartment, and between four and ten other variables. These were drawn randomly with an equal probability of being selected from a list of 34 variables, which were mainly derived from previous housing research in Finland. We hoped that this would enable comparisons with results of previous studies.

The respondents were then asked to think about what they find important when looking for an apartment. They could remove the default variables, add new ones, connect variables to each other, and determine whether they were attributes, consequences or values. The completed maps were collected online, and we also collected background data from the respondents.

3.2 Practical application

We decided to implement the mind map tool as a web-based application on our institute's website. The application was designed to be easy to use and a web-based tool was a practical way to collect data. The application was produced with Java[6]. We received user feedback during the data collection process and made some improvements to the application. The first bigger change to the application was to show the help text at the start-up. This improved the quality of the replies, and resulted in networks that are more complex. The second larger change was to alter the application so that all tasks were possible simply by clicking the mouse, without first choosing the right mode. We are working on further improving the application, and intend to use it in the future.

[6] http://java.com/en/ (Accessed 7.9.2010)

The respondents were directed to the questionnaire through a variety of channels. The main channel was an advertising campaign on one of the main Finnish housing websites. The advert was displayed as a banner, and by clicking it, the respondents were directed to the survey website. Later on, we expanded the sourcing of data with announcements on the Finnish Forest Research Institute's website and its Twitter feed, newsletters, and intranet. We also sent out the link through Facebook to our contact network.

4. RESULTS AND DISCUSSION

4.1 Data

The results of this research project reflect the fact that the data collecting method was experimental. We got a total of 50 replies. The number of valid responses, where the respondent has made some changes to the default settings is 31, i.e. 62 percent of all responses. The small number of responses means that the results are only indicative and would need further study in order to be generalisable.

The proportion of valid responses varied to an extent between respondents according to gender, age, and educational level. Women had a little higher rate of valid responses, but the difference is insignificant. Age has a weak negative correlation with valid response rate, younger respondents being more likely to return valid maps. Educational level correlates slightly more strongly with rate of valid responses, as those with a Master's degree or even higher education level have a noticeably higher rate of valid maps than those with lower educational level.

Figure 1 displays the key characteristics of the respondents. The respondents are somewhat skewed towards the younger, more educated section of Finnish people, and there is a much larger proportion of females among the respondents than in the general population.

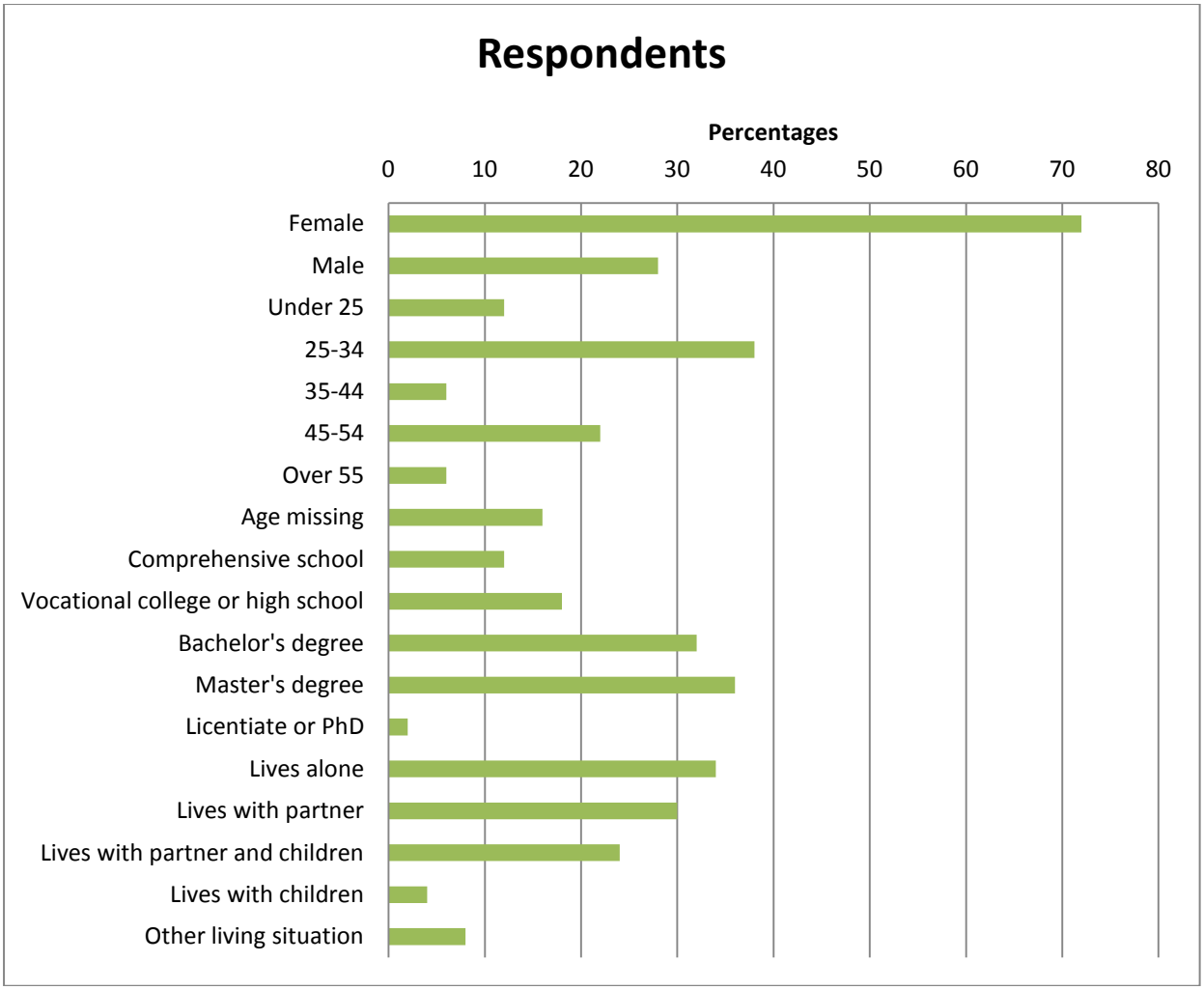


Figure 1: Background information of respondents.

4.2 Analysis of results

The resulting mind maps were of reasonably good quality. There was quite a lot of variety in terms of complexity of the maps, and in most of the valid responses there were some interesting linkages. The responses contained 119 variables in total. The variables listed include the 34 default attributes incorporated in the application, which means that the respondents added 85 variables to different categories. Some variables appeared on many different levels, for example, 'security' was labelled most often an attribute, but it was also deemed a consequence, and a value in different maps. Almost 60 percent of all variables were attributes, and there were more values than consequences on the maps.

The full list of variables has some overlaps with previous studies (see section 4.3.), but there are also interesting new issues. Most of the requirements for apartments are quite practical, e.g. good functionality of the layout, but there seems to be also quite a lot of emphasis on the needs of children and family. Figure 2 lists those variables, which appeared on the maps at least twice. Attributes are marked in red, consequences in green, and values in blue. It is easy to see that attributes appear most often on the maps, which indicates that people look for these when searching for an apartment. The smaller numbers for consequences and values might be explained either by it being more difficult to think about those, or by the greater variance between people in this respect.

