The Technological and Managerial History of Innovation in British Columbia's Forest Industry

FRST 497

April 11, 2011

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Abstract

The forestry industry in British Columbia has undergone many changes throughout its existence. It has evolved from simple coastal logging operations to become a highly regulated and commercialized process spanning across the province. Technological and managerial innovations have played a dominant role in shaping progress in the industry. Innovation made the industry more efficient, allowed logging to take place where previously impossible, and developed new ways to manage the landscape and the changing values on it. This essay will examine the history of technological and managerial progression in BC, how and when it occurred, as well as how it affected the industry. The paper will conclude with some thoughts on the future direction of forestry in the province.

Keywords: Management, Forestry, Historical, Progress, BC

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Introduction

The forest industry of British Columbia (BC) was one borne out of the discovery of an abundance of natural resources. The First Nations people, pioneers and explorers who first saw these forests marveled at their size, expansiveness and utility. It is of little surprise then that once these forests were discovered they were immediately subjected to intense harvest activities with little concern for the land, large as it was. British Columbia's coast became a hub for logging activities, bringing busy life to a once silent space.

Over time, innovation in the industry has allowed loggers to move faster and reach further into the forest to extract timber. Furthermore, innovation has created progression in the development of quality and quantity standards in the industry; still others have ensured the maintenance of the harvest. At the heart of the progressive capacity to enhance the industry are two methods of innovation: technological and managerial. Technological innovation is the process whereby new, or improved, technologies are developed and brought into widespread use. Managerial innovation is the process whereby new strategies to manage people, places or technology are developed and utilized. These innovative processes have the capacity to drive labor markets, product markets, industries, economies, cultures and whole countries. These are the two main driving factors pushing BC's forest industry forward.

Throughout the history of BC, technological and managerial innovations have played a major role in shaping the forest industry as we know it today. This essay will examine the history of technological and managerial progression in BC, how and when it occurred, as well as how it affected the industry. This work attempts to highlight only the most important innovations while merely alluding to the vast amount of information on the topic. Industry progression continues to this day and this paper will conclude with some developments on the future of the industry with regard to potential technological and managerial innovations.

Pre-European Contact

Logging on the west coast has not always been an industrialized process. Long before European settlers made their way to North America's shores, the aboriginal people of what is now British Columbia also logged the forests. Many coastal First Nations groups, such as the Haida, or Musqueam Nations selectively cut down or scavenged large logs and used them for fashioning canoes, totem poles and building their homes. Trees were cut using primitive axes, and then yarded using human power, to the desired location. Trees were pulled by ropes made of hemlock roots along cleared paths, sometimes for up to two miles (Gould, 1975). The work would have been extremely strenuous and very long. Bringing a single log down to the water, where it could be transported, could take numerous men weeks of work. Due to the abundance of trees and minimal demands placed on the forest from the insignificant populations living on the coast, there was no need to actively manage the forest for timber production. The forests were, however, managed and manipulated for other values like berry production and animal grazing through the use of burning technique (Turner, 2001). The aboriginal peoples who inhabited the area enjoyed unspoiled forests and resources exceeding any possible level of domestic utilization.

European Contact

Some of the first Europeans to set foot in what is now BC were Captain James Cook and his crew in 1778 (Gould, 1975). Cook also became the first European to log the coast when his ships anchored in Nootka Sound, off Vancouver Island, for about a month to repair broken spars and masts aboard. While Cook showed little interest in the value of the timber in Nootka Sound, others aboard took note and word soon reached England of the expanse of trees available. As a result, in 1787, Captain John Meares was given instructions by his firm, Merchant Proprietors of London, to bring as many spars as could be stowed. Upon departure of Nootka Sound in 1788 with a full load of timber, Meares noted that the forests "are capable of supplying with their valuable materials, all the navies of Europe (Gould, 1975)."

Word of the quality and quantity of timber on North America's shores spread throughout Europe, and as demand began to increase, the Hudson's Bay Company (HBC) got involved in the trade of timber resources on the west coast. In 1848, the HBC opened what was the first sawmill in the soon-to-be BC, just west of Victoria at the mouth of the Esquimalt river (Gould, 1975). The water-powered Millstream mill sent its first shipment of lumber to the HBC outpost in Langley in 1849. The mill was also the first to enter the export trade market by supplying lumber to California during the gold rush in the early 1950s. The valuable timber in the area soon sparked the construction of other mills. In 1849, a mill was opened in Sooke, eventually being sold off and moved to the mouth of Sooke Harbour and converted to steam power. The HBC built its second Vancouver Island mill in Nanaimo in 1854 to meet the growing demands of coal mining in the region. The mill was supplied by Nanaimo-area aboriginals, who would trade eight logs for an HBC blanket at the time. By 1858, another company had built a mainland mill in New Caledonia at Fort Yale on the Fraser River and filled the small trading post with 5000 residents. The mill pumped out 6000 board-feet of lumber per day; the going price for lumber at the time was $125/thousand board feet (Gould, 1975). Despite the tremendous opportunity in the industry on the coast in the late 1850s, growth was slow. An economic depression hit in 1857, and insufficient investment capital and labor shortages put a halt to the industry's progress. Nevertheless, the birth of the logging industry in BC, starting on Vancouver Island, made for exciting times and high hopes for those settling the new land.

