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Concept note

Under the "publish or perish" mantra and the race for grants, insights to catalyze research into wood science

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ABSTRACT

The quality of research is the lifeline to get a good wood science, as science generally; embracing a 'publish but don't perish' stance might be a valuable insight to stride this science forward. A focus on quality rather than quantity of published material would greatly reinvigorate our science and entrepreneurial capabilities, ensure continued public trust in the academic enterprise, address the needs and expectations of the 21st-century society, and help to secure a truly sustainable future, one that responsibly maintains the well-being of nature and people. Stimulating wood-based innovation certainly develops a fundamental niche in such sustainable future fitting the main goals of the sustainable development.

KEYWORDS: Wood science, high-quality research, innovative research, open science, grant funding, sustainable development, ethics.

Figure 1 - Renewed commitment to wood science and innovation can yield practical benefits. Image credit: designed by A. Harfouche and F. Nakhle.

It should be gratifying to find, in the knowledge age, that the general interest in science is greater than ever before, and that scientific progress and excellence as well as technological innovation are key assets for individuals, social communities, and nations. Where is wood science in this global scene?

For better or for worse, wood was a driving force behind the growth of civilizations. The first timber home literally dated back to the Stone Age. Now skyscrapers, innovation centers, office towers, residential districts, sport stadium, and impressive architectural structures that withstand wind, earthquakes, and other forces are constructed from wood around the globe. Today, wood has become even more highly valued and used for fine and intelligent furniture, technological paper, textiles, biofuels, bioplastics, high-value chemicals and materials (Tamantini et al. 2021), and other everyday innovative products thanks to its special structure and ultrastructure, attractive aesthetics, and its sense of naturalness and warmth. As such, global demand for wood is expected to significantly increase in the future. But how can we integrate wood and its application into a sustainable world? Detailed knowledge of wood is required to have an energy-efficient and sustainable processing, a rightly addressed production and harvesting, a proper use of wood and wood-based materials. Successful product development should also go through interdisciplinary research and development (R&D) that integrates not only xylology, material sciences, and product design, but also natural sciences, social sciences, and humanities.

It is well known that science must benefit from the scientific workforce and its makeup in order to pursue questions and problems beyond the narrow scope that it is currently set up to serve. But even though the number of scientists is increasing and much more funding is being spent on research, the pace of scientific progress appears to be slowing (Geman and Geman 2016). This situation, in spite of the progress of the last years, risks to be not an exception for wood science. So, what might be the reasons and how can they be overcome?

Some argue that many branches of science suffer from the 'lack of theoretical models' because the systems under study are too complex and are not amenable to abstraction, and that future challenges are more about computation, simulation, and big data empiricism, and less about mechanisms and unifying theories (Geman and Geman 2016). However, many natural phenomena seem hopelessly complex before being truly understood (Geman and Geman 2016). While indeed data analytics can be daunting, making sense of the results is even more challenging. Theories provide context for data

and shed insights on which correlations are interesting enough to follow-up on. Further, 'analogical innovation' can help reduce the complexity of the systems under study by finding and applying analogies (i.e., the ability to find and apply deep structural patterns across domains, Kittur et al. 2019) from other domains. That said, big data analytics can aid in advancing theoretical model formulation in complex systems where, today, there is a growing opportunity to accelerate analogical innovation by distributing this task across both human and machine using crowds and artificial intelligence (AI) (Kittur et al. 2019). These new ideas and questions are inspiring and show what can – and how can – be done.

Another argument is that, in many domains, like wood science, it is only in the last decade that 'enabling technologies' entered the scenes and they have been applied e.g., to applied to industrial manufacturing (Podor et al. 2017) and to wood in cultural heritage (Manfriani et al. 2021). A field which is going to be expanded is 'wood digital phenomics' defined as the use of digital tools to upgrade the phenotyping of wood anatomy also for wood identification to one that is high-resolution and high-throughput recently more feasible due to an increased availability of experimental and observational data necessary for an in-depth understanding of wood as a complex system, including the formulation of unifying principles and the validation of explanatory models. Thus, evidence again calls wood science to increase multidisciplinary interactions, branch out and incorporate important insights from other domains and technologies, including, but not limited to, information systems, data science, AI, digital phenomics, digital biotechnology, data architecture and technology infrastructure; such multidisciplinary approach could lay the groundwork for theoretical breakthroughs in the coming years. The challenging environment for the realization of such breakthroughs though would be the recent changes in the practice of doing science, driven by an alteration of the system of rewards and incentives (Geman and Geman 2016). Indeed, academia has often become a 'small-idea factory' where the scientific community is rewarded for publishing more frequently, and scientists search for the minimum amount of information that can be used to generate publications, known as 'minimum publishable units', which often turn out to be the just early 'progress reports', quickly superseded (Geman and Geman 2016). At the same time, there is enormously increased pressure to secure outside funding, converting most of the best scientists into government contractors (Geman and Geman 2016). All this favors just incremental progress, and, distinctively, young scientists argue that being original is simply too risky. Even though announcing or marketing research ideas is time-consuming, it receives more rewards than the effort to engage in real field-changing thinking; thus, deep thinking, which can be considered a key to transformative research, is at risk of being marginalized (Buntgen et al. 2021), and the incentives for exploring truly novel ideas have practically disappeared (Ness 2015).