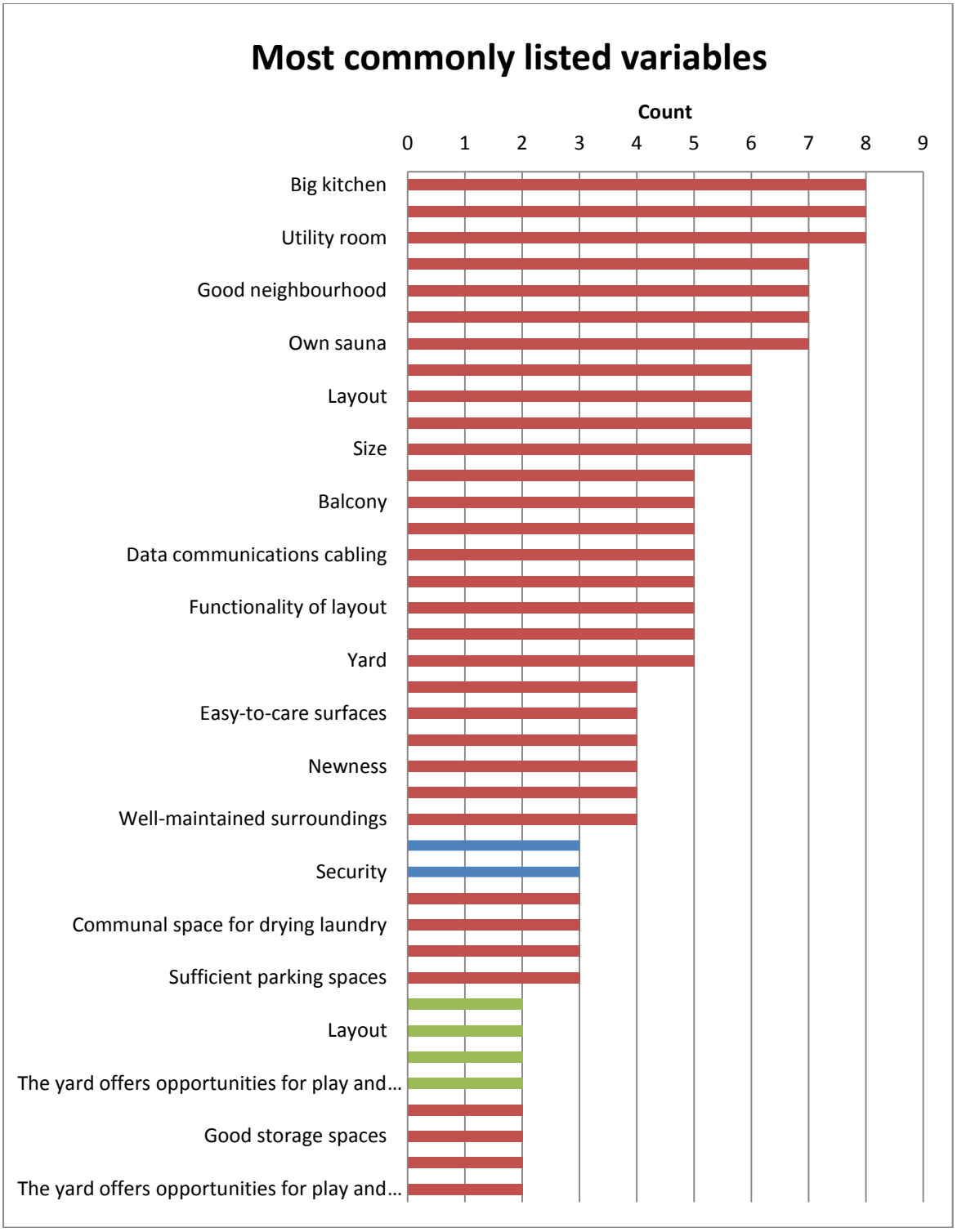


Figure 2: Most commonly listed variables.

The next step was to analyse the quality of the mind maps, which forms a key part of our study and of the new method. The assessment of mind maps has been studied before (e.g. Evrekli et al. 2010) but these approaches have tended to focus on mind maps as a tool for learning. In Evrekli et al. (2010), mind maps were scored by several evaluators, awarded points according to their complexity and the number of linkages, and the scores given by different evaluators were then compared. Cline et al. (2010) used an even more structured

marking system, where students constructed concept maps online, and these were graded by comparing them to a concept map created by the course instructor. In our study, there were no correct answers, so we could not adapt these approaches directly.

Figures 3 and 4 show some examples of mind maps we received from the respondents. Figure 3 shows a simple map, where variables are only connected to the apartment, and only one ('healthy apartment') is at the level of value. There are also some unnecessary arrows, which only connect an attribute to itself. Figure 4 shows a more complex map. There are more interconnections, a greater variety of issues presented, and more levels of variables. Thus, it would be reasonable to argue that the latter map provides a more comprehensive picture of what this particular respondent finds important in apartments and why.

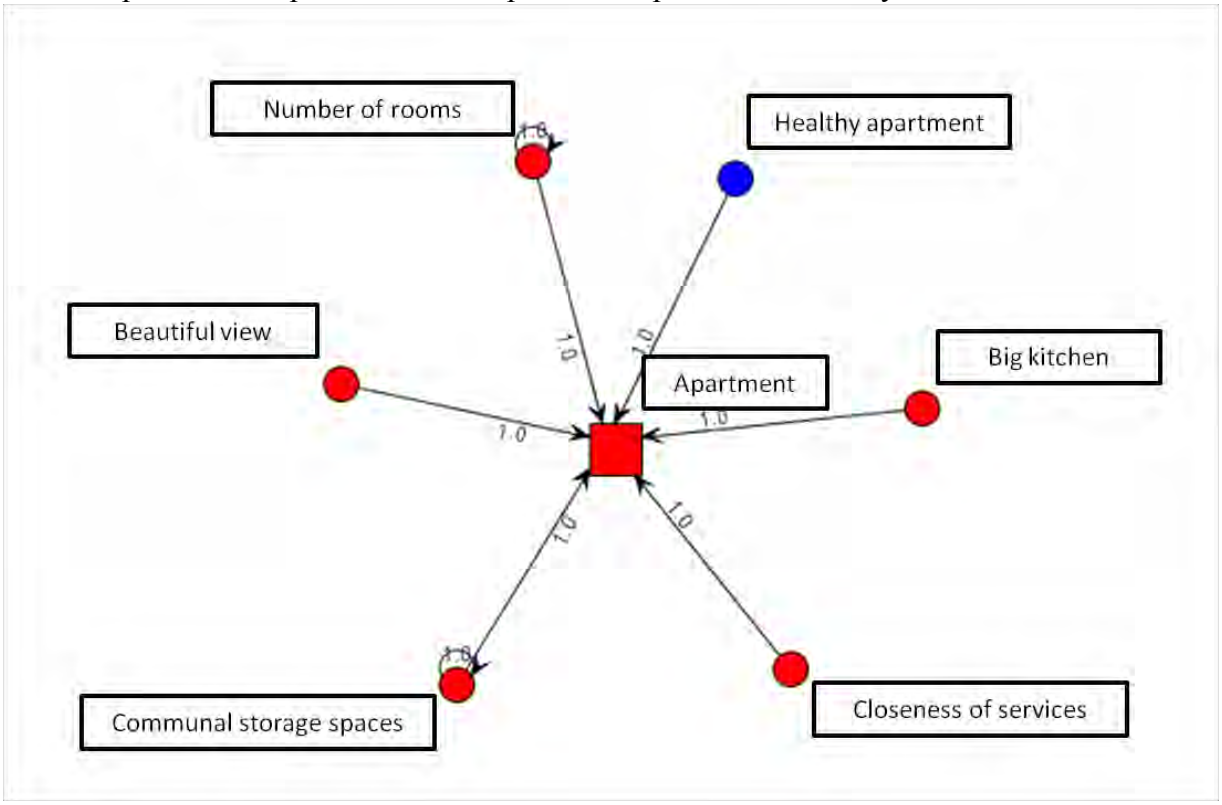


Figure 3: Mind map 1, respondent female, 28 years, Bachelor's degree, lives alone.

Complexity of a mind map seems to make it more representative, and thus in the analysis of data we chose to focus on the combination of all 31 mind maps, look at the complexity, and try to find patterns in it. The first analysis focused on the number of linkages coming into and going out of each node. The combination of these two formed the degree to which a particular node is connected to others. Degree is a commonly used indicator of properties of networks, and can also be used as a proxy for the importance of a particular node in a network. (Albert and Barabási 2002). The focal point 'apartment' was left out of this analysis, based on the assumption that most attributes would be connected to it. Figure 5 shows those nodes, which had a degree count of over four, the top eight percent of the connections.

The variables, which have the greatest number of connections to others, include those, which are generally recognised to be important in housing. Location, comfortable home, good neighbourhood, and layout of the apartment are obviously important features of housing. These are also included in the most commonly listed variables in figure 2 above. In fact, none

of these variables, with the possible exception of public transport, are very surprising at the top of the list. However, it is also interesting that there are large numbers of variables, which are connected to very few others. 13 variables are connected to 3 others, 28 to two, 45 to one, and 20 to no variables at all. This may reflect the complexity of housing as an issue, or just indicate that people find it difficult to make connections between variables.