1860-1900: The Emerging Forest Industry

While the past decade had proved to be a difficult one for the emerging forest industry, the next decade was one of major expansion and development. In 1860, H.A.R. Homer, one of New Westminster's pioneer residents, opened a mill on the north arm of the Fraser River, bringing the lumber business to the royal city. At the same time, numerous other mills began operations in the area. In 1861, a new mill in Port Alberni was built. It produced 14000 board-feet of lumber daily using a six

gang of saws, and thus, became the largest production facility in BC. The mill quickly entered into the export market, shipping timbers across the globe to Peru and Australia. Mill specialization soon began as New Westminster's second mill was built in 1863 with the ability to manufacture flooring and dressed items (Gould, 1975). Simultaneously, Burrard Inlet Mill was built in Moodyville, present day North Vancouver, where it became the first mainland mill to enter the international export market. In 1867, Captain Edward Stamp, the owner of Anderson and Anderson Mill in Port Alberni, opened Hastings Mill, on the south side of Burrard Inlet, which immediately began competing with the mills across the water in Moodyville. 1867 was also the largest lumber export year to-date, with 20 million board feet going abroad (Gould, 1975). The expansion of milling capacity in the lower mainland allowed the development of timber harvesting operations to expand throughout the coastal region, with Vancouver becoming a hub for all timber processing and export. The emergence of mills and the development of increased milling speed played a major role in shaping industry capacity at the time.

Figure 1 - Early Loggers
Photo Credit: British Columbia Archives

In 1865, the *Land Ordinance* had been introduced, whereby all timber on authorized forest lands could be leased annually for a dollar an acre (Gould, 1975). This, the first government attempt to separate land from timber license, and crudely manage it, was utilized by many to enter the expanding timber market. Prior to 1865, land had been distributed to large lumbering companies by the individual colonies. Stamp took advantage of the ordinance, purchasing all the timberlands between New Westminster and Point Grey, as well as parts of Howe Sound, with which he supplied his busy mills for

the next few successful years (Gould, 1975). The 1865 *Land Ordinance* brought a number of new players into the industry, which encouraged continued mill expansion and township development around the mills. The development of mills was the primary driver of population influx and development in the province, leading to major cities such as Nanaimo, Victoria, New Westminster, Coquitlam and Vancouver among others.

Figure 2 - Oxen Yarding, 1890
Photo Credit: British Columbia Archives

Logging at the time was crude by comparison to today's methods. Trees were cut down using cross-cut saws and hand tools (Figure 1). The trees were then bucked into shorter logs and yarded using oxen teams to th s along skid-roads, essentially a rough railway with no rails, used to reduce friction on the logs. Skids were greased to further decrease friction; since conventional oil and grease were expensive and difficult to find, natural oils from fish, bear fat, pig fat and lard were derived to cover the skids initially (Mackie, 2000). The logging team consisted of fallers, who would cut the trees down; buckers, who would cut the downed tree into shorter, more manageable logs; barkers, who would limb and de-bark the logs in order to allow

for easy transport; snipers, who would angle the blunt edges of the leading logs to allow them to ride over skids easier; doggers, who would attach large chains between logs; the bull puncher, who would keep the oxen moving where they needed to go during yarding; swampers, who would clear the road; skidders, who would place logs down on skid-roads at intervals; and the greaser, who would be in charge of lubricating the skid-road. This system used a great deal of human and animal power and co-ordination to get the logs to the landing. However tedious, animal yarding was used well into the 20th century.

Steam power yarding first made its way to the Pacific Northwest around 1890 (Gould, 1975). Power yarding, along with the construction of the Canadian Pacific Railway across BC in 1887, led to the development of many previously inaccessible harvest areas. The simple power yarding steam engines consisted of an upright spool driven by a vertical engine, which was attached to an upright boiler. This ground-lead system was used to yard logs to a central location, from which a horse would pull the cable line back out into the forest. Eventually a haul-back line was utilized to pull the line back out, thus, eliminating the need for animals altogether. Power yarding technology, however, did not take off until the late 1890s and early 1900s.

One of the key technological progressions of the industry was the advancement of using industry-specific boats to move logs over water. The first tugboats were used in the early 1860s, powered by burning wood billets and bark; they required ten-man chopping crews to maintain their meager power (Gould, 1975). Over time, more powerful engines were developed and by the late 1800s there were numerous tugs capable of over 1000 horsepower. Tugboats were a necessary element in the logging operation, moving huge booms of logs down-coast where they could be milled and exported. Boom-men would typically move around the booms, sorting out the logs, aiding the boat driver making connections. Boom work would eventually be given to boom boats, small maneuverable boats able to zip in and out of the boom.

The 1880's were a time of major expansion in the industry. The early 1890's, however, had poor lumber markets, which slowed technological progress in the industry, and bad weather, which disrupted transportation and communication, further agonizing industrial processes. Hastings Mill, which by 1890 had been dramatically improved and expanded, was trading 250 000 board-feet per day. Furthermore, in 1889, Ross, McLaren Sawmills began construction of the largest sawmill in the world, costing some $350,000 at the time. The new grandiose mill, built in Maillardville along the Fraser River, had opened in 1890 but closed down soon after due to the poor markets and conditions (Gould, 1975). It remained closed until 1903. The timber recession in the 1890s made it difficult for companies to invest in development of new technologies and also prevented newcomers from entering the increasingly competitive industry (Rajala, 1998). At this point, many of the major mill owners owned multiple mills and the rise of major market players was well under way. Despite the advances in milling technology and productivity as a result, times remained tough for the forest industry businesses.

The late 1800s were used by policy makers to introduce and test various methods of land management in an attempt to better control, and capitalize, on the forest industry. In 1884, the *Timber Act* was established which gave formal recognition to short-term timber licenses (Dore, 2001). Licensees paid annual fees, but gained the ability to hold on to their lease. 1886 saw the first timber reserves set up along the Canadian Pacific Railway corridor. Undoubtedly, Government was beginning to see the need to manage such a valuable resource, at least from a land development perspective. In 1890, the *Timber Mark Act* was established. This act declared that all logs being floated or rafted would need to have registered ownership marks on them (British Columbia Forest Service, 2011). This was likely done to ease communication between the vast number of companies moving logs on the water and to ensure inspection could be done to the appropriate timber. In 1892, the terms of timber leases were re-organized so that leases were 21 years long and had mill appurtenancy requirements attached to them. Leases without mills nearby had to pay 10 cents per acre to ensure the development of a mill. In 1899,

the *Land Act* was further refined to include the requirement of each timber lease to have a mill attached to it (British Columbia Forest Service, 2011). While the government increasingly attempted to put more regulations on the forest land licensing, most companies, and individuals, were unconcerned about the potential impacts of logging. Land management was scarce to non-existent and there was a feeling as though the timber would never run out.

