DEVELOPMENT OF IMPROVED TREE-TRIMMING EQUIPMENT AND TECHNIQUES[1]

by Dennis E. Holewinski, James W. Orr and James P. Gillon

Electric utilities must maintain adequate clearance of overhead circuits to prevent interruptions to their customers' service. Uncontrolled tree growth commonly causes service interruption by contacting energized conductors and creating momentary faults, complete outages, or mechanical breakage of utility facilities.

The overall objective of the EPRI Project ". . . is to design and produce prototype equipment capable of lowering costs and improving efficiency, safety, and flexibility of line clearance tree-trimming operations." The scope of the project is limited to positioning and cutting equipment and does not include removal of debris.

Tree/wire Relationships

Ideally, trees are trimmed back from electric conductors to allow them to grow 2 to 4 years before they again become hazardous to the line. Trees are either top, side, overhang (under), or through trimmed according to their relationship to overhead conductors and their potential for interference (Figures 1 and 2). Basic trimming methods include: pollarding, shearing or rounding over, and natural trimming (Figures 2 and 3). Because of long-term line clearance limitations, pollarding and rounding over are undesirable methods. Natural trimming is the method recommended by most professionals.

Natural Trimming

Natural trimming consists of cutting potentially interfering branches flush to a suitable parent limb toward the center of the tree crown. This method

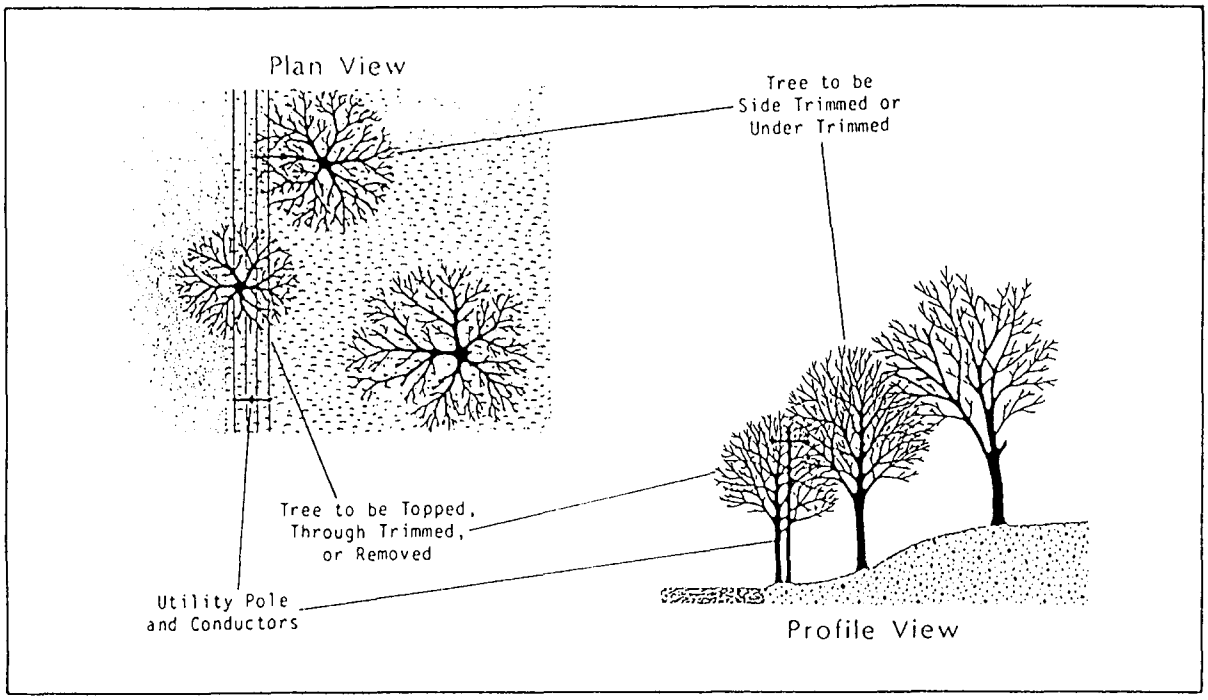

Figure 1. Tree/wire relationships

[1]Presented at the annual conference of the International Society of Arboriculture in Louisville, Kentucky in August 1982.

is sometimes called "drop crotch" or "lateral" trimming. Generally, cuts are made with a saw and minimal pole pruner work is required. The result is a natural looking tree. Natural trimming is also directional trimming, since it guides growth of the tree away from the wires.

Crew Types

Utility lines located along streets and highways are maintained most economically by tree-trimming crews working from vehicle-mounted aerial devices. Utility lines traversing areas inaccessible to vehicles are normally maintained by manual crews using climbing ropes and belts. Selection of the type of line clearance crew to be used in a given area depends on a combination of factors. The number of men and type of equipment assigned to a crew is determined after evaluating such variables as:

- Location of utility lines — roadside, rearlot, or cross country
- Tree type, growth rate, wood strength, branching habit
- Tree conditions
- Terrain
- Climate
- Labor poor — availability, cost, experience
- Urban or rural utility system
- Customer expectation
- Budget considerations

A national survey shows that 56 percent of all tree-trimming crews are lift crews; 44 percent are manual crews. The most common crew types are 2- or 3-man lift crews (44 percent) and 3- or 4-man manual crews (27 percent). It is important to note that, while nationally 56 percent of the tree-trimming crews have been mechanized with lift trucks, 44 percent of the crews are operating essentially as they did 40 years ago. Improvements and innovations to line clearance tools for manual crews have been minimal since the 1940's.

