Innovations and Sustainability

Part 5

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This Discussion Paper is intended to spark discussion and debate. Please use it but ensure that the ideas presented within are appropriately attributed to the author. Correspondence about the project as a whole can be directed to Dr. Robert Gibson at rbgibson@uwaterloo.ca or Dr. Maureen Reed at m.reed@usask.ca

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Innovations and Sustainability

5. Repositioning the forest industry to become a leading sector in the 21st century's knowledge-based economy. Goals, strategies and rationales. Local initiatives leading to innovations in the Canadian Model Forest Network (CMFN). Corporate re-structuring. A three way divergence in a world of accelerating change.

Each of the three main innovation strategies described in the *Innovation and Sustainability* Discussion Papers (2, 3 & 4) has different impacts or implications for Canadian communities. The Canadian Innovation System strategies being promoted by the federal government and many private sector corporations (*Innovations and Sustainability – 2)* have been taken up by the forest industry in Canada. The industry is using them to advance their own work towards creating 'next generation' forest management practices and creating new and different arrays of production processes and products that will compete successfully in both domestic and export markets. They also see the approach they have adopted for doing this as a model for developing the Canadian Innovation System.

Re-positioning the Forestry Sector in Canada for the 21st Century.

Natural Resources Canada (NRCan) administers several programs relating to the forest industry under its *Promoting Forest Innovation and Investment (PFII) Management Control Framework.* The PFII is to enhance economic opportunities for Canada's forest sector as a result of increased investment in forest innovation. It has three main components: 1) *FPInnovations*, formed in 2007, to consolidate three non-profit forest research institutes, one for solid wood product research, another for pulp and paper research, and the third for forest harvesting and transportation research; 2) The Canadian Wood Fibre Centre formed in 2006, and made up of staff from NRCan facilities across Canada doing research on increasing the value of forest fibre; and 3) the Transformative Technologies Program (TTP) that in 2007 received $55 million over three years to support 'pre-competitive' research conducted by the FPInnovations groups as well as academia and other research organizations.

FPInnovations presents itself as the world's largest private not-for-profit forest research institute. It has about 600 employees located in six NRCan research and development laboratories (in Vancouver, Edmonton, Thunder Bay, Ottawa, Montreal (Pointe-Claire),

and Quebec City), and a budget of about $90 million (in 2010). It has a fees-based membership of about 350 organizations from the forest industry sectors, including eight provinces. It is organized into four broad program areas for forest-based initiatives, wood product-based initiatives, pulp and paper-based initiatives, and fibre-based initiatives. The research it undertakes is intended to offer full value-chain solutions from forest management practices through to consumer products. Collaborative research programs, aligned with key markets are for resource assessment & forest operations; wildfire operations; primary wood products manufacturing; secondary wood products manufacturing; advanced building systems; market pulps; paper, packaging & consumer products; bio-refinery and bio-energy; bio-materials; and program innovation transport.

In cooperation with the Forest Products Association of Canada, in 2010 and 2011 FPInnovations carried out "*The Future Bio-Pathways Project*" to provide

> "a blueprint for an exciting future for Canada's forest products industry – a blueprint that would see the industry lead the world in innovation and give Canada an advantage in world markets. It's a future defined by new prospects for growth as the Canadian forest sector moves from an established, process-driven commodity industry to a nimble and 'green' industry serving wider markets and driven by opportunities emerging in the 21st century bio-age". FPAC and FPI (2011: 2).

Key findings of this project were:

- "Numerous viable options exist to convert forest biomass to bio-energy, bio-chemicals and bio-materials;
- These options are best achieved by integrating their production with the traditional forest industry;
- Producing these products at forest industry facilities improves the economic results for the bio-products and forest industry facilities. It increases the job potential by up to five times versus stand-alone bio-energy plants and is environmentally beneficial;
- Markets already exist and are dynamically growing for this broad range of innovative bio-products that can be provided by extracting maximum value out of the wood fibre from every tree. These new markets will reach an estimated $200 billion annually by 2015;
- Canada's forest sector is already producing a range of bio-products, but it is not maximizing their contribution to the industry's bottom line;

- Integrating new bio-technologies into existing production will ensure a vibrant future and a Canadian advantage for the sector." (*ibid*:1).

Background studies leading to the above conclusions were conducted by Crespell and others (2011) for North American bio-materials, and Browne and others (2011) for bio-energy and bio-chemicals.

This work has been supplemented by further explorations into the most promising of the new bio-pathways. Crespell and Gaston (2011) examined the market prospects for Cross-Laminated Timber (CLT) that is one of the more promising bio-materials. Their "deep dive" review compiled information and data on CLT in terms of market needs, approach to market, benefits of the products, and competition. They note that CLT is already in use in Europe, so it works. CLT-prefab systems have great potential and preliminary cost data indicate that a CLT plant in Canada would be feasible. FPInnovations is supporting the Wood Use Strategy for Construction in Quebec. Together they had a six-story glue-laminated structure with a concrete core built in Quebec City to serve as their Quebec office building. It also was designed to achieve LEED™ certification and has received two design prizes. It opened in May 2011. (FPInnovations 2010).

Bio-energy and bio-chemicals present a more difficult situation in that they would be niche competitors for the fossil fuels energy sector, and especially the petroleum industry. The key constraints are the practice of energy pricing that so far ignores carbon cost accounting, a simple 'advantage' that cannot drive wide-ranging adoption of bio-energy or bio-fuels, and the fact that the scale of production depends on the costs of collecting the raw materials to be refined. Natural gas and many oil deposits have an impressive advantage in this regard compared with the bulky, wet, and widely distributed forest biomass supplies and the costs of transport as well as processing them for feedstock applications.

Browne and others (*op.cit*.) identified two strategies to examine (and pursue). One is "a step-wise modification of existing mills and capacities towards a more diversified bio-based business model; and/or build green-field mills for bio-production on conventional forest industry sites or as stand-alone mills" (p.4). The small-scale modifications to

existing mills should generate some revenue from new products in the short-term while also demonstrating the new processes leading to the new products. More significantly, the forest sector will have to evolve from a bulk commodities supplier to a much more responsive sector that can meet emerging needs and possibilities in non-traditional small volume niche and customized specialty markets. This will require different mixes of managerial and marketing skills.

It can be noted in passing that a much wider range of specific studies and/or literature reviews have gone into the Pathways projects, including detailed overviews of forest operations research products and services (Ryan 2012). Other examples include "carbon footprint" analyses at mill levels in three fibre supply regions (BC Interior, NW Ontario and Saguenay/Lac St. Jean, Quebec) (Lansbergen 2011), and Scenario analysis for the traditional and emerging Canadian forest industry based on economic factors that would directly affect the industry under four sets of conditions (Palma and others 2010).

The forest industry sector has been successful in accessing opportunities provided by the federal government under provisions for the Canadian Innovation System. The Networks of Centres of Excellence (NCE) Program was established in 1989 and is managed by the Tri-Council in partnership with Industry Canada. It became a permanent arrangement in 1997. Every approved network is eligible for two seven-year funding cycles subject to reviews of on-going work. The NCE program was then supplemented by establishing Centres for Commercialization and Research, and since 2007, by four business-led NCEs.

The Sustainable Forest Management Network (SFM) began in 1995 and completed the two seven-year rounds of continuous funding. The SFM was based at the University of Alberta. Adamowitz and others (2001) commented on the work of the SFM during its first cycle. They noted the five criteria that all networks had to meet, i.e. research excellence, networking and partnerships, highly qualified personnel, knowledge exchange and technological exploitation, and network management. During this first phase over 100 research personnel from 30 universities had partnerships with four provincial governments, 14 industries and five other organizations that contributed about 40% of the network's $7 million annual budget. The concept of 'ecosystem management' was

the basis for developing relevant science, and its application was based on the concept of 'natural disturbance management (NDM)'. The latter considered alternative approaches to NDM such as intensive forest management, integrated forest management, policy and institutional analysis, and value-added and alternative products. These were also explored in the context of a TRIAD approach that included landscape scale mixes of protected areas, extensively and intensively managed areas along with difficult issues of trade-offs. Time scales posed a problem for practitioners. Many needed to show results much sooner than the natural rotation periods (50-100+ years) used for forest planning. The SFM groups also took up issues of criteria and indicators as requested (required?) by the Canadian Council of Forest Ministers (CCFM), i.e. for ecological factors, water and wetlands, sustainable Aboriginal communities, and "social and economic".

MacNab (2005), the research manager for the SFM network, observed changes that had occurred over ten years of the partnership. There had been a shift to larger and more integrated project teams that required many more dialogues in order to agree on research priorities while more graduate and other students were being brought into the collaborations where they would experience multi-disciplinary work directly. Klenk and Hickey (2009) identified the most important results and outcomes from this SFM network based on statistical analyses and interviews with key informants. They found that by its 14th year, the SFM network had provided almost $50 million in completed research funding for 347 projects by 443 researchers.

Four edited volumes by different authors present the main findings along with 20 "synthesis reports and 39 research notes". Other publications may be forthcoming. Generally, they had fulfilled the primary criteria expected from the network. They had also succeeded in incorporating some social science into forestry (20% of the research personnel in the network were social scientists). Some had also succeeded in getting aboriginal communities involved in their work. The network also funded about 1,600 "highly qualified personnel" that meant many people in the next generation will be familiar with multi-disciplinary approaches to forest issues.

Klenk and others (2010) used the data from their analyses of the SFM network from 1995-2009 to discuss some theoretical concepts about network structures and

development including the role of social capital and bridging relationships in large networks. They raise the possibility of pre-designing networks to achieve different results than might otherwise emerge from self-organization among small groups of individuals all competing for the available research funds. This generally seemed to be the case in the Canadian Network of Centres of Excellence.

