Time4WoodCraft – the time of wood craftspersons, the time of crafts' wood – a transdisciplinary exploration

Time4WoodCraft – le temps des artisans du bois, le temps des bois d'artisanats – une exploration transdisciplinaire

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ABSTRACT. Multiple dimensions of time are omnipresent in wood and in crafts. Crafts are intertwined with historical time, time of learning and experience, with rhythm and marks of the craftsperson's action, with time and meaning of work, with time perceived and the perception of the material. Biological and geophysical time is inscribed in the wood of the tree. Physical time governs the mechanical behaviour of wood material. A transdisciplinary project called Time4WoodCraft – for "it is time" to rethink our relationship to time and to the living – aims at creating a dialogue between four viewpoints in the human and social sciences, physics and material sciences, life and environment sciences, and craftspersons. To address this wide topic, we organised the research in three interrelated, realistic levels. A broad exploration is based on sharing knowledge from different scientific and woodworking fields, and on collecting information from written sources. Case studies connecting craftsmanship and laboratory analyses are examined in three main directions: perception and measure of temporal markers of wood; changes through time in the selected wood for specific uses; different meanings of wood ageing. Interviews target the importance of time in craft work. The data gathered will be used for mapping connections between physical, biological, and cultural dimensions of time in woodcrafts and in crafts' woods.

RÉSUMÉ. Les dimensions multiples du temps sont omniprésentes dans le bois et dans les artisanats. Les artisanats se conjuguent aux temps historiques, d'apprentissage et d'expérience, aux rythmes et traces du geste, aux temps et sens du travail, au temps perçu et à la perception de la matière. Le temps biologique et géophysique est inscrit dans le bois de l'arbre. Le temps physique gouverne le comportement mécanique du matériau-bois. Un projet transdisciplinaire, nommé Time4WoodCraft car « il est temps » de repenser notre rapport au temps et au Vivant, veut faire dialoguer les 4 points de vue des sciences humaines et sociales, physiques et des matériaux, du vivant et de l'environnement, et des praticiens artisans du bois. Pour aborder ce vaste sujet, la recherche s'organise en trois niveaux réalistes imbriqués. Une exploration large se base sur l'échange de savoirs entre domaines scientifiques et du travail du bois, et sur la collecte de sources écrites. Des études de cas qui connectent savoirs artisanaux et analyses de laboratoires sont examinées dans trois directions : perception et mesures de marqueurs temporels du bois ; changements au cours du temps dans les bois choisis pour un usage spécifique ; différentes significations du vieillissement du bois. Des entretiens sont ciblés sur l'importance du temps dans le travail des artisans du bois. Ces corpus seront utilisés pour cartographier des connexions entre les dimensions physiques, biologiques et culturelles du temps dans les artisanats du bois et les bois d'artisanats.

KEYS-WORDS. Wood, Craftsmanship, Physical time, Biological time, Cultural time.
MOTS-CLÉS. Bois, Savoirs artisanaux, Temps physique, Temps biologique, Temps culturel.

1. Introduction

The multiple dimensions of time are omnipresent in wood and in crafts. Biological and geophysical time experienced by the tree is inscribed in the wood (biomechanics, biochemistry, dendrochronology, dendroclimatology, phylogeny). Physical time governs the mechanical behaviour of the wood material (viscoelasticity, moisture transfers, ageing) and its properties. Historical time, with its cultural gradients in spatial and temporal dimensions, has shaped the crafts and the choices of wood made by craftspersons. Socio-economic and political time has placed craft work on the margins of the industrial age - but this came later for wood than for other categories of materials, as the inherent biological variability of wood does not sit well with standardisation and normalisation processes. The time of the craftsperson's movement and skill, the time of the work sequence – the chaîne opératoire, "*the time to do well and beautiful*" – could, and sometimes still manage to take precedence over "*time is money*". The time of the craftsperson's skill is also reflected in the traces, the marks of working tools eventually merging with the traces left through history and conditions of conservation time. The human time of learning, the time of personal experience, shapes technical dexterity and the perception of the material. Psychosensory time offers a reflection of material properties, while questioning the memory remanence. In this article, we explore how different dimensions of time, and different disciplinary viewpoints can be interconnected, in the particular context of woodcrafts and of crafts' woods. Although our intention is to explore these themes and to provide elements of reflexions at several historical scales, the main focus will be on contemporary craft production and/or on interactions between academic researchers and contemporary craftspersons.

1.1. Some a priori *hypotheses of possible connections between different dimensions of time*

We try here to propose some *a priori* aspects of times of wood and craft that sit at the interface between the (irreducible to each other) notions of "natural time" and of "lived time" (Huneman & Bouton, 2018), developing from an initial focus on contemporary crafts, to cultural aspects, on to natural aspects – physical and biological, and their possible interactions.

Crafts in the contemporary context are not just a "small-scale mode of production", they can either be continuous reminiscences of non-industrial work (Jaeger, 1982), or any "forms of making that self-consciously set themselves apart from mass production" (journalofmoderncraft.com, 2022). In both cases, wood crafts are trades often embedded in a material culture, shaped by the long history between humans and wood (e.g. Radkau, 2012). The time of the craftspersons is itself eminently cultural and varied, depending on learning and on cultural perceptions, as much as on what wants to be produced, all this being moreover affected by the historical trajectory of cultures and tools. Ancient, transmitted knowledge about the choice of wood for various technical uses could be considered as "reverse methods" in the identification of species and/or types of wood with particular technological properties (Klein *et al.*, 2016). Opinions have often developed on concepts of quality, and on concepts of ageing, of merit attributed – or not – to the age of the material and/or of the objects produced from it (e.g. Carlier *et al.*, 2015). To this macroscopic time scale is added the mesoscopic scale of the time of personal acquisition of craft, experience, skills and knowledge (sometimes explicit, often tacit; e.g. Schwint, 2002). In addition to this practice over a long period of time in a career, the practice is often also over relatively long periods on a *micro* time-scale corresponding to each achievement, as one individual person generally works on the whole operational sequence from conception to finishing. The work, often with hand tools, and often including latency in the processes, favours sensory perception of the material. Although artisans' dexterity with hand tools brings such speed and efficiency that it easily surprises the contemporary layman, still, relatively slow processes and simple tools give a chance to take the time of reflexion for "thinking through making" (e.g. Ingold, 2017).

These temporal dimensions in crafts are apt to reveal time-dependent physical phenomena ("*the passing of time*" especially, but one can hardly separate "*the changes in the weather*" from it). This can

be an important source of inspiration when one is interested, as a mechanician, in a (hygro-)viscoelastic material. An hypothesis is that transient destabilisation or unstable phenomena, followed by a slow return to equilibrium according to a physical ageing process, could explain several "anomalies" observed in the mechanical behaviour of wood (Hunt & Gril, 1996; Brémaud & Gril, 2021). However, the time of wood is not limited to the time of the material and its uses but begins with the time of its formation in the tree. The progressive release over time of locked-in stresses (hygroscopic or biomechanical in origin) could underly several empirical observations by craftspersons regarding time of drying/seasoning (Gril & Thibaut, 1994; Cabrolier *et al.*, 2016; Matsuo-Ueda *et al.*, 2016). There are also fundamental questions about the drivers and properties of different types of wood formed during the life of the tree.