1900-1930: The Rise of Technological Progress

The early 1900's were a time a great change in the forest industry. While power yarding was beginning to be used more and more at the turn of the century, animal logging was still very commonplace. There was, however, a definitive move from oxen yarding to horse logging. Horses are smarter, stronger animals, with the capacity to be used in small or large groups, to yard logs. The record for a single horse log pull remains 73 tonnes, an impressive feat considering modern logging trucks carry little more than that (Gould, 1975). Horses were used to increase yarding capacity and efficiency and were utilized in many places across the province for years onward.

Mechanical yarding, however, would inevitably take over, eliminating the animal presence in logging. Steam powered systems were in use by 1897, but it wasn't until 1900, when overhead cable yarding was utilized, that the system reached mainstream. Dragging the logs by an elevated cable to a central location, overhead yarding was far easier than the initial ground-based

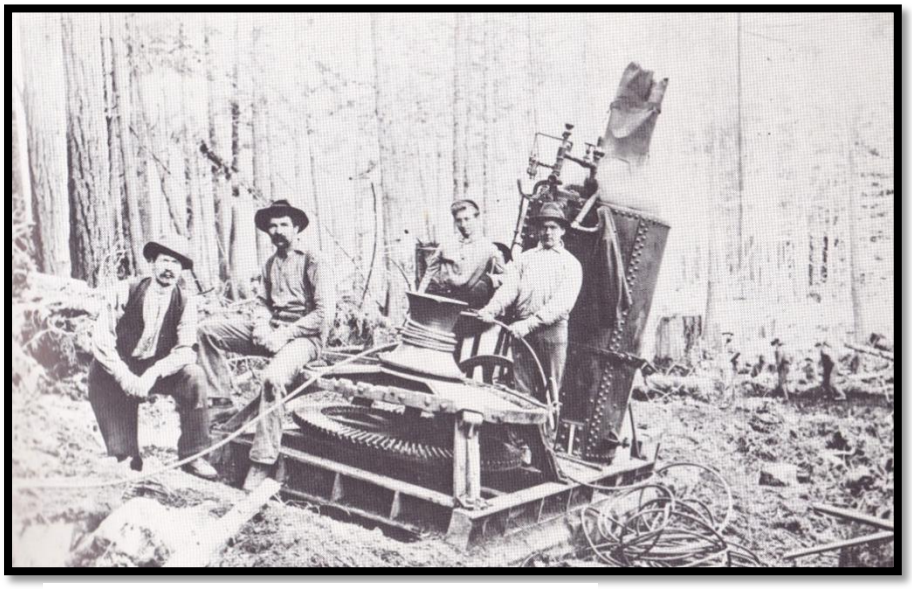

Figure 3 - Early Mechanical Yarding Machine
Photo Credit: R.E. Swanson

systems, where logs would constantly get caught-up on obstacles (Figure 3). The cable yarding system utilized a whole different set of workers: the hooker, who was the head of the yarding operation; the chokerman, who placed the chokers on the logs; the rigging slinger, who was in charge of choosing the appropriate logs to yard; the whistle-punk, who would relay information between the rigging slinger and machine engineer; the chaser, who would unhook the chokers from the logs at the landing; the engineer, who operated the donkey engine; the fireman, who would ensure the fire was maintained in the engine; and the woodcutters, who would cut wood to power the steam engine (Gould, 1975). This yarding system still required a high degree of co-ordination between workers. Furthermore, it required the constant upkeep of the machinery. Engine breakdowns meant major losses in productivity, unlike the past animal yarding systems, which could remain productive with the loss of an animal or two. Steam engines also posed major fire-risks to the surrounding forest and required constant monitoring. These engines required large amounts of water, which had to be pumped in over great distances using pipes. While the power yarding may have been more efficient overall, it was by no means easy, and there remained many things to consider during harvesting operations. Additionally, loggers generally resented the move away from traditional harvest methods, and felt as though the new technologies were somehow taking away from the proud industry.

As power yarding was being introduced across the province, railway logging was also expanding (Figure 4). Railways provided companies with efficient transport of logs both across North America to the eastern provinces and states, where much of the forestland had already been used up, as well as across the province to mill centers and export yards. By 1920, BC's rail system had expanded to contain over 1100 kilometers of track spread over 79

Figure 4 - Railway Logging
Photo Credit: B.C. Jennings

logging rail lines (Rajala, 1993). With shoreline timber exhausted, railways provided the necessary transportation ability to move logs from places like inland Vancouver Island, out to the coast. Canadian Western, the largest lumber company in BC at the time, spent over a million dollars modernizing their operations on the island, developing railways and re-outfitting their Fraser Mills with new equipment to meet growing demand and match the constantly evolving competition standard. Rail continued to develop new technologies throughout its existence, with things like air brakes and standard couplers becoming commonplace in the 1920s, making for a safer and more efficient operation.

