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Program
THIRD ANNUAL FOREST ENGINEERING COUNCIL WORKSHOP

August 18-22, 1980

Forestry and Harvesting Training Center
Gulf Park Campus
Long Beach, Mississippi

HOSTED BY: Forestry and Harvesting Training Center, Auburn University, and Mississippi State University

THEME: "Forest Engineering as Related to Future Forest Management"

Tuesday, August 19, 1980

6:00 p.m. - Registration in Campus Auditorium

Wednesday, August 20, 1980

8:00 a.m. - Registration in Campus Auditorium
9:30 a.m. - Session I: Business meeting - Dr. George Brown and Dr. Billy Watson
11:30 a.m. - Banquet Luncheon: Welcome - Dr. Bobby Lanford and Mr. John Mann, Keynote Speaker: Dr. Ross Silversides
1:00 p.m. - Session II: Future Forest Management and Its Engineering Problems, Moderator - Dr. Emmett Thompson
Northeastern United States & Eastern Canada - Dr. Tom Corcoran
Dr. Norm Smith
Western United States & Western Canada - Mr. Bill Bentley
Dr. George Brown
Southern United States - Mr. Bill Smith
Environmental Problems - Mr. Howard Hanna
5:00 p.m. - Adjourn
6:00 p.m. - Social Hour
7:00 p.m. - Shrimp boil on the beach

Thursday, August 21, 1980

8:00 a.m. - Session III: Forest Engineering as Applied to Regeneration
Moderator - Dr. John Miles
Mechanical Regeneration Techniques - Dr. Bob Fridley
Harvest Methods to Enhance Natural Regeneration - Mr. Earl Priegel

10:00 a.m. - Session IV: Use of Cable Harvesting Systems
Moderator - Mr. Glenn Young
Harvesting Large Timber - Mr. John W. Mann
Harvesting Small Timber - Dr. Ed Aulerich
Thinning Small Timber - Mr. Soren Erickson

12:00 noon - Lunch

1:00 p.m. - Session V: Use of Ground Skidding Systems
Moderator - Mr. Glenn Plummer
Northeastern United States & Eastern Canada - Mr. Ken Kelly
Western United States & Western Canada - Mr. Jake Jacobsen
Southern United States - Mr. Don Simmons

3:30 p.m. - Session VI: Use of Forwarding Systems
Moderator - Mr. Tom Gafner
Large Machine Forwarding Systems - Mr. Tom Wildman
Prehaulers - Mr. Don Tufts

5:00 p.m. - Adjourn

6:00 p.m. - Social hour - Dinner on your own

Friday, August 22, 1980

8:00 a.m. - Session VII: Forest Engineering Education Programs
Moderator - Dr. Tony Short
Innovative Extension Programs - Mr. John Garland
Equipment Manufacturer's Programs - Mr. Lee Gustafson
Forest Industry Program - Mr. Jack Warren

11:30 a.m. - Wrap-up - New Chairman

12:00 noon - Adjourn

SPEAKERS

Dr. Ed Aulerich, Forest Engineering, Inc., Corvallis, Oregon
Mr. Bill Bentley, Crown Zellerback Corporation
Mr. Virgil Binkley
Dr. George Brown, Oregon State University, Corvallis, Oregon
Dr. Tom Cocoran, University of Maine, Orono, Maine
Mr. Soren Erickson, Nordfor, Charlotte, North Carolina
Dr. Bob Fridley, Weyerhaeuser Company, Tacoma, Washington
Mr. Tom Gafner, Gafner Manufacturing, Inc., Eufaula, Alabama
Mr. John Garland, Oregon State University, Corvallis, Oregon
Mr. Lee Gustafson, John Deere, Moline, Illinois
Mr. Howard Hanna, Container Corporation of America
Mr. Jake Jacobsen, Caterpillar Tractor Company
Mr. Ken Kelly, Eaton Yale, Ltd., Woodstock, Ontario
Dr. Bobby Lanford, Auburn University, Auburn, Alabama
Mr. John Mann, Forestry and Harvesting Training Center, Long Beach, Mississippi
Dr. John Miles, University of California at Davis, Davis, California
Mr. Glenn Plummer, Georgia Kraft Company, Rome, Georgia
Mr. Earl Priegel, USDA Forest Service, Atlanta, Georgia
Dr. Tony Short, University of New Brunswick, Federicton, New Brunswick
Dr. Ross silversides
Mr. Don Simmons, pulpwood dealer, Macon, Mississippi
Mr. Bill Smith, North Carolina State University, Raleigh, North Carolina
Dr. Norm Smith, University of Maine, Orono, Maine
Mr. Don Studier
Dr. Emmett Thompson, Auburn University, Auburn, Alabama
Mr. Don Tufts, Bodcaw Company, Pineville, Louisiana
Mr. Jack Warren, Forestry Update, Inc., Long Beach, Mississippi
Dr. Billy Watson, Mississippi State University, Starkville, Mississippi
Mr. Tom Wildman, Great Northern Paper Company
Mr. Glenn Young

Minutes

Business Meeting

Third Annual Forest Engineering Council Workshop

Long Beach, Mississippi

August 20, 1980

The business meeting of the Third Annual Forest Engineering Council Workshop was called to order by Billy Watson, co-chairman of the meeting. After introducing co-chairman Bill Schmitt and Bobby Lanford, he turned the meeting over to George Brown.

Brown opened the meeting by extending the thanks of all attending to Watson, Schmitt, and Lanford for their work in setting up the workshop and to their home institutions for their support.

The meeting began with a discussion of the next workshop and its timing. Members voted unanimously to convene the next meeting in 1981 as planned.

The members next considered the draft organizational charter developed at the 1979 meeting. A motion to amend Article II (4) to read "To facilitate the exchange and dissemination of technical information in forest engineering subjects" passed unanimously. It was also suggested the dissemination of information be a topic of the next executive committee meeting.

Members discussed a motion to establish an office of secretary-treasurer for the Council. After some discussion, it was agreed that the functions proposed (collection of dues, official correspondence, distribution of publications) could be handled within the proposed organizational structure. The motion was amended to allow the chairman flexibility in assigning these duties. The amendment passed, thus superseding the original motion.

Two additional changes were made in the text of the organizational charter. Article IV (1) was amended to read "A member may be employed in <u>public agencies</u>, the forest based industries..." Article V (5) was amended to read "The Membership Committee is...organized to identify those persons actively involved in practicing, teaching, research, or extension..."

The issue of membership dues was discussed at length. The sense of the meeting was to let the executive committee set the dues and their use. Members expressed a willingness to pay dues as a means of registering active interest in the organization and to support publicity and newsletter activities of the Council.

Brown then asked for a motion to accept the amended charter of Council on Forest Engineering. Such a motion was moved, seconded, and unanimously approved.

The members next elected the following officers for 1981:

Chairman..........................Tom Bjerkelund, University of New Brunswick, Fredricton, N.B.

Vice Chairman.....................Ed Aulerich, Forest Engineering, Inc., Corvallis, Oregon

Past Chairman.....................Billy Watson, University of Mississippi

..................................Bobby Lanford, Auburn University

Policy Committee Chairman.........George Brown, Oregon State University, Corvallis, Oregon

Membership Committee Chairman......John Mann, Forestry and Harvesting Training Center, Long Beach, Mississippi.

Aulerich agreed to host the 1982 meeting at Coeur d'Alene, Idaho.

During the election of the vice chairman, the members agreed that industrial organizations should take an active role in hosting Council meetings. The 1982 meeting is one example. In addition, Deere and Company would consider hosting a meeting. Dennis Eagan agreed to inquire about the possibility and respond directly to Tom Bjerkelund. The target would be a 1983 meeting in Moline, Illinois with a field trip to Deere's harvesting equipment plant.

There being no further business, the meeting adjourned.

GEORGE W. BROWN
Principal Research Engineer
Forest Products and Engineering Research.

My name is John Mann and I am the new Director of the Forestry and Harvesting Training Center here in Long Beach, which is one of the co-hosts of this meeting of the Forest Engineering Council. I don't know how long I'll have to introduce myself as the <u>new</u> director of the Center, but I believe that this adjective applies very well at the present because I've only been here about two weeks.

For the past six years I've been working on the West Coast in northern California and Oregon and have not yet had the opportunity to meet many forest engineering people from other parts of the country, so this meeting is an excellent time for me to become acquainted with you ladies and gentlemen.

I was at the Forest Engineering Council meeting at Oregon State University in 1978, so I am somewhat familiar with the background of the organization. I am a forest engineer with a Master's degree in logging engineering from Oregon State University and to me, forest engineering is perhaps the most important and definitely the most exciting part of forest management. The primary reason that the Forestry and Harvesting Training Center exists is to help improve the effectiveness of timber harvesting and forest operations, so we work almost exclusively in a forest engineering function. Therefore, I am extremely happy to have been selected for leading this Training Center and extremely happy to have as one of my first official functions to help host this professional meeting.

I know that many of you that are from the southeastern part of the United States are quite familiar with the origin and organization of the Forestry and Harvesting Training Center; in fact, a few of those present have been involved in the Center from the time it was

PROPOSED AS A RATHER VAGUE IDEA OF A TRAINING NEED AT AN AMERICAN PULPWOOD ASSOCIATION MEETING IN THE EARLY 1960'S. FOR THOSE OF YOU NOT KNOWLEDGEABLE ABOUT THE TRAINING CENTER, IT WAS ORGANIZED IN 1973 AND BECAME OPERATIONAL IN 1974. WE ARE NOW AN ADMINISTRATIVE UNIT OF THE SCHOOL OF FOREST RESOURCES OF MISSISSIPPI STATE UNIVERSITY, BUT THE SUPPORT FOR THE CENTER IS FROM THE CONTRIBUTIONS OF 18 FOREST PRODUCTS COMPANIES AND FOUR SOUTHERN FORESTRY SCHOOLS. EACH MEMBER ORGANIZATION IS CONSIDERED AS AN EQUAL PARTNER IN THE ENDEAVOR.

AS I MENTIONED PREVIOUSLY, THE CENTER IS DEDICATED TO INCREASING THE EFFECTIVENESS OF TIMBER HARVESTING AND FOREST OPERATIONS IN THE SOUTHERN UNITED STATES, AND IT SUPPORTS THE EFFORTS OF THE COOPERATING UNIVERSITIES IN THEIR INDUSTRIAL FORESTRY PROGRAMS. THESE OBJECTIVES ARE ACHIEVED BY ASSISTING WITH FORMAL COLLEGE EDUCATIONAL PROGRAMS, CONDUCTING RESEARCH AND TECHNICAL ASSISTANCE PROGRAMS, AND BY CONDUCTING CONTINUING EDUCATION TRAINING PROGRAMS IN FOREST OPERATIONS RELATED TOPICS. IT IS A RATHER UNIQUE ORGANIZATION AND, TO MY KNOWLEDGE, IS THE ONLY ONE OF ITS KIND SERVING BOTH FOREST INDUSTRY AND UNIVERSITY. IN MY SHORT TIME HERE, I HAVE BEEN EXTREMELY IMPRESSED WITH THE ENTHUSIASTIC SUPPORT AND COOPERATION FROM THE MEMBER ORGANIZATIONS. FOR ANYONE INTERESTED IN LEARNING MORE ABOUT THE CENTER, I LOOK FORWARD TO TALKING WITH YOU OVER THE NEXT FEW DAYS. ON BEHALF OF THE FORESTRY AND HARVESTING TRAINING CENTER AND ITS MEMBERS, I WELCOME YOU TO THE MISSISSIPPI GULF COAST AND HOPE THAT YOUR VISIT HERE WILL BE SOCIALLY PLEASANT AND PROFESSIONALLY BENEFICIAL AT THIS THIRD ANNUAL MEETING OF THE FOREST ENGINEERING COUNCIL.

THANK YOU.

"FOREST ENGINEERING AS RELATED TO FUTURE FOREST MANAGEMENT"

Forest Engineering Council Workshop
Long Beach, Mississippi, August 20, 1980

Showing a great lack of imagination, I thought I would title this paper "Forest Engineering as Related to Future Forest Management", the same as the theme for this Workshop.

For the past year I have been dealing with futures, with predictions and trends. Futurology has been described by economist Lester Thurlow as the intellectual's version of going to the palm reader. The more I read, the more I believe it.

What is our forest management of the future going to be? This must be agreed upon before we can give any real consideration as to where forest engineering fits in and what contribution it can make to such forest management. There will be many forms of forest management and the form taken for any one forest will depend upon the location and size of the forest, the tree species and their silvicultural requirements, forest ownership whether public or private, the products to be produced. Forest management can range from exploitive, where the forests are completely liquidated to highly intensive where single tree selection is practiced.

In a way it is a chicken and egg situation, and which came first. Do the trees in the forest govern the finished product or does the demand for a product govern how and to what size and species the trees will be grown?

The forest management we have been taught in schools has been inherited from the European traditions. This form of forest management was based upon a scarcity of timber, a stable economy and a sawtimber industry.

Professor Jack Walters of the University of British Columbia some years ago published a very thought provoking paper entitled "The Uncertain Forester". In it he described and discussed the dilemma foresters find themselves in today when forests are regenerated and plantations are planted without any concept of what their final disposition will be. In other words trees grow at the rates determined by nature while the uses for the trees or products from them change at an almost exponential rate. New forest products emerge yearly.

Examples of this dilemma are many. In Brazil large plantations of pine and eucalypts were planted by the Brazilian railways as a source of fuel for their steam locomotives (Brazil has no coal). By the time the plantations were ready for harvesting the railways had converted to diesel electric locomotives. This resulted in the rapid growth of the pulp industry in the country.

In Michigan a large pulp and paper company with free hold lands in the Upper Peninsula raised high quality long fibred spruce under intensive management for its pulpmills there. When the spruce reached merchantable size and was ready to cut the pulpmills had all been converted to pulp short fibred poplar, and the spruce was exported north to a Canadian newsprint mill.

What I am trying to say here is that it is not possible to say what the forest management practices will be in the 21st century, the beginning of which is only 20 years away. Today we do not know what the dominant use of our forests will be half a century from now. All we do know is that it will probably be very different from what it is today. And these new uses will affect our forest management practices dramatically. A good example is the 2 - 5 year rotation which should make European foresters of the past spin in their graves.

Since 1973 and the oil embargo by OPEC there has been an increasing interest shown in the so-called energy plantations. Work along this line was carried out here in the southern United States on sycamore silage but I don't believe it ever got beyond the pilot planting stage. The initiative at that time, pre-1973, was for pulping and the justification for it was not as powerful as it is today, which is a substitute source of energy to oil. In Canada, because of our northern latitudes we are working with poplars and are taking advantage of hybridization and hybrid vigor. Some work is being carried out with Salix and Alnus, both north temperate species. Plantations of 15000 stems/acre are planted. They are harvested every 2 years on a 10-year cycle and produce $6\frac{1}{2}$ tons/oven dry per acre per year. This material can be used as a source of energy through direct combustion, gasification, pyrolysis, etc. It has also proven to be an excellent form of fodder for cattle after being processed in a retort in which the material is placed under pressure and heat, and when brought to atmospheric pressure the wood explodes and is fiberized - a process somewhat similar to the Masonite process. From the heat the wood sugars appear carmelized. Feeding trials of this material, primarily aspen, to beef cattle along with hay show that it provides all the necessary diet.

This is mini-rotation poplar. If left until 5 years of age the trees are suitable for fibre and indeed are today harvested for this purpose. Here we have a situation where foresters are working with mini (2) midi (5) and short (10) rotations. This would not even have been dreamed of by teachers in forestry schools, ten to fifteen years ago.

The energy content of wood averages approximately 8000 BTU's per pound OD (+ 10 percent) regardless of species. There is little difference in the energy content of wood and bark. There are wider variations in the moisture content of green wood however, and this is one factor which man can influence or control. There are a number of processes for the densification of wood. In this instance wood is reduced almost to a powder condition and then put through an extrusion process. The result is a smooth dry hard material with a uniform energy content close to 9000 BTU/lb. It's form lends itself to easy handling and storage as it is granular and flows readily. Wood in this form because of its uniformity makes an excellent feedstock for energy or chemical plants.

The rate of change in the use of wood will continue with an increasing tempo and the rate of change in forms of forest management will keep pace, I am sure.

It has been projected and it seems to have been borne out todate that there will be a continuing increase in fibre and reconstituted wood products in competition with sawtimber and products which are mechanically broken down but which are still dependent upon tree size for their physical characteristics. Even with lumber, changes are rapidly taking place. Continuous high-speed finger-jointing processes are in place which permit all sizes of sawn timber to be made up with either horizontal or vertical joints. Another example of making big pieces from little pieces.

If this trend continues we will probably see few large specimens of trees in the future, outside of reserves and parks, after the current old growth forests have been liquidated.

I have touched briefly on the possiblility of energy plantations and the effect these may have on future forest management practices. The use of natural forest biomass for energy will have an even greater effect.

Many foresters today have come to accept energy as a legitimate forest product. I am one of these. I think a wider acceptance of energy as a forest product and its use by industry will have a tremendous impact on our forest management process and also upon the machinery that will be used. I am thinking here of natural forest areas such as are harvested today, not biomass energy plantations.

- Conventional forest products of sawtimber and pulp wood are species selective while biomass for energy is species independent.