Socio-environmental concerns arise as many presently preferred woods are characterised by (very) slow growth, so their future is particularly threatened by the current environmental upheaval. Slow- or fast-growth can be linked to certain species, and to ecological state and forest plots and trajectories, including presence of aged trees and depletion by human exploitation (e.g. Billamboz, 2012). It impacts growth rings and usable diameter of course, but also heartwood content and wood physical properties, therefore woodworking issues. In terms of the biodiversity crisis, some craft species that reach "*useable maturity*" after at least 100-200 years may be able to withstand industrial overexploitation as living species but may not be available in the required qualities for long generations of craftspersons. In terms of climate change, the temporality of wood formation is a marker for reconstructing past changes and even modelling the effects of future changes (LaMarche, 1978; Hughes *et al.*, 2011; Karanitsch-Ackerl *et al.*, 2019). At the same time, the effects of climate change on the properties of wood, and this in ways varying in relation with species and biotopes, are complex to predict within the framework of generic "wood quality" (Barnett & Jeronimidis, 2003; George *et al.*, 2019), but even more so for the multiple criteria involved in the artisanal choice of wood, which integrate physical properties, cultural expectations and perceptual parameters. Archaeology and dendro-archaeology document some past episodes of climate changes, interacting with other changes to forests (socio-cultural pressure, overexploitation), resulting in changes in wood supply and wood-material characteristics that in turn impact human activities and wood crafts (e.g. Billamboz, 2012; Mille, 2022); yet current changes occur at unprecedented speed and level of impact.

Returning to the topic of temporal phenomena at the interface between craft knowledge and physical-mechanical analysis, it is also important to take into account the different processes when exploiting and working wood, insofar as they can be indicators both of phenomena, of the time between the tree and the object, and of the time of the craftsperson's skill. Processes are also "filters" between the behaviour of the raw material and the perception that craftspersons have of wood during their practice. The question of time arises in different ways in terms of psycho-sensory perception. Certain physical temporal markers are very clearly perceptible (notably the damping in auditory perception); the temporality of the formation of the wood is expressed in the parameters (texture and colour of the wood) perceived visually and aesthetically (e.g. Carlier *et al.*, 2018); the sense of touch of the wood interacts with the rhythm of the craftsperson's working hand (e.g. Bouras, 2018; Martin, 2020). At the same time, the question arises as to the persistence of sensory information in memory over time. In terms of preferences (visual, tactile, auditory, etc.), we should not underestimate the influence of personal and/or cultural developments, or even of fashion phenomena. Hedonic sensory preferences, or even socio-economic ostentation, linked to inherited socio-cultural contexts, can contribute to increasing the use of species that are becoming rare or threatened, sometimes with disastrous consequences in the current biodiversity crisis (Lake Zhu, 2020).

From a more committed perspective, "it is time" to rethink our relationship to time and the environment – between organic time and discretised-mechanised time, to the time and meaning of work, to the time of the Living – of the tree and/or of the human. The global acceleration of time in late-modern societies (Rosa, 2014) is hardly compatible with the long-term time of trees, nor with

the strong relationship between time and matter that underly craftwork. The growing revival of craft trades, observed both in the life choices of individuals and in the development of academic research on craft, and the increasing interest for wood both in society and in research, bears witness to this growing need to make sense of time and of matter.

1.2. Time4WoodCraft transdisciplinary exploration

Analysing these eminently variable dimensions of time in woodcrafts and crafts' wood within a purely disciplinary framework would be necessarily limited. Such a topic requires to think outside one's box. This paper reports on the preliminary stages of an ongoing project called *Time4WoodCraft*. This acronym represents the above topical temporality on different socio-environmental levels (*"it is time"* to rethink our relationship to time, work, environment and matter). It also represents the willingness to start a dialogue between four communities within the physical and materials sciences, life and environmental sciences, humanities and social sciences, and woodcraft practitioners, to reflect on their ways of working with and representing the multiple dimensions of time. Within this extremely wide and general topic, the scientific approach is based on three interrelated levels of work (***figure 1***). This paper follows such an organisation, starting from a broad exploration (including a workshop and literature), followed by selected laboratory-craft case studies, and by the preparation of a survey with craftspersons. In the future we will use the results for drawing a map of interactions between physical, biological, and cultural dimensions of time.

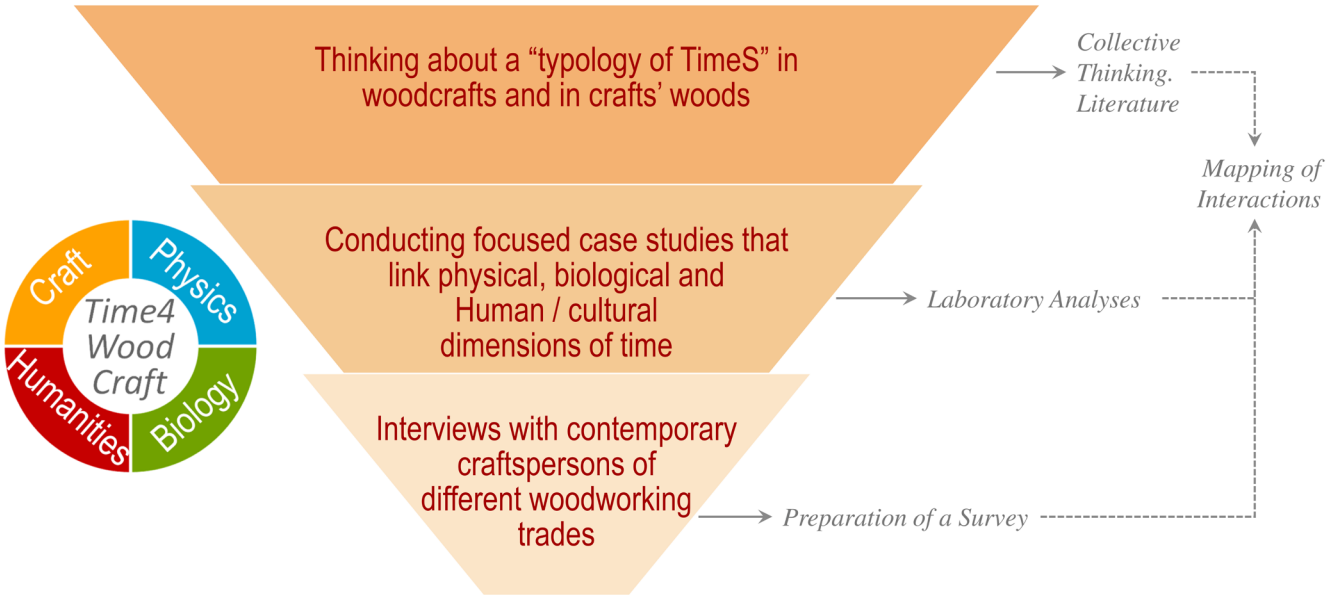


Figure 1. *The approach of Time4WoodCraft project: transdisciplinary exploration, and nested scales of work – from a very wide question to realistic research, then to re-complexification. © I. Brémaud* et al.

2. Cross-perspectives between viewpoints, disciplines, and experiences

2.1. Can there be unique definitions?

The meanings of "*time*" can vary depending on scientific disciplines and cultural background. Definitions may also vary for "*craft*"; but only to a limited extent for "*wood*". Time, as a universal and intangible notion, is a fundamental topic of physics and philosophy (e.g. Huneman & Bouton, 2018), declined in biology, history, social sciences... Without debating on such general questions, the theme of our paper convenes both the *physical/natural time* and the *lived time*; different categories of linear, cyclical or instant time; some modalities such as flow, duration, speed, acceleration; and some expressions of time such as change, evolution, movement, rhythm, memory, etc. Defining *"craft"* can

also vary depending on backgrounds and contexts and may not bring to mind the same images to an academic researcher specialised in archaeology, to one specialised in design or engineering, or to a crafts' practitioner specialised into a given production. The amount of academic literature on craft has greatly increased over the past decade, notably that with philosophical and/or sociological and/or anthropological reflexions on the meaning of work and on the practice-based construction of knowledge (e.g. Sennett, 2010; Crawford, 2016; Ingold, 2017), or reflecting the recent growth of the new field of "craft sciences" (e.g. Kokko *et al.*, 2020; Groth *et al.*, 2021). Yet, few of these recent research trends address woodcrafts specifically.