The SFM network kept detailed records of research projects, including summaries of each on-going one, and a results and implications summary for completed ones, as well as a bibliography of publications and lists of authors (e.g. SFMN 2007). There was no mention of the model forests other than they were among the various organizations that the network had contacted.

The model forests were to demonstrate good or best practices for forest management at site or landscape scales and they were engaged with the same range of subject matter as the SFMN. It remains unclear if there were some role differentiations or just overlaps. MacLean and others (2010) prepared detailed summaries of all the work that was done by the SFMN in the 210,000 ha Black Brook Forest District owned by J.D Irving Ltd. in northern New Brunswick. The Fundy Model Forest was in south-eastern NB during this period. The Foothills Research Model Forest in the eastern Rockies near Jasper National Park in northwestern Alberta, drew upon prior work on patterns of natural disturbances in the region to create an interagency planning group that used this information to prepare a 10-year (2005-2015) integrated natural disturbances emulation plan for a 70,000 ha area of older growth forest surrounding a main highway traversing three forest management units and one wilderness provincial park. The Foothills Research Institute (that was the MF organizational entity) deemed this to be the first in Canada at the time. The group used the concepts and planning strategies that were otherwise also promoted by the SFMN across Canada.

The SFM network was very much dominated by academic personnel through its existence, especially in its first years but they were always a majority of the participants throughout. The model forests seemed to rely upon local consultants for a number of their activities. This is not necessarily a fault, and may only reflect the dominance in the model forest of their ‘partners with authority’ (forest corporations, provincial foresters

responsible for forest tenure licenses and top-down guidance from the Canadian Forest Service, the funding agency).

Canadian Forest Nanoproducts Network – ArboraNano:

ArboraNano was created in 2009 as one of four business-led Networks of Centres of Excellence funded by the federal government through NSERC. The founding members of ArboraNova are FPInnovations and NanoQuébec and the network is to develop products based on NanoCrystalline Cellulose (NCC). ArboraNano has recruited 16 members (including seven universities) and 19 network partners (including five other universities. Members have signed a network agreement and provide shared cost contributions, and in turn they can receive network funding and own Network Supported Intellectual Property. Partners participate in certain research projects on some shared cost basis. ArboraNano's Board is chaired by FPI, the management team is a Network Director and two support staff, while the Scientific Committee has four "product platform leaders" from the aerospace, automotive, forestry and medical industries, and four "research theme leaders" for nanotech coatings, composites, fundamentals and processing R&D operations. The federal government has allocated $8.99m over the period 2009-2013, and with cash or kind from industries and various other government sources, the total budget for ArboraNova is $16,631,000. Some 20 projects are underway in eight industry sectors. The attraction of this governance structure for the membership and partners is that it is driven by industry and gives them great flexibility when selecting projects for funding (ArboraNano 2012).

A major related accomplishment was scaling up the production of NanoCrystalline Celluose (NCC) production by "CelluForce", a joint venture by FPInnovations and Domtar at the latter's state-of-the-world mill in Windsor QC. Built at a cost of $36 million, production is to be gradually increased until it reaches about 1,000 kg of NCC/day in 2012. Technical collaborative agreements to purchase the NCC have been made with companies in Asia, Europe and North America in four main industrial sectors.

<u>NSERC Forest Sector University R&D Networks</u>

In 2008, the federal government identified the forestry sector as a priority for the Canadian economy over the next decade. In 2009, NSERC, FPInnovations and NRCan formed a partnership to create the NSERC Forest Sector R&D Initiative. This was a $34

million five-year initiative to identify commercially relevant research programs that could create new market opportunities for the forest sector. The funds came from the NRCan Transformative Technologies Program and are administered through FPInnovations under the latter's "Flagship Innovation Program". The program has five themes:

Next Generation Building Solutions – NSERC Strategic Network on Innovative Wood products and Building Systems;

Next Generation Pulps and Papers – NSERC Green Fibre Network;

Energy and Chemicals from Forest Biomass – NSERC Biomaterials and Chemicals Strategic Network;

Novel Bioproducts from Forest Biomass – Canadian Forest Nanoproducts Network (AboraNano). This is the only forest Business-led Network of Excellence;

Integrated Value Maximization – NSERC Strategic Research Network on Value Chain Optimization.

In 2011, the NSERC Forest Sector University R&D Networks were aligned under "One Organization, FIBRE, or Forest Innovation By Research and Education". The university R&D networks comprise seven NSERC strategic initiatives. Besides the four noted above, the three others are: For Value Net, Bioconversion, and Lignoworks.

Each network has a required Governance structure consisting of a Board of Directors, chaired by a professional expert who is not affiliated with the network or any of its member organizations, while the other members of the Board should be drawn from relevant public, private and academic sectors, that together reflect the multi-sector and multi-disciplinary composition of the network. The Board also includes the Scientific Director of the network and an NSERC (*ex officio*) representative. The network also has to have a Scientific Director and a Network Manager.

From available information for each of the seven NSERC networks (their websites and background documentation some have posted), they can be summarized briefly as follows.

NSERC Bioconversion Network, 2008.

Based in the University of Guelph, School of Environmental Sciences, and the University of British Columbia, Forest Products Biotechnology/Bioenergy. The network aims to develop the technology, ensure environmental sustainability, capture intellectual property (IP), and market share of valuable industrial chemicals and renewable bio-ethanol from lignocellosic biomass conversion.

The network has six universities and nine private sector and government partners. Board has 11 members. A Young Bioconversion Scientists Network for grad and post-doc students participating in the research is supported and has a major role in annual conferences.

Research themes: The network uses a common feedstock and substrates to investigate bioconversion through pretreatment, enzymatic hydrolysis, fermentation, process economics and scale ups.

NSERC Biomaterials and Chemicals Strategic Network (Lignoworks). 2010.

Based in the University of British Columbia, Department of Wood Science in the Faculty of Forestry. The network aims to provide alternatives to fossil fuel feedstocks by creating technology platforms for lignin-based chemicals and materials.

The network has 16 faculty in science and engineering from nine universities and three industry and government partners, including Lignol Innovations, based in Burnaby BC. Lignol has a $40+ million state-of-the-art technology for developing a range of industrial applications of fuel grade ethanol and co-produced 'green' chemicals known collectively as HP-L™ Lignin. It is also customizing Lignin Derivatives for wider use and has a "robust" IP program for patents protection.

The network has a Board of eight (including the Chief Operating Officer for Lignol Innovations). It also has a Technology Exploitation Committee (five members) and a Scientific Operations Committee (five members).

Research themes: 1. Polymeric Products – technical lignins for nanostructure reinforced biocomposites; functional aromatics and novel functional materials. 2. Thermochemical Processing of Lignin – developing value-added aromatics from the thermal breakdown of lignins; "green" extraction separation using switchable solvents and surfactants to extract aromatics. The network has access to the Institute for Chemicals and Materials from Alternative Sources, at the University of Western Ontario. 3. Catalytic processing of Lignin – a number of possibilities are being explored.

NSERC ForValueNet; Strategic Network on Forest Management for Value-added Products, 2009.

The over-all objective of this network is to develop a series of new and integrated models to simulate and optimize the forest-wood value chain. Three integrated models are being developed: 1) Process-based stand/tree canopy growth models; 2) 3-D stem quality (stem geometry/wood characteristics) models; 3) Primary and value-added produce recovery models. Integration of these models will produce integrated, value-based decision support systems to optimize wood manufacturing processes and harvesting schedules/decisions. They will also be valuable tools for silvicultural planning.

The network has 31 research personnel from ten universities and has also engaged 14 Masters & 24 PhD students and six post-doctoral fellows. The Board of Directors has ten voting members, and the NSERC budget is about $5 million over five-years.

NSERC Green Fibre Network. (The Canadian Strategic Network for the Development of Innovative Green Wood Fibre Products). 2010-2015.

This network is to create technology platforms for developing green products based on wood fibres and wood fibre networks that will replace fossil-fuel based and other non-renewable products. The scientific issues to be dealt with are grouped under technology platforms; functionalized wood fibres for special applications; strong networks from hydrophobic and hydrophilic fibres; water vapour transport through cellulose-based fibres; formation of 3D structures from wood fibres; and wood fibre-biopolymer composites.

Three themes are to be addressed by 19 projects at the interface of Materials Science, Green Chemistry and Engineering, Pulp & Paper Science, Cellulose and Lignin Chemistry, and Industrial Design. The themes are: Chemical Modifications of Wood Fibres and Wood Fibre Networks – led by the University of New Brunswick; Barrier Properties and Water Resistance of Wood Fibre Networks – led by McGill University; Novel Eco-friendly Lignocellulosic Fibres – led by the University of Toronto.

The network has 21 academics from six universities, 25 graduate students, and 12 research personnel from FPInnovations. The NSRC federal contribution is $5.3

million over five years with the expectation that some matching funds from partners will be received. The Board of Directors has eight voting members.

NSERC NewBuildS Network: (Strategic Network for Engineered Wood-based Building Systems), 2010 -2015.

The purpose of the network is to advance scientific knowledge and construction technologies that will enable wood-based products to be used in mid-rise and non-residential construction or integrated into hybridized construction. The collaboration is between the wood industry and the design community organized into four themes:

1. Cross-laminated timber (CLT) material characteristics and structural performance;
2. Hybrid building systems structural performance;
3. Building systems fire performance, acoustic and vibration serviceability;
4. Building systems durability, sustainability and enhanced products.

The network consists of 23 professors from 11 universities and 19 research personnel from FPInnovations, the Institute for Research in Construction (National Research Council) and the Canadian Wood Council, supervising 60+ graduate and post-doctoral fellows. The Board of Directors has 13 members and the Scientific Steering Committee has ten members. The NSERC budget is $5.3 million over five-years.

