Eco-Link

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Forest Engineering

Landscape-Level Forest Management and Sustainable Forestry are great visions guided by sound principles. Everybody wants them to become realities. However, for the past several years all the emphasis has been on biology while technology has been pushed into the background. The forest products industry was often advised never to show timber being harvested in a forest, or processed in a mill, for fear of offending the public. Hiding reality only fuels our urban mass-consumption society's misperception that building materials, furniture and paper products appear out of thin air, as if by magic. Information, engineering and the application of technology make useful things appear in our lives. By reconnecting people to the sources of things they use, we enable them to make informed choices. We must take from life to live, while putting back to provide for future generations.

Technology makes Sustainable Forestry and Forest Ecosystem Management possible. Foresters manage large landscapes over long time horizons. They write silvicultural prescriptions to keep forests healthy, just as physicians prescribe to keep patients healthy. These silvicultural prescriptions often require thinning of overstocked and stagnated stands of trees, to reduce the threat of fire, insects and disease. Since trees compete for sunlight, water and nutrients, proactive forest management is needed to reduce stress, prevent stagnation and maintain forest health. Fortunately a wide variety of sophisticated instruments and machinery are available to carry out the foresters' prescriptions. We can extract commodities from the forest while protecting all the other values including habitat, recreation, aesthetics, soils and water.

Population & Wood Demand

Since 1940, the population of the United States has doubled to 263 million people, creating a tremendous demand for wood products. This demand is met primarily with wood produced in North American. The world population has grown even faster, reaching 6 billion people. We all have needs for food, clothing, shelter, energy, transportation, and quality of life. These needs are met by the conversion of raw materials (e.g. timber, oil, ore) into useful products. Wood is unique as the only resource, which is at the same time, renewable, biodegradable, recyclable, energy efficient, non-toxic, durable, versatile, and extremely beautiful. As our world population doubles again, to 12 billion people in an estimated 70 years, wood will play an ever more critical role in meeting our needs and sustaining quality of life. The question isn't whether we need wood it's where we source it and how we produce it in a manner that ensures the continuation of productive, resilient, diverse and healthy forests. Equipment manufacturers and contractors are working together with foresters and forest engineers to meet the challenge. In the end, it can only be done with technology.

He who cuts his own wood warms himself twice.

Technology

Forest Engineering is as important as any discipline in forestry. We depend on forest engineers to design good roads and bridges, and harvesting operations with minimal impact on soils, water quality and habitat. We depend on other engineers to design equipment that is environmentally sensitive while still being able to do the job in a safe, productive and cost effective manner. This machinery must be purpose-built to match a variety of timber, terrain, underfoot and weather conditions. Today's sophisticated machines require educated operators who understand forestry, mechanics, hydraulics, electronics and computers. It's a new world in the woods, where mechanization has overtaken manual labor. Technology is making both woods and mill operations environmentally compatible, safer and more efficient.

Road Building

We need forest roads to; manage the forest; harvest timber; fight fires, insects and disease; salvage dead and dying timber; and to access forest recreation. Most forest roads were built with the economic incentive of timber harvest. These roads then became multiple-use roads. In fact most of the people using forests for recreation get there on roads initially constructed for timber harvest.

Motor graders maintain more miles of forest roads in the US than exist in the entire Interstate Highway System. The long wheelbase helps this machine to take the bumps out of the road for the operator and those of us who travel on them.

Many of the past problems associated with harvesting such as erosion and stream sedimentation were related to road building. Slope and road failures are highly visible, cause stream degradation and create negative public perceptions. Today, roads are being built to very strict standards in compliance with forest practice acts. In many areas, road construction has been minimized by using forwarders, skyline cable logging systems, and helicopters to transport the timber over longer distances, and over steep and sensitive terrain. Once again, a strong case for excellence in forest engineering.

We all agree that we must sustain our environmental resources so that they continue to provide benefits for people and other living things on our planet.

Harvesting & Processing

After roads are constructed the next step is harvesting and processing the timber in the forest. The old image that has been burned into the public consciousness is Paul Bunyan and Babe the Blue Ox felling trees from Maine to Minnesota, and beyond. For many of us, these icons represent courage and the pioneering spirit used to conquer nature, develop the frontiers and grow the nation. Unfortunately, Paul went from hero to villain as we transitioned from the pioneering frontier phase of our development towards sustainable development and living in harmony with nature. This shift from pioneering to sustainability is one of the largest cultural changes in our history. It was accelerated by the Apollo missions, when we could look back and see our entire planet as one ecosystem from space. We are still struggling with the transition.