During this period, a number of policies were created or changed to further refine the forest management strategies. In 1902, the *Timber Measurement Act* was put into place, which required that logs be scaled using the BC log scale standard, replacing the *Official Scalers Act* of 1894. Furthermore, in 1906, the *Timber Manufacture Act* required all timber be manufactured in the province, tying the labor to the land and creating jobs for the BC economy (British Columbia Forest Service, 2011). During that time, BC made history with the development of the *Forest Act* in 1912, creating a professional bureaucracy to manage crown timber lands (Rajala, 1998). The province hired a Chief Forester, who was in charge of the management of forest lands in the province, a position under the provincial Forest Branch still in existence today. The creation of such a government organization marked a move by the industry to refine its methods. As the majority of forestland in BC was, and still is, publically owned, the government's forestry branch played the dominant role in shaping how forest management occurred, as it continues to do today.

Education of forest professionals was also beginning to take place at major universities and colleges on the west coast. Increasingly complex forest operations warranted the use of engineers to develop transportation infrastructure and manage cable yarding operations at a higher level. BC, however, lagged behind some of the more progressive American schools like Yale and Washington State, and subsequently, did not introduce a program in the province until 1920, at which time the University of

British Columbia became the principal training ground for BC forestry professionals (Rajala, 1998). The newly educated forest engineers were put in charge of much of BC's topographic mapping, railroad construction and overhead cable logging system layout, and for the first time, professional thinking was leading to more efficient logging systems. The introduction of forestry programs in major universities also resulted in the development of forest industry research programs. One such program in the early 1920s discovered the detrimental impact of overhead cable logging on soil and consequently to seedling regeneration. The issue was of little concern in BC, on crown land, but private American land owners concerned about the future of their land took strong interest in the re-stocking issues (Rajala, 1998). Research would continue to play a major role in shaping forest industry standards and technological advancement throughout the century.

The development of overhead logging was continuing to make the logging industry more and more efficient. By 1915, high-lead and skidder cable set-ups were in very general use throughout the province. In 1917, the first multi-speed donkey engine was introduced, allowing increased yarding speeds and further maximization of engine output. These faster speeds permitted the use of cold decking, whereby logs were yarded to a large pile, where they would later be swung to the railway by a skidder cable-line. With the adoption of overhead systems, and thus, longer yarding distances, railroad construction costs declined for most major companies. The use of overhead systems typically utilized a spar tree, a centrally located tree used for cable attachment set-up by the high-rigger, an integral crew member of the new logging systems. By the mid-1920s, however, several forestry companies were utilizing portable steel spar skidders on rail lines, giving them the ability to move about the rails as desired, utilizing the natural contours and logical landing locations (Rajala, 1998). The portable spars were not used across the province extensively however, until 30 years later.

Technology was also being developed to deal with inventory. Aerial photography came into widespread use for forestry applications after World War I (British Columbia Forest Service, 2011).

Typically, forest inventory was being done by timber cruisers, who would go on multi-day treks across the forest to note the species, volumes, and access points among other things. Aerial shots of the forest allowed companies to get general estimates on species and size before sending in a cruiser to further refine the details of the area.

1930-1960: The Industry Refined

By 1930, the forest industry in BC had become a sort of factory, capable of pumping out large volumes of wood with increasing efficiency and precision. Sawmills had expanded, with many rural developments primarily depending on the constant flow of timber from the surrounding area to support their livelihood. While higher level planning was often utilized to deal with timber licensing, land leases, and stumpage, the tax paid to cut timber on Crown land, macro-scale land management remained limited.

Technological advancement at this time was unprecedented, and the resulting increases in production led to the eventual need to begin to think about managing the landscape at a different scale. In the 1930s, gasoline engines began being utilized as an alternative to steam power. These alternative power sources began to be used in many of the operations where the heavier steam power was not necessary. Many of the steam engine operators had already converted from wood to oil as a fuel, eliminating the need to chop wood constantly. Eventually, diesel engines were developed capable of generating over 300 horsepower, causing the inevitable withdrawal of steam-power from most operations (Rajala, 1998).

The 1930s also saw the development of truck logging in the industry. While trucks had been used to some degree beginning in the 1920s, it was not until later when pneumatic tires, powerful gasoline and diesel engines, and advanced suspension and braking systems were developed, that they became commercially profitable (Gould, 1975). The logging truck soon became the primary mode of transportation for logs, primarily due to its ability to reach previously inaccessible areas, creating

mobility beyond any other traditional system. Log truck roads were initially constructed using wood planks on which the trucks would drive. This cheap alternative to building railway lines was an attractive option at the height of the great depression, which began in 1929 and carried on well into the early 1940s. The industry struggled as global markets collapsed. Companies were forced to become innovative in order to survive.

Trucks were soon utilized across BC's landscape, and innovation regarding this method of transport soon followed (Figure 5). With economic hardship at its height, forest engineers were getting creative finding ways to cut time and costs off of harvesting and transportation operations. Truck preloading was invented in an attempt to reduce idle time for truck drivers. Truck bunks were made detachable and were preloaded and then moved onto trucks when they arrived, leaving the empty bunk behind for the next pickup. Similarly, truck turntables were created to save time during log removal at the water. Trucks would drive straight onto the pier, unload, and then the whole pier would swing 180 degrees so the driver did not have to reverse or maneuver out (Gould, 1975). Still, there were many limitations in trucking. Many roads at this point were one way; trucks moving up and down roads had to be coordinated, there were designated passing tracks, and passing was organized by a dispatcher. There were telephones located along the length of the road so that drivers could tell the dispatcher where they were (Gould, 1975). These archaic systems, along with other methods, were soon eliminated and log trucks and road development continued to become more efficient throughout the next 30 years. The system was continually becoming safer and allowing increasing access to difficult-to-reach areas. The emergence of log trucking also signaled the end of logging railways. By 1948, there were only 16 logging railways left, and 20 years later, only 2. The days of rail were finished; capped at 5% grades using large turning radiuses; they were no match for the logging truck roads, which could be built on grades of 20% around much tighter curves (Gould, 1975).