NSERC SENTINEL: Canadian Network for the Development and Use of Bioactive Paper, 2005-2010. Continuing under additional funding.

The goal is to create inexpensive paper products that detect and repel or de-activate waterborne or airborne pathogens. The core of the project is to prove the concept of bio-detection. New product possibilities include: Pathogen-trapping paper such as protective clothing, face masks, air filters, water purification; Diagnostic paper for food packaging, health monitoring, biohazards, bio-defense; and Security papers for brand protection, anti-counterfeiting, and document authentication.

The network is based at McMaster University, Hamilton ON, Department of Chemical Engineering. Its founding partners include nine industries, the Institute of biological sciences, National Research Council, the Ontario Centres of Excellence, and NSERC; 24 professors from ten universities along with 20 graduate students and 20 post-doctoral

fellows are conducting the research. Technological Platform Working Groups have been formed for Rapid Pathogen Detection; Optimal Substrates; Printing and Coating; and Barrier, Capture and Deactivation. On-going projects are grouped under three main themes that together address the technological platforms: Bio-Science Projects (7); Material Sciences Projects (6): and Surface Science Projects (9).

SENTINEL has the standard structure of a Board of Directors, Network Manager and Science Manager, as well as a Technological Exploitation Committee and a Scientific Operations Committee. Its original five-year funding was about $2 million annually, 25% of which came from industry partners. The partners also created a small Technology Transfer Fund of about $400,000 for use by possible spin-off or start-up companies to commercialize some results from the applied research.

NSERC Strategic Network on Value Chain Optimization (VCO), 2010.

The modern forest bio-economy recognizes that the challenge is to extract the maximum possible value from the forest but in sustainable ways. The VCO network is to improve forest industry competitiveness through innovations and training highly qualified personnel in the emerging fields of value-chain modeling and providing analytical tools and decision-support for optimization of the modern forest bio-economy networks. The key objectives for research in VCO are to: increase value gain from forest and asset utilization by developing tools for integrating whole value chains; improve competitiveness through new and optimized value propositions and business models; improve agile execution and value capture throughout the business networks; develop a culture of analytical decision-making; and train highly qualified personnel.

The VCO network is based at Laval University. Currently 28 professors from 12 universities in the fields of forestry, wood science, forest operations, chemical engineering, industrial engineering, computer science and operations research as well as 12 research personnel from FPInnovations are involved with a number of projects under five main themes while also supervising five Masters and 14 doctoral students and four post-doctoral fellows. The research also draws upon work in other networks including forest biochemicals, ForValueNet, GreenWoodNet, and NewBuildS.

Theme 1: Integrated Forest and Industry Strategies for the New Forest Bio-economy. Six projects address issues such as optimization models for long-term forest strategies, tenure and land use policies and resulting agent behaviours; value chain capacity planning; integrated design of TRIAD and value chains. Theme 2: Designing Agile Logistics and Manufacturing, and Theme 3: Integrated and Collaborative Planning have eight on-going projects on topics such as designing collaborative value chains, flexibility vs customization, designing inter-modal infrastructures, policies, sales and operations of different companies. Theme 4: Value Optimizing Scheduling & Control; and Theme 5: Knowledge Representation for Agent-based and Sector Modeling have seven projects underway to address issues under these headings. The network includes nine forest companies and the Forest Products Association of Canada along with government partners such as FPI, CFS, and Environment Canada. There is a Board of Directors of eight people, a Steering Committee of nine people.

The Forest Industry as a Model for the New Knowledge-based Economy

The Forest Products Association of Canada and FPInnovations made a submission to the "Review of Federal Support to Research and Development" (FPInnovations 2011). This review was conducted by an Expert Panel convened by the Minister of State for Science and Technology to review the $5 billion of support provided by the federal government annually for R&D in Canada (that came to be known as the "Jenkins report"). The submission endorsed the preliminary observations of the Panel that later became the basis for its major recommendations.

The submission offered the forest industries approach as the best model for the national innovation system, emphasizing that:

- The FPInnovations had experience in building a strong and integrated public-private partnership that could be applied to similar efforts in other sectors;
- Innovations is about ideas in use to help create wealth;
- R&D may not have any immediate connection to a problem or challenge within an industry or emerging area of public concern. If it only leads to ideas that may be patentable this alone is insufficient;
- Returns on innovation investment should be measured in terms of outcomes not process. Peer-reviewed papers published, or number of patents filed, are

not of particular use since it leads only to peer recognition or to intellectual property protection;

- Outcomes metrics in terms of return on capital employed, impact on shareholder value and margins, growth of sales in new markets, productivity gains, and new products and services brought to market are the relevant ones;
- Cluster-based applied research that is industry-driven with innovation development and deployment linked to market intelligence is a clear strategy for Canada to pursue.

Larger-scale Phase Cycles and Trajectories Also Underway in the 21st Century

Given the Canadian forest industry's commitment to the new global economy and emerging new technologies, it should be noted (at least from a complex social-ecological systems perspective) that phase cycles and trajectories also operate at the global scale. The 'discursive domain' adopted by the forest industry seems to have ignored the implications of this.

There is a huge literature about this larger scale that is not reviewed here. But a few points are worth noting. Starting at the beginning of the industrial age (with the steam engine c 1780) there have been at least five (with the sixth in sight) "long waves of prosperity" followed by collapses into severe economic depressions that occur over periods of about 50+or-10 years that can be divided into an A phase up-swing and a B phase downswing with the first sometimes lasting somewhat longer than the latter half. The drivers of these phenomena include historical and demographic trends that lead to shifts in the demand side, and trends and innovations that structure the supply side of the economy. They are often called the "Kondratieff long waves" named after a Russian economist who in the 1920s detected them from his analyses of trade data. The most recent (5th K) is from 1970-2020, driven by the emergence of earlier ITC primarily, with the downswing signaled by the global financial crises from 2008 on. The response to this can be seen in the urgency given to the creation of national innovation systems especially bio-technologies and nano-technologies, but also in genomics, photonics, materials science, robotics and web 3.0 machines-to-machines handling of vast reams of data that can be analyzed to reveal underlying patterns as well as track anything,

anybody, anywhere 24/7. Ethics or possible downsides are either ignored or subsumed under 'risk analyses' that may be recommended to individual firms. Scaled up drone warfare and cyber attacks are examples of what might be ahead.

Arthur (2011) hinted at K cycles when he noted that "every so often – every 60 years or so – a body of technology comes along and over several decades, quietly, almost unnoticeably, transforms the economy: it brings new social classes to the fore and creates a different world for business" (*ibid*:1). He gave as an example the unseen strictly digital domain that is creating a kind of "neural system for the economy". It underpins the new knowledge-based economy as a kind of second unseen underground economy that generates intelligent reactions to what goes on above ground. It is not likely to create many 'physical jobs' so the challenge ahead is how to shift from *producing* prosperity to *distributing* prosperity (emphasis in the original *ibid*:7).

"Globalization" can mean many things. One is the role and future of the nation-state in a worldwide capitalist economic system. This opens up a huge arena of scholarship under the general heading of "world-systems". For example, some contemporary predicaments are described by Hornborg (2009) and Moore (2011; 2012). Historical studies have included the history of capitalism in the world of nation-states since the former emerged about 500 years ago in Europe with resulting struggles for power and hegemonic domination (e.g. Wallerstein 1999; 2000; 2005); the longer global trends associated with hegemonic transformations (Arrighi 1995; Arrighi and Silver 1999); wars as an integral component of these transitions (Modelski 1996; 2005); millennial processes that have been associated with the 'rise and demise' of civilizations over the past 12,000 years (Chase-Dunn and Hall 1997), and the perceptions of the unfolding of 'globalization' as the transformation of the world-system into a single class/caste structure of dominance by the rich and powerful over many different class/ethnic layers of less well-off dependent groups and a lowest and largest layer of the totally destitute. South Asia today could serve as a proto-type for what this 'globalization' entails (Robinson 2011).

As many observers have long suggested, the relentless and endless drive for the accumulation of wealth and power by controlling any and all resources requires endless growth with no sense of 'enoughness' nor concern about the destruction this entails. While ideologically romanticizing the virtues of 'creative destruction' for businesses or

anything else that stands in the way, capitalism as it is being practiced and praised this way is a fundamental world pathology (e.g. McMurtry 1998). It is also a world where "geopolitics" has a role in interpreting what is happening (e.g. Friedman 2010).

"Complexity" entails contradictions, tensions, paradoxes, ambiguities, dialectical processes, and collaborations. 'Steering' this for desirable forms of sustainability is still an art to be learned. But it is a context of relevance to the forest industry that has already been affected by it.

Innovations and the Model Forest & Forest Communities Programs

For detailed overviews of this program (and of biosphere reserves) under the theme "Governance Matters!" please see Francis (2011 a; b).

It is generally recognized that the innovation process has about four (three to five) phases and an inherently linear logic in that discoveries and inventions precede the commercialization and applications of them. The problems to be solved can, and as the Canadian forest sector argues should be identified by businesses that seek to benefit from practical solutions. The processes for putting all this together can be difficult and time-consuming. It becomes a challenging learning exercise for all concerned which itself takes time and energy of all the main players. And that assumes that all the main players have been identified and are engaged in the learning processes.

The Model Forest and its successor, the Forest Communities Programs have similarities to biosphere reserves and other community-based resource or local economic development management programs. First, the concepts underpinning these programs were innovative in the forestry sector. Second, the strategies and methods adopted by the local lead organizations to conduct their programs may be either incremental adjustments to programs already underway or on occasions quite innovative new ones. Third, some practical solutions the local organization adopts to deal with particular local circumstances on site can be innovative. Finally, the way they go about creating networks or inter-organizational arrangements for scaling out and scaling up their new ways of doing things so that they can have lasting impacts may also be innovative. Model forest sites might also be adopted by other organizations to try out programs

under different circumstances. There are also pitfalls with organizational and 'social traps' to avoid all along the way. Examples of each of these possibilities are noted below.