Thousands of real people in timber producing communities were hurt when timber harvests were dramatically and abruptly reduced on National Forests and Bureau of Land Management holdings. These folks were villianized to justify their victimization. Mechanization in the forest and modernization in the mills would have slowly reduced their numbers, but they went from Paul Like-like folk heroes to unemployed villains virtually overnight. This is an ugly chapter in our history with many lessons to teach about how consumers treat the producers who meet their needs.

Mechanized timber harvesting and processing has been accelerated due to the need for more productivity and profitability, the cost of workers compensation insurance, and the transition to smaller trees. As increasing amounts of federal timber is put off limits private forests must be managed more intensively. There is a need for significant forest health (thinning) and salvage work on public lands. Within limits, it is possible to get most woods workers into the safety, comfort and productive work environment of a forest machine. These machines are now able to harvest and process trees to log lengths in one motion! It will be rare to see trees in commercial forests larger than 24" in diameter at harvest, which means they can be harvested mechanically. Loblolly Pines grown for pulp are harvested in 20 years and Douglas Firs can be grown to 24" inch diameter in just 50 years. The trend is to shorter rotations. The advent of engineered wood products has further accelerated this trend because smaller and lower quality trees can be used. However, there will always be a market for large, high quality, vertical grain timber, and incentives must be put in place to encourage this. Large trees are also needed to create structural diversity for wildlife habitat.

The evolution of harvesting and processing techniques has been happening at a lightning fast pace. Trees were once harvested and processed with axes and cross cut saws known as "misery whips." Next came huge chain saws requiring "two men and a boy" to operate. Eventually we got to the modern chain saw, which is used to fell, delimb, top, and buck the tree into log lengths, ready for a cable skidder to take to the landing. The next innovation was machines equipped with mechanical shears used to snip the trees off at ground level. The shears were soon surpassed by circular saws, which could cut the trees faster and with less fiber damage. These feller-bunchers can fell trees and put them in bunches just the right size for grapple skidders which take them to the landing to be further processed by a delimber or chipper. This completely mechanizes the operation getting the labor off the ground. The feller-bunchers soon got competition from harvesters, which can cut the tree and process it into log lengths all in one motion. Forwarders then pick up the processed logs and piggyback them to the roadside minimizing the need for roads and landings. The Harvesters and Forwarders work as a matched system. Excluding cable logging systems and helicopters, which are really transportation systems, machines used for the mechanized harvesting and processing of trees can be divided into two main ground systems:

Mechanized Logging Systems

Tree-Length System (North American)	Cut-to-Length System (Scandinavian)
Feller Buncher	Harvester (Feller-Processor)
Grapple Skidder	Forwarder
Delimber (Processor)	
Log Loader	

The Cut-to-Length systems, which have now gained acceptance in North America, were developed in Scandinavia. These machines have several advantages. Harvesters process the trees in the woods leaving the tops and limbs on the forest floor where the nutrients can return to the soil. This organic material also protects the soil from compaction and rutting as the machines drive over it. Instead of skidding or dragging "turns" of logs, the self-loading forwarders carry the logs piggyback style to the road where they load them onto trucks. The need for large landings is eliminated, along with the problem of what to do with the debris (slash), which was the result of processing at the landing. Burning this slash had also become a significant problem because of smoke and soil degradation from intense heat. In general, new woods technology has migrated from Scandinavia to Eastern Canada and then on to the rest of Canada and United States where it has undergone modifications. In Scandinavia, harvest technology was pushed at the same rate as the ecological and silvicultural knowledge base.

Transportation

There are several ways to get trees from where they are harvested to a road or landing where they can be loaded on a truck for transport to the mill. The trees can be skidded (dragged) out of the forest using a Cable Skidder or Grapple Skidder on tracks or wheels. They can be piggybacked out using a forwarder, after being bucked (cut) to log lengths. They can be pulled (yarded) to a landing by cable yarding systems. They can be relayed or swung to a landing by a log loader in a process known as "Shovel Logging". They can also be transported by helicopter. There are many options, which must be matched to the timber, terrain and underfoot conditions. Depending on the conditions and economics the forest engineer can choose the appropriate mix of ground, cable or aerial systems.