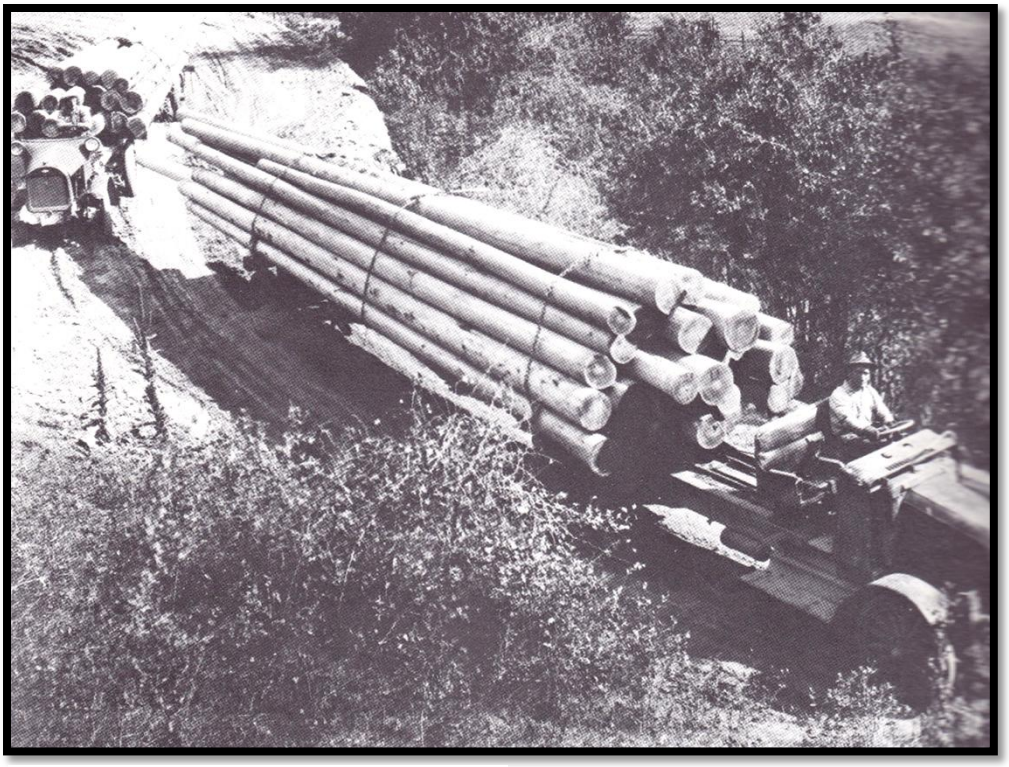

Figure 5 – Early Logging Trucks
Photo Credit: BC Forest Service

One of the other major innovations in the industry was the development of the tractor machine or "cat", short for Caterpillar, the primary producer of the vehicle. Cats were used initially for road clearing, as bulldozers, with large blades attached to the front to clear debris. However, cats began to be used for yarding operations starting in the 1930's (Gould, 1975). Logs would be attached to chokers, which would be cinched up to the back of the cat, where a large arch would provide lift to the logs. Initial cats had no arch, dragging the logs entirely along the ground. Furthermore, the first cats had no driver protection, neither from falling debris or weather; rudimentary cat cabs were added in the 1940s, making driving one safer and more enjoyable. The evolution of these machines opened up the yarding opportunities on flatter terrain where large, difficult to set-up cable operations would have been unprofitable.

One of the most revolutionary devices created at this time was the power saw. Early power saws were creatively designed but near useless devices. Inventors tested numerous designs in an attempt to up productivity during the falling stage. Some of the early saws burned through the tree using electricity, while others were cumbersome 600 pound steam powered machines, unpractical for use in BC's variable terrain (Gould, 1975). But by 1936, chain saws had been developed and were being used in coastal operations south of the border. By the 1940s BC loggers were using Stihl chain saws, 140 pound machines that required two men to yield them but that were capable of cutting logs in minutes (Gould, 1975). These saws were initially difficult to handle but technological advancement made them lighter and more powerful than ever before. The utilization of magnesium, a lighter material, in the saws made one man operation of power saws possible (Figure 6) (Rajala, 1998). The replacement of cross cut saws and axes by power saws increased harvesting operation efficiency dramatically in BC, driving productivity up, but employment in the sector down.

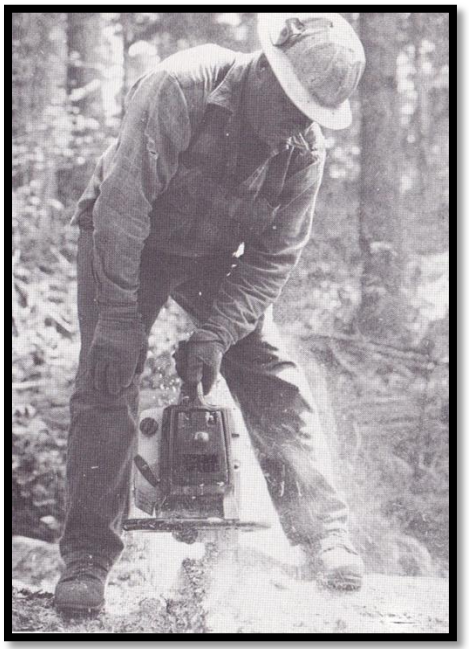

Figure 6 – Chainsaw in use
Photo Credit: British Columbia Archives

Times during the great depression were difficult for the logging industry, but the innovative progress being made was unprecedented. The reduced demand for timber products also led to changes in harvest methods never before utilized. Clear-cut harvesting was typical in the logging industry, but with the reduced demand, specific wood types were sought after while others were completely disregarded in the market. Differentiation in the marketplace for species and quality led the forest industry to reconsider how it would harvest timber to maximize revenue. Thus, selective harvesting was introduced (Rajala, 1998). The increased mobility afforded to the industry by logging trucks, tractor skidders and

power saws allowed companies to precisely harvest only the wood that the market demanded. Cut-block uniformity remained high but as the industry matured so did the shape of the cuts, becoming increasingly complex and thought-out to maximize the various values.