- Conventional forest products are size selective, mechanical saw woods appear to operate more economically with larger sawlogs. Biomass for energy is size independent.

- Conventional forest products are very sensitive to the quality of the stock in terms of defects and deformities. Biomass for energy is quality independent.

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- Conventional forest products are quantity or volume influenced. While harvesting on a single tree basis or even with multi-stem techniques, productivity and cost are influenced to a degree by stand density but it is not a major factor if compared with tree size, for example. Sometimes a light stand density is offset by increased mobility in the stand. If the whole stand is to be harvested for energy then stand volume per unit area will have a marked effect on productivity and cost as biomass harvesting is area selective or sensitive.

- Harvesting conventional forest products normally utilizes only part of the forest stand, often less than 50 percent. Biomass harvesting by itself or in conjunction with the harvest of conventional products can utilize 100 percent of the stand.

- The harvesting of both conventional forest products and biomass are terrain sensitive. Both require machines to traverse the area to be harvested.

- There should be little difference in transport production and cost between conventional forest products and biomass as long as it is possible to make the locally allowable payload.

Because biomass for energy has no specification as to quality, species, size, etc. it means that for the first time low quality material has a value. There no longer will be such things as pre-commercial thinnings as everything will be commercial. It means we can now low grade our forests instead of high grade them. It means that in a thinning operation the added growth resulting from release doesn't have to carry the whole cost of the operation as the material removed may pay for itself.

It is recognized that it is not all a oneway street and biomass harvesting may affect nutrient recycling in forest stands and soils. But under what circumstances and to what degree is still under study and will be for years.

I have touched upon several scenarios for future forest management. What of the Forest Engineers? To may mind Forest Engineering is the most interesting of all the subdivisions of engineering because of the diversity of problems it must solve it involves a happy blend of the natural with the physical sciences and is truly an applied science.

Forest Engineering as visualized is a different discipline from that in the past. In Canada for example degrees specifically in forest engineering have been granted since 1910. Forest Engineering was recognized as an important aspect of professional forestry training in what might be termed the exploitive stage in forestry. This is the period when road and railroad construction was at its peak. When river driving, river improvements and civil engineering structures played an important role in the transporation of wood. Forest engineering flourished in the thirties and forties, but in the late 1950's and 1960's dramatic changes took place in the forestry schools. They became schools of natural resources, schools of environmental studies, schools of wildlife and resource management.

Forest engineering subjects and enrollments reached an all time low. It is a commentary on our times when in our forest schools today, the end result of forest management, the tree, is accepted as something that should not be utilized industrially, that harvesting and renewable resource is equated with rape and forest engineering students are looked upon as second class citizens by the forest biologist, silviculturalist and entomologists. Forest engineers are in fact the one group which should be able to bring together all the disciplines taught under the umbrella of forestry in the culmination of their work to optimize a forest crop and ensure its succession, however this is done.

Whether we like it or not technology is a force which exists and is growing. Due to the nature of our society it would appear that engineering solutions may be the order of the day.

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Back in 1977 a version of the Corrim Panel II Report of the National Academy of Sciences was published in the July issue of the Journal of Forestry. It was by Conor Boyd, Ward Carson and Jens Jorgensen, familiar to all of you I am sure. It was titled "Harvesting the Forest Resource - Are We Prepared?". The essence of the article was that in the United States you are not.

This article contains a number of very relevant statements. Perhaps it should be reprinted and distributed to all members and prospective members of the Forest Engineering Council. A number of the statements bear out what has already been said here.

Quote: "Technology for site preparation, regeneration, pre-commercial and commercial thinning, road building and other harvesting activities influences the wood supply, the economics of timber removal and the environmental acceptability of forest operations. The need for infrastructure of well trained people supporting a high-technology approach to each of these operations is apparent and yet there are indications that this country has not maintained this basic framework adequately."

End of quote

One measure of the technological level of any industry is its educational and R & D Base. In 1974 1½% of the scientific man years in forestry R & D was in forest engineering systems. For the same year 1974, in industry and government. There was an estimate of only 70 people engaged in forest engineering R & D. Again for 1974 only 7 out of 50 accredited schools gave programs which could be designated as forest engineering.

I would be interesting to have an update on these figures to see how much progress has been made, if any.

Based upon its annual roundwood harvest, Sweden has six times the professional manpower devoted to forest engineering R & D than has the United States, and nine times more than Canada. If the United States was at the same level as Sweden there would be 500 forest engineers instead of seventy.

In January 1979 a national workshop on "Future Challenges in Renewable Natural Resources" was held in Rosslyn, Virginia. A most interesting paper given there was titled "The Future of Renewable Resources = A Global Perspective".

I found it of particular interest as it tied in with the comments by the Corrim Panel II, comparing forest engineering in the United states with that of Sweden.

The tenet of the paper was that sweden can be regarded as a precursor to the United States in terms of societal experience. To be a precursor is to be a fore runner, to be an indicator of what is to come. I suppose the most famous precursor in our society was John the Baptist. I don't want to take this anology too far as John the Baptist had his head served up on a platter and Christ was crucified.

Comprehensive programs dealing with our Natural Resources, in this instance, our forests must take into account not just the economical and technological factors, but also changing values and attitudes and the total socio-political environment in which such programs must function. Predictions of this future environment are not amenable to traditional established forecasting techinques which do poorly when applied to societal factors.

Sweden has been able to react to experiences more rapidly than most countries. Many countries use Sweden as a precursor - France, Norway, Finland & Denmark. Nations that share a similar culture and the "advanced" or "post industrial" countries are very likely to react to circumstances in similar ways and to develope similar or related solutions.

Swedes have a tendency to anticipate problems before they achieve a level of great urgency. They have no monopoly on good ideas but they have the capacity to rush these into application on as broad a scale as possible. In North America, in Canada as well as the United States, brilliant ideas stay just that. Usually put into practice partially, spasmadically, and unsatisfactorily. In our area of interest I think the development and explortation of tree harvesting and processing equipment is a good case in point.

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If Sweden can be looked to as a precursor in forest engineering research and development we can expect perhaps to see the 500 people in forest engineering R & D as mentioned earlier, and also more rapid progress in those areas of forest engineering that have been described.

FUTURE FOREST MANAGEMENT AND ITS ENGINEERING PROBLEMS

IN THE WESTERN UNITED STATES AND WESTERN CANADA

BY

William R. Bentley and George W. Brown

ABSTRACT: Future forest of the West, expecially those under industrial management, can be expected to become more uniform with significant reduction in tree size. Intensive management of these smaller, more uniform stands will include rigorous spacing control early in the rotation, but probably not commercial thinning as practiced today. Greater uniformity of product will provide corporations with a greater range of strategic management options. Several major challenges remain for forest engineering research.

The authors are Manager, Forestry Research Division, Crown Zellerbach Corporation, Wilsonville, OR and Head, Department of Forest Engineering, Oregon State University, Corvallis, OR. Paper presented at the third annual Forest Engineering Council Workshop. Forestry and Harvesting Training Center, Gulf Park Campus, Long Beach, Miss. August 18-22, 1980.

The Forest of the West in the Year 2000

The commercial forests of Western Canada and Western United States have long been characterized by:

- Old growth timber
- Remoteness from processing facilities and markets
- Topography, rock, and other obstacles which increase cost of roading, harvesting and forest culture
- Diversity in site quality and tree sizes.

The key factors which will change as we look toward the year 2000 and beyond are the relative role of old-growth timber in the economy and variation in tree sizes. The degree to which these two factors are influenced by forest management, in turn, will influence future harvesting technology.

Timber harvest in the high productivity forests of western Oregon and Washington, coastal British Columbia and Alaska and northwestern California is shifting rapidly from old-growth liquidation to harvest of unmanaged second growth and, in some places, managed second and third growth. By the year 2000 the forest at harvest will vary among ownership types, but each type will be more homogenous over large acreages than it is today. Average tree size at harvest in western Oregon and Washington by 2000 will be approximately:

- Industrial - 14 inches d.b.h.
- Federal - 24 inches d.b.h.

based on a range of Forest Survey and other data.

Timber on other public lands will be somewhate smaller than the Forest Service and Bureau of Land Management timber, and all public forest will be more variable than private forests.

Non-industrial owners will typically harvest the earliest ages, but rotation lengths will be quite variable among this owner class and management intensity usually will be low. Consequently, the average tree size harvested from non-industrial forest may be smaller than the industrial wood, but considerably more variable in size and other quality characteristics.

Implication of Smaller, More Uniform Forests

Movement toward a smaller, more uniform forest will be most rapid among owners who understand the strategic nature of forest resource use and allocation. This will motivate long-term investment planning, commitment to operational implementation of this long-term investment plan, and tighten control both in terms of short-term quality of practices and in long-term learning about forest responses. Many industrial owners in the West are exhibiting this strategic sense today and most are likely to move toward intensive management of the next few years. In the diversy mix of small non-industrial owners, however, there will be only a few cases of intensive management. The public sector, in contrast, will be limited by commitment to implementation of annual funding plans devised by legislators, control against high qaulity standards, and integration of timber goals within the constraints of multiple-use non-declining even flow and other public policies.

Interestingly, the rationale for intensive forest management is most vivid in context of low productivity stands. Figure 1 abstracts some age/yield relationships for lodgepole pine. The solid line is the "average" relationship, but the ranges, defined by the dotted lines, are of greater interest. As stocking levels move toward optimum, especially in early, rapid regeneration, and as protection problems are solved, the "average" moves toward the "best".

Poorer stocking, regeneration lags, and major pest and pathogen problems, in contrast, push the "average" toward the worst. The potential stand response to management, then, is estimated by the difference between current stand trajectory and how close that stand can come to its potential. Regeneration and precommercial spacing are thus critical managerial variables.

Even the upper curves is not fixed. Fertilization is one method for lifting the potential or "best" curve. Genetics is another. A more valuable result of tree improvement, however, may be increased uniformity--roundness and straightness--that enables more efficient processing and higher recoveries. These tools, coupled with rapid regeneration and precommercial spacing, provide the means for designing future forests. It is this ability that makes development of forest asset strategies both a possible endeavor and an attractive one.

Commercial Thinning: A Tradition in Transition

Commercial thinning is one management activity which is a bit elusive in looking to 2000 and beyond. Classically, silviculturists have favored commercial thinning because it captures biomass which otherwise would be lost to mortality. This view of efficiency, for obvious reasons, was not popular in a world where wood was cheap. Consequently, the real advantage of thinning--increased piece size--was missed for some time.

Technically, a thinning is commercial when the incremental revenues just cover the incremental costs -- that is, when it just pays to skid thinnings out of woods, load the logs and deliver them for a positive value. One of the proglems here is that all the incremental costs associated with thinning are difficult to estimate. Stem and root scaring may lead to pathogen entries, and long-term soil damage can result from wet season activities. Also, the markets for small materials are more volitile than for larger pieces. This is particularly true in the West where pulp capacity normally relies on solid-wood product residues for inputs rather than pulpwood.

If stocking control is not likely to be accomplished by commercial thinning, how will it be done? We believe the answer is better initial spacing at planting and early precommercial thinning. Only a final harvest cut will be made. Industry managers oftern are able to show that such precommercial spacing pays for itself, including compound interest, in reduced logging costs alone. Rapid increase in product value as piece size increases adds even more present net value.

It is likely, in our opinion, that commercial thinning will not be a major harvesting issue in the West by the year 2000. Once the benefits of rapid regeneration and precommercial spacing are understood, much of what currently passes for commercial thinning will be recognized as corrections for lack of early stand mangement.

One view of small uniform stands harvested at an early age with only on entry for precommercial spacing is reinforced by the opportunities for more efficiently harvesting and processing small logs. The history of western logging technology is illustrated in Figure 2. Over time, technological change has pushed the costs of logging smaller piece sizes lower and lower. Even this may represent more a response of technology to "what is" rather than looking ahead to "what will be". Unlike agriculture, where harvesting and processing systems and the crop and all designed together, forestry has tended to adapt harvesting and processing systems to whatever comes along.

With forest management increasingly focused on implementation of strategic designs, there will be much less uncertainty about the sizes of future trees and pieces. We can now proceed together to integrate crop, harvesting technology, and processing system into one unit.

Where does this leave us with respect to regional competition? High productivity Western forests can be viewed as having one of two possible competitive advantages:

- Traditional Leverage - Growing large, some what older trees than the South, with attendant piece-size advantages for our steep terrain (in harvesting and processing).

- Volume/Time Leverage - Growing small timber faster and taller than the South, and learning, adapting and developing more efficient small-pied size equipment and processes.

It is not clear that one strategy is best for all ownership types; indeed, two different corporations could select opposite strategies and be equally correct. The second strategy, however, does appear generally to be more copital efficient and more susceptible to the rationalization of activity that characterizes modern agriculture. For these reasons we predict it will be more common on industrial lands of the West.

The competitive advantage on lower productivity western forest is to grown small, uniform trees. Our large acreages lead to large volumes, if regeneration and stocking are managed.

The Challenge for Forest Engineering Research

Except for the public lands, we see the future forest being predominantly small, uniform timber. The challenge for forest engineers is to develop the technology to handle this material at lower real costs than today, with higher safety standards, and with higher environmental standards.

In the West, that is a big challenge indeed. About 70 percent of the terrain is over 30 percent slope or has sufficient short, steep pitches to make ground-based systems inoperative. West of the Cascades, soils are wet most of the year, and soil compaction is a real problem, especially on our best sites. Oregon, Washington, California, Idaho, and Alaska have forest practices acts--something the South does not have. Brush is a big problem in stand establishment. Tratidional tools for site preparation, such as aerially applied herbicides and fire, are all but eliminated. Transportation systems require detailed engineering analysis and design to match the harvesting systems chosen and to avoid soil problems. Average hauls are long - about 50 miles - and mostly in mountainous terrain. There is ample opportunity here for the application of engineering design in the solution of each of these problems. And to date, very little has been applied.

Lets examine a few of these. The biggest opportunity, in our opinion, is development of engineering systems for transportation and harvesting of these more uniform, smaller trees as an integral part of total forest management system. Up to now, engineers have worked on yarders, silviculturists have worried over stocking levels and spacing guides, and reforestation specialists have focused on planting technology. There has been no integration among these diceplines. But as we noted before, reforestation success and correct spacing will determine the nature of our future forest and, along with it, ultimate logging costs. We need to borrow a page or two from the development of agricultrual systems and begin to put these components of forest production together.

What about the harvesting system? They probably will still be cable systems, because of steep terrain and lower cost of operation than exotic helicopters or balloons. Any system chosen must have a low impact on the soil. Yarding reach must be fairly long because of high road costs--and because most of our road networks will be established. Since trees will be smaller and more uniform, methods will have to be devised to consolidate small trees into a full load for yarding. We will probably yard tree length or shole trees and do most of our processing at the landing or mill. Given what we said about no intermediate harvest, the harvest method will be clearcut, at least on intensively managed private lands. While all this may sound nice and neat, there is a lot to be done between here and there. Little problems, like the lack of stump anchors for skylines in small stands, or handling 600-800 stems per day on a steep, narrow landing have yet to be solved. We must solve them quickly. The new Oregon saftey code, for example prohibits decking logs on slopes over 20 percent. If rigidly enforced, this may create havoc for most skyline operations, especially in young stands where daily piece count is high, and decks grow quickly.

Then there are the people problems we in the West have only reccently begun to address. The issues here are productivity and safety. How do you maintain and improve productivity as piece size drops? Speed may be one answer, but can you maintain a safe work environment at the same time? How will the unions respond? Training is probably a key factor, but how do you train loggers efficiently? How much can companies afford to invest in training programs?

There is obviously much to be done. Just because we anticipate a smaller, more uniform crop does not mean our problems are going to get simpler. If we take the broader view, they are going to become more complex. But this is going to make the next 20 years an exciting, challenging time for our profession.