2.2. Connecting viewpoints on time among wood academics and craftspersons

2.2.1. Fields and specialities represented in the present work

To explore specifically the meanings of time in wood and craft, and how different experiences could be connected, we organized a brainstorming workshop to launch the Time4WoodCraft project. In a mindset that had previously been experienced with a larger audience (Alix & Guiot, 2003; Cabrolier & Brémaud, 2014) – but then the scope was inter-communication, while the present scope was elaboration of common research – the goal was to exchange between "*artisans-researchers*" and "*researchers-artisans*". The workshop brought together six academic researchers specialising on wood (some with woodworking practice), and six craftspersons (some with academic background, or conducting empirical research). The scientific disciplines represented were anthropo-archaeology, wood science in general, wood physics and (bio-)mechanics, dendrochronology; while specialities of woodcraft were represented by cabinet making / furniture restoring, lacquering / varnishing, greenwood working, hand-tools carpentry, instrument making (of violin and of period instruments-ancient music). The workshop was held in September 2021, in a rural area (Cévennes mountains, France). Each participant gave a *ca.* 15 minutes presentation on her/his interest and work experience about time; then participants brainstormed during at least two half-days (more for some) to find connexions between their respective viewpoints and experiences on the different dimensions of time.

2.2.2. Expressions and words used

An analysis of the topics addressed in the presentations identified over 300 expressions related to "time of wood and of woodcraft". Compared to the *a priori* topics introduced in §1.1, workshop participants further emphasised the time of wood formation in tree, the times of its exploitation (felling/cutting trees, transport/importation, collecting and selecting wood) and the different types of ageing. But they (we) also further emphasised "*the time it takes to do things*", the "*tools and processes*", and the "*ideas, thinking and knowledge*". When analysed in terms of words used (***figure 2***), we see that "Time" and "Wood" were central and near equally addressed by both academics and craftspersons. They also discussed similarly "Tree" and "Properties". However, when scientists highlighted the time of "Ageing" and "Seasoning", craftspersons highlighted the time of "Making, Doing and Working". Time was first expressed by scientists as "Change", "Date", "History", "Chronologies", i.e. in terms of time duration and variations; and by craftspersons by "quickly/speed" and "long/slow" or "beginning" and "finishing", i.e. in terms of (variable) speed and by time sequences.

However, besides the most often stated notions, some lesser-cited words highlight some interesting concepts. For example, notions of "*reversibility / irreversibility*" that has strong but different meanings in wood physics or in furniture restoration; or of "*childhood*" (experience of woodworking) that, although rarely mentioned in presentations, was addressed by both academics and craftspersons, and discussed further in brainstorming sessions.

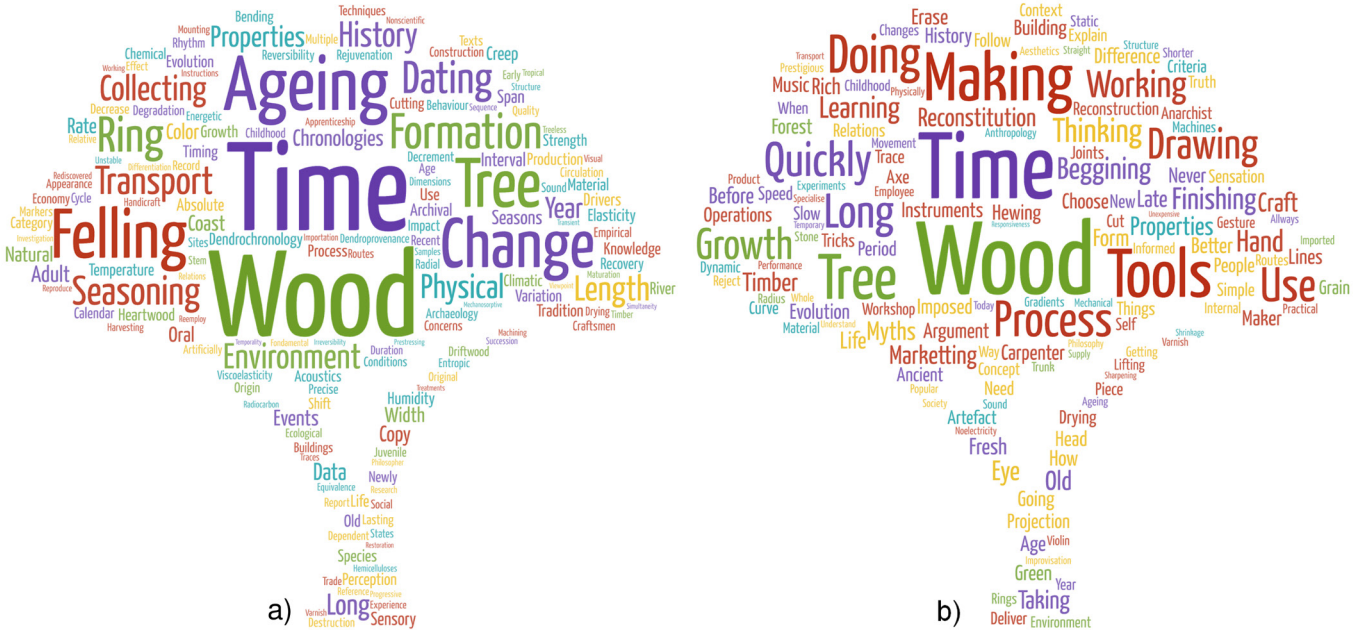


Figure 2. *Word clouds from the presentations (ca. 15 minutes per participant) to the Time4WoodCraft 1st Workshop (September 2021). (a) 6 academic researchers and (b) 6 craftsersons. Letter sizes are proportional to the occurrence of words. Green indicates notions of wood, tree and forest; purple: notions of time; blue: scientific terms/disciplines; dark-red: craft and processes; gold: more generic ideas and concepts. © I. Brémaud* et al.

2.2.3. Interconnected notions

Attempts to connect these different notions were conducted during the following brainstorming sessions and completed through smaller meetings, in persons of by videoconferencing. The addressed notions, concepts and ideas were numerous and their interactions rather complex (***figure 3***). Notions are summarized below, and in the future, we wish to turn the pictured draft into a kind of interactive map of topics.

