

# Building from England's Woodlands

## Research into using more hardwoods

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Confor UK Policy Conference, 7<sup>th</sup> December 2023

# Building from England's woodlands

- Enhance use of the forest resource in England
  - In the built environment
  - Demonstration of what is possible
  - Inform future forest strategies (species)
- Open up the value chain
  - Test compatibility for MMC
  - Education and outreach

# Project work packages

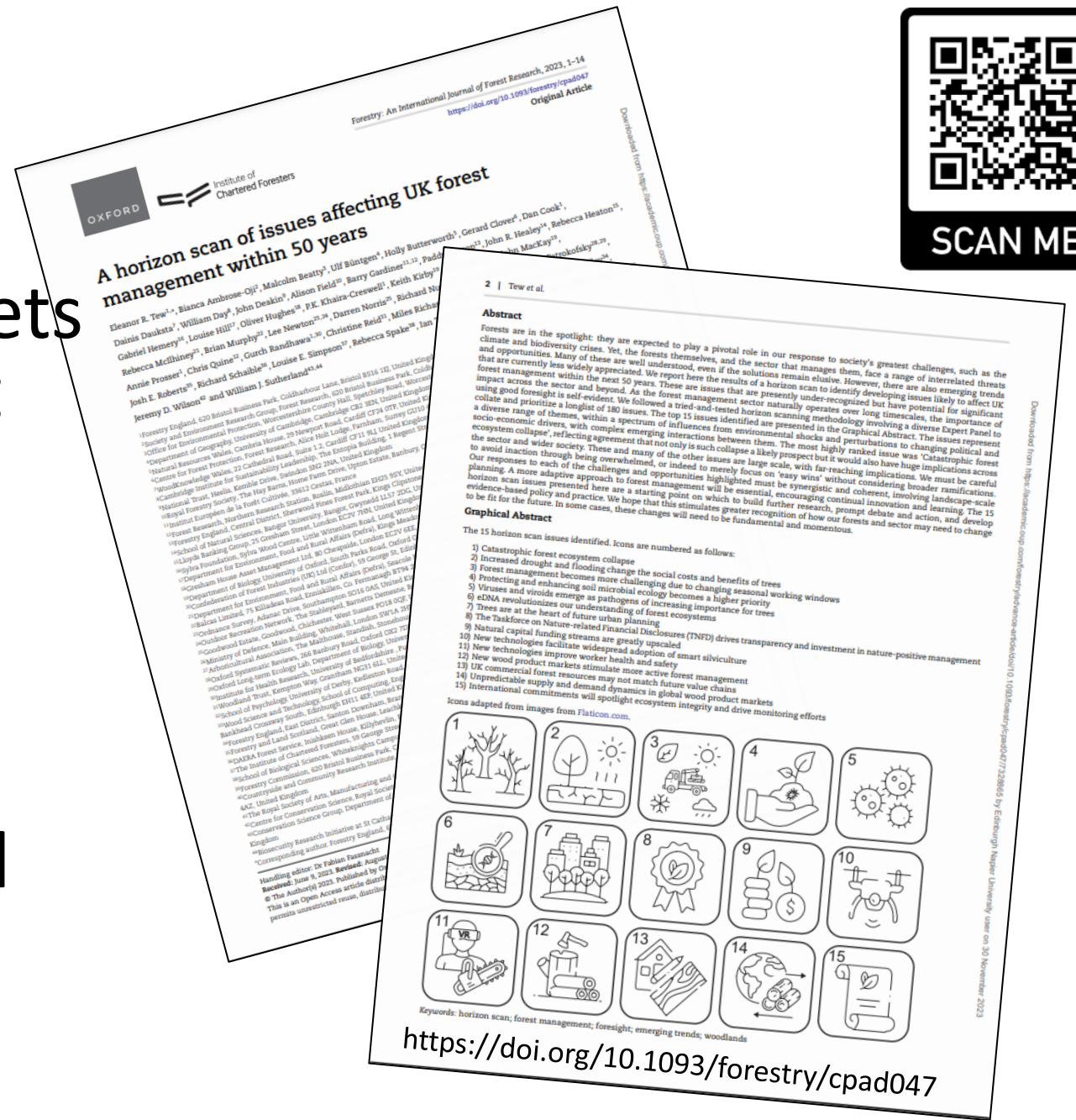
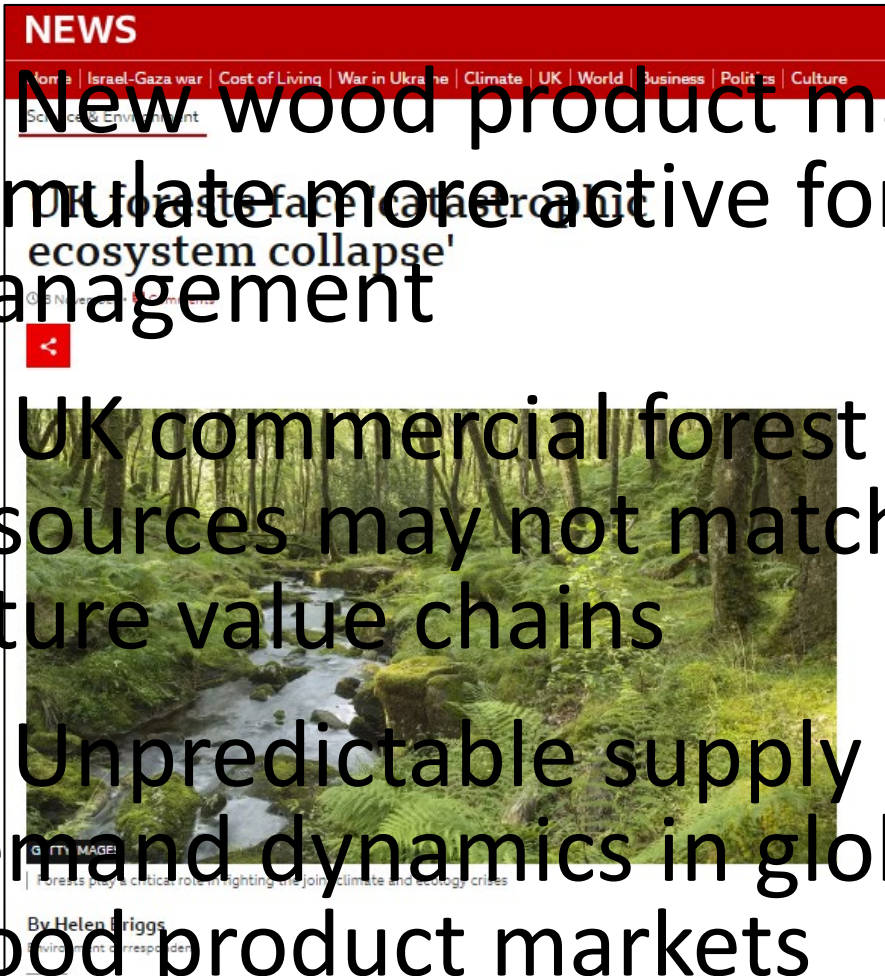
Timber in Construction Innovation Fund