MECHANIZED REGENERATION TECHNIQUES

Third Annual Forest Engineering Council Workshop
Long Beach, Mississippi
August 18-22, 1980

R. B. Fridley
Silvicultural Engineering & Plant Propagation Department
Weyerhaeuser Company

MECHANICAL REGENERATION TECHNIQUES

AGENDA

Forest Engineering Workshop
August 18-22, 1980

THE STAND MANAGEMENT SYSTEM

- SYSTEM ELEMENTS
- DEFINITION OF TERMS

REGENERATION (STAND ESTABLISHMENT)

- OPERATIONS
- TECHNOLOGY UNDER DEVELOPMENT
- SYSTEM INTERACTIONS

CURRENT STATUS

- SOWING -- MECHANICAL ROW SEEDER
- ROOT CULTURE -- MECHANICAL UNDERCUTTER, WRENCHER, LATERAL PRUNER
- LIFTING -- MECHANICAL LIFTER WITH LABOR INTENSIVE HANDLING, CULLING AND PACKING

TECHNOLOGY UNDER DEVELOPMENT

- SOWING -- PRECISION SOWER AND SEEDBED PREPARATION
- ROOT CULTURE -- IMPROVED UNDERCUTTER AND BOX PRUNING
- LIFTING -- IMPROVED LIFTER AND MATERIALS HANDLING

STAND ESTABLISHMENT (REGENERATION)

- STOCK PRODUCTION
- SITE PREPARATION
- STOCK OUTPLANTING
- COMPETITION CONTROL -- FIRST YEAR
  - VEGETATION
  - ANIMAL

STAND CULTURE

- VEGETATIVE COMPETITION CONTROL
- STAND FERTILIZATION
- SILVICULTURAL THINNING -- THINNING MAINLY FOR STAND QUALITY

STAND HARVEST

- COMMERCIAL THINNING -- THINNING MAINLY FOR IMMEDIATE COMMERCIAL GAIN.
- FINAL HARVEST

MECHANICAL REGENERATION TECHNIQUES
SITE PREPARATION

Forest Engineering Workshop
August 18-22, 1980

CURRENT STATUS

- TREE CRUSH/ROLL 'N CHOP
- KG, PILE, BURN
- BED
- RIP

TECHNOLOGY UNDER DEVELOPMENT

- IMPROVED RECOVERY OF HARVEST RESIDUALS
- IMPROVED RIPPER

CURRENT STATUS

- HAND PLANTING BY SHOVEL, DIBBLE OR HOEDAG
- MACHINE PLANTING
  - CONTINUOUS FURROW
  - HAND FEED

TECHNOLOGY UNDER DEVELOPMENT

- ADVANCED PLANTING MACHINE
  - AUTO DIBBLE
  - MECHANICAL FEED
  - BAREROOT STOCK

MECHANICAL REGENERATION TECHNIQUES

COMPETITION CONTROL -- FIRST YEAR

Forest Engineering Workshop
August 18-22, 1980

CURRENT STATUS

- HERBICIDE CONTROL OF VEGETATION
    - BACK-PACK SPOT APPLICATIONS
    - TRACTOR STRIP APPLICATIONS
    - AIRCRAFT BROADCAST APPLICATION
- MECHANICAL CONTROL -- DISKING

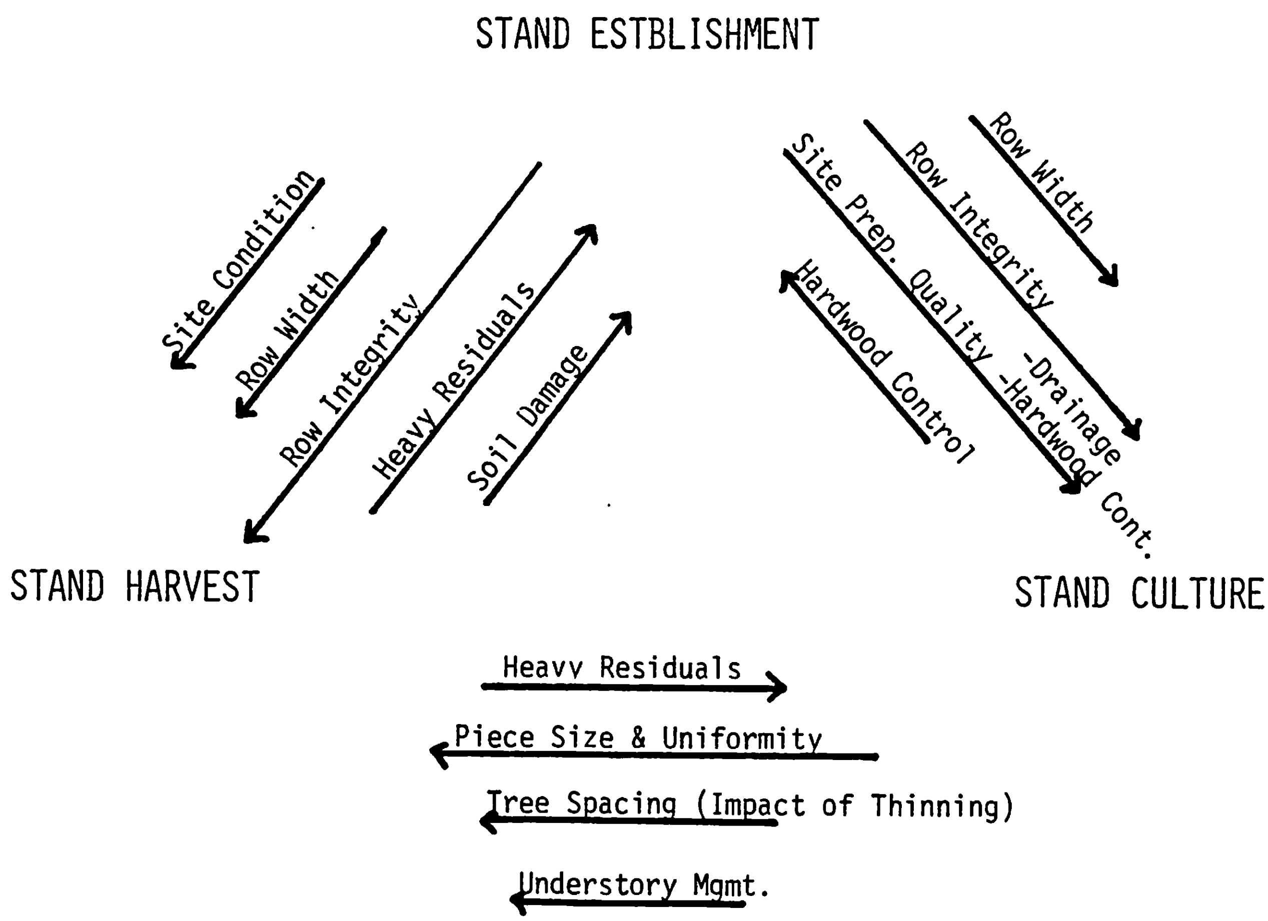
TECHNOLOGY UNDER DEVELOPMENT

- IMPROVED DISTRIBUTION OF HERBICIDES
- IMPROVED METHODS OF MECHANICAL CONTROL
- INTEGRATION WITH MACHINE PLANTING

MECHANICAL REGENERATION TECHNIQUES

SYSTEM INTERACTION FOR MECHANIZATION

Forest Engineering Workshop
August 18-22, 1980



THE EFFECTS OF HARVESTING PRACTICES ON REGENERATION IN THE SOUTH

Earl Priegel*
Forest Service, USDA
Atlanta, Ga.

I. Private Lands - 93%

1. Management Systems - Large ownerships

   a) Even-age Management - (Intermediate cuts & Regeneration cuts)

2. Management Systems - Small ownerships

   a) Even-age Management - Thinnings & Regeneration cuts (Seed Tree, Shelterwood, Clear Cut)

   b) Uneven-age Management - Selective Harvest often High Grading

II. Public Lands - 7%

1. Management Systems - Normal Use Areas

   a) Even-age Management - Thinnings & Regeneration cuts (Seed Tree, Shelterwood, Clear Cut)

   b) Uneven-age Management - Selective cut, various removal cuts

2. Management Systems - High Use or Visability Areas

   a) Even-age Management - Aesthetic Shelterwood Cut, Thinnings

III. Equipment Use - Impacts on Vegetation/ Environment

1. Mountains

   a) Rubber-tired Skidders
   b) Cable Systems
   c) Low psi vehicles
   d) Helicopters

2. Piedmont Plateau

   a) Rubber-tired Skidders
   b) Low psi vehicles

3. Coastal Plains

   a) Rubber-tired Skidders
   b) Low psi vehicles
   c) Helicopters
   d) Cable Systems

4. Wetland Impacts

   a) Rubber-tired Skidders
   b) Low psi vehicles
   c) Helicopters
   d) Cable Systems

* Earl Priegel heads up the Sale Layout/ Logging Systems Program for National Forest Systems in the Southern Region.

THE EFFECTS OF HARVESTING PRACTICES ON REGENERATION IN THE SOUTH

My original talk was based on equipment use and natural regeneration. However, I changed the title so I could expand the subject and hopefully make it more interesting and assist us in exchanging information. First off, let's talk about Private lands and Public lands and how regeneration is different, because of the imposed management systems. Averages are approximately 93% in Private lands and 7% in Federal lands.

The larger ownerships are usually managed and either leased or controlled by one or more forest industry firms. Their management activities are nearly always oriented around even-age management and undergo periodic intermediate thinnings and a final regeneration cut. A seed tree harvest may be used, but is not a major cutting method on most private land. These stands are nearly always machine planted. At the same time the smaller ownerships may get a variety of treatments, ranging from "pick and pluck" to a clear cut. Many company and consulting foresters who work with small owners, have found it much easier if they sell a selective harvest package, very often highgrading. So, depending on the size of the parcel of forest land, we may be looking at planting or natural regeneration.

The public lands are a minority ownership in the South and all totalled they contribute less than 1-1/2 billion board feet out of nearly 12 billion board feet. On National Forest lands, the primary thrust has been toward even-age management. Cuttings are in the form of intermediate thinnings, and regeneration cuts, in that order.
There are particularly high use or high visibility areas where selective cutting and aesthetic shelterwood cuts are employed.
Hardwood areas are regenerated naturally, usually by clear cutting unless the stands are selected for conversion.

Most of you are more interested in logging equipment than silviculture however, the management systems all of us use are interrelated with the harvesting technique.

The remainder of my presentation will cover logging systems and their impacts on vegetation and/or the environment. I'll cover the mountains, piedmont plateau and coastal plains, and the problems we encounter in bringing about hardwood and pine regeneration.

Slide Presentation of:

- Rubber-tired Skidders
- Low psi vehicles
- Cable Systems
- Helicopters

HARVESTING LARGE TIMBER WITH CABLE YARDING SYSTEMS

BY
JOHN W. MANN
FORESTRY AND HARVESTING TRAINING CENTER
LONG BEACH, MISSISSIPPI

AS YOU MAY HAVE NOTICED FROM THE ORIGINAL PROGRAM, THE SPEAKERS INTENDED TO DISCUSS THIS TOPIC WERE DON STUDIER AND VIRGIL BINKLEY, BOTH VERY QUALIFIED LOGGING ENGINEERS WITH THE U.S. FOREST SERVICE IN OREGON. DUE TO TRAVEL RESTRICTIONS RECENTLY IMPOSED ON THE FOREST SERVICE IN THAT REGION, DON AND VIRGIL WERE NOT ABLE TO ATTEND THIS MEETING, A FACT THAT WE JUST LEARNED LAST WEEK. SINCE I HAVE HAD SOME SMALL AMOUNT OF EXPERIENCE IN THIS AREA AND BECAUSE IT WAS TOO LATE TO RECRUIT A SUBSTITUTE SPEAKER, I DECIDED TO SEE IF I COULD COME UP WITH SOME INFORMATION ON THIS SUBJECT.

CABLE LOGGING OF LARGE, VIRGIN TIMBER IS VERY COMMON IN THE PACIFIC NORTHWEST AND, TO SOME EXTENT, THE INLAND EMPIRE OF IDAHO AND MONTANA. STEEP, RUGGED TERRAIN AND SOMETIMES LARGE AREAS OF OLD GROWTH TIMBER THAT HAVE NOT BEEN PREVIOUSLY HARVESTED MAKE LOGGING OF THIS RESOURCE A DIFFICULT AND COSTLY ENDEAVOR. AT THE PRESENT TIME, APPROXIMATELY 35% OF THE TIMBER SOLD ON NATIONAL FOREST LAND IN REGIONS 1, 5, AND 6 IS LOGGED WITH SOME TYPE OF SKYLINE SYSTEM AND ANOTHER 5 TO 15% IS HARVESTED WITH A HIGH-LEAD CABLE SYSTEM. IN WASHINGTON, OREGON, CALIFORNIA, IDAHO, AND MONTANA THIS AMOUNTS TO ABOUT 2½ BILLION BOARD FEET ANNUALLY, AND MOST OF THIS FALLS IN THE CATEGORY OF LARGE, HEAVY TIMBER. DOUGLAS FIR, COASTAL REDWOOD, PONDEROSA PINE, SUGAR PINE, HEMLOCK, LARCH AND SEVERAL SPECIES OF TRUE FIR ARE THE MAJOR SPECIES INVOLVED. INDIVIDUAL TREES OF 100

INCHES DBH AND OVER 200 FEET IN HEIGHT ARE STILL ENCOUNTERED, HOWEVER THEY ARE NOT AS PLENTIFUL AS THEY ONCE WERE. TREES OF 60-70 INCHES DBH ARE STILL VERY COMMON IN MANY AREAS. SINCE A BUTT LOG OF THIS SIZE TREE CAN EASILY WEIGH 30 THOUSAND POUNDS, THE EQUIPMENT USED MUST BE LARGE AND POWERFUL.

A VARIETY OF EQUIPMENT IS CURRENTLY BEING EMPLOYED TO MOVE THIS TIMBER. IT WAS RECENTLY ESTIMATED THAT THERE ARE OVER 145 YARDERS OPERATING IN IDAHO AND MONTANA, ABOUT 70 WORKING IN CALIFORNIA AND MORE THAN 200 IN OREGON AND WASHINGTON.

THESE CABLE LOGGING SYSTEMS ARE COMMONLY DESCRIBED BY SUCH CHARACTERISTICS AS YARDING DISTANCE CAPABILITY, RIGGING CONFIGURATIONS, TOWER HEIGHT, LINE SIZE, LINE SPEED, AND NUMBER OF OPERATING DRUMS. A COMPLETE DESCRIPTION OF ALL THE VARIATIONS OF THESE CHARACTERISTICS WOULD BE QUITE TIME CONSUMING, SO I WILL ATTEMPT TO USE ONLY YARDING DISTANCE CAPABILITY TO DIFFERENTIATE BETWEEN MANY EQUIPMENT TYPES. THE CATEGORIES OF YARDING DISTANCE THAT WE WILL DISCUSS WILL BE REFERRED TO AS SHORT SPAN AND LONG SPAN, SKYLINE, AND HIGH-LEAD.

HIGH-LEAD WAS ONCE THE MOST WIDELY USED CABLE LOGGING SYSTEM IN THE WESTERN UNITED STATES BUT IS NOW BEING REPLACED BY SOME FORM OF SKYLINE SYSTEM IN MANY AREAS. THE SYSTEM CONSISTS OF A TWO DRUM YARDER WITH AN AUXILLARY DRUM USED FOR RIGGING AND A WOODEN SPAR OR STEEL TOWER. THE TERM "HIGH-LEAD" REFERS TO THE LOCATION OF THE MAINLINE BLOCK WHICH IS ELEVATED ABOVE THE GROUND BY THE SPAR. THIS PROVIDES THE VERTICAL LIFT WHICH HELPS THE LOGS TO OVERRIDE OBSTACLES. LINE SIZES VARY CONSIDERABLY DEPENDING

ON TIMBER SIZE BUT FOR THE LARGEST TIMBER THE MAINLINE WOULD BE UP TO 1½ INCHES AND HAULBACK LINE 1 INCH IN DIAMETER.

IN SKYLINE LOGGING A CABLE IS SUSPENDED BETWEEN TWO OR MORE SUPPORT POINTS AND THIS ACTS AS A TRACK FOR SOME TYPE OF LOG CARRIER REFERRED TO AS THE SKYLINE CARRIAGE. DEPENDING ON TERRAIN AND CERTAIN OTHER FACTORS A SKYLINE SYSTEM CAN BE RIGGED WITH A YARDER HAVING 1, 2, 3, OR 4 OPERATING DRUMS. FOR LARGE TIMBER THE SKYLINE, WHICH SUPPORTS MOST OF THE LOAD, MAY NEED TO BE UP TO 2 INCHES IN DIAMETER WHICH WEIGHS 7.39 POUNDS PER FOOT, SO YOU CAN IMAGINE RIGGING PROBLEMS ASSOCIATED WITH LAYOUT OF A LINE THIS SIZE. ON LONG SPAN OPERATIONS, TWO SKYLINE SUPPORT POINTS MAY BE 5000 FEET APART.

SMALLER YARDERS THAT WOULD FIT INTO THE CATEGORY OF A SHORT SPAN SYSTEM REACHING 1500 FEET OR LESS OFTEN USE THE RUNNING SKYLINE RIGGING CONFIGURATION AND BECAUSE OF THE WAY THE SKYLINE IS DOUBLED OVER ON ITSELF THE SAME LOAD CARRYING CAPACITY CAN BE ACHIEVED WITH A SMALLER DIAMETER LINE. AGAIN, A WIDE VARIETY OF THESE TYPES OF YARDERS, OFTEN REFERRED TO AS A YARDING CRANE, ARE IN OPERATION.

SINCE THE PRIMARY THEME OF THIS MEETING IS DIRECTED TOWARD THE PROBLEMS FACING FOREST ENGINEERS DURING THE NEXT TWO DECADES, I WOULD LIKE TO TRY TO ADDRESS WHAT I PERCEIVE AS THE MAJOR PROBLEMS ASSOCIATED WITH CABLE LOGGING OF LARGE TIMBER.