With the increased efficiency of the industry and pick up of lumber markets at the start of WWII, concerns began to grow over the long-term sustainability of the industry. As a consequence, in 1943, the Sloan Royal Commission was initiated to survey the situation. The recommendations of the 1945 Commission report established the concept of sustained-yield timber harvesting on the BC land-base (Dore, 2001). The Sloan Commission instigated the creation of Tree Farm Licenses (TFLs) and Public Sustained Yield Units (PSYUs) in which the sustained yield policies were put into action. These management forms allowed government to introduce public management on both privately held and public tenure timberlands. All licensees were required to obtain permits before cutting and forest management plans were required every five years to ensure sustainable harvest goals were being followed (Dore, 2001). PSYUs were different only in so much that they were applied to land that was not under any formal ownership or tenure. In 1946, the Silvicultural Fund was established in BC, and beginning during the 1950s, the Fund provided regeneration seedlings at no cost. There was a second Sloan Commission, finished in 1955, that further refined the first, adding management restrictions to ensure the utilization of pulp, low grade lumber, and other forest products (Dore, 2001).

A shift in the industry mindset was beginning to form as some saw how the increasing harvest productivity at the time was beginning to prove too much for the land to handle. The sudden need to regulate the harvest for long-term sustainability exposed the deficiencies in the historical management regimes. The incorporation of the Sloan Commissions into industry management and practice was a call to re-evaluate the forest and its bounds. Harvest levels would no longer be dictated by how much was demanded and could be harvested, but rather how much the land could handle. Sustainable harvest

rates were dictated by the annual allowable cut (AAC) and foresters everywhere would have to think about what their land-base could sustain.

1960-1990: A Move towards Sustainable Management

By 1960, industrial forestry was spread throughout the province. What was once an industry centered primarily around Vancouver was now a major part of the BC interior's economy. Mills had been constructed all across the central interior, with large logging operation centers such as Williams Lake, Quesnel and Prince George emerging as industry hubs (Hayter, 2000). By 1970, the forest industry in the interior rivaled the coast's operations in scale.

Road building expansion throughout the province connected transportation routes and was a major factor in allowing the interior industry to expand as it did. Furthermore, road building construction was also progressing on logging roads. Plank roads were being replaced by gravel and crushed ballast roads (Gould, 1975). The logging roads were eventually made more water-path friendly by integrating ditching along road sides, as well as culverts and dedicated water pathways where necessary.

There continued to be technological innovation in the sector. Grapple yarding systems were developed in the late 1960s; grapples allowed the operator of the cable yarder to pick up logs without the use of chokers, and thus, chokermen (Gould, 1975). Furthermore, the grapples could be attached to skidders, large land machines with rubber tires popularized in the 1960s useful for yarding. The mobile backspar was also being utilized more and more. While a mobile track backspar had been utilized in the province, it wasn't until the 1950s and 1960s that truly mobile backspars were used, allowing cable yarding operations to be set-up anywhere. Helicopters made their first appearance in a logging outfit in the late 1950s as well (British Columbia Forest Service, 2011). However, they were used more in the 1960s and 1970s on the steep coastal mountains of BC. Helicopters, while expensive, opened up timber that was previously completely inaccessible. Profitable markets allowed the use of such machines in areas where high quality timber would permit it. Another innovation developed in the industry was the

self-loading and self-dumping barges. Some of these barges were capable of loading over 1.5 million board-feet of logs. Although originally towed by tugboats, the barges were eventually built with self-propulsion and replaced many of the tugboats on the coast. What was once a 21 day trip from Haida Gwaii to Vancouver could be accomplished in 3 days with the barge (Gould, 1975).

The 1960s were also a time of political upheaval; and environmental issues were put into the spotlight. North America, seemingly overnight, became an environmentally educated population, who had come to value nature for far more than its commodity potential, and with that, desired to actively participate in the regulatory process and see policies developed that would uphold ecological integrity and social well-being (Rajala, 2006). At this time, management of the forest became far less about the market direction and far more about political standing. The Social Credit Party maintained power in BC throughout much of this period and in 1969, they created the Scientific Pollution and Environmental Control Society (SPEC). Furthermore, The Sierra Club started a provincial designation in BC that year, and Greenpeace was formed in 1971, all contributing to the increasing environmental awareness of the public, and the call to action against the forest industry (Rajala, 2006).

1972 marked the end of 20 years of Social Credit Party forest management, as the New Democratic Party (NDP) took over office. One of the first actions taken by the new leadership was the introduction of Planning Guidelines for Coastal Logging Operations (Plant, 2009). These guidelines introduced riparian standards, increased protection for fish and game, and revised rules on harvest systems, as well as introduced patch-cut logging. The 1974 introduction of the *Timber Products Stabilization Act* saw the creation of the Forest Products Board, responsible for collecting data on market trends and shaping the direction of the industry henceforth.

In 1976, the Pearse Royal Commission was appointed to survey property rights and current harvest zone structuring. The forum gave a number of stakeholders the opportunity to speak up, among them, the First Nations people of BC. The First Nations voice had slowly been growing with disagreements

over land rights and title emerging in media streams across the province. The BC Forest Service came under increasing pressure from First Nations and environmental groups, particularly over coastal operations, as disagreements escalated over Haida Gwaii and the North Coast among others (Rajala, 2006).