It can be argued that the *'model forest' concept* was an innovation. It arose at the time of the 1992 UN Rio Conference on Environment and Development (UNCED) partly in response to strong and at times bitter public opposition to prevailing forestry practices in Canada from the 1970s through to Rio (and beyond), and a political desire of some governments (including Canada) to negotiate an effective north-south UN Convention on Sustainable Forest Management. The Model Forest program was developed by the Canadian Forest Service (CFS) with the concurrence of the Canadian Council of Forest Ministers (CCMF). It was announced at Rio along with an offer from Canada to fund model forests in other countries.

In 1991-1992, CFS solicited applications from people that were interested in creating a model forest and obtain the funding that went with it. The criteria to be met were (a) the forested landscapes had to be at least 100,000 ha in size, and (b) some portion of them had to be 'working forests' under provincial long-term forest management agreements with forest industries. The goal was to develop local capabilities for "sustainable forest management" rather than the much more conventional "sustained yield forestry". The difference (not always discernable in practice) was that all forest values had to be 'balanced' for "sustainable forest management" rather than the prevailing practices of "sustained yields" that optimized the volumes of raw wood flowing to processing plants, many of them built with reference to technical criteria for maximizing the efficiencies of the internal plant operations. As NRCan (2002) states:

> "Conceptually, sustainable forest management builds on traditional forest management, but expands the time horizons (from one to many rotations), the spatial dimension (from stands and small forests to large landscapes, and the value array (from timber and selected wildlife habitat to biodiversity and social values). The desired outcome of sustainable forest management is a balance among conditions that are simultaneously economically feasible, ecologically viable, and socially acceptable" 5.0 para 2.

This *is* a main innovation for the forest industry. In addition, a model forest organization had to have representatives from all local stakeholders and strive to operate by consensus. There was an implicit assumption that 'consensus' was the key to sustainability.

Model forests have no jurisdiction over the lands within them. But this meant that some of the stakeholders were more important than others. They were “the partners-with-authority” who included the industry holding the forest management and/or timber cutting rights for all or part of the model forest, a provincial forester from the Ministry responsible for allocating Crown land forest tenures, and *ex officio*, a CFS representative of the federal funding agency. The organization was NOT to deal with policy issues, and the partners-with-authority had no obligation to accept suggestions the model forest might make to them. These stipulations caused some wonderment from non-governmental participants or observers.

Ten submissions from about 50 applications were chosen to become model forests in 1992. In phase 1 (1992-1995) each model forest received $ 1.5 million for each of the five years. Their main job was to develop a network of local partner organizations and groups, get themselves organized internally by appointing a general manager, an administrative assistant, and obtaining access to GIS technologies, and arrange for sub-committees and working groups as necessary. CFS guided all this by requiring annual work plans, progress reports and project reports. NRCan had an independent evaluation done towards the end of the five-year period that determined eligibility for a second five-year grant that was somewhat less, on the grounds that partners should provide buy-in in some form.

Phase 2 (1997-2001) also required each model forest to address three “strategic initiatives” - develop local criteria and indicators (C&I) for sustainable forestry using a template and a 265 page users’ guide that had been developed by the CCFM, enhance Aboriginal involvement in forestry work, and develop programs for private landowners owning small woodlots, a common situation especially in eastern Canada. Those eligible for Phase 3 (2002-2006) received $ 500k annually with a requirement to secure at least $ 250k from partner organizations. They were generally expected to extend their influence beyond the model forest. Some took this to mean working anywhere in the province or region (e.g. McGregor MF merging to help form Resources North, a 25.5 million ha region in northern BC; Manitoba MF took up a western region of Manitoba; Fundy MF adopted all of New Brunswick; Nova Forest Alliance took up all of Nova Scotia and a shared program in PEI, and Western Newfoundland MF extended into parts

of Labrador with Innu partners. Most also spent some more time with overseas model forests under agreements with the International Model Forest Program (IMFP) that developed in parallel with the CMFP, initially with funding from the International Development Research Centre (IDRC) and the Canadian International Development Agency (CIDA).

The Canadian Forest Service (CFS) played a strong guiding role for the model forest program. Two key groups, the CFS Model Forest Steering Committee and the Model Forest Secretariat provided this guidance. The Steering Committee consisted of four Regional Directors General who reported to the CFS Management Committee. A Director of Programs provided support to the Steering Committee and managed all Secretariat staff except the individual model forest coordinators. The model forests viewed the Director as the critical link with corporate CFS. NRCan (2002) hinted at some tensions in these relationships during the first ten years of the program in that the model forests needed to be given the 'intellectual freedom' to act as experimental models of sustainability and would be more likely be able to secure partnerships and some matching funds if they were not seen to be (as?) tightly tied to the CFS (*ibid*: 2.1).

Five objectives were established by CFS for Phase II of the model forest program. NRCan (2002) conclusions about each are also noted.

1. Encourage the demonstration of management systems that emphasize the practical applications of the concept of sustainable forest management.

Most model forests had a limited number of on-the-ground demonstrations of sustainable forest management. Most involved different topics related to forest planning, or developing guideline documents.

2. Establish acceptable indicators of measurement and monitoring systems and reporting systems that can measure performance relative to goals and objectives of each model forest.

Considerable effort in developing indicators of sustainable forest management and numerous research programs supported this objective. "These efforts have been collated and led to a publication that is considered to represent an important national contribution to sustainable forest management" (*ibid*. 2.2, no reference).

3. Ensure that the results and knowledge gained are disseminated at local, national, and international levels.

Most model forests communicate well with their constituencies, particularly in dissemination of results. A wide variety of mechanisms are used "… including events, specific and regular publications, displays, tour, signage, workshops, education tools/courses/events, and websites" (*ibid* 2.2)

4. Encourage model forest participants and organizations to work together as a network and to participate in activities at the 'Network level'.

Activities included participation in the "Network Strategic and Operations Committee (NSOC)", network activities, Strategic Initiatives, and workshop. There was little evidence of other informal networking activities.

5. Encourage the representation of a broad range of forest values in each model forest.

The governance structures established in each model forest "have been quite successful. This aspect may prove to be the greatest contribution of the CMFN to the practice of sustainable forest management. The route most taken by Model Forests to achieve this goal was through inclusiveness on the Board of Directors and other Committees" (*ibid* 2.2).

NRCan (2006) was a follow-up and mid-term (of Phase III) of the model forest program, covering the period from April 2002 to July 2005. It was conducted in a comparable way to the earlier evaluations. It found that no progress had been made on # 4 above (about participation at a Network level) but concluded this was due to a staff problem at HQ). With regard to the four objectives established for Phase III (the reported comments below are paraphrased in a few places):

1. Increase the development and adoption of sustainable forest management systems and tools within and beyond model forest boundaries.

There is "significant evidence" that there has been increased development of sustainable forest management systems and tools during Phase III but (with some exceptions) there was little evidence of this being adopted or adapted by partners in the model forest or beyond. This was a matter "of considerable concern" given the rationale for the CMFN (*ibid*. 5.1.2).

2. Disseminate the results and knowledge gained through the CMFN at local, regional, and national levels.

The majority of MFs and the MF Secretariat have developed and implemented educational and local partner awareness programs. The CMFN contribution to a World Forestry Congress (presumably the 12th Congress held in Quebec City in 2003) was an "outstanding success in communications". A concern is that the CMFN is becoming an important, non-traditional, performer of forestry R&D, yet much of this information is not easily accessed.

3. Strengthen model forest network activities in support of Canada's sustainable forest management priorities.

The relationship between the CFS and model forest Science and Technology (S&T) needs to be clarified. Given the broad nature of the research undertaken in MF, the CMFN Secretariat should explore development of stronger ties with other federal departments involved in related programs (environment, agriculture, fisheries). "There is an urgent need to clarify the relationship between the International and the CMFN. The informal links between MF in different countries occur with "no defined strategy in place that could lead to a mutual strengthening of both networks". There is little activity to suggest progress in the strategic initiative concerning enhanced Aboriginal involvement in forestry. The strategic initiative to develop local level indicators seems to be focused mainly on developing and testing a carbon budget model at the forest management unit level. Although successful, "it may be useful to revisit the requirement of maintaining this strategic initiative in its present form" (*ibid*.5.1.2).

4. Increase local-level participation in sustainable forest management.

While some MF have increased local participation, it is not clear what is expected from this directive.

At the end of this 15-year period in 2007, NRCan formally terminated funding for the Model Forest program as such. The model forests continued as the CMFN, except for two that were dropped from it, Long Beach MF in BC, terminated in 2002 for non-compliance, and Bas-Saint Laurent MF in QC, apparently on the grounds that it had completed all it needed to do.

The "Forest Communities Program" (FCP)

The CFS also established the FCP through an applications process. All of the former model forests applied for the Forest Communities program. Six were funded as FCs and another six were not. Newcomers in 2008 included Le Bourdon, QC, Lac Saint-Jean Model Forest, QC, Clayoquot Forest Communities, BC, and Northeast Superior Forest Community, ON. In 2010, the Weberville Community Model Forest in northern Alberta was added for a new total of 15 FCs.