A 3-year project (started June 2022), £296,520 value

- WP1 Project management
- **WP2 Wood properties categorisation**
- **WP3 Optimised engineered timber products**
- WP4 Pilot manufacture and prototype testing
- **WP5 Outreach and education**

# Why?

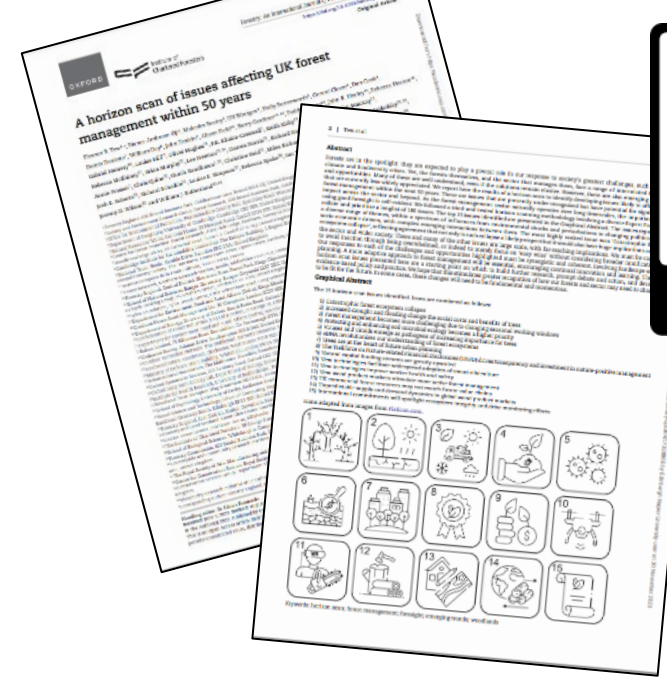
- 12) New wood product markets stimulate more active forest management
- 13) UK commercial forest resources may not match future value chains
- 14) Unpredictable supply and demand dynamics in global wood product markets