The Pearse Commission re-established the unanimous desire for public ownership of forest lands in BC, but it attempted to redefine property rights and tenure once again. The commission stressed the need to manage the land base for a sustainable rate of harvest, rather than the sustainability of the ecosystems. Pearse saw the land as a multiple-use management area, with timber being just one of those uses. He called for a re-organization of thinking to evaluate the land, not just for its timber values but for the other values associated within the forest as well (Dore, 2001). The commission also rearranged the terms of TFLs in the province, making it difficult to keep any land out of government control for more than 21 years. The system gave little incentive for companies to re-stock harvested areas appropriately, which in some cases, resulted in a systematic regeneration failure in particular areas of the province.

In 1978, PSYUs were replaced with Timber Supply Areas (TSAs) (British Columbia Forest Service, 2011). These areas became open to harvest for companies that put in proposals to the government. Blocks were to be surveyed and identified, but no single company would control a given area. TSAs allowed new companies, without existing tenures, to enter into the harvesting business. These land management zones required the Chief Forester to look at multiple values on the land-base and set 5-year harvest levels. Harvest levels were monitored, though some would argue that TSAs provided far less long-term security to the renewal of BC's forest land.

With increased environmental concern, as well as increased mobility in the forest due to technological advancement, the shapes of cut-blocks were rapidly evolving. While clear-cut logging still had its place, a variety of other harvest systems were introduced. Variable retention systems were

being used, as well as new selective harvesting and single tree selection systems. Other harvest systems were used to increase the chance of regeneration and adjacent stand vigor such as shelterwood or seed-tree harvest systems. Government silviculture programs were set-up and in some TFLs, silviculture was required (British Columbia Forest Service, 2011). Silviculture would continue to become a priority in forest management, and soon all harvesting operations would require demonstrable silvicultural planning before harvesting operations could commence.

A stronger federal Fisheries Act was passed in 1977, bringing environmental concern further into the spotlight. The public perception was that logging was depleting salmon stocks, and eroding the landscape in the process. The battle over logging bans and regulation became highly political over the next ten years. Research into forestry and fisheries interactions on Vancouver Island eventually led to another set of logging guidelines being developed in 1988 (Rajala, 2006). Despite initial resistance, the Council of Forest Industries (COFI) adopted the guidelines, citing their desire to make integrated resource management a reality. Despite the lip service, many were looking for real results from a forest industry that had all but abandoned the Coastal Logging Operations Guidelines established in the early 1970s.

1990-2010: Politics and Computers

In 1991, the Peel Commission Report was released. Among other things, this new Royal Commission called for the adoption of formalized forest practices regulations. These would coordinate renewable resource management, forest land use planning and harvesting operations in an attempt to integrate environmental, ecological and social values into the system (Plant, 2009).

In 1994, the government developed the Forest Renewal Strategy, a long-term plan aimed at creating jobs, protecting ecosystems and maintaining sustainable forest development. 1994 also saw the implementation of the *Forests Practices Code Act*, a direct response to the Peel Commission (Plant, 2009). This landmark policy provided the industry with a set of standards for all aspects of forest

practices and operations. The code required long-term management planning and introduced enforcement standards for those who were incompliant. The code also attempted to negate any potentially negative effects it may have on the industry by capping its influence on the AAC to six percent. Declining markets in the late 1990s led to the *Forest Statutes Amendment Acts*, which intended to streamline the code and improve productivity in the industry. The introduction of the Liberal Party into power in 2001, led to the changing of forest policy and management once again. In 2004, the *Forests and Range Practices Act* (FRPA) was passed. The FRPA administered an entirely new set of forest management guidelines (Plant, 2009). The new results-based practices reduced administrative burden and increased managers' freedom to reach targets. Forest stewardship plans were required for any logging operations; these detailed all harvesting, reforestation and environmental protection occurring on the land.

Management during this time period became more and more complex. There was a trend towards increased stakeholder participation across the province, as the public continued to influence what occurred on both crown and private lands. Integrated management values also placed emphasis on managing for more than just timber. Management plans began to include the valuation of timber, non-timber forest products, wildlife, water, recreation, aesthetics, spiritual values, cultural values, carbon, and biodiversity among others.

A major theme in recent forest management activities is the inclusion of First Nations people in the process. The favorable rulings of the Delgamuukw and Haida cases in 1997 and 2002 respectively by the First Nations people brought land title and accommodation further into the multi-stakeholder process agenda (Rajala, 2006). Furthermore, Gordon Campbell, the Liberal Premier from 2001-2011 made it a priority to include First Nations in discussions on land use in the province. He, very effectively, patched much of the hostility between the Government and First Nations regarding land management, though there is still much work to be done regarding the issue.

Technology at the time was also changing rapidly. The introduction of computers changed many aspects of the industry. Micro-electronics were introduced in the 1960s and 1970s but computer controlled milling machines took over in the 1980s. Robotics and electronic control systems were revolutionizing the way much of the provinces timber was being utilized. Furthermore, the advent of increased telecommunications and information passage led to a revolution in the way companies communicated. The technological revolution continued into the 1990s and 2000s as milling procedures and harvesting mechanisms were increasingly being controlled and monitored via computer systems.

Computers also changed the way forests were managed at a much smaller scale. New software allowed detailed inventory data to be much more easily processed and stored. Furthermore, data could be more easily collected. The introduction of user-friendly geographic information systems (GIS) software and hand-held devices allowed foresters to map out data quickly and effectively. While the system is still being refined, it is not hard to imagine a time when all data will be collected on tablet software. Computer models were also developed to deal with making management decisions across large landscapes, integrating vast amounts of data. Models can provide foresters with information on trends, consequences of management decisions and analysis of multiple scenarios like never before. The use of models will undoubtedly increase as the software becomes more user-friendly and accurate in its assessments.