The new FCP itself was incorporated as a non-profit organization in 2008. It got launched in 2008-2009 with its initial budget of $400k cut back slightly to $325,000 annually for each FC when it got underway. The ADM of CFS is accountable for the program. The Director General (DG) of the Science Program and DG of the Atlantic Forest Centre provide "strategic program guidance" to ensure that the FCP meets NRCan intended outcomes. The FCP is supported by eight FTE staff from NRCan-CFS regional offices and from the National Capital Region (office in Kemptville, ON). The main challenge facing the new FCP was to organize this new configuration of the CMFN, without the previous levels of support provided by CFS and other partner organizations from the private sector, into a viable program that could make significant contributions to forest-based communities forced into 'transition' because of major changes affecting the traditional forest industry in Canada (and elsewhere). As they report:

> "Together, our (CMFN) sites represent nearly 1 million Canadians living in more than 270 First Nation and non-First Nation communities. These communities have faced nearly 80 mill closures and approximately 12,150 residents have lost their jobs. This means that nearly 1.5% of the population in CMFN partner sites have been unemployed as a direct result of the forest sector crisis. When we consider forest sector indirect job losses, nearly 18,200 additional citizens have faced unemployment as a result of the past decade of instability. Combining these numbers creates a total impact of the forest downturn in our partner communities of nearly 30,300, or over 3%. The harsh reality is that approximately 1 in 32 people in our regions have been unemployed as a result of this forest crisis" (CMFN 2011: 2-3).

As NRCan (2011) adds: "However, the Forest Communities Program is small and work undertaken at the eleven (then) sites will not transform the approximately 200 rural and remote forest-dependent communities in the Canadian forestry sector" (*ibid*. 4.1.1). And:

"NRCan is best positioned to offer knowledge and expertise on the forestry sector, rather than provide program delivery. In this context, questions have been raised on the relevance of NRCan's role in economic development and capacity building in forest-based communities. The economic portion and capacity building of the Forest Communities Program may be best delivered through other departments with stronger mandates and more substantial funding (*ibid.* 4.1.3).

Nevertheless, the FCP has created a more tightly organized network structure for its governance of the CMFN including a vision statement ("Sustainable Forests; Sustainable Communities"), a clear statement of six CMFN Objectives, and an Implementation Committee in which people from individual MF & FC take a lead as Vice-President (VP) working with 3-4 other volunteer members from the network to develop terms of reference, priorities and proposed steps for moving forward, especially to 'grow partnerships'. It does not, however, have a significant research capability. This new arrangement does provide a structure for annual general meetings (e.g. CMFN Annual Report, 2008-2009: 2011). It could easily be seen as a core structure for what eventually may develop.

Achievements

The highlights of the model forests and forest communities work have been published in their e-newsletters called **"Innovations"** with the apparent intention of suggesting that everything they did was innovative, at least in the places they were doing it. One has to read through detailed work plans and annual reports in order to get a clearer sense of the local situation. Even then, one senses a lot of interesting activities and various enthusiasms among presumed beneficiaries but at best only some modest interim results – forest ecosystems (not to mention some organizations) just don't respond fast to whatever is happening to/for them. Nevertheless, some projects do seem to stand out. A number of them were flagged by the CMFN (n.d. c 2006; 2011). The main subjects are noted briefly below, and in alphabetical order so as not to infer a pre-determined ranking among them.

Aboriginal Involvement in the Forest Industry:

The situation generally was viewed to be how to encourage Aboriginal people to become much more engaged and employed in the forest operations component of the industries, at least to start. Five federal programs have been addressing this in different ways over the past several decades, including the First Nations Forestry Program administered by NRCan from 1996-2010 (when it was terminated). Wyatt (2007) reviewed the various stages, from exclusion to co-management, that have been used to define roles for Aboriginal peoples, but was aware of the cultural ambivalences inherent in each. The most thorough review of these issues was carried out by Stevenson and Perreault (2008) on behalf of the Sustainable Forest Management Network. They noted the cultural contradictions that underlay the framing of the situation, i.e. “capacity for what and capacity for whom?”

Model forests had only supplemental roles to play in this larger situation, although these can be helpful. For the only Aboriginal model forest in the CMFN, the Cree Research and Development Institute is following up work done by the Cree Model Forest in Waswanipi that helped Cree families in that community map and maintain information on landscape features of importance in their traditional hunting territories. Following “The Peace of the Braves” agreement between the Quebec government and the Cree of northern Quebec in 2002, the Institute has had a “Cree Forest Lexicon” created after extensive consultations with people in each community and translated their oral vocabularies into English and Cree. The latter used a standard international phonetic alphabet as well as a version in syllabics. The Institute is also leading a series of meetings for “Harmonizing Cross-Cultural Views” to build mutual understanding of forest-related activities and values in the region.

Other initiatives include the partnerships between the Eastern Ontario MF with the Mohawk Council of Akwesasne that has led to the adoption of “mutual respect” as a basic principle, planning for the “seventh generation” as the proper perspective, and the “zeal to deal” as a basic partnership relationship (Story and Lickers 1997). The Prince Albert MF has contributed to the development of the Paspiwin Cultural Heritage Site in Prince Albert National Park that serves a variety of traditional spiritual and ceremonial purposes for the Cree and Métis people, as well as being an educational centre for visitors.

Carbon Budget Models:

In 1992, the Canadian Forest Service's "carbon accounting team" addressed the need for an "operational scale carbon accounting tool" needed to meet criteria and indicators reporting for sustainable forest management. It was also compliant with the Intergovernmental Panel of Climate Change (IPCC) good practical guidance methods required under the Kyoto Protocol. Two model forests, Lake Abitibi and Western Newfoundland were selected as pilot sites for developing and testing the model. The model uses much of the same information that is required for forest management planning such as forest inventory growth and yield curves, and human disturbances including harvesting schedules. Other model forests helped co-sponsor local technical training workshops. Altogether as of 2012, 16 workshops with over 400 participants have been held in Canada and abroad. "Tree Canada" an NGO that promotes "urban forestry" has elaborated the model for the urban and near-urban situations it works in (Tree Canada 2009).

Climate Change, Adaptations, and FireSmart®:

The extensive literature on climate change and its implications for forests and forest communities is not reviewed here. "BIOCAP Canada" functioned as a major Centre of Excellence for addressing issues of the impacts of climate change on "biological capital" such as understanding carbon cycles, reducing greenhouse gas emissions from agriculture, enhancing carbon sinks in forest and agricultural systems, and developing sustainable biomass energy systems. BIOCAP functioned from about 1998 until 2008 when, with a change in the federal government in 2006, it was effectively closed down. Johnston and others (2006) prepared a synthesis paper on adapting forest management to the impacts of climate change in Canada. Over about the same period, considerable research was being conducted in the Prince Albert MF that encompasses a major, and quite sharply defined ecotone zone between the prairie parkland ecosystem and the south edge of the boreal forest. Johnston (2008) compiled field evidence from a number of sources to confirm that the small 'islands of spruce' stands within the northern parklands were quite stressed. A climate moisture index that relates annual precipitation to annual evapo-transpiration combined with soil textures and depths that retain moisture provided a good indicator of the actual location of the ecotone transition on the landscapes. Davidson and others (2003) summarized the main factors whereby human communities perceived hazards associated with this drying out, and Duinker and

Ordonez (2010) discuss some practical strategies or forest managers might enhance the resilience of forests to these changes.

In 1990, the Alberta Forest Service (now Alberta Environment and Sustainable Resource Development) took up issues of wildfires and urban interfaces. They created a “Partners in Protection Program” to facilitate inter-agency cooperation, public awareness and education about reducing the risk of loss of life and property from fires in the wildland/urban interfaces. Key people to engage in this were community leaders, local firefighters, industry partners and vulnerable community members. In 1999 they created the FireSmart® brand and published a comprehensive manual “FireSmart Protecting Your Community From Wildfire”.

Foothills MF had been doing practical studies of natural disturbances including fire regimes, and contributed this to the Alberta project for the Northern East Slopes Integrated Resource Management Strategy undertaken by an Alberta Fire Smart Landscapes Task Force formed in 2002. *Foothills MF* was based in Hinton, AB, about 29 km east of Jasper, in what is now the “Innovista Industrial Park”. The local industrial partner at the time has seen several re-organizations but is now Hinton Wood products – Division of West Fraser Mills Ltd (Vancouver). It has a pulp mill and a sawmill operating under a forest management license for about one million ha, including seven small communities in it. As of 2011, West Fraser was integrating FireSmart® into Forest Management for this region and consulted closely with people in the communities about the optimal location for FireSmart blocks of forest that would be harvested and regenerated in some orderly way.

The *Prince Albert MF* in SK has also taken up issues of firesmart for four high risk areas, Candle Lake, Montreal lake, Waskesiu (the large townsite for Prince Albert National Park) and Weyakwin. They help with training for local students and residents including preparation of detailed fire hazard maps. *Manitoba MF* at one point had someone working closely with Pinawa on FireSmart® and also distributed the Homeowners FireSmart Manual widely. Elsewhere, *Resources North* includes fire hazards in their Community FireSmart Assessments. *Lake Abitibi MF* in northeastern Ontario was contracted by the Ontario Ministry of Natural Resources in 2010 to develop a FireSmart® program for Timmins that has a number of suburban developments as well

as cottage developments in its area. Local committees for each of these areas were formed.

Criteria and Indicators for Sustainable Forest Management in Canada:

This project was initiated in 1993 and maintained by the Canadian Council of Forest Ministers (CCFM). It entailed funding a series of technical studies to identify suites of criteria and qualitative indicators for each, and having them reviewed by technical working groups and public focus groups. The latter were often associated with the Canadian Forestry Association and supportive of the succession of National Forest Strategies. Phase II of the model forest program included as one of three required "strategic initiatives" the development of local level quantitative indicators of sustainable forest management, using a detailed guidebook prepared for the CCFM. Each MF was to report back by 2000, and then continue to test local level indicators and their use for local extension work. The CCFM had issued its first national status report on sustainable forest management in Canada in 2000. It revised their set of national indicators in 2003, and then issued a second national status report (CCFM 2006). This report included some references to local applications by a model forest when it could, but the model forests/forest communities programs were not featured in it. CCFM views the continuing refinement of data sets and indicators to be a national priority. In 2008, CCFM issued a "Vision Statement" for 2008 and beyond that would be up-dated every three years until 2018. The two areas requiring immediate attention were development of the forest sector into a "renewable bio-economy" through the use of new technologies, and addressing the impacts of climate change.