LOGGING COSTS

FIRST IS THE PROBLEM OF INCREASING LOGGING COSTS IN VIRTUALLY EVERY CATEGORY. LOGGING ON STEEP, RUGGED TERRAIN HAS ALWAYS BEEN

EXPENSIVE BUT COSTS NOW SEEM TO BE INCREASING EXPONENTIALLY. A LARGE MACHINE WITH STEEL TOWER THAT WOULD BE USED FOR A LONG SPAN PROJECT COSTS IN THE NEIGHBORHOOD OF $600,000 IN 1976. TODAY THE SAME PIECE OF EQUIPMENT WOULD BE CLOSE TO 1½ MILLION DOLLARS. ADDITIONALLY, MUCH OF THE REMAINING OLD GROWTH TIMBER IS IN AREAS THAT HAVE ALWAYS BEEN AVOIDED UP TO NOW BECAUSE OF THEIR INACCESSIBILITY. ROAD BUILDING COSTS TO GET TO SOME OF THESE AREAS ARE OFTEN WELL IN EXCESS OF $100,000 PER MILE. WHEN ALL OF THESE CONSIDERATIONS ARE COMBINED WITH THE FACT THAT CULL PERCENTAGES MAY RUN AS HIGH AS 40% OR GREATER, THE PROJECTED LOGGING COSTS ON A PER UNIT BASIS FOR NET VOLUME ARE STAGGERING. LOGGING COSTS ARE ALWAYS A CONCERN WITH ANY TYPE OF HARVESTING SYSTEM, BUT FOR THE COMBINATIONS NEEDED TO TRANSPORT THE REMAINING OLD GROWTH TIMBER, COST INCREASES ARE PARTICULARLY DISTURBING.

ENVIRONMENTAL CONCERNS

REMOVING THIS LARGE TIMBER FROM AREAS HERE-TO-FORE AVOIDED BECAUSE OF THE PHYSICAL DIFFICULTIES INVOLVED IN CONJUNCTION WITH THE MYRIAD OF ENVIRONMENTAL CONCERNS FOR THE FOREST SITE PRESENTS A DIFFICULT SITUATION FOR THE LOGGING ENGINEER AND THE FOREST MANAGER. LOGGING IN STREAMSIDE PROTECTION ZONES WHERE WATER QUALITY AND FISHERY RESOURCES ARE IMPORTANT, FROM SCENIC AREAS WHERE VISUAL RESOURCES ARE OF PARTICULAR VALUE AND FROM UNSTABLE GROUND WHERE GEOLOGIC AND SOIL EROSION PROBLEMS EXIST ARE ALL VERY REAL PROBLEMS THAT CONFRONT THE LOGGING ENGINEER EVERY DAY. THE COMMENT IN REPLY TO THESE CONCERNS THAT "YOU GOT TO SQUASH A

FEW TOMATOES TO MAKE KETCHUP" HAS LITTLE BENEFICIAL EFFECT ON THOSE CONCERNED WITH THESE OTHER FOREST RESOURCES, AND RIGHTLY SO IN MANY INSTANCES.

COORDINATION OF LOGGING WITH SILVICULTURE

ANOTHER PROBLEM THAT HAS BEEN OF PARTICULAR CONCERN TO ME FOR SOME TIME IS THE COORDINATION OF THE LOGGING OPERATION WITH THE SILVICULTURAL OBJECTIVE OF THE HARVEST. BECAUSE OF SOME OF THE ENVIRONMENTAL AND OTHER RESOURCE CONCERNS JUST MENTIONED, AND BECAUSE OF REGENERATION PROBLEMS, SILVICULTURISTS ARE NOW OFTEN ALTERING THEIR CUTTING PRESCRIPTIONS TO SOME TYPE OF PARTIAL HARVEST IN MANY OLD GROWTH STANDS. REMOVING JUST SOME OF THE LARGE OLD TREES IN A SHELTERWOOD TYPE CUT WITH CABLE SYSTEMS HAS OFTEN RESULTED IN UNACCEPTABLE LEVELS OF LOGGING DAMAGE TO THE RESIDUAL STAND. THIS IS UNDESIRABLE FOR A NUMBER OF REASONS:

1. SITE NOW UNDERSTOCKED SO INVESTMENT IS POOR.
2. PLANS MUST BE REVISED TO ACCOMPLISH REGENERATION TO BRING SITE BACK INTO FULL PRODUCTION.
3. MORE COSTLY BOTH DURING LOGGING AND TRYING TO CORRECT DAMAGE AFTERWARD.
4. LOSS OF CREDIBILITY WITH OTHER MEMBERS OF THE FOREST MANAGEMENT TEAM AND THE PUBLIC ON THE PART OF THE LOGGING ENGINEER.

SOME WAY TO PREDICT AND QUANTIFY ANTICIPATED LOGGING DAMAGE BEFORE THE HARVESTING OPERATION WOULD ALLOW THE SILVICULTURIST TO ADJUST HIS PRESCRIPTION ACCORDINGLY. THIS IS AN AREA THAT

NEEDS A COORDINATED RESEARCH EFFORT BETWEEN FOREST ENGINEERS AND FOREST MANAGERS.

OF COURSE THERE IS NO ONE ANSWER AS TO WHAT IS THE SOLUTION TO ALL OF THESE PROBLEMS. ONE AREA IN WHICH WE HAVE MADE CONSIDERABLE IMPROVEMENT BUT THAT WILL CONTINUE TO BE INCREASINGLY IMPORTANT IS THAT OF TRAINING AT ALL LEVELS. EXECUTIVES MAKING FINANCIAL AND OTHER MANAGEMENT DECISIONS NEED TO BECOME MORE PROFICIENT; UNIVERSITY PROFESSORS MUST CONTINUE TO UPDATE THEMSELVES IN NEW TECHNOLOGY AND ANALYTIC METHODS; LOGGING ENGINEERS MUST BECOME MORE KNOWLEDGEABLE ABOUT ALL FACETS OF THE HARVESTING OPERATION; SILVICULTURISTS AND OTHER RESOURCE MANAGERS SHOULD OBTAIN SOME BASIC INFORMATION ON WHAT TO EXPECT FROM DIFFERENT TYPES OF LOGGING SYSTEMS; AND THE LOGGING CREW RIGHT DOWN TO THE CHOKER SETTERS NEED TO BE TRAINED IN HOW TO EMPLOY THE NECESSARY TECHNIQUES TO ACCOMPLISH THE DESIRED RESULT.

THERE IS STILL A VAST AMOUNT OF OLD GROWTH TIMBER LEFT IN THE UNITED STATES AND CANADA AND ALSO IN MANY OTHER PARTS OF THE WORLD. BIG TIMBER LOGGING WITH CABLE SYSTEMS IS TREMENDOUSLY EXCITING AND INTERESTING BUT IS BECOMING MORE COMPLEX EVERY DAY. THE CHALLENGES ARE THERE AND IT IS LARGELY UP TO THE MEN AND WOMEN OF THE FOREST ENGINEERING PROFESSION TO HELP MEET THIS CHALLENGE.

NORDFOR - A COMPANY SERVING THE FOREST PRODUCTS INDUSTRY

Many of you maybe unfamiliar with the NORDFOR name, so I have decided to devote some time to a presentation of NORDFOR and the products we have:

To be a forest worker is one of the most demanding and dangerous occupations there is. The working environment of our forest workers does not differ much from the working environment they had 100 years ago. Normally, it is too cold in the wintertime and too warm in the summertime, and there is no shelter against rain or snow. To improve the working situation for our forest workers, we ought to supply them with proper aids in form of tools, machines, and properly designed protective apparel.

This is where NORDFOR enters into the picture. NORDFOR was started by epople who were actively involved in the forest work. As forest workers they obtained practical experience, which went into the development of most of the products in the NORDFOR Products Program. Many product ideas have come from forest workers who have participatedin training courses held by NORDFOR. NORDFOR is a small company by most standards, but it is worldwide in scope. NORDFOR has helped the forest product industry in several continents, including the countries of Sweden, Germany, Spain, Portugal, S. Africa, Brazil, Australia, Canada and North Vietnam. The United STates is a new frontier for NORDFOR and promises its best prospect.

The overal objective of NORDFOR is to supply our markets with: Professional products designed with consideration for the forest and the people who work there. In everything we do, whether it be machines, training of people or design of protective apparel, the leading theme is consideration for the people and the working environment. This is not merely a sentence, for us it is a reality.

For almost two years, NORDFOR has been working with the development of winch thinning systems for the southeastern United States. New methods have been successfully introduced and are available for introduction through our training department, headed by Mr. Soren Eriksson. Some of the companies we have been working with are: Champion Timberlands, International Paper Company, Union Camp, Westvaco, and Weyerhaeuser.

In addition to our winch and training programs, our product program also comprises a full line of protective apparel and tools. We are presently starting up a nationwide distribution of our product line. This is being done out of our headquarters in Charlotte, N.C. In this context it should also be mentioned that whereever possible, we are going to have local manufacturing of our products.

Within NORDFOR we are a very enthusiastic group of people, eager to get in the field to meet you, the customer. We would be very pleased to get your reaction to the brief discussion of our product program which we are going to give you today.

Let's start with NORDFOR Training.
Within NORDFOR training we developed systems and train personnel. Within our training group we arrange courses that deal with specific tasks, such as felling technique, delimbing technique, and bucking technique. Our courses can also cover training of machine operators,

people operating clearing saws, and people operating winches. Training courses are also arranged for instructors, so that a customer can train his own personnel.

Our experience and expertise in training is given direct application in the thinning systems and the protective apparel which we are going to introduce to you. The right methods and the right tools insure economical work, both in the short and the long term.

When NORDFOR gets a training job in a certain market, we will start using the instructors who are based in the specific market area. Should our resources not be sufficient, we will recruit instructors from other NORDFOR operations in the world. All our training programs incorporate separate progrms utilized for the selection of people who have the natural talent to become a good forest worker.

The main objectives in our training programs are the following:
Firstly: to increase the safety in the working operation.
Secondly: To increase the production on a crew basis.
Thirdly: To increase the job satisfaction within the individual.worker.
Fourthyly: To create a spirit of team work within the crew.

It has been our experience that, as long as we can create pride within the worker about what he is doing, but also a spirit of teamwork within the crew, the productivity and the safety will be automatically increased.

In concluding the portion about training, I'd like to give you some ideas of what we at NORDFOR consider important in training:

1. Job and system analysis must precede training.

   This may suggest development and testing of new technique, systems and equipment. A simple rearrangement of an operation can give more than 50% productivity increase.

2. Training is to be carried out at the operational area where trainees will be working afterwards.

   That is in the woods. Also, there we can systemize training by using special training devices, like delimbing simulators.

3. The number of trainees ~~for~~ per an instructor must be limited to a handful.

   This gives better safety, better results, and better economy in the long run.

4. Training must cover all personnel that is affected, and all levels must received practical contact with the job.

5. Cooperation with all trainees is necessary in order to take advantage of their experience of equipment and working conditions.

6. One-time is not enough.

   Techniques are learned by repetition and after a course, each trainee must be guided into his working area. That's why follow-ups have to be scheduled.

7. For small companies and very new techniques, we recommend training of workers directly. For large project, company instructors should be trained to train the workers.

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Turning our focus over to the NORDFOR winch program, which at present time consits of4 different winches, all having the following features in common:

Firstly: They are all being radio operated, which facilitates operation and increased production.

Secondly: They all utilize the exclusive Capstan feature, which gives you constant tractive force and constent speed; irregardless how much cable you have on the drum.

The first winch on the program is a conventional winch used in combination with a fram tractor or a conventional small skidder. The tractive force on this winch is 6600 lbs and the winching speed is 2.8 or 8.2 feet per second. The cable length is 240 feet. This winch is normally marketed to the farmer working in the woods.

The second winch is a boom mounted winch. By boom mounted, I mean a winch that is assembled on top of a knuckle boom loader. This winch has a tractive force of 3300 lbs. The winching speed is 4 feet per second. The cable length is 400 feet. This winch is presently being used in combination with a forwarder.

The third winch, which presently is being used in the United STates is the Flying Saucer winch. This winch does not require a carrier since it can pull itself from one place to another. The winch is powered by a

16 HP gasoline engine. The tractive force is 3300 lbs. The winching speed is 4feet per second. The length of the cable is 400 feet. In its present application in the United States, the Flying Saucer winch is being used in steep terrain.

The fourth winch, and the most popular so far, is the NORDFOR Tilt Winch. This winch ahs found several applications in thinning operations in the United States. It has a tractive force of 4400 pounds. The winching speed is 5 feet per second. The length of the cable is 400 yards. This winch can be equipped with re-haul or a haulback feature. Lateron in this presentation I am going to show you a movie of the tile winch system. Before doing so, I would like to briefly discuss some of the basic parameters about the forest and the people who work there, that went into the desing of our tilt winch system. What I am going to say is based on research work that was carried through in Scandinavia. As far as I have been able to determine, very little has been published in the United States concerning this subject.

1. In geometrical thinning pattterns, such as row thinning or corridor thinning, possibly up to 50% of the best trees could be removed depending on width and spacing of rows respective corridors.

2. Clearing of skidding rows can reduce the annual increment in basal area with as much as 17% depending on width and speacing of skidding rows.

3. The risk for wind-throws is considerably increased by the opening up of skidding rows. An average of 4% of the residual trees will be felled by the wind.

4. By driving into the stand with a heavy skidder or forwarder, the annual increment can be reduced with up to 30%.

~~Before I show the movie~~, I would also like to briefly discuss selective thinning.

By selective thinning we mean the removal of trees that are deseased, crooked and and/or surpressed. Thus, you leave the best trees to grow to maturity. We solve the problem with a too heavy stocking resulting in too high competition.which in turns leads to growth stagnation and/or stunting. We see the following advantages with thinning:

Firstly: The growth potential on residual trees is increased.

Secondly: We capture fiber from trees that which would die before a full rotation.

Thirdly: We get an early return on part of the investment that has been made in the forest stand.

Fourthly: We get an increased value of a larger product.

The movie you are going to see is made in Sweden. It shows a clear cut application in steep terrain. However, it will illustrate the winch as such. ~~And~~ let's start with the movie.

The NORDFOR Thinning System has found applications both in plantations and natural stands in the United States. Since the plantation application has been described in the APA Technical Release No. 79-R-68, I have elected to describe here today a system for natural stands. This system can deliver to roadside either tree-length or full tree material.

Basically the system consists of a 5 - 6 men crew, 3 - 4 chainsaw operators, and 2 winch operators. Each chainsaw operator is assigned one acre to cut This acre is 110 yards deep and 44 yards wide. Each acre is divided by the chainsaw operator into 4 skidding racks. The chainsaw operator starts his work at the back of each rack. He clears a 2 to 3 feet wide skidding strip and then he selectively fells trees.into the skidding strip.. When the felling is done, you have bunches of 2 - 5 trees lying in a fish-bone pattern in these skidding strips. The chainsaw operator has been trained to select trees in plots that are 1/20 of an acre. The plot has a rectangular shape with the dimensions 11 x 22 yards. In this plot he selects 1/20 of the number of trees that should be left on the entire acre. In order words, if 220 trees should be left standing after the hinning operation is done, he will leave in each plot 11 remaining trees. After the cutting operation is finished, the winching operation starts.

The winch is a small ground skid machine with a re-haul or haulback line. The functions of the winch are controlled by tone modulated radio signals. There are two operators with the winch. One at the tractor, has a transmitter with 8 functions, while the second in the woods has a transmitter with six functions. Switches on both units are of the toggle type, and for additional machine protection the tractor operator has an override stop. Control of the function is passed from one transmitter to the other by activating a special signal. As long as one transmitter has the control function, the other cannot operate any fuction, with the exception of the tractor operator's override stop.

The winch is equipped with electric over hydraulic valves. The mainline is a 5/16 inch cable and the haulback line is 1/8 inch cable. The mainline drum holds approximately 400 yards of line while the haulback drum has half a mile of cable. The mainline drum is powered. Its functions are to store line, retrieve the line as it returns over the capstan and supply sufficient pressure to the line wrapped on the capstan in order to prevent slippage. The mainpulling force of 4400 pounds is supplied by the capstan winch. The haulback line returns the empty sled or skidding cone and chokers to the crew member.in the woods.

(Overhead)

When setting up the winching operation, the haulback line is taken back from the tractor and attached to the tree with a nylon strap and a snatch-block. The line then is taken to the back of the rack. Another corner point is established and the line carried on a right angle to the rack to be skidded. There a third corner is set up, also through the use of a nylon strap and a snatchblock. The haulback line then will be taken straight back to the tractor, where it is attached to the mailine which carries the sled and chokers. Winching then starts at the point nearest the tractor and progresses to the rear of the rack. When the last turn is skidded, the field operator disconnects the haulback line from the mainline and sends the last load to the tractor positioned at roadside. While the final load from the rack is going in, the choker operator moves the haulback line across to the next rack, where the third snatchblock is again set up. He then starts walking up the rack and meets the tractor operator who has moved the tractor into position as soon as he cleared it of the last load.

Each turn of trees skidded will average 1/4 to 1/2 of a cord. Initial set up of the winch takes about 5 - 10 minutes, while each relocation requires 2 - 5 minutes. There is sufficient line on the haulback drum to work for about 5 days without retrieving it and starting again. When planning and designing the system every effort was made to provide the worker with an interesting occupation. One in which he can see evidence of a job well done and one in which he can feel mentally stimulated. The selection of trees and planning of the manner in which the trees will be placed provide interest and variation to the work. And teamwork is essential. The cutter must place the felled trees on the ground correctly in order for the winch operator to meet his overall production goals.

Every member of the thinning crew goes through an intensive training course. In this course participants learn:

1. Operation and maintenance of a chainsaw.
2. Use and maintenance of lifting hooks.

./.