Expensive equipment for harvesting and processing trees must be well selected, well supported and operated properly. It's like racing Indy cars where you have to choose the right body (chassis), the right engine, and the right tires for the track and length of the race. You also have to have an excellent driver (operator), excellent mechanics, and lots of spare parts. It's the same in the woods. A good logger must have an incredible wealth of knowledge and experience. The Forester, Forest Engineer, Wildlife and Fisheries Biologist, Equipment Supplier, and Logger all work together as a team.

Summary

Technology is both our curse and our salvation. While many people yearn for a simpler time, few would give up our modern conveniences for the "good old days." The United States, Canada and other developed countries have used technology to create strong economies, which in turn support human populations with quality of life. With a world population of 6 billion, on its way to 12 billion in 70 years, we have no choice but to accelerate our development and application of technology. We have to produce more from less; less raw material input, less waste and less pollution. We have to maintain healthy, diverse, resilient and productive forests, which will supply commodities and provide a variety of other benefits to society.

We are transitioning to environmentally friendly "green technology." This is happening at a rapid pace throughout the forest products industry, in both the mills and the woods. At places like the Forest Training Center in Forks, Washington machine operators are learning forestry, computer technology, diesel mechanics, hydraulics, electronics, economics and more. Meanwhile, forest engineers are laying out roads and timber sales to minimize impacts on the environment. Loggers are actually placing woody debris back in the creeks to enhance fish habitat. Equipment manufacturers are designing machines, which reduce compaction, soil disturbance, erosion, and damage to residual trees. They are designing machines with ergonomics to maximize operator comfort and productivity. They are designing safer machines, and machines that don't leak. Modern harvesters are processing trees right in the woods to maximize yield, minimize damage, and leave nutrients on the forest floor. Roads and landings are being minimized.

It's time to bring forest engineering back out of the closet. The paradox of life is that we must all take from life to live. The question is whether we can live sustainably by caring for what we have and staying within our economic and ecological means. We are accountable for knowing where everything we use comes from, and how it is produced, used and disposed of. Parents, teachers and students must understand how technology is being used to meet our challenges. They can be part of the solution by being informed consumers, voters, and by choosing careers where they can make a difference. Forestry and Forest Engineering are good options.

The Foundation will feature woods and mill technology on all of the Teachers Tours it conducts on behalf of the Teachers Tours Coalition. This has been a highlight of all the tours, leaving participants with a new appreciation of the skill and dedication, which are applied to meet our needs. We all need wood products and we all want clean air and water, healthy forests, habitat for other creatures, recreation and aesthetics. We need our best minds, science and technology.

Sources

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Glossary

Skid: The bunch of logs pulled behind a track or wheel skidder. Also known as a pull, turn, drag, or twitch among other names.

Skidder: A machine on tracks or wheels used to drag logs from the forest to a landing where they can be further processed and loaded on a truck. Skidders are equipped with cables or grapples.

Forwarder: A machine with a crane that can load logs onto its chassis and piggyback them to a road where it can sort and pile them or load them directly onto a truck.

Harvester: A purpose-built machine with a head (attachment) for felling and processing trees into log lengths. Sometimes the processing head itself is referred to as a Harvester.

Delimber: An excavator based machine with an attachment, which removes a tree's limbs and bucks the top off the tree at the landing. A log loader then places the, processed logs on a truck.

Mechanized: Harvesting and processing timber with machines, reducing manual labor on the ground.

Roads: Generally classified as skid trails, spur roads, and main haul roads.

Shovel Logging: Relaying logs from a harvest area to roadside using a hydraulic log loader.

Side: A group of people and machines working together as a unit. A contractor might have a "skidder side" and a "cable side" working on the same "show."

Feller-Buncher: A machine that fells trees using a mechanical shear or a disc saw as an attachment. A Feller-Buncher may accumulate several trees before creating just the right size bunch for a grapple skidder to take to the landing. A mechanical delimber or a whole tree chipper might be waiting at the landing to further process the tree.