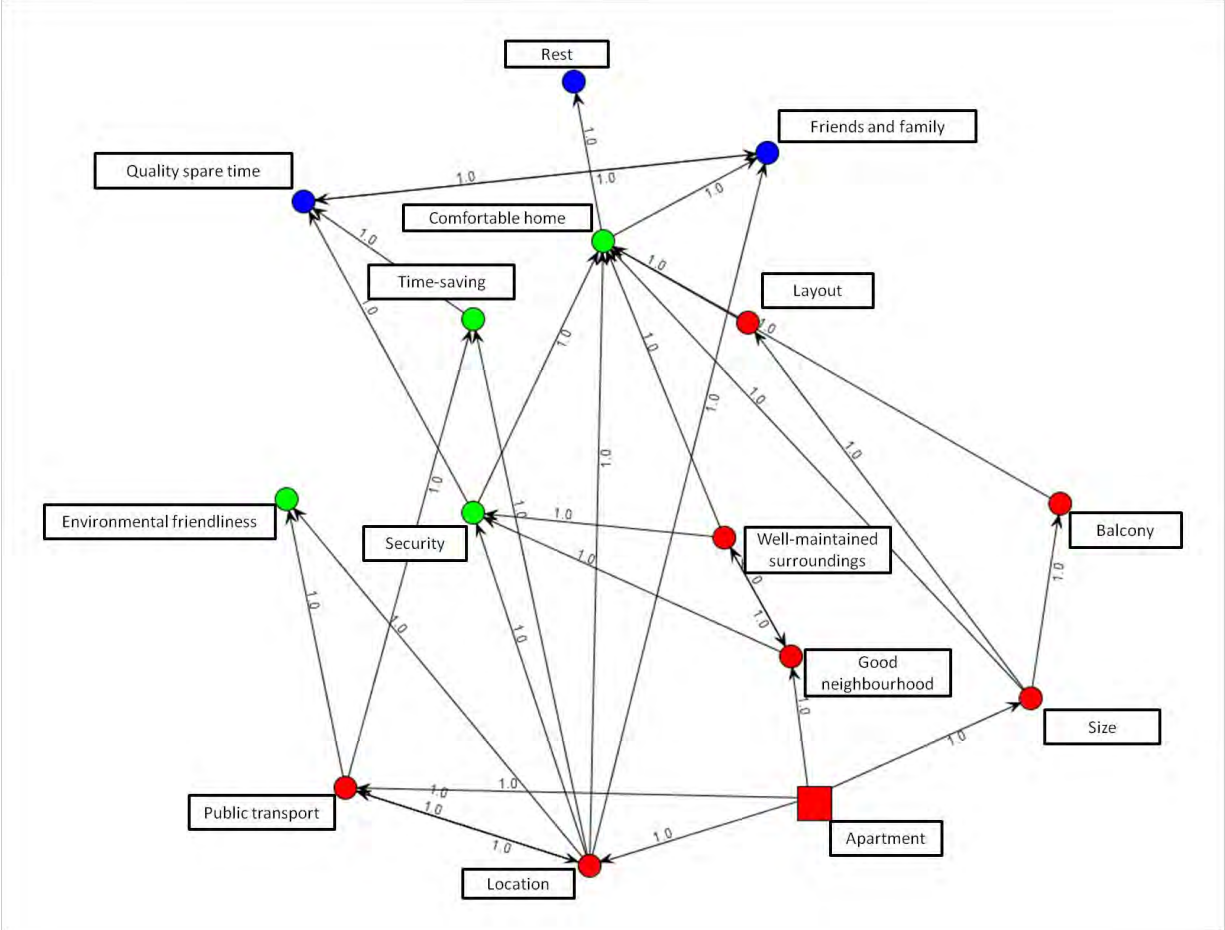


Figure 4: Mind map 2, respondent female, 26, Master's degree, lives alone.

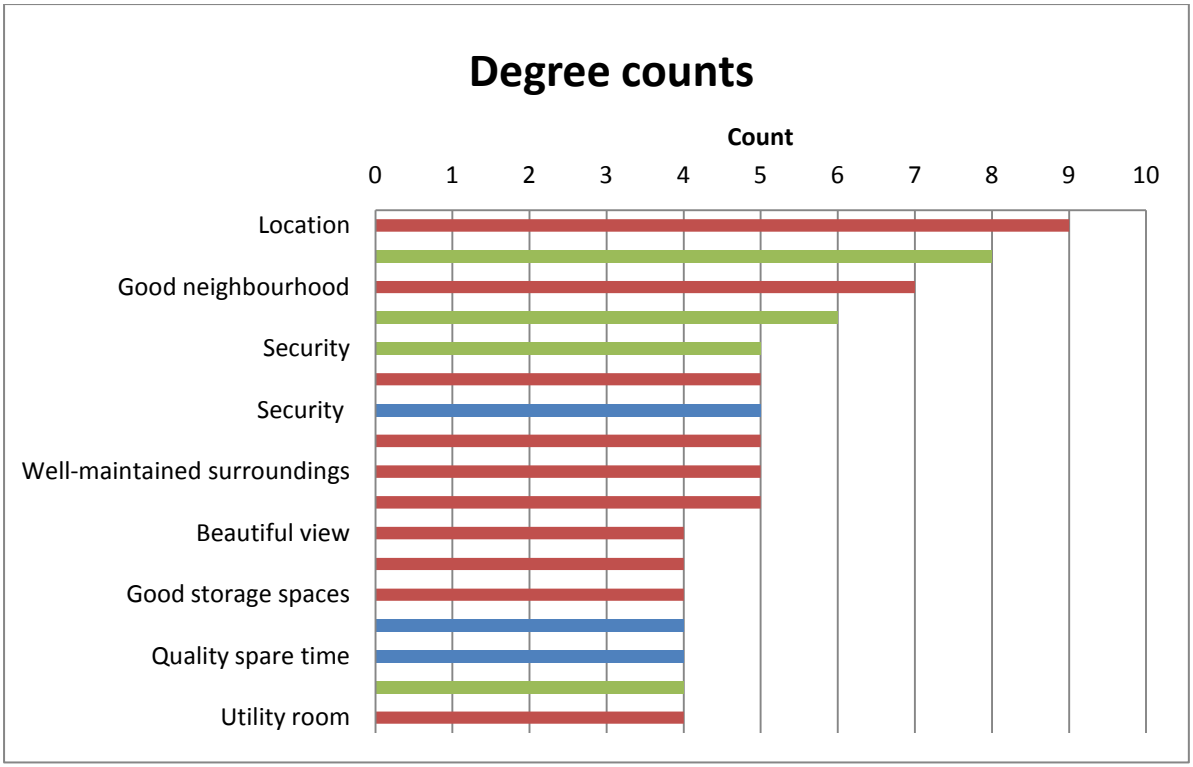


Figure 5: Highest degree counts of variables. Attributes in red, consequences in green, values in blue.

Another interesting finding is that almost all linkages between the variables were unique. Links which appeared more than once linked 'apartment' to 'healthy apartment', 'good neighbourhood', 'big kitchen', and 'beautiful view', and quite interestingly 'location' to 'public transport'. The very small number of shared linkages indicates that housing is a complex issue, and there are few shared ideas about why certain aspects are important.

4.3 Comparisons with previous studies

Although the results of our study are rather tentative, it is interesting to compare them with other studies on housing preferences in Finland. These give more perspective, and may help in interpreting the maps.

Helminen-Halkola et al. (2001) studied the housing preferences of people living in Espoo, capital region of Finland. While the main focus was on the living environment, they also asked about the desired properties of apartments. ATT (2005) in contrast focused on the properties of apartments, and their survey acted as a basis for the development of their construction activities. Arvola et al. (2010) concentrated on the general surroundings of two neighbourhoods (one purely residential, one a mix of residential and commercial) in Helsinki capital region in Finland.