Forest Ecological Goods and Services:

In February and March 2007, the CMFN and the Canadian Federation of Woodlot Owners (CFWO) sponsored five regional workshops (Amherst NS, Quebec City, QC, Peterborough ON, Saskatoon SK, and Victoria BC) attended by about 250 people altogether to hear presentations and discuss the concept of ecological goods and services and how landowners that provide them might be compensated (CMFN 2008). Examples of similar concepts from elsewhere were included in presentations. The main conclusion was that the CMFN should follow-up the general conclusions from these meetings as a "strategic initiative". The report was released in the fall of 2009 and has been distributed to all MFs as well as the CFWO at about the time the new FCP was

getting underway. The FCP did adopt this as a strategic initiative with the coordinator for Fundy MF as its champion. NE Superior MF is to help out, as is (informally) EOMF. Two sites were chosen to help develop a local tool kit for evaluations, Upper Miramichi in NB and Manitouwadge in NE Superior. EOMF has held some informal meetings with groups in their region to explore concerns and interests, especially in the light of the long awaited but much needed up-date of the Ontario Endangered Species Act that came into effect in June 2008.

Economic Impact Models:

Foothills MF and Lake Abitibi MF had work done on economic models of greater scope than conventional input-output calculation of the dollar flows though market exchanges in some given sector or across sectors in a pre-defined regional economy. The CFS's Socio-economic Research Network used a "social accounting matrix model" to describe the Foothills MF economy and estimate the impacts of resource management policies in the region (Patriquin and others 2003; White and Patriquin 2003). Lake Abitibi MF had consultants do surveys of nine communities in their area compiling both data from secondary sources (e.g. Statistics Canada) with local interviews of residents. Consultants also helped develop the broad outlines for a "Regional Constellation Impact Model (RCCIM)". There were apparently rather severe differences of opinion in the local organization for L. Abitibi MF throughout Phase II of the program that delayed progress for at least a year, and it is not clear what eventually was done. The models did, however, emphasize the need to adopt cross-sector perspectives on regional economies and prospects, especially if the forest sector itself was failing.

Forest Certifications and Chain of Custody:

The Eastern Ontario Model Forest (EOMF) is home to large numbers of owners of small woodlots most of whom are farmers or cottagers whose livelihoods are not directly dependent on these remnant patches of woods directly. Yet, for many years, eastern Ontario along with western Quebec and northern New York State was the source of wood for Domtar's pulp mill in Cornwall ON. The EOFM, in consultation with the international Forest Stewardship Council that certifies well-managed forests

according to strict principles and criteria agreed in 2000 to have the EOMF take a lead in seeking certifications on behalf of groups of woodlot owners as a way of encouraging them to practice good forest management on their lands, and from time-to-time to sell small lots of wood to Domtar. In 2006, Domtar, with little notice, closed the Cornwall plant and laid off all the mill workers. This slowed things for a while until it was realized that some local sawmills would welcome certified wood. Maple syrup producers also were interested in certification.

The EOMF has carried on with a Certification Working Group, produced a wealth of information materials on the process and procedures of certifications, and holds a number of information workshops or other events usually cosponsored by either a County association, or the Ontario Woodlot Owners Association. There are now at least 42,000 ha of lands under FSC certification through different groups of owners overseen by the EOMF. All are subject to third party inspections annually. In 2012, the EOMF started to extend the certification to FSC endorsed producers of products from certified forests. This certifies “chains of custody” of the products through to consumers. A potential wide range of other businesses (than pulp and saw mills) are interested in assuring customers that wood products they sell are from reliable sources.

Forested regions with many owners of small patches of forests are common throughout southern Quebec and the Maritime provinces. Model forests in these provinces do work with groups of woodlot owners, and some have certifications (e.g. cooperatives in Bas-Saint Laurent MF), but owners in other regions are reported to be, or remain skeptical about government intentions.

Junior Ranger Training:

Most provinces have some form of junior rangers associated with their natural resource management agencies, and other groups often help out during field courses. Two model forests in particular became major contributors. The Manitoba MF helped Manitoba Conservation (the main provincial agency) with their annual 3-week training programs for students in grades 10-12. Provincial certificates are offered with instruction in first aid and CPR, boating and ATV safety, forest fire-fighting, and forest surveying.

Non-certified instruction includes orienteering with compass and GPS, and Aboriginal traditional cultures and values ("Wisdom from the Elders"). One goal is to encourage young people to complete their secondary schooling so that other opportunities become available such as entry-level local jobs, college diplomas in various subjects, and for some, under-graduate university options. The Manitoba MF also took a lead in creating the "Winnipeg River Learning Centre". This entailed up-grading a vacated public school building in Pine Falls MN for a wider range of course offerings available from different providers. They include job-training skills for former mill and field employees of Tembec after the mill was suddenly closed in 2010.

The Prince Albert MF has helped develop a Saskatchewan Aboriginal Junior Forest Ranger program that provides a 6-week summer program for youths in the 16-22 years age range. Certification is available for first aid and CPR, workplace hazardous materials management, transportation of dangerous goods, pleasure craft operations, restricted radio operators, firearm safety, and restricted fire fighting (to fires already under control). This began in 2006 with one community and by 2010 eight communities were each hosting the 6-week program and altogether had graduated 88 graduates over five years.

Non-Timber Forest Products:

While Aboriginal and other local people in forest communities have long known about non-timber forest resources such as wild berries, mushrooms, medicinal plants, syrups and resins (e.g. Boxall and others 2003), the FCP was initiated with the idea that these products might be the basis for renewal of local forest economies. The Nova Forest Alliance, on behalf of the CMFN, contracted the Centre for Non-Timber Resources at Royal Roads University (RRU), BC, who then had an overview of the situation prepared (Mitchell 2008). Regional forums were also held (e.g. RRU 2008) and other overview reports published (e.g. Mitchell and Hobby 2010). The intent of CMFN now is, with help from the RRU, to prepare and keep up-to-date on-line e-information about "tools for entrepreneurs" in this sector, lists of people engaged in it, and contacts that could help market the products.

The Lac-Saint Jean MF "is fast becoming a national leader in NTFP" (CMFN 2011). The Northeast Superior Forest Community has a draft concept plan for commercial high bush blueberry (*Vaccinium corymbosum*) production that is designed as a hubs and spokes

arrangement that connects the seven First Nations communities with six other small communities that are in this 4 million ha region that would serve both to spread the benefits and the risks. A local entrepreneur has already started with a 160 ha layout in Wawa ON immediately north-east of Highway 17. He expects the first commercial crop in 2012.

Watershed Management:

There is wide recognition of ecological connections between forests and water flows and quality and the importance of understanding this for sustainable forest management in different geographic and forest regions of Canada. While the boreal forests usually have a number of rivers and lakes, or marine coasts immediately adjacent to them, forest hydraulic relations are much more relevant in the Maritime provinces. Fundy MF was a main supporter for a five-year (1993-1997) Haywood Brook Watershed Study that was a series of detailed field studies of this small (30 km^2) area owned by J.D. Irving, Ltd. (a private forest company) near the Town of Petitcodiac. Fundy MF also partnered with a number of groups in the Petitcodiac River Watershed Alliance, especially for conducting studies on woodlot management and practices as well as maintaining wildlife habitats in the 314 km^2 Pollett River that the Alliance deems to be the 'crown jewel' (Steeves and others 2006). The Fundy MF also sponsored the Washademoak Environmentalists' Watershed Group investigations on the current state and functioning of the Washademoak Lake and lower Canaan River watershed.

The Nova Forest Alliance (NFA) also contributes to a number of watershed studies. In Halifax County, the purpose was to study water quality resulting from forest harvesting activities (i.e. eutrophication, acidification, siltation, and drinking water quality) on Pockwood Lake and two tributaries, Peggy Creek (a control watershed) and Moose Cove Brook (a "treated watershed" logged during the study). This study was modeled on the lines of the Haywood Brook study in NB (Pockwood Partners 2005). NFA has also partnered with the Mersey-Tobiatic Research Institute (in the Southwest Nova Biosphere Reserve) in 2008 to conduct experimental studies on liming three watersheds to reduce their acidity (from "acid rain" fallout) that has had serious cumulative effects on spawning Atlantic Salmon and freshwater trout. This work is continuing.

NFA has also been working with the St Mary's River Association since 2007 to help the Association develop a community-based vision leading to a 25 year "Integrated Watershed Management" Plan. There are a number of agencies and non-governmental organizations involved in this project. The river (one of the largest in NS) drains approximately 1,350 km^2 including, with its various sub-watersheds, an estimated 130 lakes of various sizes all in Guysborough, Antigonish and Pictou Counties that constitute the northeast region of mainland Nova Scotia. The major concern is maintaining a viable Atlantic salmon fishery and protecting wildlife of interest, notably a disjunct population of wood turtles. The NFA also established a Prince Edward Island Model Forest Network Partnership in 2003. It is advising agencies and private owners of woodlots on a number of woodland management issues, including replenishing forests along stream courses to reduce erosion and associated run-off that ends up in valued coastal waters.