# Some considerations

- The need for wood
- Social and cultural value
- Nature
- Climate change
- Pests and diseases

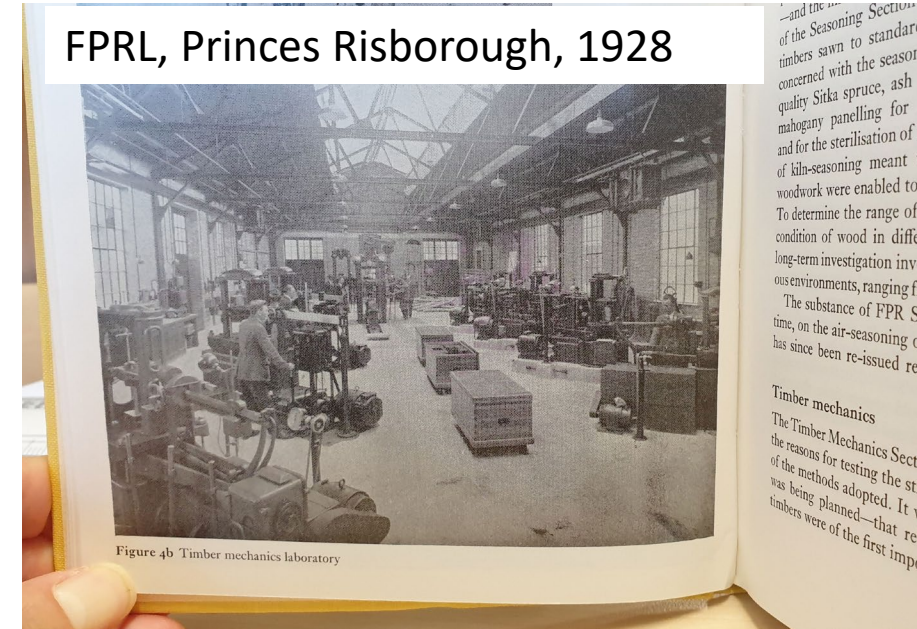
Should we see  
*“the trees for the wood”* or  
*“the wood for the trees”*?