This mantra of 'publish or perish' and the race for grants hinder the ethical and professional standards of scientific research; they take away the incentives to pursue creative explorations beyond conforming to current trends and doing whatever is needed to get a paper published or a grant awarded (Buntgen et al. 2021). The time is perhaps ripe to question the wisdom of this philosophy. Once acknowledged as a problem, the solutions to that problem are simple, but not easy. In order for universities, research institutions and funders to play a dynamic role and firmly commit to support researchers throughout their career choices and development, they have the duty to reassign priorities, as to focus more on scientific progress than on accumulating publications; they have to acknowledge with critical emphasis that, at the heart of any research project, it is the inspiration, the novelty, the vision, and the creativity by individuals that matter. It is also important to note that failure is something that all scientists experience and learning to handle it is just part of scientific life (Parkes 2019). The rational path would then be to devote more time to each research project to cross disciplinary boundaries, to spend less time announcing ideas and more in formulating them, and to carefully promote and provide incentives for quality over quantity research.

Certainly, the practice of science needs to be improved, and academic, non-academic, R&D and innovation institutions, and funding agencies should now address and pursue such improvements. In this regard, for example, the Massachusetts Institute of Technology's 'Hypothesis Fund' is helping in advancing scientific knowledge by supporting early-stage, innovative research that increases adaptability against systemic risks to the health of people and the planet. The fund focuses its attention on research projects at their earliest stages, typically before there is any preliminary data, and on bold new ideas instead of continuations of existing research. Likewise, the European Commission has recently announced plans to put together a European Union-wide agreement on research assessment, proposing to reward ethics and integrity, teamwork, and a diversity of outputs in addition to research quality and impact (*Research evaluation needs to change with the times,* 2022, p.166). Similarly, the UK Future Research Assessment Programme is proposing ways to ensure that assessments become more inclusive (*Research evaluation needs to change with the times,* 2022, p.166). Could something similar be doable in wood science? Intriguingly, in fields with high commercial potential, such as wood science, we should encourage early career researchers to pursue entrepreneurship initiatives that equip them with skills and competences to translate research findings into practice and enable them to make their innovative ideas *(i)* desirable: do people want this? *(ii)* feasible: can we do this? and *(iii)* viable: should we do this? We suggest taking such initiatives into account and widen the focus of the role of science and technology deemed essential if funded research is to protect and preserve its mandate to work to improve society.

Additionally, it is of paramount importance for the results of scientific studies to be reproducible and replicable. This means that scientists and researchers should consider providing full details on input data, computational steps, methods, code, and conditions of their analysis (Gibney 2022). But as peer reviewers do not have the time to scrutinize the analysis, we recommend that researchers also provide interactive tutorials in computational notebooks to combine input data, code,

output results, and explanatory text in a single document that can execute the code to reproduce or replicate the results (Nakhle and Harfouche 2021). This will not only ensure that findings are reproducible, but will also enable 'open science', and findable, accessible, interoperable, and reusable (FAIR) science; it will consequently improve science trustworthiness.

Good science is what the research world needs most right now. If we are to counteract any detrimental impacts of the publish or perish practice on scientific research, it is the quality, not the quantity, of research that would make the biggest difference to the society facing specific challenges in its pursuit of sustainable development. Readers, journals, peer reviewers, and the science community can help by being discerning consumers of research, valuing quality over quantity (Corona 2021). It may often be the case that many do science research because they love identifying a problem, or a gap in the knowledge, and yes, research on any branch of science, and in particular on wood science and technology, will always be a lot of hard and joyful work. It can also be a 'win-win' situation, where society can benefit from wood scientists doing frontier research to tackle challenges, and scientists can navigate the competitive job market. Perhaps this will bring us back to a culture of great ideas and great discoveries. Then, let us publish, but don't perish to publish.

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