Wildlife and Species at Risk:

The most attention has been given to large forest-dependent mammals, notably boreal populations of woodland caribou (*Rangifer tarandus caribou*) that are officially declared (by the Committee on the Status of Endangered Wildlife in Canada – COSEWIC) to be "threatened", and moose (*A. alces americana*) that are declared to be endangered in Nova Scotia, but of no concern (or 'secure') in most of the rest of the Canadian boreal forests. The Manitoba MF for some 15 years monitored five separate groups of caribou in the original MF area (east side of Lake Winnipeg) to identify the approximate numbers of animals and their preferences for summer and winter range. This included fitting 50 animals with radio collars (GPS and VHF) and soliciting traditional ecological knowledge from First Nations communities. These data allow for some version of a population viability assessment to judge long-term survival prospects. Manitoba MF also co-sponsored (with many other organizations including forest industries) the 13^{th} Caribou Workshop "Sustaining Caribou and their Landscape – Knowledge to Action", in Winnipeg in 2010 (proceedings pending, 2012). Prince Albert MF has also assisted similar studies and has been able to share results with the Vilhelmina Model Forest in northern Sweden on the themes of engaging Aboriginal youth and elders on traditional knowledge applied to these animals, i.e. Sami people and their reindeer herds in the Swedish situation.

The “Sturgeon River Plains Bison Stewards” is a collaborative initiative to keep track of a free ranging herd of about 250 plains bison (*B. bison bison*), a species judged to be “threatened” in Canada. This herd became established in the southwestern side of Prince Albert National Park and adjacent prairie parklands and range over an area of about 800 km^2. A long-term management plan is being developed to promote the conservation of the group and reduce conflicts with ranchers and farmers. An advisory group of nine First Nations and about 12 other organizations including the Prince Albert MF is overseeing this work and will cooperate on the management of the herd. The implicit adoption of a ‘commons’ defined by the range of the herd is a novel approach. The Foothills Research Institute established its Grizzly Bear program in 1999 to provide knowledge and planning tools for resource managers to ensure the long-term conservation of grizzlies in Alberta. Grizzly Bears (*Ursus arctos horribilis*) are species of “Special Concern” because of their declining numbers all along the Rocky Mountain front range in Alberta. The original site for field work in the Foothills MF has now been extended in its scale and entails use of satellite imagery and landscape analyses to identify preferred habitats, and new techniques for capturing bears and conducing DNA analyses to identify and track individual animals.

Wildlife work in the Atlantic region has adopted a “featured species” approach, by which the occurrence of specific species is used as indicators of the condition of forest ecosystems. For example, pine marten (*Martes americana*) are considered to be indicators of healthy old growth forests. They are “threatened” in NL, and “endangered” in NS (although there have been several re-introductions of them from northern NB, especially into Kijimkujik National Park in SW NS). Detailed field studies often include census of breeding birds, and various plants in the understory vegetation as useful indicators of forest conditions.

Innovations and/or Resilience and Adaptive Management

A number of examples noted above can be considered ‘innovative’ in the sense they were quite new to the place, or situation they were in. Some were able to build upon previous work by others. “Scale out” phenomena are evident in the local adaptations of

criteria and indicators for sustainable forest management that were keyed to the national template developed by the Canadian Council of Forest Ministers. Local testing of carbon budgets is another example. It is also a way to interpret the collaborative work on woodland caribou in the different model forests where they still exist. In other cases, the work was unique to the model forest's situation, such as Aboriginal involvement of the Cree people in the Waswanipi Model Forest, and of the Mohawk Council in the Eastern Ontario Model Forest. This is similar to the quite different situations that led to studies of grizzlies in the Foothills Model Forest and plain bison in Prince Albert Model Forest.

From complex systems perspectives, resilience and adaptive management for desirable kinds of sustainability is a positive trait. Some of the watershed studies in model forests were useful, even if somewhat 'imitative' of standard practices elsewhere. This kind of ambivalence of interpretations is inherent in these situations, revealed in this case by the CMFN. One can leave the semantic arguments to whoever wishes to pursue them.

The Larger Context That Frames the Model Forests/Forest Communities

The larger context is the global restructuring of the forest industry that started in the 1990s and has been accelerating ever since, especially after the global financial debacles from 2008 on. One result is that the industry has become more fragmented, and large portions of it are controlled as "assets" by "investors" instead of being assets owned primarily by the forest management and wood fibre manufacturing companies. The process goes on across borders of nation-states to become configured by the globalization of both production and markets (e.g. Sande 2002; Karltorp and Sandén 2012).

In 2007, a Forest Products Industry Competitiveness Task Force reported the situation in Canada backed by detailed analyses by an industry consulting firm (FPAC 2007). While the 'path to renewal' requires industry to "get the costs right, get the industrial structures right and get the future right", and for which industry has to take the lead, it also requires government policy changes in forest tenure systems, transportation and energy costs, taxation and regulatory structures, and enhancement of labour productivity. These views have been presented on numerous occasions over the past five years and in different contexts (e.g. Lazar 2007; House of Commons 2008; Senate

of Canada 2011). It can be noted that this 'position' was formulated just before the critical financial crisis disrupted the US markets for Canadian exporters.

In May 2012, with the arrival of a new CEO, the FPAC set out its "Vision 2020" with three ambitious goals for the sector:

* Products: Generate an additional $20 billion in economic activity from new innovations and growing markets,

* Performance: Deliver a further 35% improvement in the sector's environmental footprint,

* People: Renew the workforce with at least 60,000 new recruits including women, Aboriginals and immigrants.

In December 2007, the House of Commons natural resources committee decided to hold extensive hearings on the challenges and opportunities for a "market-driven action plan" that would lay the groundwork for the industry's renewal, prosperity and sustainability". The committee subsequently received evidence from 25 organizations and individuals "representing various spheres of forest industry activity and various perspectives on the industry as a whole". In the final 63 page report (House of Commons 2008) with quotes above on p.1, there was no mention at all of the model forest/forest communities program.

The Senate Standing Committee of Agriculture and Forestry held hearings from September 2009 to December 2010, and heard from over 100 organizations as well as many people speaking as individuals. In its report (Senate of Canada 2011) it summarizes much of the well-known problems (by then) in the forestry industry. The Senators adopted a broad definition of innovation i.e. "Innovation is new or better ways of doing valued things. An 'invention' is not a innovation until it has been implemented to a meaningful extent" (*ibid*:102). In a section on "possible solutions" the report devoted a great deal of attention on the need to develop a "wood culture" across Canada:

> "The key to success is, first, better education on the opportunities that wood affords as a construction material. Sector professionals must know the advantages and characteristics of wood as a construction material from the standpoints of the environment, physical resistance, versatility, fire resistance, aesthetic appeal, insulation capability, and its heritage, contemporary and economic value" (*ibid*: 42).

There followed much discussion with extensive quotations from people who suggested the scope and importance of this issue. Required changes in professional training of architects and engineers, getting rid of the “tree killer syndrome” weighing on the industry, sweeping away fears about fire resistance, holding design contests, creating multidisciplinary research chairs in the design and construction of wood buildings, making major changes in the fire and building codes, and just build them higher and higher were among the proffered ‘solutions’.

In a chapter dealing with the social and ecological implications of the forest crisis, the Senate report makes note of the MF and FC programs in five paragraphs (several people associated with the CMFN had appeared before the committee) and recommended that the FCP be funded for a second five-year period after 2012 (*ibid*:125-126).

Concluding Comments

It seems rather trite to observe that serious cross-currents are stretching the forest industry in different and sometimes mutually contradictory directions. At the corporate level, different companies are being pulled in different directions by strategies of whoever owns or controls them as ‘assets’ and in some cases by asset acquisition strategies they themselves may be trying to implement. The strong conviction that ‘high tech’ is the key to the future has much plausibility, but it can take decades to realize desired outcomes from whatever is being adopted (and possibly thwarted by competitors adopting different technologies). As noted above, the main “discursive domain” adopted for re-positioning the forest industry sector was that of the ‘high tech’ knowledge-based economy. But within that, a number of old boundaries associated with particular professions are dissolving and a much richer mix of knowledge and skills is coming together to deal with the issues they face.

As community-based initiatives, the model forests officially seemed to ignore all these as extraneous forces because they would raise policy issues that model forests were not to address. Yet, the collapse of local industry in their midst would surely become major pre-occupations for many groups who were partners and among the consensus-seeking local stakeholders. This generated a quite different “discursive domain” around the

concept of ‘sustainable forest management’ that was at best somewhat detached from the industry versions. In contrast, the forest communities program recognized they were expected to help heal local wounded communities with what could (uncharitably) be seen, with all the initial attention to non-timber forest products, as a return to some latter day hunter-gather mode. That would appear to be almost diametrically opposite to the industrial discourse.

All of these issues also go well beyond ‘just forestry’, sustainable or otherwise.

References cited

Adamowicz, W.L., T.S Veeman, G. Binsted, B. Macnab, D. Korber, and A. Coyne. 2001. The Sustainable Forest Management Network: Maintaining scientific excellence and relevance in a changing world. *The Forestry Chronicle*, 78 (1): 112-114.

ArboraNano. 2012. *Interviews reported in the ArboraNano Newsletter.* Winter, 2012.

Arrighi, Giovanni. 1995. *The Long Twentieth Century: Money, Power, and the Origin of Our Times.* London: Verso

Arrighi, Giovanni, and Beveley J. Silver. 1999. *Chaos and Governance in the Modern World System.* Minneapolis: University of Minnesota Press.

Arthur, W. Brian. 2011. The second economy. *McKinsey Quarterly*, October 2011.

Boxall, Peter C., Gordon Murray, and Kames R. Unterschultz. 2003. Non-timber forest products from the Canadian boreal forest: an exploration of aboriginal opportunities. *Journal of Forest Economics*, 9: 75-96.

Browne, Tom, Rory Gilsenan, Michael Paleologou, and Douglas Singbeil. 2011. *Bio-Energy and Bio-chemicals Synthesis Report.* Ottawa. PFInnovations.

CCFM. 2006. *Criteria and Indicators of Sustainable Forest Management in Canada: National Status, 2005.* Ottawa: Natural Resources Canada, Canadian Forest Service. 154 pp.