Helminen-Halkola et al. (2001) asked their respondents to rate a list of 22 variables according to how important those were in their dream apartment. Most of the variables related to the apartment itself, but some referred to the housing company or nearby surroundings. Those ranked the most important among all respondents were functionality of layout, soundproofness, an own sauna, a terrace, good storage spaces, healthy apartment, well-

maintained surroundings, and good neighbourhood. Many of these, e.g. good neighbourhood and functionality of layout also feature prominently on our maps.

Some interesting similarities emerge between ATT (2005) and Helminen-Halkola et al. (2001). A healthy, well-soundproofed apartment is very desirable, as are good storage spaces. The most interesting difference between these two studies seems to be the difference assigned to communal aspects of housing. In ATT (2005) communal aspects, including laundry and storage facilities were deemed considerably more desirable than was the case in Helminen-Halkola et al. (2001). The mode for these was 'the most suitable', and the difference was at its clearest in the case of lifts, which were not very important at all in Helminen-Halkola et al. (2001), while almost all respondents in ATT (2005) thought a lift would be very suitable for them. These differences are interesting, and not explained by respondents' age or type of housing they live in.

The hierarchical value maps represented in Arvola et al. (2010) are only in some ways comparable with our results, as that study did not focus on attributes of apartments. Their hierarchical value maps include more shared connections than our mind maps do, because of combining variables mentioned by interviewees to make up larger entities. The main similarity to our study appears to be the importance assigned to good location and the tendency to highlight attributes which are good for children.

Thus, it appears that the findings of our study are reasonably in line with the previous housing research in Finland. People tend to value good location, and practical attributes of housing. However, ecological values, evidenced e.g. by the rank of public transport (figure 5), seem to have gained in importance to an extent.

4.4 Application to timber construction

The applicability of the data to timber construction is an interesting issue. The variables which might be useful in terms of timber construction are 'wood as building material', 'facade material', 'frame material', and 'good soundproofing', because multi-storey timber buildings sometimes have problems with soundproofing (e.g. Karjalainen 2002). Most of these variables did not feature very often on the mind maps. 'Facade material' appeared five times as an attribute and once as a value, and was not linked to any other variables. 'Frame material' appeared once as an unconnected attribute, and 'good soundproofing' featured as an attribute on one map, where it was rather oddly connected to 'sufficient parking spaces'. In comparison, 'wood as building material' featured on the maps quite often, five times as an attribute, once as an unconnected consequence, and once as a value. All of these variables were also quite likely to be removed from the default maps, which indicates that they might not be that important to people.

The one mind map where 'wood as building material' featured as a value is quite interesting and is represented in figure 6. In this map, wood is directly connected to 'closeness of nature' and through it to other variables related to quality of life. This seems to indicate that at least for some people wood as a building material has positive associations with environmental values, and might form a target market.

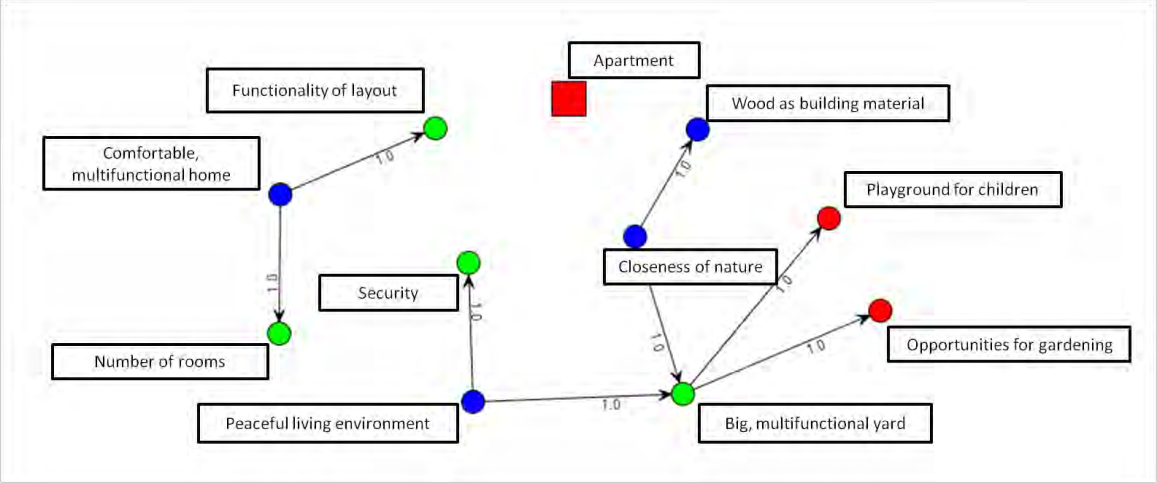


Figure 6: Mind map 3, respondent female, 36, Master's degree, lives with spouse and children.

What these results suggest to timber construction industries is that facade material is more important than frame material, and that wood might have a positive image, which could be utilised in e.g. marketing. Our data also indicates that good soundproofing might not be quite as important to consumers as the other Finnish studies claim. Thus, the challenges of good soundproofing in timber frame buildings might not be such a hindrance, as long as the buildings meet the norms set in regulations. In general, timber construction industries should focus on producing houses that are practical, attractive, and of high quality. As for example Karjalainen (2002) suggests, the Finnish construction industry in general struggles with quality issues, and high quality timber buildings might be able to gain larger share of market.

4.5 Suggested improvements to the application

Our experimental application had some problems, which caused the rather low 'response rate'. The site on which the instructions were was opened 872 times during the data collection process, and out of these, 314 people clicked to open the questionnaire, although due to the security message some may not have launched it. Even though some of these visits were from members of the research team, the fact that we only got 50 responses indicates that the application was not yet sufficiently easy to use.

The concept of mind maps was not familiar to all the respondents, which caused some confusion. It seems some respondents were unable to structure their thoughts in a visual manner, despite the instructions given in the application. Secondly, the distinction between attributes, consequences and values appeared difficult to understand, which is a general problem with means-ends chain theory (see e.g. Grunert and Grunert 1995). It appears to be hard for people to think about their preferences in hierarchical terms. We thought the visual approach would make seeing interconnections easier, but the respondents still struggled with this.

The respondents also had some difficulties with the graphical user interface of the application. We received some feedback on these issues, e.g. that the separate windows in the original application were confusing, it was difficult to execute all the different commands, and that it was problematic to connect the attributes. Some respondents were also wondering if the location of the nodes had some significance, or if the axes should have labels.

Some of the difficulties originated from the instructions, which were deemed confusing. Suggested improvements for this were a simple demo map, or constructing the map in a controlled setting, e.g. during a fair. Giving the respondents too much freedom in this type of setting might make it more difficult for them to provide responses, because an interviewer does not guide them. Still, in order to get an accurate picture of the thought patterns of people, it would seem preferable to give them more leeway and freedom, even if this leads to some responses getting lost along the way.

On a positive note, a majority of the respondents were able to make changes to the default maps. They removed variables they did not find important, added new ones, connected variables to each other, and changed attributes into consequences or values. Some connections seem a little strange, as does the labelling of some consequences or values. Nevertheless, the respondents attempted to draw complex mind maps. We also received positive feedback about the visual nature of the tool, which made it easier to think about complex relationships. Thus, it seems that the tool does have potential, but needs further development.

5. CONCLUSIONS

The mind map as a tool to uncover means-ends networks is an interesting application, even if it still requires technical development to improve its usability. For many respondents it was easier to think about a complex issue such as housing with the help of a visual tool. For others usability might improve with clearer instructions.

Our tentative findings seem to be mostly in line with the previous housing research conducted in Finland. Our respondents appreciated a comfortable, well-located home with a good layout in a good neighbourhood, which is hardly surprising. It was also interesting that for example child-friendliness of apartments and surroundings, and environmental values seemed to feature more strongly in our data than in the earlier studies.

Timber construction sector could benefit by focusing on good architecture and building high quality multi-storey buildings. Our respondents did not seem to find the frame material or soundproofing, which have sometimes been seen as hindrances to larger-scale timber construction, very important. In our data, wood as a building material had some positive associations, but was mostly not linked with other variables, so more work needs to be done on assessing consumer perceptions of wood in buildings. However, it seems likely that consumers are more concerned about other attributes of housing than building materials.

6. REFERENCES

Albert, R and Barabási, A-L (2002) Statistical mechanics of complex networks, Reviews of modern physics, vol 74, pp 47-97.