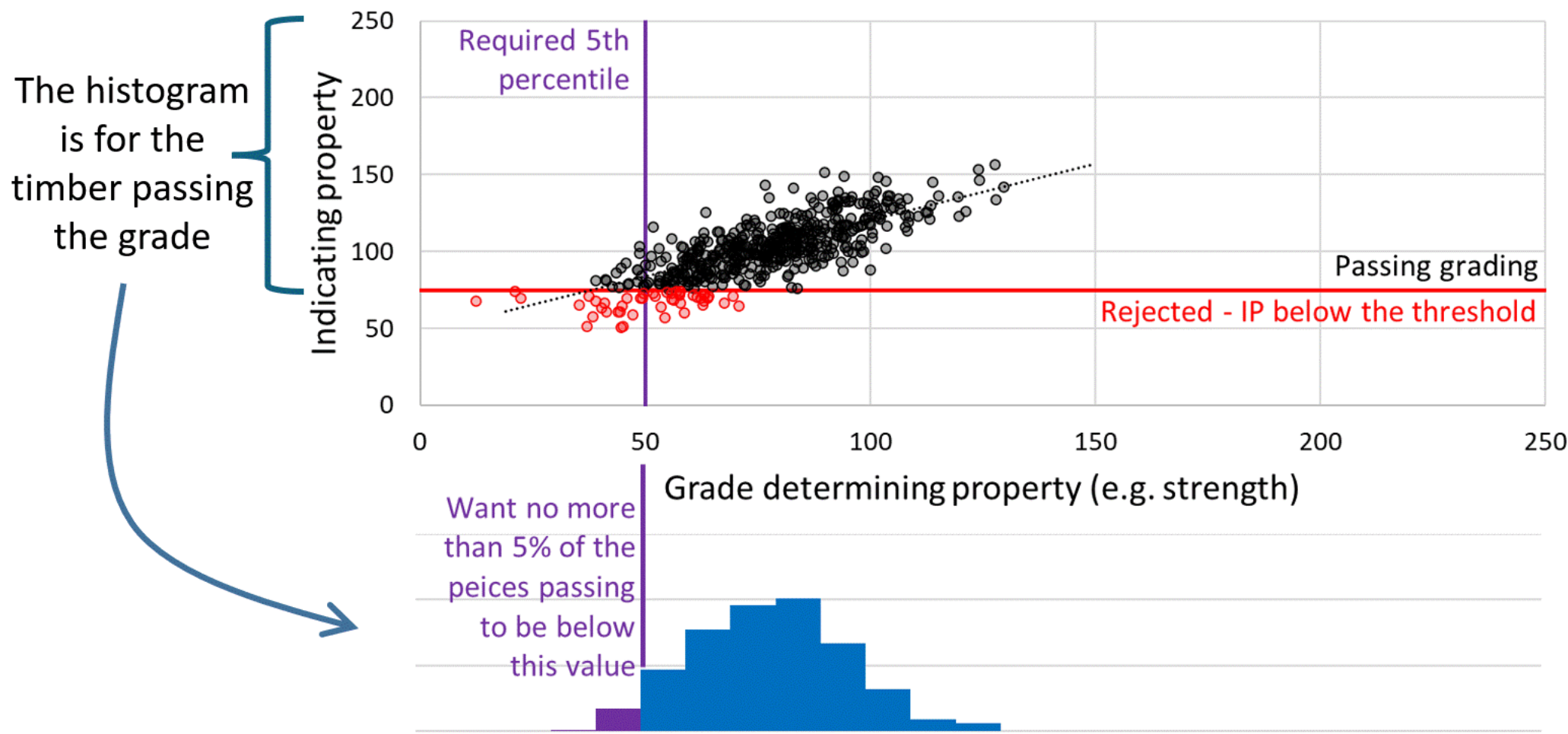


# Wood properties categorisation

- Which species have potential?
- What are their properties?
- Best route to strength grading?
  - For “new” species?
  - Are existing routes still fit for purpose?
  - How can standards be improved for species diversification?



# Construction and strength grading





# UK softwood summary

<https://doi.org/10.1080/20426445.2022.2050549>

	Species	Research	Data	Strength	Ungraded Stiffness	Density	Grading <small>From 95% machine yield</small>	Durability <small>Fungi, EN350</small>
Grading options	Spruce <small>(UK &amp; IE) (Sitka &amp; Norway)</small>	ENU, FR, UoG	😎	C18	C16	C20	C16 to C27	5-4
	Larch <small>(UK &amp; IE) (European, Japanese, hybrid)</small>	ENU, FR, UoG	😊	C20	C20	C35	C20 to C35	4-3 😊
	Douglas-fir <small>(UK &amp; IE)</small>	ENU, FR, UoG	😊	C16	C22	C35	C16 to C40	4-3 😊
	Pine <small>(UK &amp; IE) (Scots &amp; Corsican)</small>	ENU, FR, UoG	😊 😬	C20	C18	C35	C16 to C24* 🔍	4-3 😊
No current strength grading options	Noble fir	ENU, FR	😬	C14	C16	C18	C14? to ?	4
	Western red cedar	ENU, FR	😬	C16	C14	C16	C14? to ?	3 😊
	Western hemlock	ENU, FR	😬	C18	C18	C30	C16? to ? 🔍	4
	European silver fir	ENU, FR	😬	C20	C18 <small>(C22?)</small>	C24	C16? to ? 🔍	4
	Grand fir	ENU, FR	😬	C14	C16 <small>(C20?)</small>	C14 <small>(C27?)</small>	C16? to ? 🔍	4
	Pacific silver fir	ENU, FR	😬	C16	C18	C16	C16? to ? 🔍	Not listed
	Serbian spruce	ENU, FR	😬	C16	C20	C27	C16? to ? 🔍	Not listed
	Japanese red cedar	ENU, FR	😬	<C14	<C14	<C14	C14? to ?	5
	Caucasian fir	ENU, FR	😞	<C14	C20	C24	C14? to ?	Not listed