Chase-Dunn, Christopher, and Thomas D. Hall. 1995. *Rise and Demise: Comparing World-Systems.* Boulder: Westview.

CMFN. n.d. c 2006. *Achievements*. Canadian Model Forest Network.

CMFN. 2008. *Advancing sustainable forests and sustainable communities*. 2008-2009 Annual Report. Canadian Model Forest Network.

CMFN. 2011. *Developing Sustainable Forests and Communities*. Canadian Model Forest Network.

Crespell, Pablo, David Fell, Chris Gaston, and Francois Robichaud. 2011. *North American Bio-Materials Summary.* Ottawa: FPInnovations.

Crespell, Pablo, and Chris Gaston. 2011. *The Value Proposition for Cross-Laminated Timber.* Ottawa: FPInnovations.

Davidson, Debre J., Tim Williamson, and John R. Parkins. 2003. Understanding climate change risk and vulnerability in northern forest-based communities. *Canadian Journal of Forest Research*, 33: 2252-2261.

Duinker, P.N. and C. Ordonez. 2010. *Beyond forest restoration for climate-change mitigation and adaptation: the case of Canada' forests*. Paper presented at the 18th Commonwealth Forestry Conference, Edinburgh. March 2010.

FPAC. 2007. *Industry at a Crossroads: Choosing the Path to Renewal*. Report of the Forest Products Industry Competitiveness Task Force. Forest Products Association of Canada.

FPAC and FPI. 2011. *The New Face of the Canadian Forest Industry: The Emerging Bio-revolution – The Bio-pathways Project*. Ottawa: Forest Products Association of Canada and FPInnovations.

FPInnovations. 2010. *Annual report for 2009/2010.* Ottawa.

FPInnovations. 2011. *Making Innovation Happen: FPInnovatons – Turning Research into Competitive Advantage.* Ottawa: Submission to the Review of Federal Support to Research and Development, February 18th 2011.

Francis, George. 2011 a. *Synoptic overviews of governance associated with model forests and biosphere reserves at international, federal-provincial and local jurisdictions*. Governance Matters! Part 2 Discussion paper on-line. School of Environment and Sustainability University of Saskatchewan.

Francis, George 2011 b. *Governance framework for individual biosphere reserves and model forests. Structures, funding, program strategies and project activities. organizational development*. Governance Matters! Part 3. Discussion paper on-line. School of Environment and Sustainability, University of Saskatchewan.

Friedman, George. 2010. *The Next 100 Years: A Forecast for the 21st Century*. New York: Anchor Books.

Hornborg, Alf. 2009. Zero-Sum World: Challenges in Conceptualizing Environmental Load Displacement and Ecologically Unequal Exchange in the World-System. *International Journal of Comparative Sociology*, 50 (3-4): 237-262.

House of Commons. 2008. *Canada's Forest Industry: Recognizing the Challenges and Opportunities.* Ottawa: Report of the Standing Committee on Natural Resources, 39th Parliament, 2nd Session. June 2008.

Johnston, Mark, and 8 others. 2006. *Adapting Forest Management to the Impacts of Climate Change in Canada.* A BIOCAP Research Integration Program, Synthesis Paper.

Johnston, Mark. 2008. *Impacts of Climate Change on the Island Forests of Saskatchewan.* Final report prepared for Prince Albert Model Forest. Saskatoon: Saskatchewan Research Council Environment and Forestry. SRC Publication No. 12168-1E08, March 2008.

Karltorp, Kersti, and Bjorn A. Sandén. 2012. Explaining regime destabilisation in the pulp and paper industry. *Environmental Innovation and Societal Transitions,* 2: 66-81.

Klenk, Nicole L., and Gordon M. Hickey. 2009. The Sustainable Forest Management Network (1995-2009): An overview of its organizational history and perceived legacies. *The Forestry Chronicle*, 85 (4): 521-527.

Klenk, Nicole L., Gordon H. Hickey, and James Ian MacLellan. 2010. Evaluating the social capital accrued in large research networks: The case of the Sustainable Forest Management Network (1995-2009). *Social Studies of Science*, 40 (6): 931-960.

Lansbergen, Paul. 2011. *Biopathways: Carbon Footprint Report*. Ottawa: Forest Products Association of Canada.

Lazar, Avrim. 2007. Making Canada World-Competitive: The Forestry Industry as a Case Study. *Policy Options*, July-August 2007, pp. 50-54.

MacLean, David A., Luke Amos-Binks, Greg Adams, Gaetan Pelletier, and Marc-Andre Villard. 2010. *Legacy of the Sustainable Forest Management Network: Outcomes of Research Collaborations Among J.D. Irving, Limited, University of New Brunswick and Université de Moncton.* Knowledge Exchange and Technology Extension Program (KETE), Sustainable Forest Management Network.

Macnab, Bruce. 2005. Challenges, achievements and impacts from interdisciplinary research and training: The Sustainable Forest Management Network. *The Forestry Chronicle*, 81 (3): 342-344.

McMurtry, John. 1998. *The Cancer Stage of Capitalism*. London: Pluto Press.

Mitchell, Darcy. 2008. *Non-Timber Forest Products: What's Happening in Canada's Model Forests?* Report prepared for the CMFN, Royal Roads University.

Mitchell, Darcy, and Tom Hobby. 2010. From rotations to revolutions: Non-timber forest products and the new world of forest management. *BC Journal of Ecosystems and Management,* 11 (1-2): 27-38.

Modelski, George. 1996. Evolutionary Paradigm for Global Politics. *International Studies Quarterly,* 40: 321-342.

Modelski, George. 2005. *Global Political Evolution, Long Cycles, and K-Waves*. Paper presented at the NATO Advanced Research Workshop on "Kondratieff Waves and World Security", Couilha, Portugal.

Moore, Jason. W. 2011. Ecology, Capital and the Nature of Our Times. *Journal of World-Systems Research,* 17 (1): 108-147.

Moore, Jason. W. 2012. Cheap Food and Bad Money: Food, Frontiers and Financialization in the Rise and Demise of Neoliberalism. *Review: A Journal of the Fernand Braudel Center,* 33 (2-3)

NRCan. 2002. *Canada's Model Forest Program – Phase II Evaluation Report*. Ottawa: Natural Resources Canada, Evaluation Reports 2002.

NRCan. 2006. Canada's Model Forest Program – Follow-up and Mid-term Evaluation. Ottawa: Natural Resources Canada. Evaluation Reports (EO5002).

NRCan. 2011. *Evaluation of Forest-based Communities Sub-Activity Final Report*. Ottawa: Natural Resources Canada. Evaluation Reports 2011.

Palma, Cristian, Gary Bull, Andrew Goodison and Steven Northway. 2010. *Scenario Analysis: The Traditional and Emerging Canadian Forest Industry.* Forest Resources Management Working Paper, 2010:1, University of British Columbia and Forest Products Innovation.

Patriquin, Mike N. and 5 others. 2003. Estimating impacts of resource management policies in the Foothills Model Forest. *Canadian Journal of Forest Research,* 23: 147-155.

Pockwood Partners. 2005. *The Pockwood Bowater Watershed Program*. Summary Report.

Robinson, William I. 2011. Globalization and the Sociology of Immanuel Wallerstein: A Critical Appraisal. *International Sociology*, 26 (6): 723-745.

RRU 2009. *Non-Timber Forest Resources: Linking Research, Policy and Economic Opportunities.* Forum Summary. Centre for Non-Timber Resources, Royal Roads University.

Ryan, Mark. 2012. *FPInnovations – Forest Operations Research, Products and Services*. Kenora, ON: Presentation April 4, 2012.

Sande, Jon Bingen. 2002. *Restructuring and Globalization of the Forest Industry: A Review of Trends, Strategies and Theories*. Agricultural University of Norway, Aas, Norway.

Senate of Canada. 2011. *The Canadian Forest Sector: A Future Based on Innovation*. Final report of the Standing Senate Committee on Agriculture and Forestry. Ottawa. July 2011.

SFMN. 2007. *Projects and Publications Guide: research programs, selected completed projects, selected publications*. Ottawa: Sustainable Forest Management Network.

Steeves, Mathew, Mathew Botts, and Graham Forbes. 2006. *Watershed-based Woodlot Management Planning. Final Report to the Fundy Model Forest*. Fredericton: University of New Brunswick.

Stevenson, Marc. G., and Pamela Perreault. 2008. *Capacity for What? Capacity for Whom? Aboriginal Capacity and Canada's Forest Sector*. Edmonton: Sustainable Forest Management Network.

Story, P.A., and F.H. Lickers. 1997. Partnership Building for Sustainable Development: A First Nations Perspective from Ontario. *Journal of Sustainable Forestry*, 4 (3): 149-162.

Tree Canada. 2009. *Forest and Urban Tree Carbon Project Protocol: A Standard for the Eligibility and Measurement of Tree Canada Carbon Offset Projects*. Ottawa: Version 1.1 prepared in collaboration with ArborVitae Environmental Services Ltd. November 2009.

Wallerstein, Immanuel. 1999. *The End of the World as We Know it: Social Science for the Twenty-First Century.* Minneapolis: University of Minnesota Press.

Wallerstein, Immanuel. 2000. Gobalization or the Age of transition? : A Long-Term View of the Trajectory of the World-System. *International Sociology,* 15 (2): 249-265.

Wallerstein, Immanuel. 2005. *World-Systems Analysis: An Introduction*. Durham NC: Duke University Press, 2nd printing.

White, Bill, and Mike Patriquin. 2003. *A Regional Economic Impact Modeling Framework.* Paper presented to the 12th World Forestry Congress, Quebec City.

Wyatt, Stephen. 2007. First Nations, Forest Lands, and "Aboriginal Forestry" in Canada: From Exclusion to Comanagement and Beyond. *Canadian Journal of Forest Research*, 38: 171-180.