

Opportunities for joint FPL and VTT research

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Openness, collaboration and sharing of information in developing the basic underlying, precompetitive science and technology for areas of emerging importance to the forest products sectors of the US and Finland are expected to provide synergistic benefits and allow for more creative problem solving. There appear to be a number of common interests with respect to developing the underlying science and technology needed to reinvent and reinvigorate the Finnish and US forest products industry in the 21st Century.

Introduction

Openness and free information sharing through scientific discussion; presentations at scientific symposia conference and workshops; publications in the open literature; and scientific exchanges of researchers amongst laboratories have long been the hallmarks for advancing science and technology. In addition, the disclosure of problem information to a larger and diverse group of researchers is an effective means of solving scientific problems as problem-solving success has been found to be associated with the ability to attract specialized solvers with a range of diverse scientific interests and expertise. Interactive clusters of researchers with diverse specialties have been able to solve problems at the boundary or outside of their fields of expertise, indicating a transfer of knowledge from one field to others. However, global market place competition has intensified among companies, nations and trading blocs of nations. As a result, openness and free information exchange has oftentimes fallen victim to the desire to gain a proprietary advantage – even in emerging areas where the underlying science and technology based upon first principles has not been established.

Such lack of openness and transparency oftentimes means that scientific problem solving is constrained to fewer numbers of scientists working in isolation and who fail to leverage the entire accumulation of scientific knowledge available thus impeding progress.

Government industry-university cooperation in the US

Across all industry sectors in the US, the Federal government and private industry are by far the two largest contributors of research (basic and applied) and development funding. The Federal government provides approximately 28% of all US research and development funding while industry provides 65%. US expenditures with respect to total funding for basic research, applied research and development are 18%, 23% and 57% respectively. The US Federal government focuses its funding most toward fundamental, underlying science and technology in new and emerging higher-risk, high pay-off areas. Industry tends to focus most of its funding toward applications and developments where risks are lower and the path forward is more clearly defined. Industry expends approximately 80% of its funds on development and the Federal government spends approximately 50% of its funds on basic research. Universities conduct over 60% of the basic research while industry carries out about 90% of all development. Federal funding for research primarily goes to universities and federal laboratories. However, Federal government and industry interests oftentimes come together. For example, Federal government public interests are linked to private industry success by such things as the need for job retention and creation, implementing strategies for sustainable use of forest-based materials, offsetting the costs of forest management on public lands, maintaining privately owned forest lands as forests versus conversion to non-forest uses, meeting national goals for biofuels and energy independence, etc. On the other hand, to industry success means being able to maintain profitability, compete in the market place domestically and internationally and to cost effectively produce new and improved goods and services that consumers want. While industry and the Federal government often work together, the reasons each side uses for doing so are usually quite different.

Proposed areas of mutual cooperation

While market place competitiveness is essential to cost effectiveness and efficiency of production of products for consumers, it makes sense to work openly and freely share information in emerging areas where the underlying science and technology has not yet been developed sufficiently to allow for competitive applications. For the USDA Forest Service, Forest Products Laboratory (FPL), such emerging areas where cooperation and openness with VTT are desirable include:

- The forest biorefinery for producing advanced biofuels and other value-added co-products without the need for massive government subsidies
- Nanotechnology involving wood-based materials and nanomaterials derived from wood
- Next generation advanced wood-based composites where hyper-performance is desired
- Advanced wood-based structures that are more energy efficient, environmentally preferable; and functional – as our current wood frame construction concept for housing dates back to the 1830's
- Understanding, isolating and cost effectively using for industrial purposes the components of living cells within trees that transport oxygen, carbon dioxide, and water as well as separate water from waste products and perform other functions.

Reasons and benefits for FPL to work with VTT

Forestry and forest products are important industry sectors in both the US and Finland with both countries being in the top ten producers forest-based materials world-wide. In addition, Finland expends about 3.5% of its GDP on research and development and ranks first among nations with respect to numbers of scientists and engineers per capita. The US is the world's largest producer of forest products but its forest products industry is only ninth with respect to size as compared to other industrial sectors in the US. Several multinational forest products companies operate substantive production facilities both within Finland and the US. Both VTT and FPL are substantively government funded and operated as national laboratories which are tasked with developing new science and technology.

There appear to be a number of common FPL/VTT interests with respect to developing the underlying science and technology to reinvent and reinvigorate each country's forest products industry in the 21st Century. In particular there appears to be a mutual interest in creating the underlying pre-competitive science and technology needed by which commercially important novel and innovative applications for wood and wood-based materials and from which industry in both countries would benefit. By focusing on pre-competitive science and technology the mutual perceived benefits from the FPL perspective are:

- Allowing for higher risk/higher reward research to be undertaken by both institutions
- Creating the underlying science and technology for new and emerging innovations
- Allowing industry within each nation to use the research for competitive purposes
- Side stepping/avoiding issues of intellectual property
- Permitting research findings to be freely shared via open communication and publications
- Achieving critical scientist mass and speeding up research progress
- Reducing cost and unnecessary duplication of effort
- Helping create the forest products industry of the 21st Century within each country
- Allowing for future expanded partnerships with others within and external to Finland and the US

Mutually identifying underlying science needs

For each area of cooperation, precompetitive science needs – mutually acceptable to both FPL and VTT – would need to be developed. For example in nanotechnology related to wood and wood-based materials, the following have been identified by FPL as potential precompetitive science and technology needs:

- Determining the range of nanomaterials obtainable from wood (cellulose nanocrystals and nanofibrillar cellulose)

- Developing energy-efficient liberation and fractionation of cellulose nanocrystals and nanofibrillar cellulose from wood
- Achieving reproducible and artifact-free characterization of nanomaterials from wood
- Functionalization and chemical modification of surfaces of cellulosic nanomaterials
- Determining the photonic effects achievable from wood-derived nanomaterials for light scattering, light absorption, light transmission, wavelength shifting, etc.
- Developing processes for preparing, stabilizing, and utilizing wood-based nanomaterials in manufacture of composites
- Developing biomimicry – using nanomaterials for ultra high strength and particular effects by imitating natural structures
- Developing nanomaterials that react to ambient stimuli optically, electronically, or mechanically
- Developing protocols and methodologies for imaging and holography with wood-derived nanoparticles
- Developing standard nomenclature for wood-derived nanomaterials and getting this adopted with ISO.

As mentioned above, for each area of cooperation, priority activities would need to be mutually developed.

Conclusions

FPL and VTT have a number of mutual research interests and common objectives as government funded national laboratories. To move the US and Finnish forest products industries forward, we need to create the new science and technology needed to move into new product areas and enable creation of new and improved valued-added products, co-products and materials. With fewer professional staff available within companies, research on new technologies and innovative materials is falling more and more to not only industry suppliers but also governmental laboratories and academic research institutions. Instead of being at odds with one another over trade and other issues and with the concurrence of

their respective industry groups and partners, the US and Finland would be best served by taking advantage of cooperative working relationships and commonalities with each other's economic systems that has been developed over many decades.



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