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Subject to change as more data is collected, date made: 19/09/2023

ENU = Edinburgh Napier University; FR = Forest Research; UoG = University of Galway

\* Pine grading options are very limited and probably not optimal

Durability is for heartwood against fungi. 5 = 'not durable'; 4 = 'slightly durable', 3 = 'moderately durable'



Strategic Integrated Research in Timber



# The route to strength grading

Plot stage



Phase 1: A first idea of wood properties  
50 to 200 boards tested

*Select species with potential*



Phase 2: A better idea of wood properties  
200+ boards tested, more than 1 site

*Select promising species*

Commercial stage



Phase 3: Initial grading work  
500 to 1500 boards tested, 4+ sites, range of sizes  
Needs to be representative of actual production  
Less usual species require more data

*Species in commercial production*



Phase 4: Further grading work  
1500+ boards tested, many sites, sizes, machines

Assessing potential

Gathering data on:  
variability  
adjustment equations  
secondary properties  
potential for species combination  
likely yields  
processing issues

Improved grading options  
Monitoring existing options  
Forest management effects

# Hardwoods

## Mainstream hardwood property profiles

Oak

*Spain, Italy, France*

Sweet chestnut

*Sweden, Norway, Ireland*

## Other hardwoods

*Italy, France, Belgium, Austria*

Birch, ash, beech, sycamore

cherry, lime, American red oak

## Possibly suitable for “softwood” markets

Poplar, aspen, alder, willow

*France*





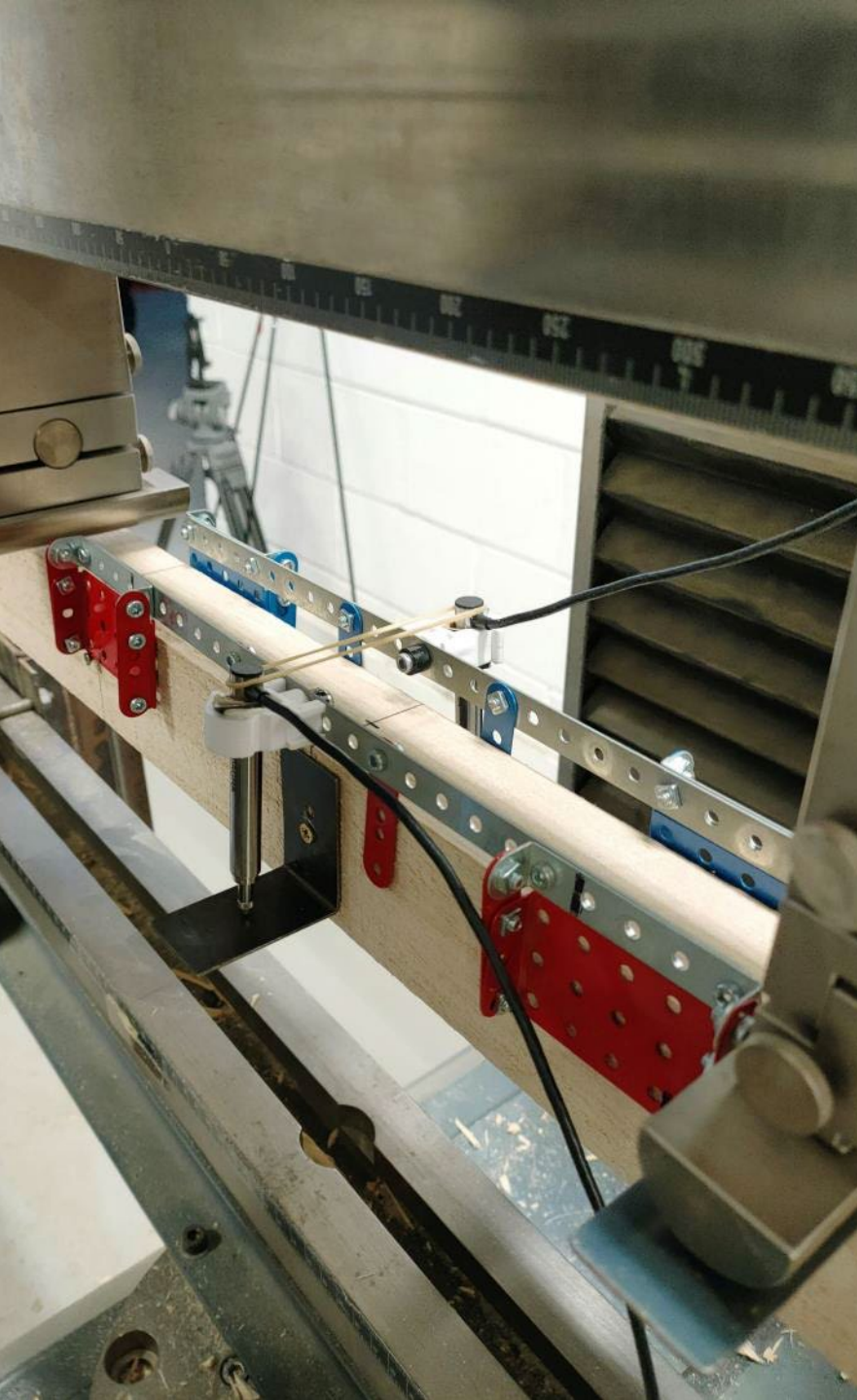








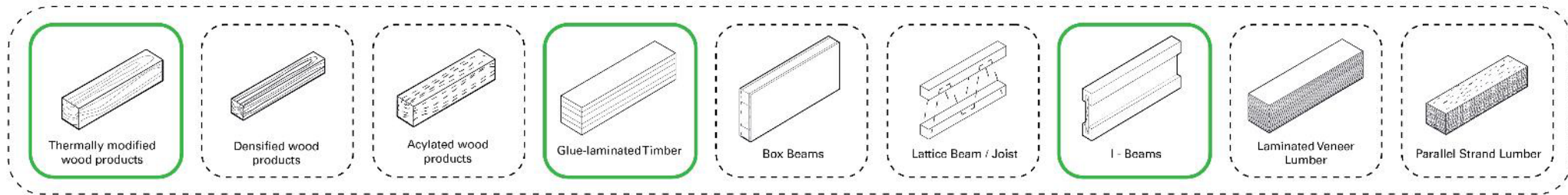




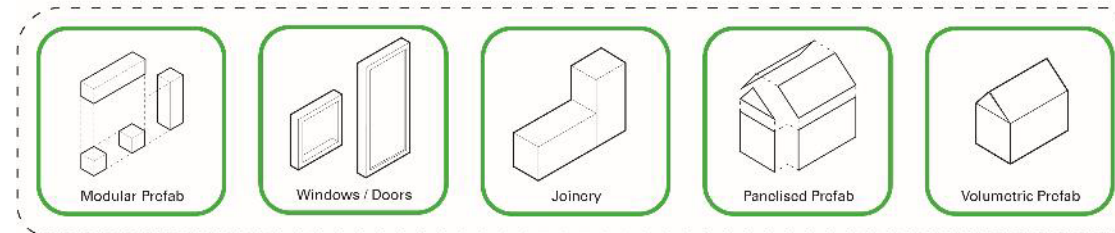


# Some products

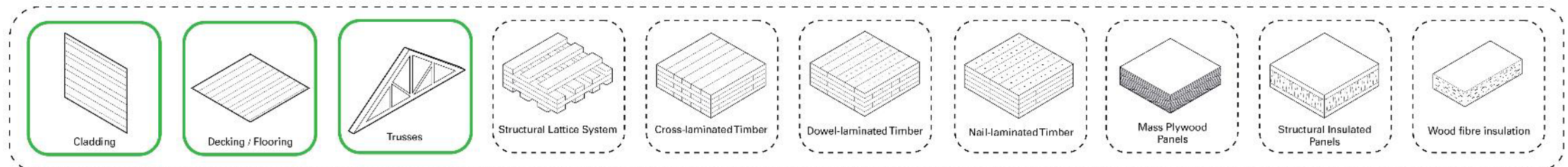
## BEAM / JOIST SYSTEMS



## PRE-FABRICATED SYSTEMS



## WALL / FLOOR / ROOF



# Some products

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Research. Innovate. Commercialise.