3. Felling techniques.
4. Operation and maintenance of the winch and its components.
5. Operation and maintenance of transmitter controlling winch.
6. Lay=out of harvesting system.
7. Requirements of planning and how to do it.
8. Safety hazards and prevention.

A crew consists normally of3 - 4 felling specialists and 2 winching specialists. Every two crews are headed up by a foreman who's basic goals are:

1. High productivity
2. High utilization.
3. Products according to standards.
4. Low lost time rates.
5. Low machinery rates.
6. Good and safe working conditions.

All operating procedures and all equipment are designed for safety. Each thinning crew member is taught the safety features and how tosafely use the chainsaw and the winch.

In addition to teh benefits arrived from selective thinning, the following advantages exist with the NORDFOR thinning:

1. No soil compaction as it is being received by the use of heavy equipment. Heavy equipment is limited to truck and infield roads and does not enter the forest stand. A sled or a cone is employed when the trees are skidded

further insuring minimal soil disturbance.

2. Little damage to residual trees. Without heavy equipment operating in the stand, and with skilled specialists working in the stadn, residual trees experience no or very little damage.
3. A cool operation. The felling specialists operate 3 - 5 days ahead of the winch, which maintains a continuity and a safe working environment.
4. Energy efficiency. In a time when the energy useage is carfully examined, the selective thinning system is concentrating on utilizating the skills and talents of people rather than machines.
5. Employment opportunities. In direct contrast to the trend of replacing people with machinery, this system operates with people replacing machinery. The highly trained and skilled crew is the key.

In concluding ~~this portion of my presentation~~, I would like to mention for those who don't know it yet, that Westvaco was awarded the 1980 award in Forest Management from the American Paper Institute for its implementation of the NORDFOR selective thinning system.

THIRD ANNUAL FOREST ENGINEERING COUNCIL WORKSHOP

FORESTRY AND HARVESTING TRAINING CENTER

GULF PARK CAMPUS

LONG BEACH, MISSISSIPPI

AUGUST 18 - 22, 1980

LARGE MACHINE FORWARDING SYSTEMS

Presented by Thomas A. Wildman

Manager, Logging and Transportation

Great Northern Paper

LARGE MACHINE FORWARDING SYSTEM

Forwarding in the Forest industry can be explained as carrying the wood material completely free of the ground from the stump to roadside or loading area. Large machine forwarding systems usually are those which transport log lengths, tree lengths or whole trees. Load capacities would run anywhere from four to twelve cords. This presentation will deal primarily with the Koehring feller-forwarder.

Areas which will be discussed are: a) the history behind Great Northern's involvement with Koehring and the eventual purchase of the Koehring feller-forwarder; b) machine specifications, c) operating techniques, d) production data, and e) advantages and disadvantages of the Koehring feller-forwarder.

Great Northern's mechanical harvesting operations in late 1975 consisted of the feller-buncher, grapple skidder, Logma delimber combination to fell, skid and delimb trees, leaving them in piles at roadside in preparation for the loading-transport or trucking stage. Great Northern was concerned about the numbers of feller-bunchers and grapple skidders needed to harvest the required volume to say nothing about the requirements for qualified operators as each machine was operated a double shift thus requiring two qualified operators per machine. It was learned in late 1975 that Koehring-Waterous, a division of Koehring based in Brantford, Ontario, had built a large machine which felled and forwarded whole trees (excluding stumps), Great Northern agreed to a machine trial on its limits at the Telos Lake operation. The trial began in January of 1976 and Great Northern agreed to purchase the machine in late March of 1976.

The Koehring (KFF) feller-forwarder is a large (45 tons empty) rubber tired vehicle (43.5" X 39") with a hydraulic knuckle boom felling attachment (24" shear head) and a ten to twelve cord capacity bunk. The machine is 45'6" long and 16'6" wide at the tires. Ground clearance is 2'10". The standard engine is a GM diesel 8V-92 rated at 345 horsepower. The loaded machine would weigh near 160,000 pounds.

The basic machine has a maximum cutting reach of 20' and a minimum of 14'. Possible cutting swath is 220° or about 30'. The machine most normally utilizes about 130° for cutting. The 24" felling head features an accumulator with the bottom accumulator arms opening and closing with the shear. The machines operating or felling arc would be 30° left of center-line and 90° to the right. The machine would fell and forward away from the road or landing only on the opening pass. Subsequent passes would have machine felling and forwarding toward the landing. Once fully loaded, the machine proceeds to roadside or landing, dumping the entire load at once by raising the bunk front first with a large hydraulic cylinder and moving the machine forward thus losing load. The load stays completely intact. The machine then returns to the woods to make another turn.

Travel speed ranges from ½ to 3½ miles per hour depending on empty or loaded and what the ground conditions might be like. Normal forwarding distances have been set at 1320' maximum. When conditions warrant, shorter or longer distances might be required.

Production will vary according to terrain conditions and tree size. Operator experience is also another important aspect of production. Great Northern operates five Koehring feller-forwarders scheduled 80 hours per week, 50 weeks per year. These machines operate in weather conditions ranging from the high 90° Fahrenheit to five feet of snow and -40° Fahrenheit. Ground conditions are rough but will support the Koehring's weight in most cases. Stand conditions are poor with overstocked small diameter spruce and fir. Merchantable volumes will run about 30 cords per acre at 13 - 15 trees per cord. Many unmerchantable stems hinder tree felling and forwarding operation. The five Koehring feller-forwarders operated by Great Northern produced 61,705 cords from January 1, 1980 to July 27, 1980. This amounted to 801,943 trees in 7,075.5 operating hours or 113.3 trees/8.7 cords per operating hour roadside. This is quite significant when you consider the fact that this machine is both felling and forwarding. The Logma delimber completes the job by delimbing, topping and piling at roadside.

The advantages and disadvantages of a large machine forwarding system such as the Koehring feller-forwarder can be summarized as follows:

ADVANTAGES

1) A one machine concept - one machine and one man doing the job of two machines and two men,

2) The large load carrying capacity means less turns and less ground compaction,

3) Forwarding can mean wider road spacing or less cost,

4) The feller-forwarder concept carries the tree free of the ground thus ensuring clean wood and certainly lends itself to whole tree chipping,

5) The machine moves slow and thus ensures operator comfort.

DISADVANTAGES

1) The machine is large and difficult to move on the highway. It would require two lowbeds and a special permit. It would work best in areas where it could be operated for long periods of time before being moved,

2) Although the floatation is good, when stuck it would require some special rigging such as blocks and tackle and support machine to unstick,

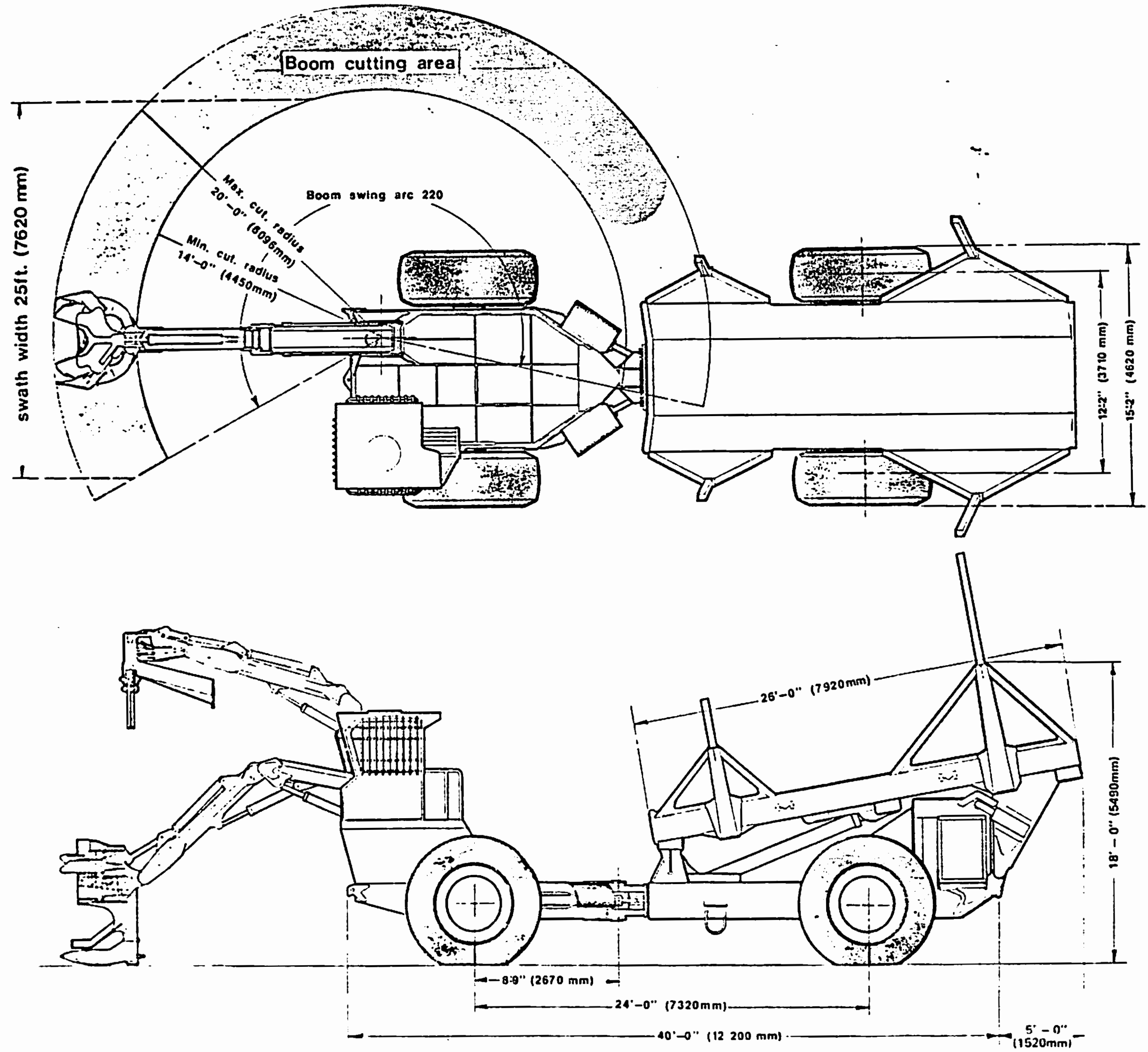
3) The machine's size prohibits partial harvesting except in strips.

This presentation has covered the basic machine specifications, operating technique, production data and advantages and disadvantages of the Koehring feller-forwarder (KFF). This machine will certainly fit some needs and not be suitable for others. It is important that all aspects of an operation be closely examined before making a decision. Machine selection can be very complicated at times and hasty decisions often turn out to be poor ones.

MECHANICAL HARVESTING PROFILE REPORT
YTD 7/27/80

Description	Total for 5 KFF's
Scheduled Hours	11,536.0
Mechanical Downtime - breakdowns	2,041.8
Actual Available Hours	9,494.2
% of Scheduled Hours	82.3%
% Standard	85.0%
Operational Downtime	2,418.7
Actual Operating Hours	7,075.5
% of Available Hours	74.5%
% Standard	75.0%
No. of Trees - Actual	801,943
No. of Trees - Standard (100 trees/op.hr.)	707,550
Productive Performance %	113.3%
Overall Efficiency %	109.0%
Cords Produced - Actual	61,705
Trees Per Cord	13
Cords Per Operating Hour	8.7

KOEHRING FELLER FORWARDER



PREHAULERS

Written For: Third Annual Forest Engineering Workshop
August 18 - 22, 1980 BY: Don M. Tufts

Our definition of prehauling in logging is the transportation of logs or trees before the main haul to a woodyard. In prehauling the logs or trees are carried without any part of the tree or log dragging on the ground. This contrasts with skidding where part or all of the log or tree is dragged on the ground. In prehauling the wood may be loaded on a wagon or sled and pulled by an aninal or by a rubber tired prime mover or a track type tractor or the wood may be carried on the back of the prime mover. In this paper we consider the word forwarding as being the same as prehauling. We do not include any cable systems in prehauling nor do we include bunching of trees or logs as prehaulers. Feller-bunchers would not be included as prehaulers nor are tree harvesing machines which cut and stack wood.

The main advantage of prehauling with small prehaulers in pulpwood logging is that we have less residual damage to heavy stands of timber that are lightly thinned than in long length logging or logging by truck stump to stump. The trees that are spotted for cutting are normally cut with a chain saw and bucked in short lengths at the stump. These short lengths are stacked by hand into small piles to facilitate the loading phase of prehauling. After pre-piling the prehauler picks up the wood and puts it on its back or onto a wagon, and brings the wood to a landing where the wood is unloaded from the prehauler and loaded onto a setout trailer or onto the main haul truck. Where we are using the Gafner Iron Mule, the prehauler is producing 25 cords per day where the timber being cut averages eight (8) inches dbh. Tree size has a small effect on prehauling production as shown in Table I from Tufts' paper[2].

Another factor affecting prehauler production is soil condition[1]. When rubber tired prehaulers bog down, a track machine may often be used to travel over the ground. A crawler tractor has been used to pull pallets which sit on a skid pan. Where the pallet is hand loaded without previous pre-piling, the production on an 800 foot prehauling distance is 24 cords per day in timber that averages 8" dbh[2]. Instead of hand loading, the crawler tractor may be equipped with a big stick type loader, and the wood can still be picked up without pre-piling. The pallet loads of wood are dropped at the landing where the haul truck may winch the pallets onto a trailer or the truck bed.

Pallets can be moved from the woods to the truck loading area by a specially modified forklift truck. I do not know where this system is still used today. It was popular twenty (20) years ago.

Bombadier also builds a pulpwood forwarder that has a tractor and trailer equipped with tracks with a swivel connection in the middle with power for both the tracks on the tractor and the trailer. This machine also has a knuckleboom loader. This prehauler is used to pick up pre-piled wood and is used to load trailers or trucks.

One of our company crews has two prehaulers, and they required six (6) cutters and six (6) stackers to provide sufficient wood for the two (2) machines. We have tried using two (2) feller-bunchers to lay the trees in piles for the sawhands, and this also makes the stacking easier. This same operation is now using three (3) cutters and three (3) stackers, and two (2) shear operators have been added to the job.

The cutters do not like to cut small size trees, but with the feller-buncher, the small trees are put in the piles with the bigger trees, and the cutters do not object to limbing and bucking the small trees. The feller-buncher should cut the small trees last so that they are on the bottom of the pile. This prevents the tops of the small trees from getting in the way of the limbing and bucking of the big trees. We are experimenting with different methods of lining up the piles. When the feller-buncher lines up the trees, the stacks of wood are handy for loading on the prehauler. This speeds up the prehauling operation and increases the daily production. Our company crews work a ten (10) hour day, and we expect each equipment operator to be working 70% of the time on timber production. The other 30% of the time is delay time due to servicing the equipment or repairing the equipment or personal delays.

We made a short time study check to see how the actual production compared to our standards. In our time study, the total delay time was only 16% of the study time. Since most of this was personal time or repair time, we adjusted the delay time per trip to 4% of the total trip time. With this adjustment, 21% of the time was travel in and out; 40% of the time was taken up in loading the prehauler, 11% of the time was taken up in moving the prehauler from one pile to the next and 24% of the time was used to unload from the prehauler to the setout trailer. Table II shows the daily production based on distance traveled after the prehauler was loaded. Some of the delay time was due to limbs not being cut and bolts not being cut. Vines and underbrush also slowed the operation. However, the production for an 800 feet prehauling distance was 33 cords per day as compared with the 25 cord standard. It appears that using the feller-bunchers has increased the production for the prehauling operation, and we are not having as much trouble keeping sawhands and stackers.

Several manufacturers build prehaulers or forwarders. Most any kind of prehauler can be purchased to fit the customer needs. The customer may have a track type prehauler or one that operates on rubber tires. Prehaulers come in different sizes with the bigger machines more economical on longer distances and on better road or ground conditions. The smaller light weight prehauler can economically carry a small load on wetter ground than the big machines. There are several options in tire size, engine size and axles. Manual transmissions or power shift transmissions are also available.

Prehaulers have been equipped with lights so that the machines can be used around the clock. Prehaulers have been equipped with tail gates which prevent the wood from sliding out the back on steep slopes.

Prehaulers are not restricted to hauling pulpwood. The longer frame prehaulers are used to haul short length sawlogs in twelve to twenty foot lengths.

Some of the improvements for the prehauling system include a mechanical means of harvesting the trees. Several machines have been built which can sever the tree at the stump, delimb the tree, buck it into short lengths and stack the wood. A good mechanical tree harvester will buck and delimb the trees so that the limbs will not interfere with the stacking and make the prehauler loading easier. They can also make bigger piles of wood and place the piles where they are more convenient for the prehauler to pick them up.

Looking at prehauling within a complete logging system, the cutting and stacking of the trees is much more costly than the prehauling. A Swedish contractor has been delivering wood to us from a logging operation that is using Finnish equipment. The logging contractor is testing a prototype Makeri tree harvester and is making suggestions on design changes for the production model. This machine has tracks which should enable it to work on wet ground and will fell, limb, buck and stack small trees. The prehauler working with this machine is a Bruunett prehauler that has a bogie axle in front and a bogie axle in the rear. All eight (8) wheels are drive wheels. When the ground gets wet, steel tracks may be stretched around the bogie wheels. The machine has center steer and a knuckleboom loader. This prehauler should work well with the Makeri tree harvester in year around operations.