Arvola, A, Lahti, P, Lampila, P, Tiilikainen, A, Kyrö, R, Toivonen, S, Viitanen, K and Keskifrantti S, 2010, Asuinympäristön ominaisuudet ja asukkaan arvot – Kuluttajatutkimusnäkökulman sovellus asuinympäristön koetun laadun tutkimukseen, VTT.

ATT, 2005, Millaisen asunnon haluaisit?, ATT, Helsinki.

Cline, B E, Brewster, C C and Fell, R D (2010) A rule-based system for automatically evaluating student concept maps, Expert systems with applications, vol 37, pp 2282-2291.

Evrekli, E, Inel, D and Balim, A G, 2010, Development of scoring system to assess mind maps, Procedia Social and Behavioral Sciences, vol 2, pp 2330-2334.

Grunert, K G and Grunert, S C, 1995, Measuring subjective meaning structures by the laddering method: Theoretical considerations and methodological problems, International Journal of Research in Marketing, vol 12, pp 209-225.

Helminen-Halkola, R, Koskinen, U-M, Miettinen, T, Munter, A, Savikko, T, Välimäki, A, 2001, Espoolaisten asumistoiveet 2000, Tieto- ja tutkimuspalvelut, Espoon kaupunki.

Karjalainen, M, 2002, Suomalainen puukerrostalo puurakentamisen kehittämisen etulinjassa, Arkkitehtuurin osasto, Oulun yliopisto.

Miles, S and Rowe, G, 2004, The laddering technique, in Doing social psychology research, G. M. Breakwell (ed), The British Psychological Society and Blackwell Publishing, pp 305-343.

Reynolds, T J and Gutman, J, 1988, Laddering theory, method, analysis, and interpretation, Journal of Advertising Research, vol 2, pp 11-31.

Schauerte, T, 2009, Investigating consumer perceptions by applying the extended association pattern technique – A study on wooden multistory houses, Växjö University Press.

Forest Knowledge Know-how METLA Well-being

Mapping customers' minds with a new technique – case 'Housing needs and preferences in Finland'

Maria Riala

Tuomas Nummelin

Finnish Forest Research Institute

maria.riala@metla.fi
tuomas.nummelin@metla.fi

Contents

- Introduction
- Means-end chain theory in marketing research
- Mind map as a tool to mapping customers' mind
- Tentative results
- Conclusions

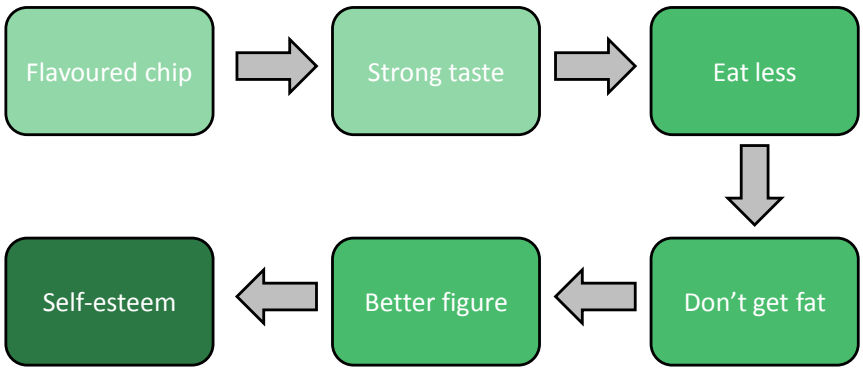
METLA

Introduction

- On-going research project into what **customers** of woodworking companies need and want from wood products
  - Includes **housing**, a complex area of consumer research
  - From the point of view of **timber construction**, knowing what aspects of housing matter to consumers might offer business opportunities
  - Funding for travel costs from Finnish Forest Foundation
- We approached housing with means-end chain theory, and developed a new method to uncover **means-end networks** related to housing

METLA

Means-end chain theory



METLA

Uncovering means-end chains

- **Laddering** interviews
  - Ways of making it easier for consumers to think about why they prefer certain aspects of products
  - Hard vs. soft laddering
- Applications generally in consumer products, e.g. exploring cross-cultural differences

METLA

Previous applications of means-end chain theory in housing

- Consumer perceptions of **residential environments** in Finland
  - Walking tour of two residential neighbourhoods
  - Assessing positive and negative aspects
  - Laddering interviews conducted by phone
- Consumer perceptions of **wooden multi-storey houses** in Sweden and Germany
  - Laddering interviews in person
  - Structured matrix postal surveys

METLA

Difficulties faced by previous applications

- Orientating consumers to discuss preferences in a **linear manner**
- **Interpreting** data – differences between attributes, consequences, and values
- Grouping variables
- Specific challenges in the **housing** studies
  - Extremely complex survey
  - Coding of the results

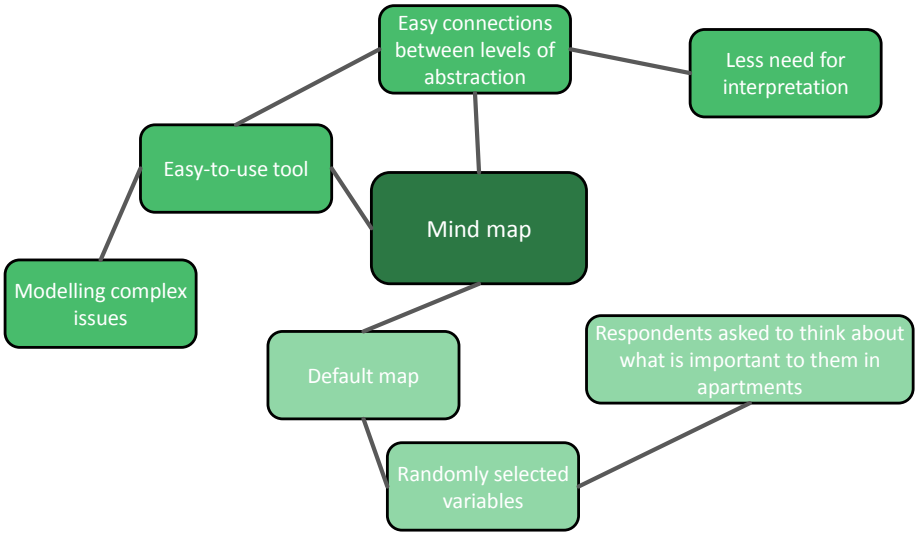
METLA

Mind map application – concept

- **Easy-to-use** tool to model complex issues in a visual manner
- Easier to make **connections** between levels of abstraction and less need for interpretations by researchers
- Starting with a default map, with a **randomly** selected group of variables
- Respondents asked to think about what is important to them in apartments

METLA

Mind map application – concept

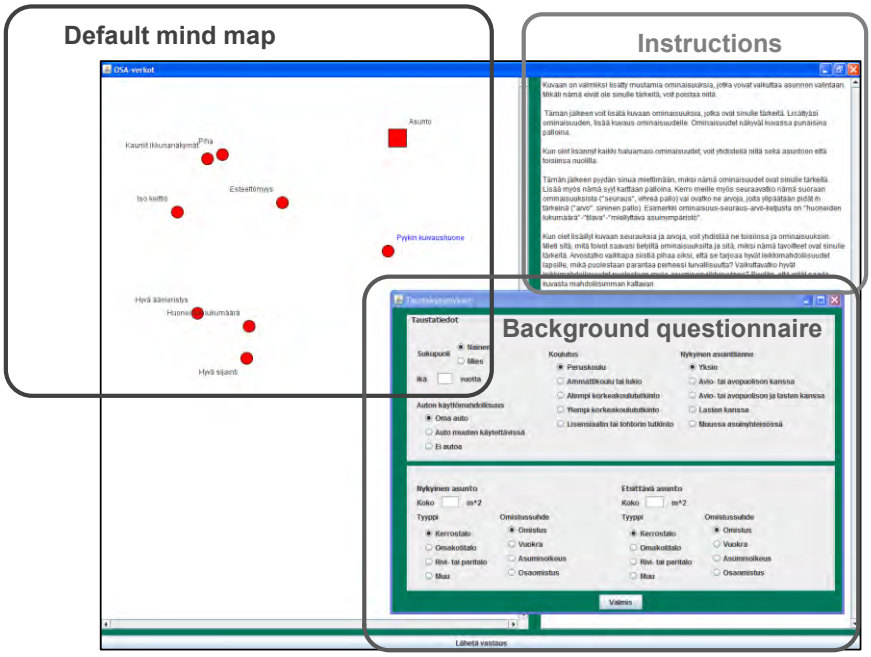


METLA

Mind map application – in practice

- **Web-based** application on our institute's website
  - Produced with Java
  - Improvements based on user feedback throughout the data collection process
- Respondents directed there through a variety of channels
  - Mainly through an advertising campaign on a Finnish website with rentals and apartments for sale
  - Also used links on our institute's website, Twitter feed, newsletter, and Facebook