## R2232\_002 Interim Report - WP3 – Compatibility of UK Hardwoods for Engineered Timber Products

AUTHORS: Wojciech Plowas, Paola Seminara, Gabriele Tamagnone, Connor Aitken, Finbar Charleson

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DATE: 20/03/2023

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R2232\_002 WP3 Compatibility\_FT3\_2020a2023.docx

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In another study at University of Stuttgart, Germany, testing of beech-spruce hybrid CLT, bonded with PUR and PRF adhesives, was conducted by Aicher [2016]. European beech (*Fagus sylvatica*) was used as a cross layer and rolling shear tests were conducted with three methods. Failure happened frequently by longitudinal shear of the spruce layers. The authors concluded that a hybrid CLT resulted in improved strength and reduced deflection when compared to CLT built with homogeneous spruce throughout.



Figure 16 - Rolling shear testing on hybrid CLT consisting of Beech cross layer [Aicher, 2016]

Large-leaf beech (*Fagus grandifolia* Ehrh.) was studied in Canada as a raw material for CLT production at Laval University [Essoua-Essoua, 2012]. The research focused on testing different polyurethane adhesives, with block shear and delamination tests being conducted. The authors noted the high level of volumetric swelling and shrinkage of large-leaf beech (26.9 and 19.0%, respectively), posing a challenge for the adhesives used in such panels. However, the results obtained from this study are within the acceptable values under the Canadian standards for block shear and delamination tests. The authors acknowledge that additional testing of CLT panels is needed, but indicate this material has the potential that could open up new opportunities for the structural wood products industry using a local raw material.

Uzelac [2020], carried out an overview of currently approved GLT members, and to place emphasis on its advantages and potential uses in construction applications.



Figure 17 - Hybrid GLT made of Beech and Spruce [Uzelac, 2020]

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## 5 Proposed EWPs – recommendations and next steps

Presented in this chapter are recommendations regarding direction of the research to be undertaken to assess the feasibility of UK Hardwood resource for EWPs manufacture. These recommendations are based on the market review, research on hardwoods carried out to date.

### 5.1 Mass Timber

Based on the research carried out to date, the best use of hardwoods for mass timber systems application is to use them strategically within the section (top and bottom flange/layers or dowels), forming combined sections of CLT and GLT. This would add the value to the current products, keeping the costs relatively low and not straining the existing hardwood resource.

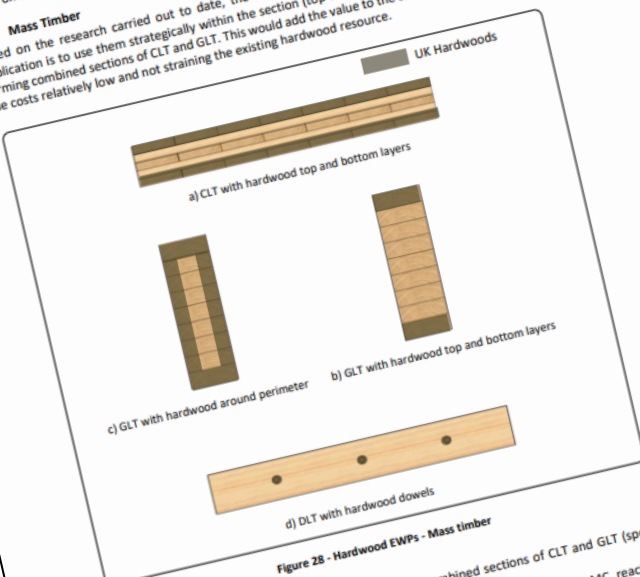


Figure 28 - Hardwood EWPs - Mass timber

Research activities:

- Selection of most appropriate specification for combined sections of CLT and GLT (species, lamella layout, manufacture process and adhesive type)
- To address manufacturing challenges outlined in this document (shrinkage, MC, reaction to adhesive, priming, fj).
- Structural analysis of combined CLT and GLT to outline potential mechanical benefits of the systems.
- Small scale pilot manufacture and lab-based testing

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# Key points

- You don't get “high quality” hardwoods just by having the trees
- We need not think only of “high quality”
- Home grown hardwoods can only be a small contribution to our timber needs
- We need everything we can get
- If we have data, we have options