While much of the technological advancement in machinery in the forest industry was slowing down, there were still a number of innovations during this time period. Feller-bunchers were introduced to BC in the late 1990s and early 2000s. These machines are capable of cutting, debarking, bucking, moving and piling a tree, all within a matter of minutes. While not practical everywhere due to diameter restrictions, these machines are extremely efficient and where usable, are a huge advantage. Many forestry machines have been re-invented to match their use more specifically, or multiple elements of machines have been added together to make more useful machines. There are now

hundreds of machine companies providing innovative technologies and machinery in the industry. As a result, forestry machines have all continued to become more efficient. For example, the development and refining of more complex engines has increased fuel efficiency in a time when crude oil costs have skyrocketed, allowing the industry to persist. Furthermore, technologies like interlock and laser guided measure and control systems have allowed increased efficiency in mechanical harvesting and handling. New machines are continually being developed and introduced into the industry. One example is the biomass harvester; with the increasing use of forests for biomass energy, machines have been developed to harvest and bundle biomass in efficient ways (John Deere, 2011). The changing uses of the forest and dynamic desires of the people drive the continual need to innovate. Machine innovation may be less revolutionary than in the early 1900s but continual small adjustments and improvements persist to move the industry forwards in a constant progression.

The Future

The future of the forest industry in BC will likely look nothing like it has in the past. Management plan formulation and actions will continue to become more complex. Calls for higher standards of logging using ecosystem based management and low impact harvest techniques are becoming more common. With certain ecosystems and species becoming rarer, it is likely that protection will be increased, reducing the harvestable area in BC. Increased pressure by regulation on the industry, and ailing markets could spell difficult times ahead for resource-extraction based communities. The recent pine beetle epidemic will leave much of the interior without a solid mid-term timber supply, indicating further hardship. Innovation may once again become necessary in order to maintain the existence of the interior industry.

However, there are a number of opportunities in the forest industry. The forests are now being enjoyed by more people, for more reasons, than ever before. The rise of integrated resource management outlines several opportunities for the industry. Firstly, there are opportunities for area

designation and plantation forestry across the province. This could localize intense forest harvest and allow specific communities to take the lead with regards to directing the industry, as well as increase yields for those areas. There is also opportunity to run more provincial community forests. Managing a land-base for a given community and their values allows each district to utilize their resources however they see fit. The restructuring of the economy towards increased domestic tourism and recreation provides BC with a number of competitive advantages given our location, terrain and range of available activities.

Another opportunity lies in the emerging carbon economy. Carbon and biodiversity credits can provide communities and landowners with monetary incentive to maintain existing forests. Given a rise in carbon prices, it is possible that it may become more profitable to avoid deforestation rather than harvest sustainably. It is likely that the fate of carbon in BC will be decided by provincial lawmakers and the political standing of the nation, as current carbon taxation is not expansive enough and current rates do not provide adequate incentive for carbon market demand to substantially increase in BC. The carbon markets, however, are increasingly drawing major European buyers overseas to offset pollution from their own countries. Development of a more precise inventory in BC may aid in advancing the carbon economy in BC, where models require detailed forest data to be validated. Much work is required to bring current inventory databases up to date.

Many of the future forest industry scenarios call for a decrease in harvest levels, but the opposite may also occur. The steady rise in global population and international demand may provide enough stimuli for the forest industry to begin growing again. Promising growing markets in China and India could easily demand more wood than BC could sustainably harvest, given enough time and marketing success. The development of these markets may well decide the fate of the industry in its current form.

Furthermore, technology continues to evolve. Increased reliance on computers and electronic systems could provide further efficiencies with regard to milling and machine operation. Computer

systems could provide more accurate data with regard to modeling forest management scenarios, predicting climate change impacts and providing feedback on decision making. The future of BC's forest industry remains an exciting topic discussed at length in numerous other publications.

Conclusions

Due to a number of factors, the Forest Industry has changed a great deal over its lifetime. Firstly, there was a need for increased efficiency (Rajala, 1998). Industrial maximization of labor, resources, and ultimately profit has led the industry to constantly pursue new ways to log. Research and development of logging companies has always been done to allow better productivity using faster processes, new machinery and smarter people. Secondly, the land base itself has driven technology. Initial logging took place along the ocean shores and river banks, and once those trees were gone, logging moved into valley bottoms and finally onto mountain hillsides of increasing difficulty (Rajala, 1998). The shift in location of industrial forest development to increasingly difficult places to log has forced innovation in order to ensure the existence and persistence of the industry. Thirdly, the depletion of resources made it necessary to be innovative with regard to managing the forest and its inhabitants. Initial attitudes of cut-and-run harvesting were appropriate given the abundance of timber relative to the level of utilization. As harvest methods were improved and the industry became capable of making an impact on the land at a larger scale, management was required to maintain the sustainability of the resources.

Hundreds of years of history have made the British Columbia Forest Industry what it is today. The industry has faced tremendous growth and prosperity at times, as well as frustration, limitation and depression during others. What began as a few men practicing unrestrained harvest using simply axes and cross-cut saws with little concern for the land has evolved into a highly mechanized factory-like process in which high powered machinery is used to cut managed forests overseen by trained professionals and the entire public population. Harvesting machinery has progressed from human power to animal power, from steam engines to gasoline and diesel engines, from ground to cable and

air based logging, and from crude systems management to computer controlled custom milling and machine operation. Likewise, forest management has undergone a massive shift in paradigm as well as scale. Initial harvesting was done without concern for future harvest, with no regulation, and by whomever. Conversely, current management requires an integrated understanding of the long-term sustainable harvest levels at the micro and macro scale, various values on the land, stakeholder participation and agreement, and knowledge of the existing regulations and best-practices. Both technology and management in the industry have become more complex over time, and the future shows no signs of slowing down. The proud industry continues to adapt and change to the desires of the people, markets and politicians. Forestry is still not simple, but nor has it ever been.

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