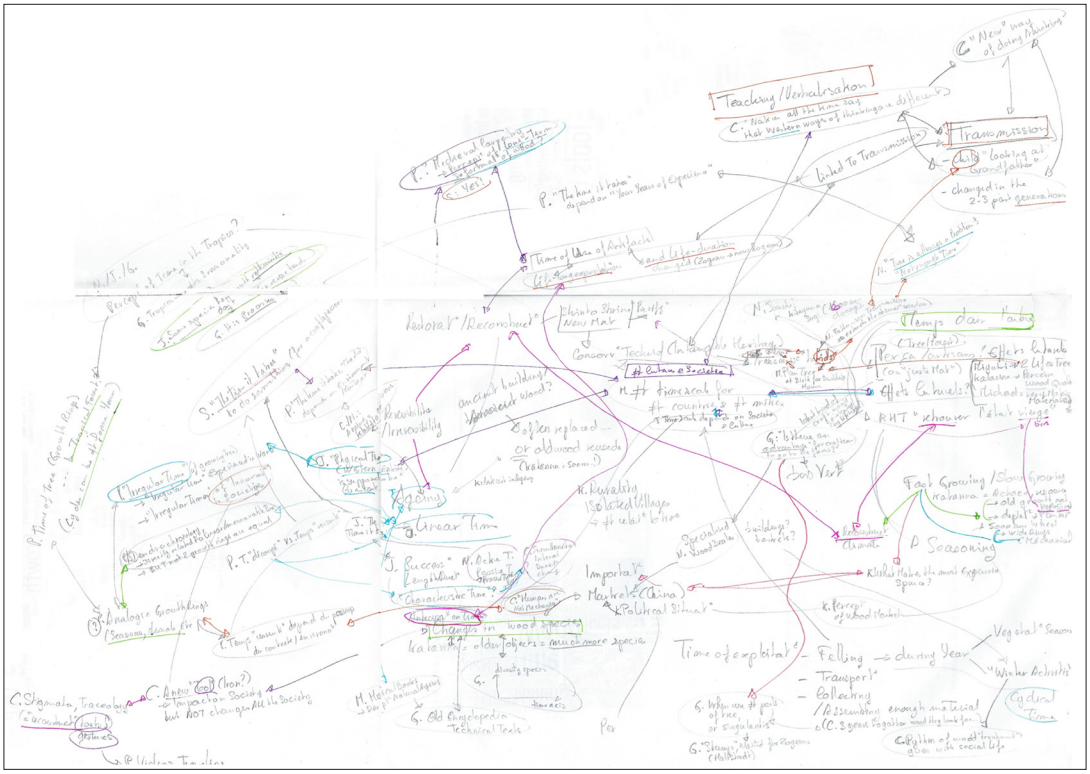


Figure 3. *A preliminary working draft trying to connect the different topics related to physical, biological and human/cultural dimensions of time that were raised during the Time4WoodCraft "brainstormings" in 2021. © I. Brémaud* et al.

Some of the inter-connections that were addressed could be grouped as follows:

i) *Can the time of the Living be described with the tools of the physical time?* Much of the discussion was about the possibility – or not – to connect the non-linear, irregular or cyclical times experienced in craft, making, living and societies, to the time of physics which is approximated as linear and constant. An idea that came up was whether dendrochronology methods could be extrapolated to analyse the rhythmicity perceived in craftwork, including technical movement, repetition and/or rhythm breaks (including "time fading away", see §4), or cyclical time. However, it was stated that, although wood formation in tree is irregular (due to climatic events) and cyclical (seasonality – or no seasonality), dendrochronological records are directly linked to linear and measurable time. Some issues were raised about how the expression or perception of time could be different in the Tropics. It was also stated that wood ageing which is a physical-chemical process, does not only depend on time but also on hygro-thermal conditions and their variations – yet is still based on physical phenomena. But mostly, our group discussions led to addressing the issue that *"time scales and perception depend on societies and cultures"*, in contrast to linear / constant physical time, that was described as part of the "Western" way of thinking, and of changes it imposed to cultures in other geographical regions (Ogle, 2015; Vidal, 2020). Yet, even in Western countries, contrasted images of times can be cited i.e. from *rural cultures* (Pelen, 2001), including some survivance of cyclical time and seasonality.

ii) *Anticipation of time.* This notion was addressed when discussing time and irregularity of rhythm in the workshop, but also when time had to be estimated and budgeted in quotes (e.g. Schilbach, 2023). It was also discussed with life-long expectations provided for objects or buildings, connected to human life duration / life expectancy (and its changes over history); as well as in craftwork experience. Transmission, including from childhood / between generations in a family, was proposed as a way to "extend the observation window" for the time of craft experience.

iii) *Perception of material and of time.* It was described as being constructed by practice, experience and transmission, here again with references to young-age experience and learning by impregnation. Craftsmanship develops out of interaction, through making and observation, between an individual and his/her world or environment, instead of the school-type learning by "conforming to directions" (Martin, 1978; Kawagley, 1990). Craftsmanship perception was suggested as an indicator of wood properties, of their natural variability (related to wood formation in trees), and possibly of their natural ageing (notably through wood colour, that was stated as one of the main indicators of wood chemical ageing). This "intimate knowledge" was thought to include some elements of long-term behaviour of wood and objects.

iv) *Changes through time.* This topic was discussed for species used through history, with observations and/or hypotheses on a general decrease over time of the diversity of used species (yet, an example of diversification will be provided below in §3.2). Changes were also stated for the evolutions of wood uses' criteria regarding fast-growth or slow-growth trees, with drivers/implications related either to slow-growth resource availability or depletion (e.g. Billamboz, 2012), or to visual-physical-mechanical properties of slow- or fast-grown wood, or both. Changes were discussed for ways of working (linked to new tools, or to markets and policies, or both); and for the ways of thinking and transmitting knowledge – this was often related to *the spreading of "Western thinking of time"* introduced in earlier (a).

v) *"Rewinding time"*. The historical record of seasonal wood formation, analysed by dendrochronology, can help to reconstruct past climate (e.g., Čufar *et al.*, 2008a and b; Hughes *et al.*, 2011; Karanitsch-Ackerl *et al.*, 2019). Biomechanical stresses are generated during steps of wood formation in trees. Gril & Thibaut (1994) formulated the hypothesis that lignin softening (at temperature and humidity above its glass transition temperature) might be equivalent, in terms of mechanical behaviour, to the lignification process occurring during cell-wall maturation. Then, the phenomenon called "hygrothermal recovery", by which viscoelastic locked-in maturation stresses are

released by softening, might be considered as a way to return to a theoretical pristine mechanical state of wood layers when initially formed (Gril & Thibaut, 1994; Cabrolier *et al.*, 2016; Matsuo-Ueda *et al.*, 2016). The contemporary re-enactment of ancient woodworking techniques, or reconstruction of ancient items or musical instruments, blur the lines between "old" and "new", as the re-creating process calls for thinking, research and experimenting, therefore creating "new" knowledge. The heritage concepts of reconstruction (rather than conservation-restoration) in Japanese Shinto shrines, bears some anthropological ideas of "purification" (by using new wood material) but also of keeping ancient knowledge alive (conservation of intangible heritage). In analyses of rural buildings, old/damaged pieces of wood could have been replaced by newer wood… Or by the re-use of (sometimes very) old wood pieces. All these call to concepts of reversibility or irreversibility and their different meanings.

Besides this (briefly summarized) exploration of relatively philosophical thoughts (especially above points i) and ii), the material gathered as part of the project is being further analysed with the aim of building a *"typology of times of wood, in craft, and for craftspersons"*. This typology should in the future be extended by literature review, and illustrated by concrete examples issued from case studies (stemming from above points iii), iv) and v), and introduced in §3 that have been identified during the workshop, and by craftspersons' representations to be collected through interviews (introduced in §4).

3. Linking physical, biological, and cultural dimensions of time and wood? An illustration through selected case studies

Following the transdisciplinary exchanges between wood scientists and wood craftspersons, a preliminary set of "case studies", were defined. They all intend to relate some physical, biological, and human/cultural dimensions of time in wood and craft. These case studies are mainly based on materials previously gathered by the different authors, which are re-examined to integrate the viewpoint of different disciplines, and with a new focus on time.