METLA

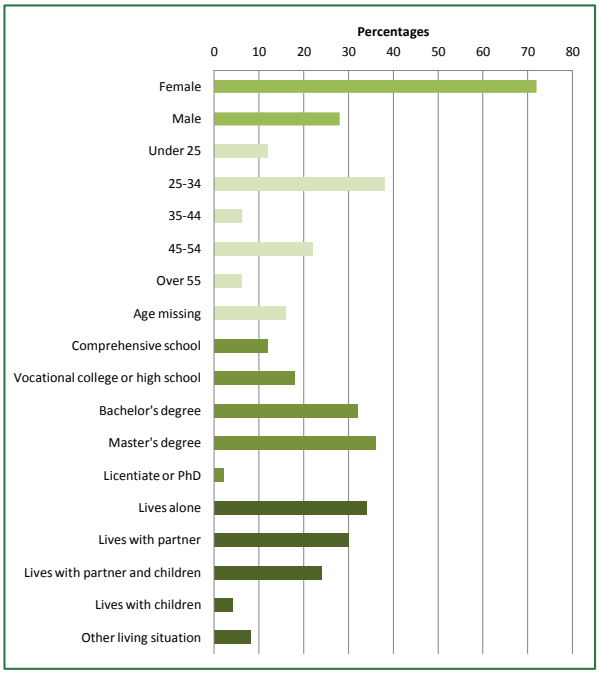


Results – data

- 50 responses, out of which 31 valid
- Small variance in the proportion of valid responses according to age and educational level

Results – respondent characteristics

- Women considerably overrepresented
- Somewhat skewed towards the younger, more educated section of Finnish population