(1) FACTORS INFLUENCING PULPWOOD PRODUCTION WITH PREHAULERS
BY: Paul Richmond Moore - A Research Report produced under McIntire-Stennis Project #1444, Louisiana State University School of Forestry and Wildlife Management and Louisiana Agricultural Experiment Station, 1976

(2) FACTORS INFLUENCING THE ECONOMIC OF THINNING PINE PLANTATIONS
BY: Don M. Tufts - Presented in 1977 at the LSU/MSU Logging & Forestry Operations Center - Forestry Professor's Seminar

TABLE I

CORDS PER DAY* PREHAULING BY TREE SIZE FOR 800 FOOT DISTANCE

DBH	CRAWLER TRACTOR WITH PALLETS THREE MAN CREW	MF TREEVER ONE MAN CREW
4	15.12	18.76
5	19.25	21.26
6	21.25	23.06
7	22.75	24.20
8	23.75	24.90
9	24.38	25.20
10	25.00	25.53

* Based on 10-hour day with 70% equipment utilization

The pallet wood was not prepiled. The Treever wood was prepiled.

TABLE II

PRODUCTION PER DAY FOR IRON MULE PREHAULING BY TRIP IN DISTANCE

DISTANCE IN FEET	CORDS PER DAY*
100	39.3
200	38.2
300	37.2
400	36.3
500	35.4
600	34.5
700	33.7
800	32.9
900	32.1
1000	31.4

* 10-hour day with 70% equipment utilization factor (Wood produced during 7 hours of prehauler operation)

Trees cut averaged 10 per cord (8.3 inches dbh) and 15 cords cut per acre, natural stand, pine clear-cut and hardwood left.

INNOVATIVE EXTENSION PROGRAMS

by

John Garland

Extension Timber Harvesting Specialist
Oregon State University

presented to

Forest Engineering Council Meeting

Gulf Park Campus
University of Southern Mississippi

August 22, 1980

I have been asked to speak with you about innovative Extension programs. The fact that I'm using this alternative mode of communication suggests that innovation is an important attribute for any Extension program, in that you never know when resources will be so limited that you can't accomplish your objectives in the more usual or customary ways.

CHARACTERISTICS OF INNOVATION

Let me first pose a question by asking what characterizes innovation in a forest engineering extension effort? There is an attibute of newness in the word innovation, but because of the limited resources that have been directed toward Extension programs in the past, any extension effort in the forest engineering area will be an innovation for most universities and for most states. Beyond the newness of innovation, the word has a connotation for creativity. Some characteristics are not only new for a particular innovation, but these characteristics are linked with creativity or going about the job a little differently.

One of the first characteristics that may be new for a university beginning a forest engineering extension effort is the interaction with a range of audiences not used to receiving university services. These audiences include loggers, equipment manufacturing and sales personnel, small landowners with harvesting and logging problems, corporate logging personnel, government agencies, and the associations that operate in the forestry area. An Extension effort provides interchange between the university and these diverse audiences. Compared to a classroom of 18-24 year old students, the diversity found within these audiences is extraordinary. Innovation is demanded by this diversity of age, education, personalities, etc.

Another characteristic of a forest engineering extension effort is the change of location from the university setting, which may still be seen as an ivory tower to many field practitioners, to educational locations out in the communities around the state. Educational programs are held in restaurants, community halls, local bank conference rooms, and out on woodland properties where the only access is by following signs along dirt roads. The logistics associated with a change in location for an educational delivery system are frightening at first. Later, the anxiety diminishes somewhat after the program is established.

Still another characteristic of an innovative extension effort is the development of a diffusion system for information. The extension faculty need to establish themselves as the contact person for information on new developments. Their exposure to audiences must be sufficient so that the clientele will be able to identify the extension person as having the potential for helping them with their problems. The diffusion system may be relatively formalized, such as with the "Forestry Update" Newsletter started a number of years ago which has now grown to a circulation of over 4,000. In the newsletter the expectations are already formed for follow-up contact with extension staff to obtain more information to solve problems. The telephone is the heart of most informal diffusion efforts.

Even innovative extension programs need to point to tangible educational results for the resources provided for educational efforts. These results are hard to measure, particularly in the behavioral changes of the clientele, but there are some more direct and measureable outputs of an extension effort that can be attributed to an educational program. For example, the log trucking industry approached Oregon State University with a problem associated with some proposed rule changes for weight regulations on logging trucks. A researcher and an extension specialist were able to conduct a survey using our Extension contacts and mailing lists which indicated the full economic impact of the proposed trucking regulations. Further analysis indicated 14.8 million dollars increased cost to the trucking industry with very little benefits to the transportation system of the state. Extension involvement with the legislative committee and the transportation department resulted in a quantifiable output for an extension/research effort.

Other Extension programs on directional falling can be translated into quantifiable savings in improved falling techniques resulting in less breakage by users. Or we can quantify purchases of small yarders for thinning operations in the northwest. And we can observe the adoption of new technology evidenced by behaviors of clientele who have been associated with Extension programs. In spite of the difficulty in measurement, the tangible educational results need to be observable for an innovative Extension program.

Innovative Extension programs are likely to use appropriate media and delivery systems to reach the diverse audiences. It is necessary to compete for the time of the audience; so films, slide tapes, newsletters, television, meetings, tours, demonstrations, publications (both refereed journal publications and trade journal publications) are logical channels for Extension educational outputs.

Simply using different media systems for delivering educational messages will not guarantee success, but combining a potent educational output with the appropriate media format can make it possible to reach Extension audiences who are unwilling to spend three days at the university for programs delivered in a traditional lecture format.

Extension programs must address the numbers game and success of the numbers game is an important element of an innovative extension program. Large numbers of interested clientele indicate to administrators support for Extension programs. For example, an easy justification for my logging film efforts is that in a two-year period an estimated 25,000 people have viewed the logging films that I've produced. Another 8,000 have viewed various slide-tape programs. To attract 550 for a Skyline Symposium makes the administrators within the university aware that a significant audience is reached with the program. Once the programs attract over 250 people, the interest level of the administrators rises dramatically! But more importantly, Extension programs must compete in the educational marketplace with quality programs that will sustain an Extension effort.

Lastly, an innovative extension effort will have a rational balance to a workload that attacks high priority volatile issues, but also addresses long range technological development for emerging problems. Individual workloads must be balanced within the individual so that a sense of accomplishment can be felt. The balance issue could also be described as a "process" versus "product" work schedule. A process oriented work schedule are activities that an Extension person does to build relationships with clientele, organizations, institutions, and individuals. This process type work involves extending gratuities to individuals (extending yourself as an extension person so that at a later date you can call upon that individual for support in delivering programs, site and demonstrations, helping with a tour, etc.).

A product work schedule is more common in a university in that the outputs are recognizable. They may be publications, successful short courses, etc. An extension person must balance process and product activities, as well as balance the educational or high priority issues versus long range technological development.

All of the above characteristics can only come about from a process that I term "educational design." Educational design is applying some of the principles of organization and conduct that have long been found suitable in a product oriented environment to the organization and conduct of procedures for educational products. Educational design has procedures like audience analysis, setting objectives, and these sorts of activities. The design engineer who carefully designs a shaft and gear system or the front end suspension system of a truck should have a counterpart in the educational delivery system where a designer is applying principles of organization and conduct to educational products. It is simply not enough to "hold a workshop." If the educational design is lacking in the workshop, then the workshop is unlikely to be successful.

ORGANIZATIONAL REQUIREMENTS

How is an organization to achieve an innovative extension program in forest engineering? The most important contribution will come from the recuitment process, but the recruitment process is entirely dependent upon the pool of suitable candidates for Extension positions. Those who have tried to fill forest engineering positions for teaching or research programs know that this pool is extremely limited. What are some opportunities for improved recruitment?

The most immediate prospect for solving the problem is through cloning research. One of our colleagues in the plant physiology department was successful in developing a clone of himself from plant material. The clone had the high intelligence of the researcher and the capacity for working long hours writing publications! The clone only required sunlight and fresh air for existence, but this clone had one drawback. Among other mental attributes passed onto the clone, one that developed beyond the researcher's expectations was the capacity for foul speech. The clone had the worst vocabulary of four letter words, vile epithets, and curses. The researcher used his own brain patterns to impress upon the clone and was shocked! The apologies that the researcher was making to secretaries and research aides was extremely embarrassing. Deciding that this couldn't go on any longer he decided to destroy the clone. Since the clone was living in the sense of moving, thinking, speaking, etc., he was extremely concerned about being arrested for murder and this troubled him greatly, but he had to take some action. And so bringing the clone to the 7th story of the botany complex, he lured the clone to the edge by pointing out a voluptuous coed sunbather down below. As the clone peered over the edge to get a better look, the researcher pushed him over the edge and there was a splat and the prospect for some composte on the pavement below! The researcher walked back to his office preparing his defenses against charges that he took a life. After all the clone was not a living human being, but was only vegetable material, etc., but that isn't what they charged him with. He was subsequently arrested for making an "obscene clone fall." Cloning research is probably the most promising short run solution for a shortage of recruiting forest engineering teachers, researchers or Extension personnel.

We could discuss the qualifications required for an Extension person which differ somewhat from what a teacher or researcher may expect, but that would not be productive because the important elements will be what the individuals bring to the employment situation. It is not possible to make generalities about whether a Ph.D. is required, how much experience is necessary, etc.

More likely it will be necessary to "grow you own." As individuals are passing through the undergraduate and graduate programs it is important to identify likely prospects for Extension, research or teaching positions in the future. These likely prospects should be exposed to Extension programs. One way of doing this has been through the use of funded Extension Assistanceships at the graduate level. Then it is possible for an individual to have an exposure to Extension activities and a project that is related to an Extension output.

I would like to share with you what requirements are essential for achieving an innovative extension program. First of all it is absolutely essential to have a <u>research and information base</u> for the Extension person to work with. A salesman trying to sell a substandard product just won't compete and neither will an extension effort if the research and information base is not developed. Not every university with an Extension program must have a highly developed research program, but there must be resources available to an Extension program to tap a research or information base elsewhere within the forest service, private industry or other universities. It simply is not possible in forest engineering to go to the literature and extract information that people need to solve problems. The substance must be there in the educational product for an Extension program to be effective. However, through an Extension effort it is possible to help build the research and information base within a department, school of forestry, etc.

Another organizational requirement is to have a support system that will aid extension programs rather than hinder them. Typically there are more than one system that govern Extension faculty. There is a forestry system, an Extension system, and a university system that all govern the individual's actions in purchasing, travel reimbursements, and all of these sorts of things. Many times these systems act as impediments to getting the job done. A conscious effort is necessary to make these systems supportive rather than obstructive.

Other systems within the state include other institutions that must support an Extension effort, such as State Forestry programs in the service area, Forest Service programs, and other government agency programs. Always worrying about whether you are stepping on someone else's turf is likely to be a nonproductive activity for an Extension person. In addition, the logging associations and various industry associations need to recognize the potential for the Extension effort in the forest engineering area.

Another area of crucial support is support from the faculty. One of the major mistakes of an Extension effort at the beginning is to try to have faculty in teaching and research given an additional responsibility of Extension. There must be a basis there for interchange and compensation between an Extension program and a research or teaching effort. That interchange and compensation does not have to be financial payment for every Extension activity undertaken, but the faculty must be willing to work on an Extension effort because they are getting something out of it. It may be help from the Extension person later on or teaching or research. It is foolish to impose additional extension workloads on faculty who are already overworked and expect them to develop support for this idea of Extension.

The other area of needed support must come from the industry. A university is typically equipment and resource poor. Extension cannot work without cooperators, cooperators within industry that have equipment, resources and an interest in working on an Extension program. For example, we conducted a demonstration program with a small yarder in eight locations around the state, demonstrating the use of intermediate supports. With the resources of the university alone, it would not have been possible to have 900 people participate in that particular series of demonstrations.

Another organizational requirement for innovative extension programs is a reward system for performance. Because Extension is not like the work that forest engineers perform in the design of a new piece of equipment or building of a bridge, where there is a tangible product at the end, the sense of accomplishment is hard to feel. The educational design may not be apparent for a number of years in the behavioral change of the individuals who have participated in Extension programs. The reward system must somehow combine immediate feedback as well as some way of recognizing successful long term performance in an Extension program. The classic university reward system in which the individuals who do a good job are rewarded with more work is certainly not appropriate for Extension. Certainly it is very difficult to determine the pay differentials for performance in Extension, teaching and research activities. There should be no difference in the reward system which would encourage someone who might become an excellent Extension person to seek a research career because of pay differentials.

The other system that the organization must provide along with a reward system is an evaluation system for tangible educational results. The evaluation system must be built into the Extension program to provide initial feedback from clientele just having participated in the program, as well as some longer term assessment of the effectiveness of an Extension effort. Some of the longer term extension efforts can be observed by changes within the operating structures of the clientele over time. For example, the use of intermediate supports was not in existence prior to a research and extension effort which began in 1973. Now this technique is becoming common throughout the logging operation in the Pacific Northwest. Previously only one operator in a logging association had intermediate support capacity; now 24 operators have the capacity of using intermediate supports when they are required.

Another organizational requirement is patience with the early development of an Extension program. Subsequently as the program grows, there must be a willingness to say "no" to extraordinary opportunities which have to be bypassed because of inadequate resources. The demands on an extension person go up exponentially over time; patience is required early as the program support and cooperation is building, and then later as the demands for service and involvement increase dramatically, the institution must be supportive if there is a lack of sufficient resources to take on a particular project.

And lastly, I think as a requirement within organizations there must be a guiding philosophy for Extension that is explicit. Overused statements like "Mention of trade names does not contitute an endorsement" have to be guiding philosophies for the way the program is operated, rather than just something that is included on a piece of paper. Or the philosophy that "Extension will take the educational program to the clientele" must be followed through even though there are travel restrictions. The guiding philosophies are compromised in times of tight resources, but the philosophies have to be the basis for a program.

BENEFITS OF AN EXTENSION PROGRAM

Finally, what are the benefits of an innovative extension system in forest engineering? The first benefit is the educational involvement with expanded clientele. Extension, by working outside the traditional classrooms of the university, interacts with individuals and organizations with a variety of problems that the university is capable of solving. Clientele for the first time through an Extension program can see the university attempting to meet some of their educational needs and problems with direct educational outputs. It is later possible to identify tangible educational results from extension programs.

Another important benefit from Extension is a feedback loop to the university research base. Not only do individuals and groups provide research needs, but often provide financial support for particular research needs. Once the research potential has been identified and the capacity for a delivery system of this research information is made known to individuals, industry and government, the feedback loop continues to be strengthened.

The Extension system provides a base for continuing education throughout forestry and professional areas. The same kind of educational design is useful for Extension programs, provides the base for a continuing education effort.

Also, there is a direct relationship between the wide exposure given to the educational outputs or products from Extension programs and the support for the university in general. These educational outputs from extension programs are acknowledged by supporters of the university, whereas only peer researchers view those outputs found in refereed scientific journals.

There is also a contribution to the undergraduate and graduate teaching program from an Extension system in forest engineering. As an Extension person addresses a particular problem, their expertise in that particular area can be made available to undergraduate and graduate teaching faculty. The information gained from extension short courses or workshops on "chipping in the woods," "sort yards," etc., has found its way directly into our undergraduate and graduate teaching programs.

Furthermore, the Extension ties with the industry can provide an excellent field environment for graduate students who wish to conduct and operate with industry on field research efforts or observational studies under field conditions.

Finally, the most important benefit to a department or to a university from an Extension system is in the "public relations" that the Extension effort provides. By "public relations" I don't mean the hollow packaging of hollow ideas that sometimes pass as a public relations effort. I mean improving the relationships with the various support publics that are based on a sound recognition of achievements in the educational and research areas. Public relations is a logger telling other members of his association about the help he obtained by going to an Extension program at Oregon State University on his particular problem. Nothing builds public relations for a university like an understanding of its potential, its past achievements and its potential for contribution to the people within the state.

I hope I have provided you with a look at what characterizes innovative Extension effort in forest engineering, what it takes in the way of institutional and organizational support to achieve a innovative Extension program, as well as what I see as some of the benefits of Extension systems in the forest engineering area. Forest Engineering Extension merits the support of the Council on Forest Engineering.

Thank you for the opportunity to present these views.

TRAINING LOGGING MANPOWER

B. Jack Warren
Forestry Update, Inc.
Long Beach, Mississippi

Since the beginning of the decline of available woods workers in the 1950's, there has been growing interest in training within the logging sector. The demands of increased production and costs have forced mechanization of logging operations--leading to higher levels of skill requirements for the workers.

Many forest industry leaders believed that the answer to the labor supply problem was in recruitment and training programs. If so, what has been done in the past two decades to alleviate this situation? What training programs are being conducted today and how effective are they? What is the current interest and motivation for logging training?

Vocational High Schools

Vocational education in high schools has long been accepted as a means of providing young people with the fundamentals of specific farm and forestry related occupations. Some felt that this was the answer to the woods labor shortage.