3.1. Perception by craftspersons of temporal markers of wood

The intimate knowledge of wood by craftspersons, brought by hands-on practice and time of personal work experience, implies a high degree of sensory perception. The hypothesis is that the qualifications of wood by crafts experts are indicators of measurable physical properties. Some fundamental research do relate sensory perception to fine quantitative characteristics of wood (e.g. Nakamura *et al.*, 2010 and 2014). However, in the context of "modern/contemporary" wood utilisations, evaluators' panels usually involve laymen, or consumers, rather than experts, skilled woodworkers – with the exception of a limited number of studies on wood perception by instrument makers (e.g. Aramaki *et al.*, 2007; Buksnowitz *et al.*, 2007). In the context of sensory archaeology or ethnoarchaeology, some studies link craftspersons' perception to measurable material properties (e.g. Procopiou *et al.*, 2013), however this is rarely the case for wood.

In the present work, we selected two case studies (***figure 4***) aiming at relating craftspersons' sensory qualification of wood with, specifically, measurable properties that are temporal markers (biologically or physically) of wood. One case study is on the qualification of spruce driftwood by Yupiit craftspersons (for carving, basketry, boat building) in Alaska; the other is on the qualification of spruce tonewood by French violin makers. Although these two case studies are from different societies and cultures, they actually share a remarkable commonality in the wood material – slow-growth spruce (*Picea abies* grown at high altitudes in Europe; *Picea glauca* grown at high latitudes in the American boreal forest), as well as in the fineness of wood perceptive selection criteria and qualification, together with a way of wood supply that is remote from the forest (see Alix, 2007, 2009 and 2016). In the treeless environment of coastal Alaska, Yupiit craftspersons collect driftwood. Work and interviews with Yupiit carvers previously recorded how finely wood is qualified, with distinct names given to specific types of wood, intended for specific use requiring specific material properties (Alix, 2007 and 2012; see also

Petersen, 1986; Fienup-Riordan, 1996 and 2007). The qualification depends on an intimate knowledge of the wood, its position within the tree (e.g. the trunk-to-root junction) and/or the patterns of growth rings (width, regularity), the presence of compression wood including the deliberate choice of a type recognised from its alternation of normal and compression wood (Alix, 2007). This last point is rather unusual, although we observed another deliberate use of compression wood veins in a different context (Cabrolier *et al.*, 2016). The material includes ethnographic information on the time of wood collection and treatment, and wood material with dendrochronological analyses. Our new analyses aim at relating these indications on wood perception and on times of craft and of tree, with characterisation of (bio-)mechanical properties, of their gradients within stems as markers of temporality of wood formation, and of time-dependent properties (short-term with viscoelastic damping, and long-term with creep).

The other case study follows, in terms of disciplines, an inverse pathway. In previous research, we had gathered data and material on violin-making spruce tonewood, including a characterisation of vibro-mechanical and optical properties and their sources of variability. We had also performed multi-modal (visual, tactile, auditory and global) sensory analyses of perception by luthiers, and a semi-quantitative survey with luthiers about their wood supply and choice criteria (Carlier *et al.*, 2018). Luthiers buy wood from specialised dealers, who usually sell four different "quality grades", and nearly none of the interviewed luthiers stated they were going to the forest. Among the wood attributes most strongly involved in sensory qualification, were some temporal markers of wood: "sound duration" (viscoelastic damping), and average width and regularity of annual growth rings (Carlier *et al.*, 2018). New analyses should include dendro(chrono)logy, with the aim to refine the relation between perceived quality for this speciality use and time of wood formation. A complementary aim is to build up on the wide collected sampling of tonewood coming from three provenances to potentially contribute to broader research on dendroprovenance. We will search for relations between previously obtained results on physical-mechanical properties and sensory perception by luthiers, and detailed tree-ring analyses. Dendrochronology was also recently tested as a predictor of quality and prices of spruce logs for more general uses (Straže *et al.*, 2022).

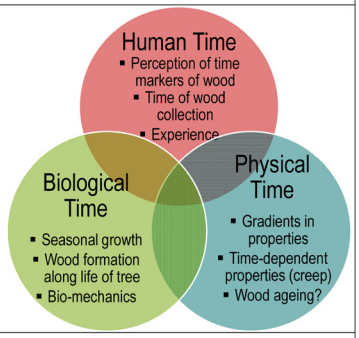
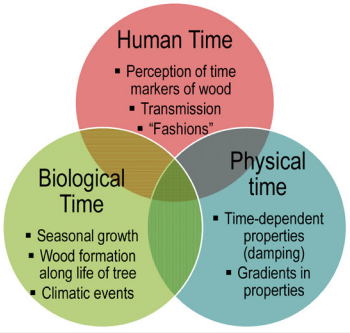
Context	Field sampling	Previous analyses	New analyses	Times connected
Uses and qualification of spruce driftwood by Yupiit craftsmen (Alaska)				
		▪Ethnographic interviews with craftsmen *(carving, basketry, boat building)* ▪Wood names for specific uses ▪Driftwood routes and collection ▪Dendrochronological analyses	▪Mechanical properties: ▪Elastic (instant) ▪Time-dependant (damping; creep) ▪Anisotropy ▪Optical properties ▪Gradients in trunks	
Uses and qualification of spruce tonewood by violin makers (France)				
		▪Vibro-mechanical properties: ▪Elastic (instant) ▪Time-dependant (damping) ▪Anisotropy ▪Optical properties ▪Gradients in trunks ▪Multimodal *(visual, tactile, auditory)* sensory perception *(by violin makers)*	▪Dendrochronology ▪Dendroprovenance ▪Microdensitometry ▪*(Growth conditions ?)*	

Figure 4. *Description of two cases studies which seek to relate fine perceptual qualification of wood by craftspersons to measurable temporal markers of wood. © Brémaud* et al. *© Photos C. Alix, I. Brémaud, C. Hargoues – CNRS Photothèque-LMGC.*

3.2. Changes through time of the selected woods

The nature and amount of diversity of species selected for a given use can vary across time, because of availability of resources, technical evolutions calling for different material properties, and cultural changes including either fashions (or wood "prestige"), standardisation processes, or craftspersons' degree of proximity to "nature" and ethnobotanical knowledge. For example, in analyses of rural buildings in Slovenia, older parts of (re-) buildings contained a greater variety of species than newer ones (Čufar *et al.*, 2013). Also, in prominent building complexes that have existed for a long time, such as castles, the use of wood species varied over time (Čufar *et al.*, 2014). Historical changes in composition of local forests can be combined with re-uses of elements. In present days, globally, use of a very small number of species in building can be driven by costs, but also by norms/standards. At the same time, the identification of woods in 9 000 utilitarian daily-life objects and tools from Austrian museums found 48 distinct native species exhibiting an unusual range of physical and haptic properties, a much greater diversity than what is found in "modern" usage today (Klein *et al.*, 2016; Grabner, 2017). This loss in used diversity can be related to loss of knowledge, to the decreasing use of wood in daily-life objects through the past century, to the standardisation of remaining crafts after industrialisation, and to decreased diversity (in species and/or in specific tree "qualities") in forestry practices.