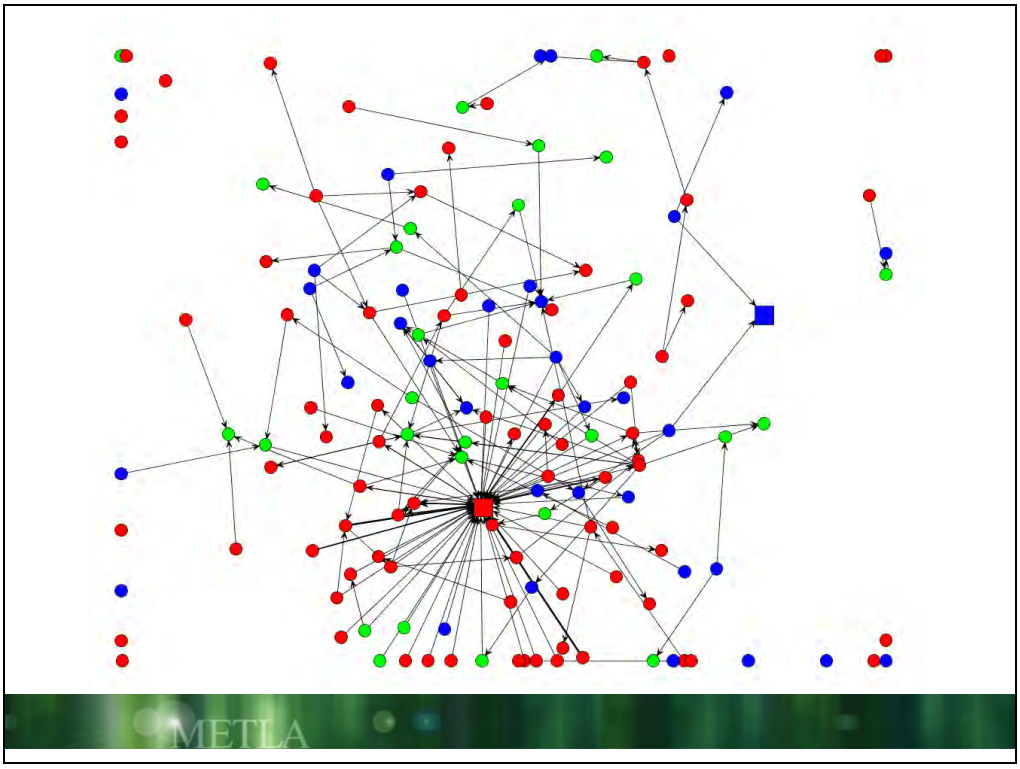


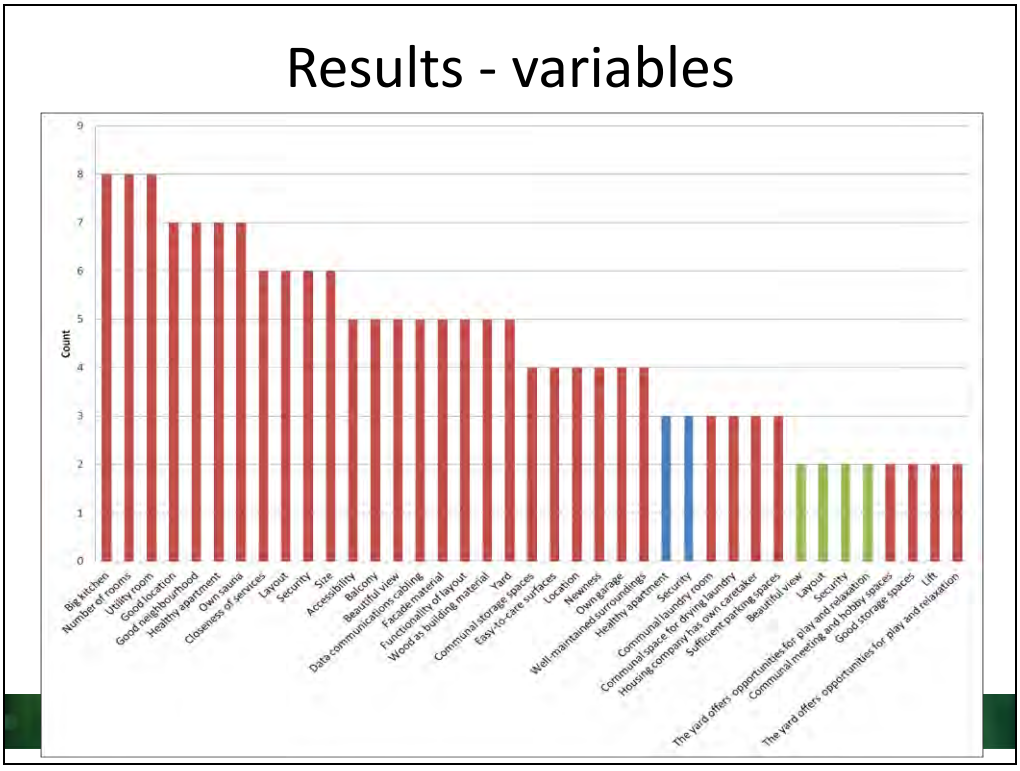
METLA

Results – variables

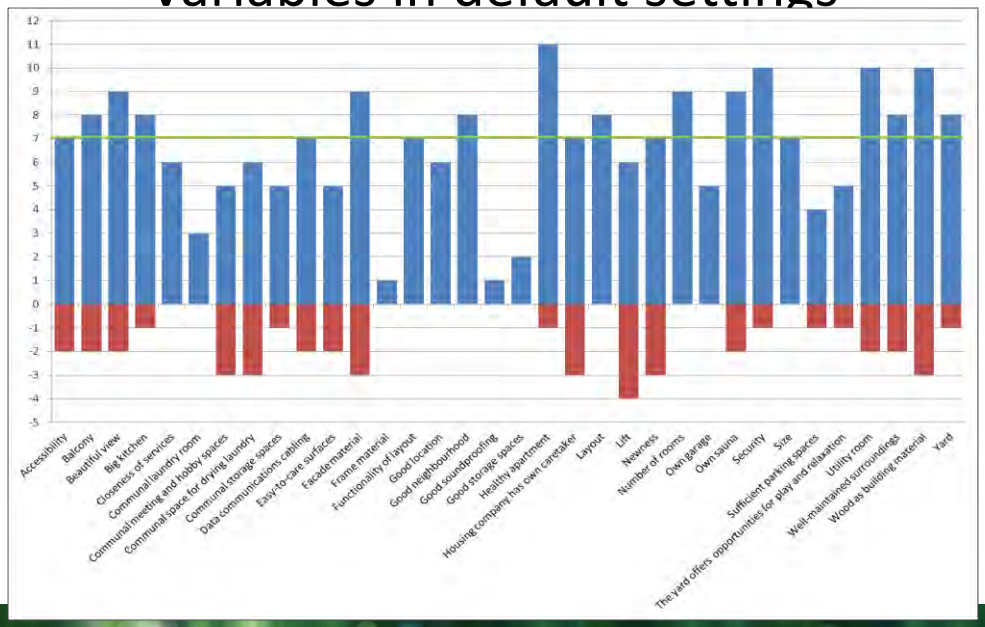
- The mind maps were of good quality
- Contained **119** variables
- Many **requirements** quite practical, and possible to detect slight emphasis on needs of children and family

METLA


METLA


Results - variables
Count
0
1
2
3
4
5
6
7
8
9
Big kitchen
Number of rooms
Utility room
Good location
Good neighbourhood
Healthy apartment
Own sauna
Closeness of services
Layout
Security
Site
Accessibility
Balcony
Beautiful view
Data communications cabling
Facade material
Functionality of layout
Wood as building material
Yard
Communal storage spaces
Easy-to-care surfaces
Location
Newness
Own garage
Well-maintained surroundings
Healthy apartment
Security
Communal laundry room
Communal space for drying laundry
Housing company has own caretaker
Sufficient parking spaces
Beautiful view
Layout
Security
The yard offers opportunities for play and relaxation
Communal meeting and hobby spaces
Good storage spaces
Lift
The yard offers opportunities for play and relaxation

Variables in default settings



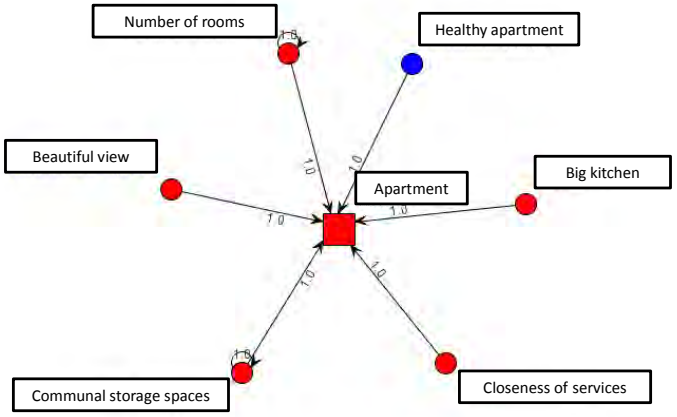
METLA

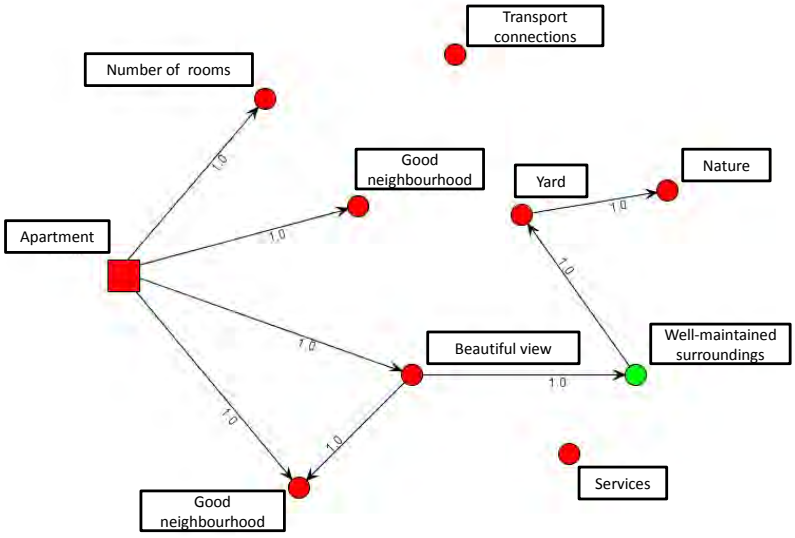
Results – complexity of maps

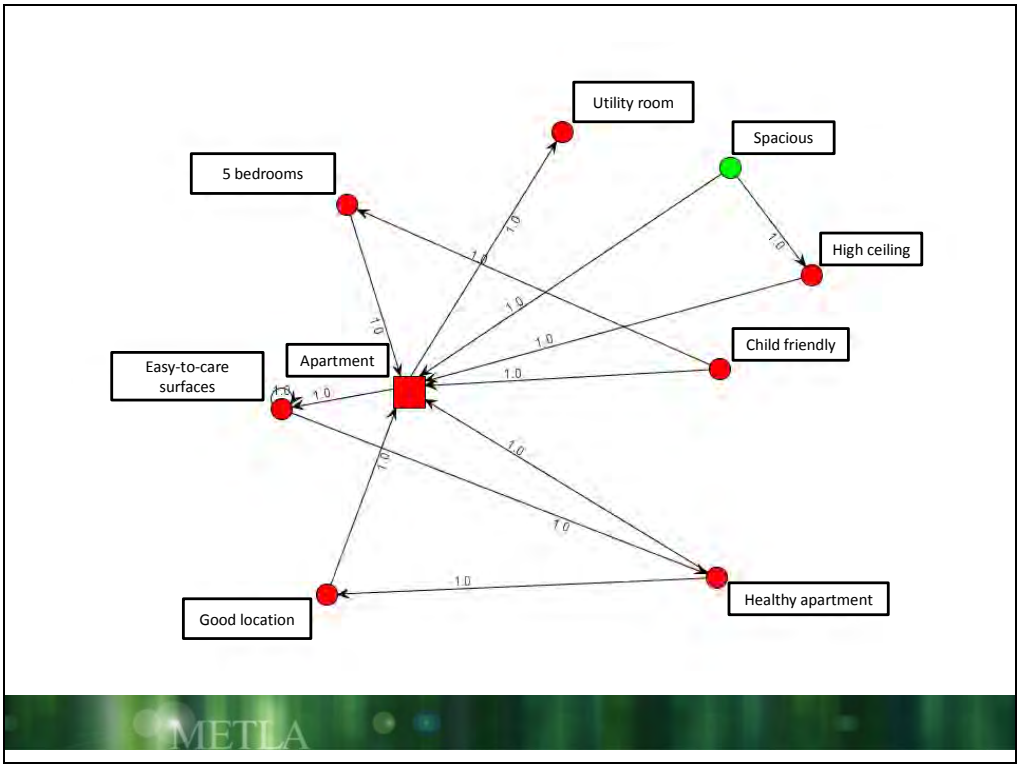
- Analysing the complexity of maps
  - Previous approaches to analysing quality of mind maps done in educational settings
  - We had no correct answers to compare the maps to
- Assumption that a more **complex** map is more **representative** of the mind of the respondent