One of the first vocational education programs in timber harvesting came along in the 1960's through the efforts of the American Pulpwood Association and several state education departments in the Southeastern United States. APA assisted high school teachers in developing courses to give students competence for beginning jobs in logging. Similar programs were also established in the Northeast and Northwest United States.

In an evaluation of these programs by the American Pulpwood Association in a 1977 survey, it was found that 44 participating schools in the Southeast graduated about 3,250 students who had taken the course and about 340 were employed in some way in logging operations, A survey in Maine and Vermont revealed a higher percentage of placement, with 90 of 247 graduates employed in forestry or timber harvesting.

Many of those involved in the program believed that the forest industry is benefiting from these programs mostly through improved public relations rather than developing new skills.

Postsecondary Schools

In 1976 over 100 vocational technical training schools offered instruction in forest technology. Most of these schools included instruction in general forestry; however, several offered programs in timber harvesting and utilization. At one time there were several schools in the East specializing in timber harvesting programs, but currently only two have survived.

The Duluth Area Vocational Technical Institute in Minnesota was established in 1969 to provide skilled labor for the forest industry. Training is given in equipment operation and maintenance, hydraulics, welding, gas and diesel engine maintenance, accounting, logging layout, wood scaling, surveying and other related subjects. Many of these subjects are applicable to harvesting but most of them relate to the industry in general. This program has experienced a high retention rate of it graduates to the forest industry.

The Washington County Vocational-Technical Institute at Calais, Maine has developed a program to train logging equipment operators and managers. The school attracts students from several Northeastern states who become efficient timber fellers and skidder operators for local pulp and paper companies and has been most successful.

Both of these schools depend on industry support for placement of students and donations of equipment.

Universities

Alabama A & M University at Normal has developed a Timber Harvesting Management degree program which requires four years to complete. Graduates are qualified to manage and supervise private and company harvesting operations in the South. In addition to the four year program there is a ten week work study program designed to give actual on-the-job training to persons who have completed two years of college level work. These programs have been very well accepted by forest industry managers and have made valuable contributions to the logging sector.

The Lake City Community College in Florida has added a one year timber harvesting option to their two year forest technician program. After completing one year of the ranger school program, a student may finish the last year in the timber harvesting program which gives a basic knowledge of the application of men and machine to harvesting.

The Red River Junior College in Hope, Arkansas is in the process of developing a two year curriculum in timber harvesting practices. Graduates will have a good foundation to complete their formal education at another institution or to go directly into woods work.

Industry Training

Most formal industry training programs have been instigated because of a lack of skilled logging labor in relatively remote areas. After several attempts, Great Northern Paper Company in Maine developed successful company training programs. Careful attention is devoted to trainee selection--most are high school graduates and are attracted from other jobs rather than from the unemployed. This type training has been relatively expensive but is showing a short payback period through increased productivity.

Westvaco in South Carolina has initiated a training program in conjunction with Nordfor Training, a Swedish firm, to train company personnel in proper felling techniques and the use of a tilt winch to skid small trees. This program consists of both classroom and on-the-job teaching techniques. Norfor is presently working with other companies in the development of their small wood logging systems approach.

Several companies in the East are conducting on-the-job training sessions for company harvesting crews which does not include employees of independent contractors operations.

Equipment Manufacturers Training

Most of the larger manufacturers of logging equipment offers formal classroom instruction for mechanics employed by customer firms. Some companies will certify the customers mechanic to do warranty work on purchased equipment.

Because of the high rate of turnover, it is difficult to offer extensive equipment operator training. This type instruction is usually limited to the salesman or serviceman spending a short period of time with the operator at the time of delivery.

John Deere Company has developed several training programs for logging managers and others which teaches proficiency in equipment selection, systems analysis, optimum harvesting methods and others.

Other Programs

The Northeastern Regional Loggers' School began in 1968 and was sponsored by the State of New Hampshire and industry. The school was funded under the Manpower Development and Training Act but was closed after one year for lack of funds.

Public forestry agencies such as the Forest Service, state extension services and state forestry agencies offer various programs periodically in the technical aspects of logging.

Timber Harvesting Magazine and Forestry Update, Inc. are conducting Business Management Workshops for Loggers at various locations in the South. These sessions are directed to the owner/operator of logging operations and cover business decisions that lead to profitable operations. Discussions include organizing a business, effective recordkeeping, tax strategies, and discussions related to potential problem areas.

Conclusion

For one reason or another training logging manpower has not been very successful in the United States. There have been a number of obstacles associated with recruiting and retaining people to work in the industry. One of these is the fact that people with the required skills to work in logging are not willing to accept wages being offered under working conditions that are physically demanding and hazardous. So workers that are willing to work in logging are usually poorly educated, lack motivation and reliability, and are not responsive to training.

In order to attract the type workers that are trainable for logging, it will be necessary to upgrade the job qualities and pay scales. The problem will not be solved by training submarginal workers for submarginal jobs. The training programs in industry that have been most successful provided relatively high wages and were administered by professional trainers who were selective in recruiting trainees.

REDUCTION OF FUEL CONSUMPTION IN FOREST OPERATIONS

Forest Engineering Workshop 1981
University of New Brunswick, Fredericton.

Keith C. Jones
K. C. Jones & Associates Ltd., Ottawa, Ontario

ABSTRACT

The scale and basic distribution of forest harvesting energy requirements are presented. The average energy requirements of mechanized and semi-mechanized forest harvesting operations are compared. The importance of examining the distribution of energy use within, and not by, individual machines is pointed out. This leads to a brief listing of possible fuel saving programs, concluding with an economic examination of these measures that indicate permanently installing fuel monitoring systems on board large machines may be economically justified.

PRICE (NFLD.) PULP & PAPER LIMITED
P. O. Box 500, Grand Falls, Newfoundland, Canada, A2A 2K1 (709) 489-2201 Telex 016-4226

ABSTRACT

In June,1980 a ten-month integrated pulpwood-fuelwood operation was begun as a cost-shared Abitibi-Price Inc.-ENFOR project. This trial was an extension of the whole-tree fuelwood chipping projects carried out in 1978 and 1979.

There were three phases during this project. Wood and residue from cutover areas and wood from pure white birch stands was processed for hog fuel. Wood from a mixed white birch-balsam fir-black spruce stand was harvested and selected for hog fuel, pulpwood and sawlogs.

In the first two phases trees were felled manually, forwarded whole-tree to a central landing by conventional wheeled skidders, chipped with a Morbark Model 22 Chipharvester equipped with a Barco Loader and transported by modified dump trucks and 40 foot chip vans to the Mill Yard. In the integrated pulpwood-fuelwood phase, trees were felled manually and the softwoods were limbed to a 3½ inch diameter top. Conventional type skidders forwarded the trees to the landing where they were selected for chips, pulpwood and sawlogs. Tops, hardwoods and unmerchantable softwoods were used for chips.

At the mill the chips were burned in a boiler furnace modified to burn bark, chips and/or Bunker "C" fuel.

William Evans

William Evans
Area Supervisor
Bishop's Falls Division

WE:ph
4th June, 1981

MEASUREMENT OF PHYSICAL PARAMETERS DURING SKIDDER USE STUDIES

by

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Agricultural & Biological Engineering Department

and

William F. Watson
Forestry Department

Mississippi Agricultural and Forestry Experiment Station
Mississippi State University
Mississippi State, MS 39762

ABSTRACT

Preliminary fuel-use studies were made during skidding operations using a cable skidder. Total fuel consumption, force in the mainline, angle of the mainline with the horizontal, skid speed, load volume, load weight and load orientation was measured or noted. Regression equations were developed for fuel-use versus horizontal force and fuel-use versus load volume.

Stand Establishment
New Brunswick's Program

by

Maurice K. Barteaux
New Brunswick Department
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Fredericton, N. B.

ABSTRACT

As a consequence of current and projected demand for wood from New Brunswick's forests the Provincial Government and Industry have embarked on a large scale reforestation program. Modern facilities, equipment and techniques have been implemented to establish 24,000 ha. of plantations annually. Due to the diversity of site conditions in the Province a variety of techniques and mechanized equipment are in use and new systems are still being evolved. Under the new Crown Lands and Forests Act which becomes operative in 1982 Industry will take on a much expanded role in the planning and operations relative to stand establishment on Crown Lands.

SESFOR-81

FUTURE SYMPOSIA IN FOREST REGENERATION

by

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ABSTRACT

The Symposium on Engineering Systems for Forest Regeneration, SESFOR-81, was a great success. The results of a survey conducted following the symposium indicated that forest engineering symposia should be scheduled every three to five years covering topics in pruning, thinning, chemical application, and cone processing in addition to the regeneration topics covered in the three day symposium. In general, the participants were very pleased with the symposium format and subject. Future symposia should follow the same tours - technical sessions format and provide an informal evening gathering so that the delegates could exchange information in a relaxed atmosphere.

FORESTRY VOCATIONAL TRAINING IN SWEDEN AND NEW BRUNSWICK - A COMPARISON

by

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ABSTRACT

Forestry vocational training in Sweden in a more modern sense goes back to around 1950 at which time the Swedish National Board of Forestry started short skill training courses for woodworkers and active woodlot owners. These activities expanded over time to include machine operators and first time supervisors. It covered basic training as well as refresher courses and upgrading.

In 1973 the Department of Education took over the responsibility for formal training and forestry became one option in the high school system. The basic course offered is a two year course and it produces an all purpose skilled forest worker. Machine operators require an additional ten weeks training. The National Board of Forestry retained the Forest Extension activites towards woodlot owners.

In New Brunswick forest vocational training is still in its development stages. Experiments are being done with forestry skill preparatory courses in the high school system. Some courses are also being developed and offered by the N. B. Community College. The Forest Extension Service is involved in skill training of woodlot owners and some training is carried out by industry in cooperation with provincial and federal manpower departments. The efforts are hampered by the fact that forest work is not yet considered as a trade and that forestry traditionally is seasonal and harvest oriented.

Wood Harvesting Course
Washington County Vocational
Technical Institute
River Road
Calais, Maine 04619

BY

Carroll Gatcomb
Department Chairman, Wood Harvesting
Washington County Vocational
Technical Institute
River Road
Calais, Maine 04619

ABSTRACT

22 WEEKS		31 hours per week
Study Areas		Emphasis
1.	Chainsaw Operation	55% of total time
	Skidder Operation	" "
2.	Chainsaw Maintenance	25% of total time
	Skidder Maintenance	" "
3.	Related Subjects	20% of total time

Below is the present method of grading used by the Wood Harvesting staff.

Field work (all types)	50%
Shop work (all types)	20%
*Classroom work (test and quizzes)	20%
Final examination	10%

*The classroom portion of the program is 20% and a vital portion for learning principles, theories, basics, etc. Therefore, the student must maintain a 70%+ average in this section in order to stay in the program. If a student fails this section, the student fails the entire program.

MARITIME FOREST RANGER SCHOOL

OVERVIEW OF DEVELOPMENT, STRUCTURE, AND PROGRAMMES

by

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ABSTRACT

An overview of the development, structure, and programmes of the Maritime Forest Ranger School provides the framework for highlighting concepts and philosophies involved in forest technician training.

CONTINUING EDUCATION FOR FOREST ENGINEERS
A CONSULTANT'S APPROACH

by

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Forest Engineering Incorporated
P.O. Box 952
Corvallis, Oregon 97339

ABSTRACT

Two major factors have increased the need for continuing education of forest engineers at least in the area of timber harvest. One is the recent innovations in equipment development and harvest planning techniques. The second is the requirements placed upon the engineer to operate under extreme environmental and economic constraints. Many college-trained forest engineers just cannot cope because of generalized college programs that did not prepare them for the task. Also many non-college practitioners are being required to meet that same criteria.

The diverse backgrounds of forest engineers presents the educator with an imposing task of presenting complex subjects to different educational levels.

The approach taken by one company is to use simple, practical, real-life situations in a problem-solving mode.

Paper presented to the Fourth Annual Workshop, Council on Forest Engineering, August 10 -14, 1981, University of New Brunswick, Fredericton, New Brunswick, CANADA.

INTERNATIONAL FORESTRY TRAINING IN LESS DEVELOPED COUNTRIES

by

Joseph E. Hoffman
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Animal Science and Natural Resources Branch
Room 3549-S
International Training Division
Office of International Cooperation and Development
U.S. Department of Agriculture
Washington, D.C.

ABSTRACT

International forestry training in less developed countries is increasing in importance. Both the U.S. Government, through the Agency for International Development (AID), and the World Bank are increasing their investments in forestry type projects. The Food and Agricultural Organization (FAO) of the United Nations has long been involved in forestry training programs. International forestry training efforts, as viewed from the author's agency, take several forms. One is for foreign participants to come to the United States for academic training, agency study tours, and short courses. The other is for Americans to conduct training programs in foreign countries. The greatest need in the future is for more short courses, conducted both in the U.S. and in foreign countries.

Paper presented to the Fourth Annual Workshop, Council on Forest Engineering, August 10 - 14, 1981, University of New Brunswick, Fredericton, New Brunswick, CANADA.

INTERNATIONAL FORESTRY TRAINING IN LESS DEVELOPED COUNTRIES

by

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INTERNATIONAL TRAINING

International training is big business. The Institute of International Education (IIE) estimates that in the 1980-81 school year there were 311,882 foreign students attending U.S. institutions. The number has been increasing rapidly in the past few years. The IIE estimates there were 48,500; 82,000; and 286,340 foreign students in the U.S. in school years 1959-60, 1964-65, and 1979-80 respectively. The majority of these students are family or home government financed. A significant portion, however, are financed by the Agency for International Development, (AID), The Food and Agricultural Organization (FAO) of the United Nations, and by the World Bank.

International Training Administrators of the International Training Division, Office of International Cooperation and Development, U.S. Department of Agriculture, are primarily responsible for "programming" foreign students financed by AID, FAO, World Bank, and by countries with agreements with USDA. Programming refers to the process of establishing a training program; calling a participant forward to begin his training;

monitoring his progress during his training program; providing funds for a living allowance, tuition, fees, books, and authorized travel; and sending him home when the program is completed.

The training objectives vary from short study tours with agencies and companies to Ph.D. academic programs. The majority of the participants are pursuing B.S. and M.S. degrees at U.S. colleges and Universities, and are in the U.S. for at least two years.

Another job of international training administrators is to coordinate USDA short courses. USDA short courses are discussed in depth near the end of this paper.

I work in the natural resources subject area, primarily in the forestry subject area. Most of my participants are AID or FAO financed and are pursuing forestry and other natural resource management degrees at U.S. universities, especially the land-grant universities.

Before AID, FAO, and World Bank development projects are discussed, there is a need to briefly identify the forestry situation in developing countries.

FORESTRY PROBLEMS AND PRIORITIES OF DEVELOPING COUNTRIES

Most developing countries are characterized by rapidly increasing populations and a declining forest area. During the present century about one-third of the forest has been lost. The two main causes of forest destruction have been conversion of forest land to agriculture and the increased demand for fuelwood. In the developing countries fuelwood accounts for about 80 percent of total wood use, compared with less than 20 percent in the developed countries. (Draper, 1981)

The primary emphasis in forest policy in many developing countries is directed towards the protection and conservation of the forest area which remains, and to reforestation programs on a massive scale with fast growing species. The main constraints to improvement of the forestry situation, other than funds, are mainly socio-economic and institutional, rather than technical. However, much technical work remains to be accomplished. (Draper, 1981)

INTERNATIONAL FORESTRY TRAINING

To better understand international forest training programs, there is a need to examine the development projects from which they arise, since training is only one part of a bigger development project. Three main agencies or organizationa have been, and are involved in forestry development projects. These are the U.S. Agency for International Development (AID), The World Bank, and the Food and Agricultural Organization (FAO) of the United Nations. FAO has shown a consistent interest in forestry projects. AID and the World Bank are showing increasing interests in forestry development projects. Each of these organizations or agencies will be presented.

World Bank interest in forestry projects has increased tremendously in recent years. Between 1968 and 1977 World Bank lending in forestry average $30.65 million per year. In 1978, 1979, and 1980 they lent $131.3, $155.7, and $268.7 million respectively. Their lending program in forestry now includes about 38 countries. (Draper, 1981)

A World Bank policy paper proposed that during the next five years, priority in forestry lending should be given to (a) environmental forestry, or forestry related to agricultural settlement projects in tropical forest regions; (b) rural development forestry oriented toward village woodlots, farm forestry and encouragement of small scale wood using industries; (c) institutional building projects such as training, education, and research; and (d) forest industrial projects.

AID, the Agency for International Development, is also increasing its investment in forestry developments. For example, in FY 1980 there was an estimated $31.78 million dollars allocated for the vegetative cover category. (The vegetative cover category includes forestry, watershed management, reclamation of denuded lands, village woodlot development, fuelwood plantations, and control of desertification.) The fuelwood component was $11.3 million. For FY 1982 the proposed vegetative cover budget is $72.1 million, of which $37.6 million is for fuelwood projects. (Kunkle, 1981)

A new Forestry Support Program has been established to provide the technical assistance necessary to accomplish the forestry development goals. This Forestry Support Program, funded through a resource support agreement between AID and the Forest Service, USDA, should be fully operational by the late summer or fall of 1981. It will consist of four professionals in Washington, D.C. and three regional resident professional forestry advisers stationed in the field. One will be in Central America, one in East Africa, and one will be in Asia.