Case studies we selected for this topic concern changes in wood selected for making musical instruments, and include both domestic (in Europe) and imported woods. The potential "drivers of change", as well as the involved biological and physical aspects, are summarised in ***figure 5***. In a previous work, we examined the changes in wood species used for different models of musical instrument bows, in Europe, from the middle age to the "modern archetype", with a co-evolution between used species, bow geometry, and socio-cultural (musical) contexts (Brémaud & Poidevin, 2013). Diversity dramatically decreased with standardisation in the 19th century. However, the 2-centuries archetypal wood species Pernambuco *(Paubrasilia echinata*) is now threatened (e.g. Lichtenberg *et al.*, 2022). This might force a re-diversification in the future. The new case studies as part of the Time4WoodCraft

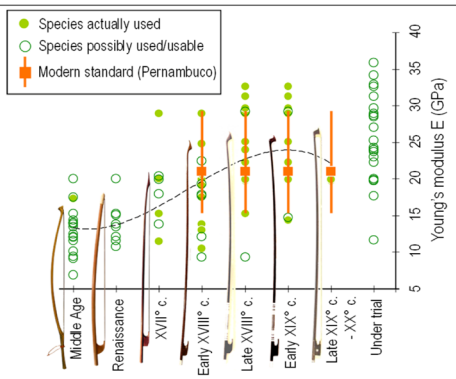
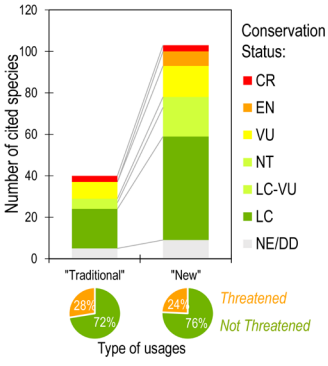
Time scale	≈ 600 years	≈ 30 years	≈ 20 years
Context	**Evolution of European instrument bows**	**Diversification in guitar-making woods**	**Making of Baroque bows**
Observations			*"Change in point of view [...]."* *"Use of softer wood, closer to the centre of the trunk, with different colour vein"* *"The feeling of time disappears during [...] heat-bending to adjust the camber"* 
Drivers of change	▪Resource availability *(Early importation of tropical woods)* ▪Changes in socio-cultural context *(Musical styles and conditions of performance)*	▪Resource availability *(threatened species, international regulations)* ▪Ethics *(rise in ecological concern)*	▪Personal experience of specialised craft ▪Changes in socio-cultural context *(New generation of musicians, trained differently)*
Biological aspects	▪Biodiversity *(inter-species; sub-populations; old-growth versus fast-grown)*	▪Biodiversity *(inter-species)* ▪Time of wood formation *(heartwood; trunk diameter; old-growth versus fast-grown)*	▪Within-species variability ▪Time of wood formation *(heartwood; juvenile wood versus mature wood)*
Physical aspects	▪Material elasticity *(instant-behaviour)* versus structure geometry	▪Optical properties and ageing ▪Time-dependent properties *(damping)* ▪Time-temperature-humidity *(heat-bending)*	▪Gradients in properties ▪Time-temperature *(heat-bending)* ▪Time-dependent properties *(recovery / creep)*

Figure 5. *Description of three case studies relating changes over time in the choice of wood, potential drivers of changes, and biological and physical aspects of time involved. Graph in the left-column is adapted from results in Brémaud & Poidevin (2013). Bar-chart in the middle column shows the conservation status of species according to IUCN 2022 and BGCI 2022, where NE: Not Evaluated; DD: Data Deficient; LC: Least Concern; NT: Near Threatened; VU: Vulnerable; EN: Endangered; CR: Critically endangered. © Brémaud* et al. *Graphs and photos © I. Brémaud, N. Poidevin.*

project aim at two analyses of changes at shorter time-scales. One is at the time- and social- scales of the personal experience of one expert maker, in the context of nearly two decades of recorded craft-science research (by the authors). When re-discussing our previous work on wood for early-music bows making, it came out that personal criteria of wood qualification within a species (Snakewood, *Brosimum guianense*, the main wood for Baroque bows) had changed, due to personal experience, change in point of view, and change in consumers (new generation of musicians) profiles and demands. The new analyses intend to characterise mechanical properties along the radius of trunks (wood with different mechanical and visual properties, related to juvenile- to mature- wood transition, and to heartwood formation), but also to proceed with more in-depth analyses of time-dependent behaviour (related to bow camber – set by heat-bending; and its loss through time – by recovery and creep). The second case study is also at a relatively short time-scale, this time at a macroscopic social scale, yet with limited research follow-up (at a minimum as can be observed in the global scientific literature). It addresses guitar-making, where several of the traditionally preferred species, notably tropical ones, are now threatened and their international trade highly regulated. Our current analyses include a wide census of newly proposed/used species, trade routes, volumes and prices, as well as evaluating the place of environmental concerns in discourses (from vendor's websites and from interviewing guitar-makers), and characterising vibro-mechanical and optical properties of wood (from trees that have to be of large diameter and heartwood content, i.e., mostly from old growth trees). We found an extremely large degree of diversification, with more than 160 species listed in year 2022 for the single utilisation of acoustic guitar backs and sides. Yet, when examining tree species conservation sources (BGCI, 2022; IUCN, 2022), a significant proportion of the "new"/alternative species compiled in our census are themselves already threatened.

3.3. Different viewpoints on the various meanings of "wood ageing"

Trees are long-life organisms, and wood is a long-life material in its uses. The structural uses of wood have prompted studies on ageing of physical-mechanical properties, often in relation to the field of conservation of tangible heritage. However, changes in properties between "old" and "new" wood are often inconsistent between different reports (Kránitz *et al.*, 2016). This difficulty to scientifically assess *"wood ageing"* highlights that several phenomena (seasoning, "true" ageing – caused only by time, changes in conditions, weathering, biological degradation) can co-occur simultaneously. But also, that material ageing is superimposed to the (wide) diversity and natural variability of wood and to the within-tree history of wood. And finally, that there are different cultural contexts about life-expectancy and ageing of artifacts (***figure 6***, upper part). Typically, the perceptions of ageing and the ethical requisites are not the same in the field of the strict conservation of objects of Tangible Heritage as a historical testimony, or in the nearby field of the conservation-restauration to preserve (historical) technical functions. Socio-cultural expectations are more different in the field of reconstruction or reconstitution, either for expending life-expectancy of artifacts and/or for conservation of Intangible Heritage (craftsmanship knowledge). The meaning of wood ageing is blurred in the field of current making of new artifacts intentionally "aged". In the field of contemporary making, wood ageing and life-expectancy of wooden objects can bear strongly different meanings depending on more or less daily-life or prestige items; more or less traditional, rural or functional uses versus purely commercial and/or or design scopes of making. Fundamentally, there are questions as to the reversibility or irreversibility of physical phenomena, and/or of woodworking processes. At the same time, questions relate also to the human perception of changes in material properties, and to whether the wood ageing starts from its formation within tree, or from when the tree is felled and wood starts its life as a human-used material (***figure 6***, lower part).

To illustrate this topic, case studies (and/or re-examinations) follow two main directions. One starts from craftsmanship processes and perception, and goes to laboratory analyses, to evaluate the respective effects on the physical-mechanical and on the visual-optical properties of wood of either natural ageing, or of artisanal processes for accelerated ageing. The other direction starts