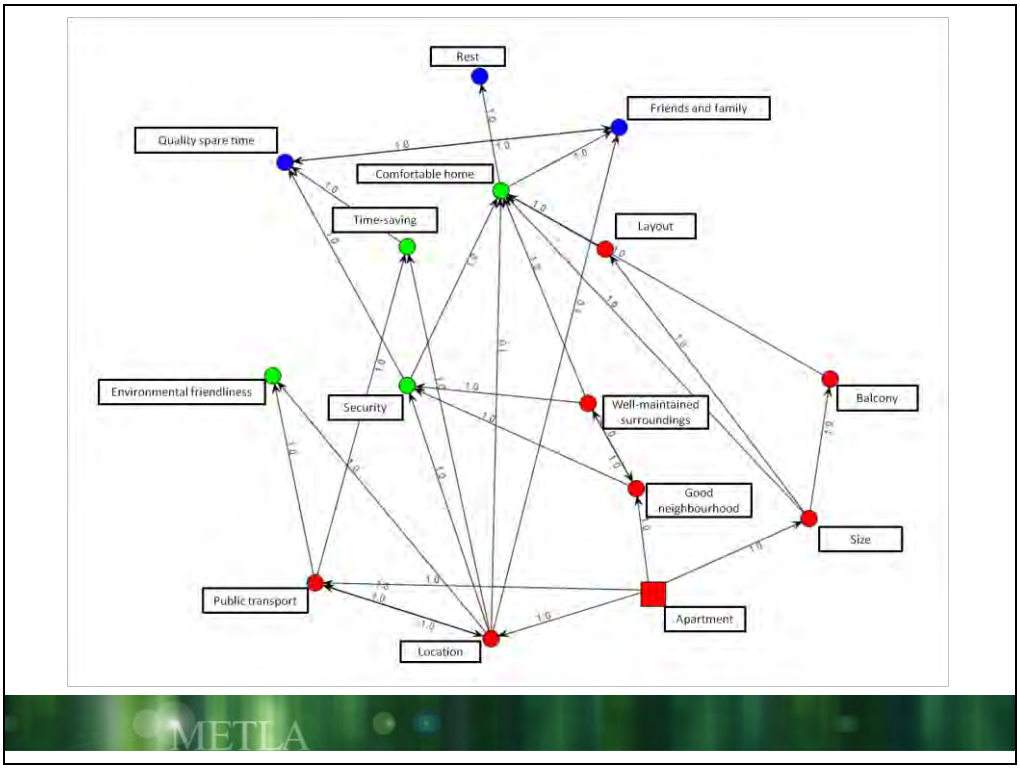
METLA

Results – examples of maps



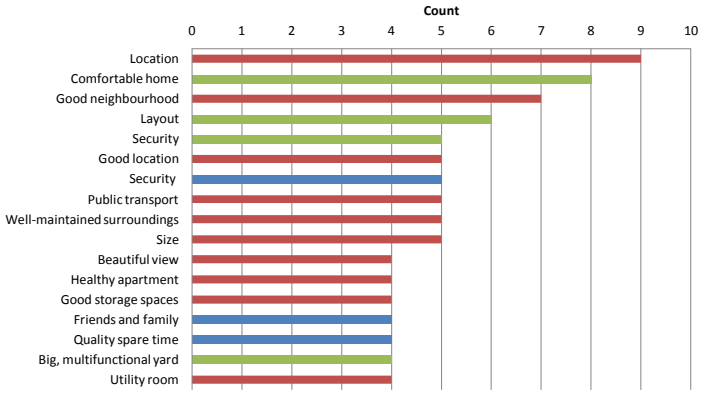



Utility room
Spacious
5 bedrooms
High ceiling
Child friendly
Easy-to-care surfaces
Apartment
Healthy apartment
Good location


Rest
Friends and family
Quality spare time
Comfortable home
Time-saving
Layout
Environmental friendliness
Security
Well-maintained surroundings
Balcony
Good neighbourhood
Size
Public transport
Apartment
Location

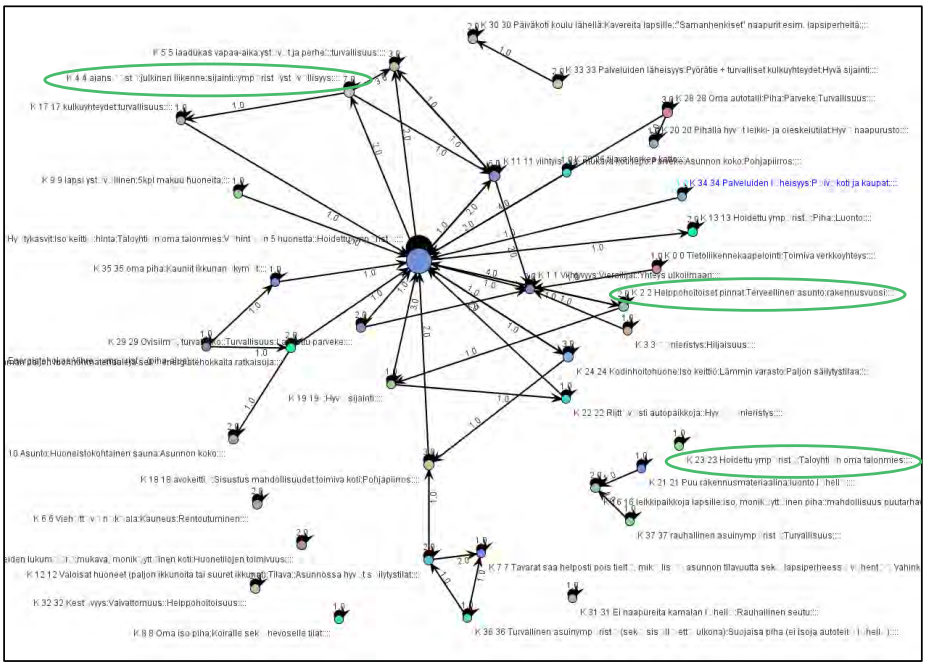
Analysis of complexity

- **Degree** counts, generally used indicator of network properties



Analysis of clusters

- The search for clusters is based on algorithm of Blondel et al. (Heuristic **modularity** maximisation).
- **Clustering** on the basis of those variables the respondents had in common
- The clusters did not differ on the grounds of background variables



Comparisons with previous studies on housing in Finland

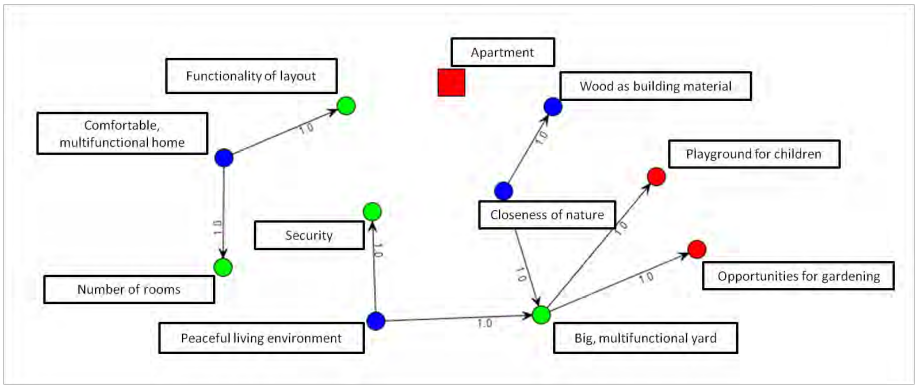
- Important aspects found in **previous studies** e.g. good neighbourhood, functionality of layout, and a healthy, well-soundproofed apartment
- Differences between previous studies e.g. importance assigned to communal aspects of housing
- Findings of our study reasonably in line with previous studies -> **good location and practical attributes**
- **Ecological** values appear to have gained in importance to an extent

Implications for timber construction

- Relevant variables did not appear on the maps very often
  - 'Wood as a building material' appeared quite frequently in comparison to others
- Our findings suggest
  - **Facade material** more important than frame material
  - Wood might have a positive **image**
  - Good **soundproofing** might not be that important

METLA

Mind map with wood as building material



METLA

Suggested improvements to the application

- General problem of means-end chains is **hierarchical thinking**
  - Attribute-consequence-value distinction also challenging
- Concept of mind map **unfamiliar**
- Problems with usability -> low 'response rate'
- Problems with the graphical user interface
- Confusing instructions
- However, **majority** of respondents were able to do what was asked of them

METLA

Conclusions

- Mind map an **interesting** method
  - Needs further development
- Finnish consumers seem to **value** a comfortable, well-located home with a good layout
  - Ecological values and child-friendliness also emerging issues
- **Timber construction** should probably focus on good architecture and high quality buildings
  - Frame material and soundproofing do not appear to be barriers

METLA