To supplement this small group of professionals the Forestry Support Program is compiling a file of forestry professionals who are interested in working on international forestry projects conducted by AID missions. If you are interested in international forestry and in working overseas, then please send your vita or resume to the Forestry Support Program. Be sure to include foreign languages known and your international experience. The address to send your resume to is:

Dr. Samuel H. Kunkle
Forestry Support Program
USDA Forest Service
P.O. Box 2417
Washington, D.C. 20013
Tel. (703) 235-2432

The Food and Agricultural Organization (FAO) of the United Nations is similar to AID in providing funds and assistance in development projects. FAO has had a strong, continuing interest in forestry. In 1978 FAO budgeted approximately $17.4 million for forestry projects, or about 10 percent of their budget. They send approximately 300 fellows to the U.S. for training, of which about 10 percent are for forestry. In 1979 FAO had a total of 62 persons on fellowships in forestry world wide. This is 7.9 percent of all fellowships administered that year. (Nicolosi, 1981)

USDA SHORT COURSES

There is one more aspect of international training that needs to be introduced. This is the U.S. Department of Agriculture series of short courses offered by the International Training Division. For 1981 there were approximately 45 short courses offered, varying from two to 14 weeks in duration, sponsored by USDA. If the demand is present the courses may be offered in foreign countries. These short courses have a very practical, hands-on orientation.

In 1981 only four of the short courses were on natural resources and none were specifically on forestry. I believe a need exists for short courses in forestry, especially in reforestation and fuelwood production. By the 1983 catalog I want to have four or five forestry short courses listed.

Some of the short courses are taught by USDA personnel or contract personnel, but most are taught at universities by university faculty under contracts between the university and USDA. The recruitment of students is handled by USDA and most of the students are financed by AID or FAO. USDA publishes the Catalog of Courses and Research Opportunities in Agriculture booklet and sends, on individual courses, flyers to FAO offices and cables to AID missions worldwide.

I need to identify those individuals and universities or organizations who desire to teach a short course for international forestry students. If you are interested, or if you know someone who is interested, in offering a short course please let me know. My address is on the front page of this paper.

SUMMARY

In summary, international training in forestry is increasing in importance, especially among the less developed countries. AID and World Bank are increasing their investments in forestry and FAO is maintaining their high level of interest. The number of foreign students studying forestry in the United States is expected to increase significantly in the next few years. This increased interest in forestry creates a need for more short courses. Those interested in presenting a forestry short course should contact the author of this paper.

Thank you for the opportunity to present this paper. If you have any questions please contact me.

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SESFOR-81
FUTURE SYMPOSIA IN FOREST REGENERATION

by

Awatif E. Hassan, P.E.
Professor
North Carolina State University
Raleigh, N.C., USA

FOURTH ANNUAL WORKSHOP
FOREST ENGINEERING COUNCIL

University of New Brunswick
Fredericton, New Brunswick, Canada
August 10-14, 1981

ABSTRACT

The Symposium on Engineering Systems for Forest Regeneration, SESFOR-81, was a great success. The results of a survey conducted following the symposium indicated that forest engineering symposia should be scheduled every three to five years covering topics in pruning, thinning, chemical application, and cone processing in addition to the regeneration topics covered in the three-day symposium. In general, the participants were very pleased with the symposium format and subject. Future symposia should follow the same tours-technical sessions format and provide an informal evening gathering so that the delegates could exchange information in a relaxed atmosphere.

SESFOR-81
FUTURE SYMPOSIA IN FOREST REGENERATION

Awatif E. Hassan*, P.E.

Wood as a source of fiber, fuel, and feed is considered to be the most valuable renewable resource in the world. Labor shortage, rising costs, and increased plantation lands dictated the need for a closer look at forest mechanization and its engineering challenges. The ASAE 1981 Symposium on Engineering Systems for Forest Regeneration (SESFOR-81) was proposed in 1978 to discuss the proper management of woodlands and intensive cultural practices for forest regeneration. SESFOR-81 established the state of the art of engineering research and development in forest regeneration which was explored during technical sessions, general sessions, equipment exhibition, and tours.

SESFOR-81 HIGHLIGHTS

The Symposium was sponsored by the American Society of Agricultural Engineers (ASAE) and co-sponsored by 15 other organizations; American Pulpwood Association (APA), Council on Forest Engineering, Farm and Industrial Equipment Institute (FIES), International Association on Mechanization of Field Experiments, International Union of Forestry Research Organizations (IUFRO), North Carolina State University (School of Forest Resources, School of Agriculture and Life Sciences, Extension Forest Resources, Division of Continuing Education), Society of American

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Foresters (SAF), Society of Automotive Engineers (SAE), Soil Science Society of America (SSSA), Soil Conservation Society of America (SCSA), Technical Association of the Pulp and Paper Industry (TAPPI), and Forest Service-USDA.

The Symposium attendance was 206 with 66 from Canada and eleven other countries. The industry participation represented 47% indicating the increased concerns for the future supply of forestry raw materials.

The Symposium began with a general session on March 3, 1981 with R. Max Peterson, Chief of the Forest Service-USDA as the keynote speaker. Mr. Peterson discussed the forestry situation and the potentials for increasing forest productivity and multiuses. The Honorable Governor of the State of North Carolina, James Hunt, emphasized in his luncheon speech on Tuesday, March 3, the great importance of the symposium theme to the world in general and to the State of North Carolina in particular. The 11-technical sessions of March 3-5, 1981 covered topics in soil erosion control, soil compaction and machine systems, seeding production, planting systems, intermittent tree planting machines, site preparation and natural regeneration, forest utilization and improvement, forest economics and forestry abroad. The technical sessions included 56 technical presentations of which 37.5% were international, representing forestry systems and management practices in Canada, Denmark, Finland, Germany, Great Britain, New Zealand, the Netherlands, Sweden, and the USSR. This international participation enabled the Symposium attendees to exchange technology and to become familiar with forestry practices abroad.

The film forum included 13 films and slide-tape shows and represented the most recent development in forest regeneration systems. There were two tours; 96 members participated in the Monday, March 2 tour to the Coastal Plain, hosted by the Weyerhaeuser Company and 56 were on the Friday, March 6 tour to the Piedmont, hosted by the Catawba Timber Company. Nineteen manufacturers and exhibitors participated in the equipment exhibition where forestry equipment was on display both indoors and outdoors.

The Conference proceedings will provide reference materials for teaching and research not presently available in the literature. Engineers, commercial forestry operators, and field managers will benefit greatly from the material contained in the proceedings which will enable them to select better systems for their forestry operations. The proceedings is 387 pages and includes 55 technical papers, the keynote address, and welcome remarks by the Honorable Governor of North Carolina. The proceeding is available for general sale at the American Society of Agricultural Engineers headquarters in St. Joseph, Michigan.

RESULTS OF SESFOR-81 QUESTIONNAIRE

SESFOR-81 was a great success because of the participants' enthusiasm and interest in the topics presented. Past experience with ASAE symposia in forest engineering (which at the time were well received) indicated the lack of follow-up for future symposia guidelines on the topics presented, which resulted in the infrequent occurrence of these symposia. Therefore, a follow-up questionnaire was mailed to all SESFOR-81 participants requesting inputs for future symposia related to forest regeneration. A copy of the questionnaire is shown in the Appendix. The total response rate was 70% (127 responded of 180 active participants;

the invited guests were excluded) and 33% of the responses were from Canada and abroad.

The following sections will summarize the results of this questionnaire, and discuss future planning of similar symposia.

Symposium Sources of Reference

The first question reflects the symposium publicity and illustrates the efforts of the symposium co-sponsors. The percent of total shown in Table 1 is based on the 127 responses received. A few of the responses indicated more than one source of reference, hence the total of this table is greater than 100%.

Many key individuals were also responsible for the promotion of SESFOR-81 activities as shown in Table 1 (personal communications item). The Society of American Foresters (SAF) through their Journal of Forestry article attracted more than 50% of all the co-sponsor participants. Closer cooperation between SAF and ASAE in future symposium planning is recommended. During the planning of SESFOR-81, it became apparent that the IUFRO representative should be from Europe to improve the communication with scientists in Europe, Eastern countries, and the USSR.

Convention Center and Services

The response to the second question indicated that the McKimmon Center facilities were adequate for this meeting; 99.2% agreed and only one of the 127 responses disagreed. The shuttle bus service was utilized by 106 respondents, of which 3.8% experienced problems and 96.2% were satisfied.

TABLE 1. SYMPOSIUM SOURCES OF REFERENCE BASED ON 127 RESPONSES - SESFOR-81.

Source	% of Total
SPONSOR	
ASAE - Agric. Engineering Journal	20.5
Mailing List (Symposium Program)	32.3
Symposium Chairman	18.8
CO-SPONSORS	
APA - (Pulpwood Highlights)	1.6
Forest Service - USDA	1.6
IUFRO (News release)	3.2
SAE	1.6
SAF (Journal of Forestry)	9.4
TAPPI	2.5
OTHER SOURCES	
Employers and Private Organization	9.0
Personal Communications	11.2
Others	3.2

One of the comments of item 7 of the questionnaire was related to the shuttle bus service and is quoted below:

"A substantial benefit from meetings such as this is the opportunity to gather informally in a relaxed atmosphere after formal sessions. The bus shuttle service and absence of social facilities at the Center meant that no informal focal point existed. Some potential benefit was lost."

Similar comments related to more evening time to "chat" talk with mutual delegates suggest that future symposia should be held in hotels or centers with adequate social facilities and away from the conservative university environment.

Symposium Attendence

The preliminary planning of the symposium indicated that over 300 registrants were anticipated; however, only 206 participated in the Symposium. The third question was aimed to find out the total participation if the travel restriction imposed in the USA in 1980-81 were removed. Only 107 answered this question with 54.2% agreed that the number of participants would have been greater than 200. Twenty-five percent of the responses to this question indicated that the attendence of future symposia might be 300-399 participants.

Frequency, Topics, and Format of Future Symposia

The fourth question was used to assure the continuation of technology transfer and interactions between researchers in the future. It is evident that a conference on engineering systems for forest regeneration should be held every 3-5 years (Table 2).

The results of the fifth question indicated that 57.5% of the participants were satisfied with the topics covered, namely: soil erosion control, soil compaction-machine systems, site preparation, natural regeneration, planting systems, intermittent tree planting machines, forest economics, forest utilization and improvement, and forestry abroad.

Several additional topics were suggested; only those that were recommended by three or more individuals, are listed below, see Table A-1, Appendix for complete listing of all topics.

1. Pruning, conversion, and thinning practices
2. Fertilizer and chemical applications
3. Seed and cone processing equipment
4. Biological limits of reforestation
5. Existing plantation and nursery management
6. Hardwoods and utilization
7. More equipment on display

A few of the paper presentations covered items 3 and 5 above. The biological limits of reforestation as related to mechanization might be of great importance and should be included in future symposia.

The Symposium meeting format (tours before and after the three days of technical presentations) was recommended by 84% of the questionnaire responses (125 responded to the sixth question). Twenty-one respondents suggested changes in format which conflicted each other (see Table A-2, Appendix). For example one recommended tours before meetings only and

TABLE 2. FREQUENCY OF FUTURE SYMPOSIA IN FOREST REGENERATION BASED ON 124 RESPONSES - SESFOR-81.

Frequency (years)	1	2	3	4	5	6
% of Total	0.8	1.6	40.8	28.0	28.0	0.8

another suggested no Monday tours. It is evident that the format used was acceptable and future symposia should follow the same guidelines.

Additional Comments

Other comments were sought in the seventh question where almost 60% of the responses included one or more comments. The most common comments were excellent symposium, well planned and organized symposium, and personal complimentary notes. Other comments are shown in Table A-3 in the Appendix.

CONCLUSIONS

The Symposium on Engineering Systems for Forest Regeneration was a great success. In general, the participants were pleased with the Symposium format and topics. The results of the questionnaire suggest an undertaking of similar conferences every 3-5 years. Additional topics are recommended for future symposia.

APPENDIX

TABLE A-1. QUESTION 5 - ADDITIONAL TOPICS.

Additional Topics	No. of Responses
1. Soil - moisture site classification systems	1
2. Prescribed burning vs. Mechanical Site Preparation	1
3. Harvesting relating to regeneration methods	1
4. Overview of Reforestation Worldwide	1
5. Methods for cooperation between scientists, manufacturers, foresters, for work and development	1
6. Early tending - naturally generated dense stands	2
7. Transportation Issues, Energy Economics, efficiency, Environment	1
8. Soil-water Issues; Micro- to Macro-planning	1
9. Insect and disease control	2
10. Beneficial practices aimed at Forest productivity (conversion, pruning, thinning)	3
11. Effects of site preparation on Forest productivity	2
12. Pre-commercial thinning	2
13. Cone collection	1
14. Fertilization, chemical application (more on display)	3
15. Site preparation equipment, systems, techniques	5
16. Aerial Application of herbicides and fertilizers	1
17. Interaction between harvesting and stand condition or reestablishment	1
18. Systems analysis; costs, quality, quantity, efficiency	2
19. "People problems" effect regeneration systems	1
20. Seed processing equipment, cone processing systems	3
21. Biological limits of Reforestation	3
22. Microsite Environmental Requirements	1
23. Natural Regeneration	1
24. Thinning - Harvesting Equipment	2
25. International comparison of Engineering Equipment	1

TABLE A-1. CONTINUED

Additional Topics	No. of Responses
26. Engonomics	2
27. Animal damage protection	1
28. Regeneration Systems for Mountainous Areas, Rough Terrain	2
29. Planting "Hand" Tools	1
30. Relationship between silvicultural measures and natural regeneration	1
31. Stump Problems	1
32. Terrain Classification for silviculture purposes	1
33. Forest Regeneration in the future	1
34. Review Practices used by major forest regions worldwide . .	1
35. Plantation and Nursery Management	4
36. Hardwoods!	3
37. More "live" hands-on demonstrations	1
38. Fire Protection	1
39. Field planting machine and adaptations for pesticide applications	1
40. Weed control	1

TABLE A-2. QUESTION 6 - FORMAT CHANGES

Changes	No. of Responses
1. Tours before only	1
2. No Monday tours (people are tired from previous day's trip)	1
3. Technical presentations of three days are too much	4
4. Have more concurrent sessions	1
5. Have short tours during sessions	4
6. Tours on day 1 and 2	1
7. Two days of Technical Presentations	3
8. No Friday tours	1
9. Three days of tours	1
10. Only one field trip (tour)	2
11. Too much happening at the same hour (conflicts with No. 4 above)	1
12. Two days of tours	1

TABLE A-3. QUESTION 7 - OTHER COMMENTS

	Comments	No. of Responses
1.	Excellent Symposium	25
2.	Well planned, organized Symposium	21
3.	Personal complimentary notes	12
4.	Asking for better conditions and directions for foreigners	1
5.	Acoustics bad, ventilation system noisy	2
6.	More equipment	3
7.	More maps	1
8.	More complete information of field trips	2
9.	Too many absentee speakers	2
10.	McKimmon Center was excellent	2
11.	Avoid more than 2 concurrent sessions	2
12.	Night sessions	1
13.	Foreign speakers were difficult to understand	2
14.	Hold different topic fields at each symposium - Too much adversity	1
15.	Very good keynote speakers	1
16.	More information on site preparation techniques	1
17.	Some presentations should be presented twice to allow more participants to attend	1
18.	Requesting small sessions (10-15 people)	1
19.	More input from industry	1
20.	Needed more shuttle bus transportation	1
21.	Travel compensation for foreigners	1
22.	Not enough time for questions afterward	2
23.	Three days of presentations not enough	1
24.	Concurrent sessions must be avoided	1
25.	More evening time to chat with mutual delegates	2

SYMPOSIUM ON ENGINEERING SYSTEMS FOR FOREST REGENERATION

McKimmon Center, North Carolina State University, Raleigh, NC • March 2-6, 1981

March 17, 1981

Dear Symposium Participants:

Your participation made our Symposium a great success. Your response to this questionnaire will provide basic guidelines for future symposia related to forest generation.

1. Where did you hear of the Symposium?

   Journal of Forestry ____, Agricultural Engineering ___, IUFRO News ____, Symposium program ____, TAPPI ____, Others (Specify) ______________.

2. Were the McKimmon Center facilities adequate for this meeting? Yes __ No __ and did you have any problems with the shuttle bus service? Yes __ No __

3. There were 206 participants; in your opinion would this number have been greater if the travel conditions were less restricted? Yes ___ No ___ and what would be the expected number of participants? __________.

4. The subject of Engineering Systems for Forest Regeneration is very important and progressing at a very fast pace; should a conference similar to SESFOR-81 be held every 3 years ___, 4 years ___, 5 years ___, others (specify) ____________________.

5. What additional topics would you suggest for those coming symposia in addition to those covered in SESFOR-81? ______________________

   ____

   ____.

6. Would you recommend the same format, i.e., tours before and after the meeting and three days of technical presentations? Yes ___ No ___. If no, specify ____________________________________.

7. Other Comments

Thank you for participating in SESFOR-81 and for answering the above questions. It has been my pleasure serving you and I look forward to meeting you again.

Very truly yours,

Awatif E. Hassan

Awatif E. Hassan
Symposium Chairman

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