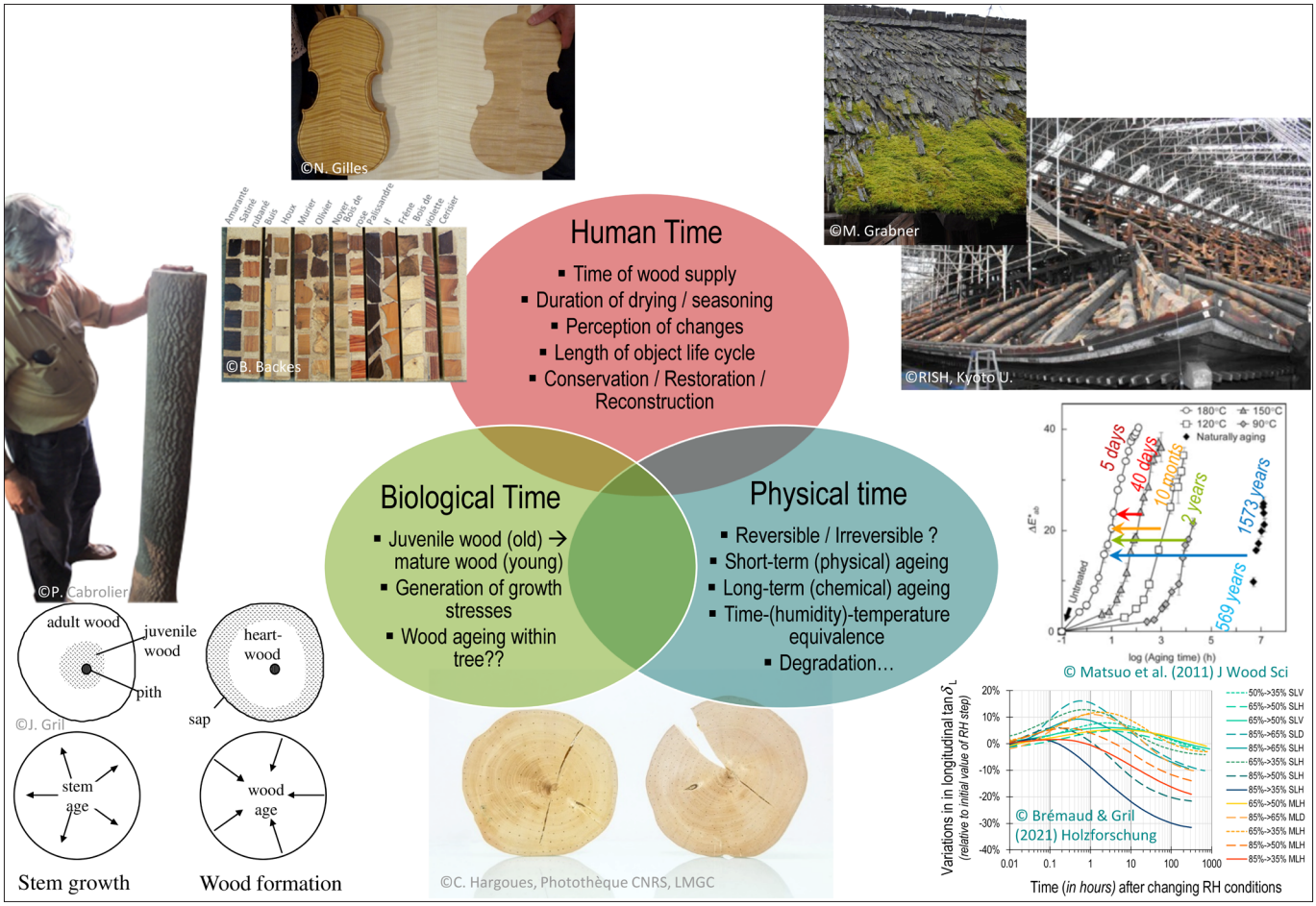


Figure 6. *Some different entry points and connexions between different topics possibly involved in the notion of "wood ageing". © I. Brémaud* et al. *© Photos B. Backes, I. Brémaud, P. Cabrolier, N. Gilles, M. Grabner, C. Hargoues – CNRS Photothèque-LMGC, RISH. © Graphs I. Brémaud, J. Gril, M. Matsuo-Ueda.*

from phenomena studied in fundamental (bio-) mechanical aspects of wood ageing, and goes into information-mining from craftsmanship sources (historical or contemporary, written or non-written) to extract observations related to these fundamental phenomena. In the first direction, mild thermal treatments were empirically tested by one of the authors as a mean for reproducing, within the workshop means but without any chemicals, the colour changes of aged wood veneers in the context of furniture restauration. Preliminary quantitative analyses showed the difficulty of relating the multiple visual features implied in appearance perception by a skilled craftsperson, with the sole colorimetric measurements. These results highlighted different kinetics and intensities of colour change along time depending on the widely diverse hardwoods species used in cabinet-making (Brémaud *et al.*, 2021), that could be related to more fundamental analyses of species-differences in colorimetric reactions to accelerated ageing (Matsuo *et al.*, 2013). Another example selected for study concerns violin-making, where contemporary luthiers strive to produce (on new wood and instruments) a visual appearance similar to aged wood and ancient instruments: a wide variety of treatments (UV, chemicals) are of common uses in workshops for reaching these visual goals, yet their potential consequences on mechanical and acoustical properties are usually unknown, therefore calling for focused research on this topic. In the second direction, the fundamental phenomena underlying ageing of wood were studied by comparing natural ageing over more than 1500 years (samples collected from restoration sites in Japanese temples), and accelerated ageing, with theoretical analyses of time-temperature, and of time-temperature-humidity, equivalence (Matsuo *et al.*, 2011; Zeniya *et al.*, 2019). Related information is now being collected from traditional knowledge, and by information mining from historical written sources, including technical books/treatises and early academic literature. However, the irreversible (chemical) processes of wood ageing take place over very long durations of time, and their most consistent effects are on wood colour, also – but to a lesser extent – on wood strength and

hygroscopicity, while effects on elastic or vibro-mechanical properties are smaller and difficult to separate from biological variability. Yet, another phenomenon plays a strong role in apparent "ageing" of wood properties, with an onset of changes starting at a much shorter time-scale (i.e. from weeks or months, to years or decades). This reversible process known as "physical ageing", is related to the woodworking notion of "seasoning" that is a somewhat ambiguous word. This is especially true in the French language, where the notions of "drying" and of "seasoning" are misleadingly designed by the single word "*séchage* [du bois]". In the case of wood vibro-mechanical properties of instrument-making wood, physical ageing/de-ageing (induced by *changes* in moisture content) was recently found to have more prominent effects than *differences* in equilibrium moisture content (Brémaud & Gril, 2021), and than long-term chemical ageing (Obataya *et al.*, 2020). Craftsmanship knowledge may well have preceded scientific results in that lesser-studied topic, as, in the preliminary results of a survey with violin-makers, they considered long-term (decades to centuries) wood ageing to be mostly "positive" for visual properties, while "acoustic" properties would be mostly "improved" over the short-term (years to decades; Carlier *et al.*, 2015). Interviews in the frame of the current project (c.f. §4) should further document craftsmanship knowledge on this topic. Eventually, the question of the intersection of the "time of wood within the tree" and the "time of wood as material" was informed by two previous research projects which provided unexpected results on the effect of hygrothermal recovery – HTR (i.e. release of locked-in growth stresses, introduced in §2.2) on vibro-mechanical properties. One was based on interviews with a specialised woodturner/woodwind maker (Cabrolier *et al.*, 2016) and the other looked at the question from a tree biomechanics perspective (Matsuo-Ueda *et al.*, 2016; Chen *et al.*, 2021). These results suggest that this process could be, both, a way to return to a theoretical pristine state of wood layers when each one was recently formed within the tree (i.e. HTR would "erase" the effects of later step-by-step maturation strains/stresses and their accumulation along the radius of a growing trunk), and an important phenomenon in the unstable behaviours of wood through time that are encountered by wood craftspersons. Further evidence is being searched through information mining from historical technical treatises (e.g. Bergeron, 1816), and will be a focus of discussions when interviewing wood craftspersons.

4. The importance of time for wood craftspersons: exploring themes for preparing a survey

Although the theme of times appears central to craftwork, it comparatively seems to be the main focus of only few research (Schwint, 2002; Eriksson *et al.*, 2019). We, the different authors of this article, have gathered, within different cultural contexts, several field experiences, ethnographic observations, interviews and surveys, or filmed techniques (see: Holzhandwerk_Revisited, 2023), that all contain information on the different aspects of time. We are planning to re-examine these materials to extract what they tell about time. For example, in the previously introduced semi-quantitative survey with French violin makers, focusing on wood choice (Carlier *et al.*, 2018), the questionnaire also contained points on time of the different activities; on opinions on the value of ancient (luthiers and violins); on time/frequency of wood supply; on preferences for time of felling; on recommended duration of drying; on opinions on effects of ageing – of wood and of instruments (Carlier *et al.*, 2015) or of varnish (Brémaud *et al.*, 2016); on interest for historical approaches; and on changes in point of view with time of personal experience.

However, time of craft was not the central topic of these previous works; we are thus preparing a forthcoming focused survey. The first step was to exchange with craftspersons, involved in Time4WoodCraft and a few other artisans. This was either in the form of informal discussions, written exchanges, or long (recorded) interviews. Themes can be identified for building an interview grid. However preliminary, this already allows drawing lines of observations (***figure 7***).

For example, the "times of work", which appears as primary topic for artisans, had been under-estimated in the *a priori* hypotheses of §1.1. The most widely mentioned themes are (within times of work, of wood, and cultural/historical times, respectively) the *"time it takes to do things"*,

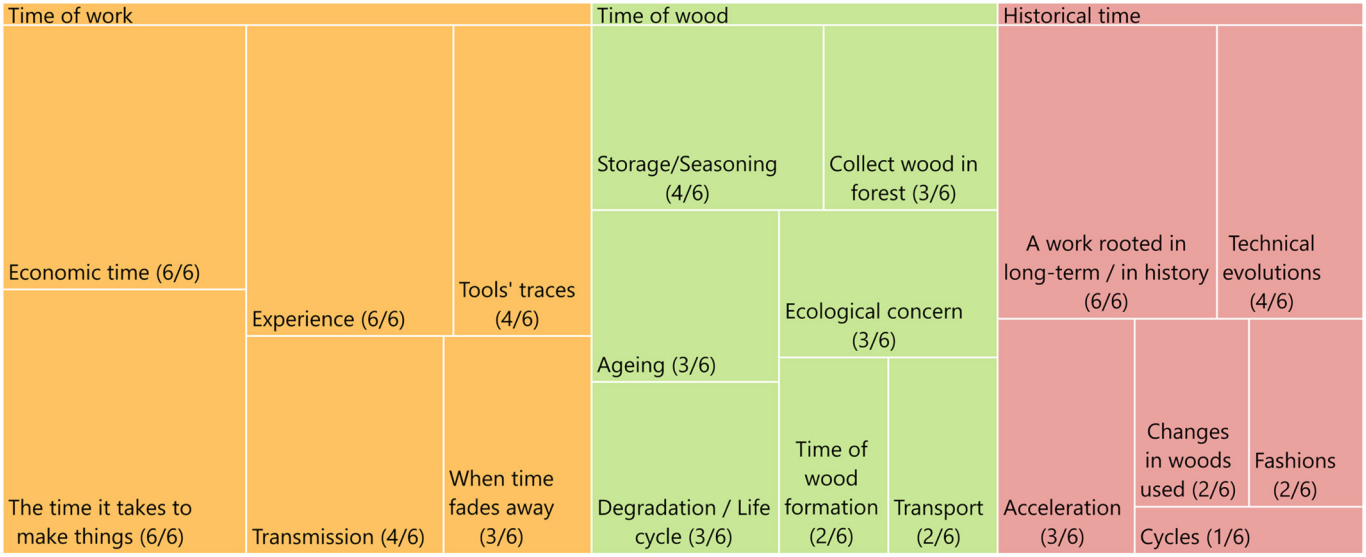


Figure 7. *Themes identified from exchanges and interviews with wood craftspersons. Themes are ranked by the proportion (indicated by numbers and by areas of boxes) of participants who mentioned them, among 6 referent artisans for this preliminary stage. © I. Brémaud* et al.

eventually related to the "economic time" (e.g. "*It is not profitable, but it feeds us – intellectually and psychically*"); the wood storage/seasoning/ageing (e.g. "*Storing old wood can be a commercial argument in lutherie. But in fact it's only the wood that remains because it was never used*"); and the importance of practicing "a work rooted in the long-term" (e.g. "*I confront the time perceived by craftsman from the past*"). However, besides these most often cited themes, others that were, in this preliminary stage, less often cited, appear most interesting. For example, in the category of "time of work", the notion of "*instants when time fades away*", that might be related to a previous work on the "diversion of time" (Schwint, 2002). This was cited as "*psychological blocking*" *before starting a difficult/tricky operation*, or as a *"potential non-existence of time in the workshop*", or as elasticity and contraction of time, either socio-cultural-economical or linked to given woodworking processes (notably processes involving high temperature, that could suggest an anthropological counterpart to the notion of "time-temperature equivalence" in mechanics). Within "time of wood", the category of "ecological concerns", can by itself meet some thoughts on the different temporalities of plants and humans (Lieutaghi & Musset, 2014). It is also associated to other environment-related quoted topics: "collecting wood in forest", "time of wood formation", and of "wood transportation", or as *"a feeling of respect when using wood from very long-lived trees"*. The "acceleration", firstly cited in the group of historical time, was also important in discourses about time of work, and of learning (e.g. *"the time of hands-on practice is shorter and shorter in institutional teaching [even of crafts]"*, that could meet older works on "craftsmanship and schooling" (e.g. Martin, 1978). Within the general phenomena of acceleration in the late modernity (Rosa, 2014), some time-issues appear to affect specifically craftsmanship experiences and knowledge building.

5. Conclusion

To briefly summarize these different levels of transdisciplinary exploration, time was highlighted as an essential marker of woods and crafts in two interrelated ways:

"*Wood as recorder of times*" ↔ "*Temporalities as essence of craftwork*",

in the sense that wood records many different scales and effects of time (perhaps more than any other type of material); and in the sense that craftwork has its essence in the relationship between matter, culture, practical knowledge, technique, and time.

This was central in the approaches from different academic and woodworking backgrounds. However, academic researchers tended to more often address the notions of chronologies, linear time, wood formation and ageing, whereas artisans highlighted the times of making, doing, thinking and working, with an additional focus on speed and sequences. Craft experience of the material can lead to a fine perception of different types of time in wood, such as temporal markers of wood formation, some time-dependent mechanical properties, and the anticipation of long-term behaviours or changes. However, if some of the above-mentioned dimensions of time of woodcraft are clearly materialistic (e.g. the time to make things, or to collect wood material), some other are more reflexive (e.g. the change in viewpoint over time, or *"when time fades away"*, or respect and/or ecological concern towards very long-lived trees). Both may be involved in potential changes in uses of wood through time – at historical or personal scales.

This ongoing exploration provided several well-rooted trends from an "auto-ethnographic" approach of a group of interdisciplinary academics and craftspersons. The focus was here to build cross-perspectives between "*artisans-researchers*" and "*researchers-artisans*". In this first stage, various fields, disciplines and craft specialities were represented, but other fields could potentially be added.

Perspectives for future work would include expanding the horizon, enriching collective thinking with insights from more diversified academic disciplines and fields and specialties of woodcraft, with deeper ecological perspectives. The strong interest that this topic of time raises with wood artisans encourages us to pursue a campaign of interviews with different woodworking specialities. An important aspect of time, that was not addressed in this preliminary paper, is that of the rhythm and skill of the craftsperson's hand when working. Focused work on filmed materials would both contribute to this last point, and potentially be used as a media to share viewpoints coming from different work experiences. Finally, the different corpus of data compiled should eventually be used for mapping the connexions between the physical, biological and human/cultural dimensions of time for wood craftspersons and in crafts' wood.

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Conflict of interest

No conflict of interest to declare.

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Rénovation du calfatage d'un chaland-sablier, Mali. © P. Féron.

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