Trimming Tools

A survey of tree trimming contractors and utilities was made to determine how tools and equipment used by line clearance crews may be improved. The most frequent requests were for:

- Lighter tools

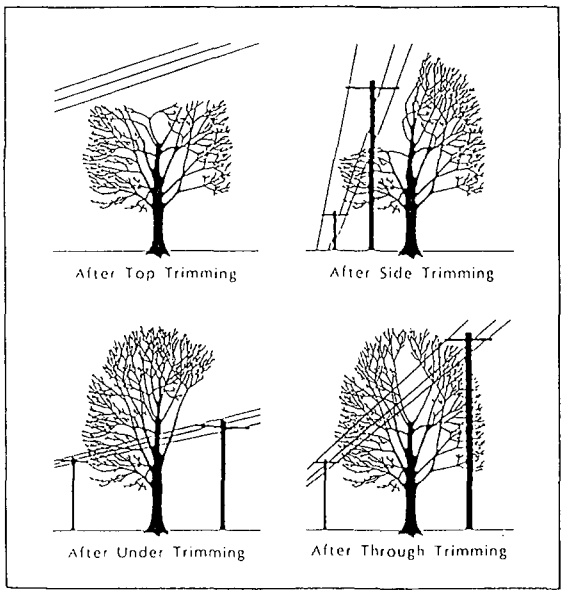

Figure 2. Natural trimming methods

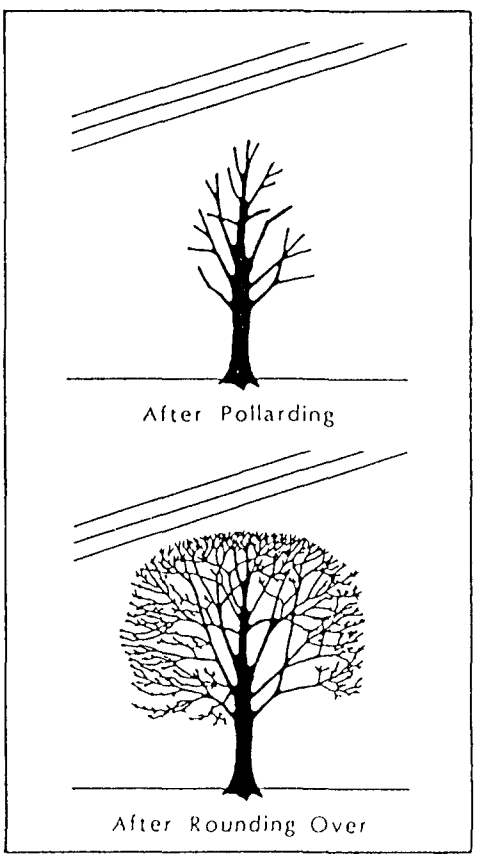

Figure 3. Undesirable trimming methods

- More reliable and maintenance-free tools
- Less expensive tools

These suggestions present conflicting requirements. This establishes the need for careful value engineering analysis of the long-term economics of changing tools that have been used, refined, and improved over many years.

New Concept Analysis

The Scientific Method, which provides guidance to define the problem, gather relevant data, formulate concepts from the data, and empirically test the concepts, was used to identify new concepts for tree trimming tools and equipment. The problem, tree trimming for line clearance, was defined by using a work measurement system that identified the day's total activity and the operations required. The lack of repetition in operations makes defining the task of tree trimming more difficult than defining assembly line work. The cutting and positioning requirements of tree trimming contain natural elements that continually change. Data were collected by a literature review, a patent search, and a study of work situations. New concepts were developed from creativity workshops and review of data gathered. These concepts were subjected to an initial screening process to

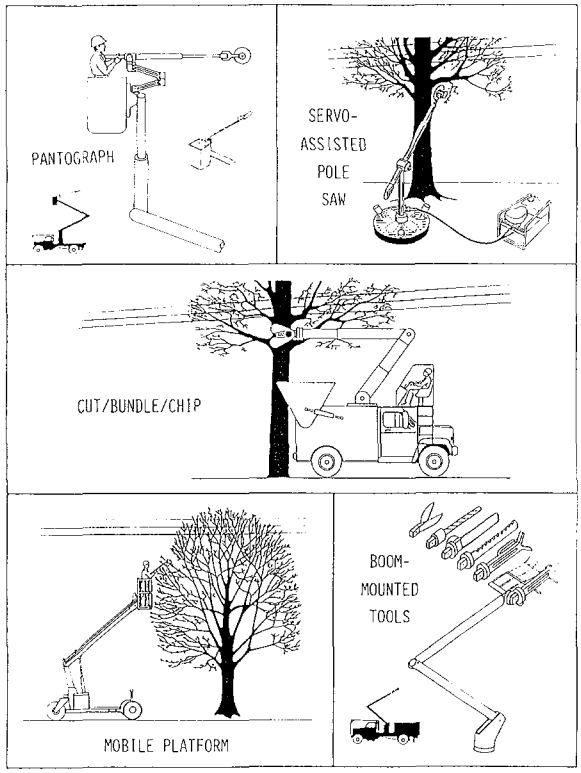

Figure 4. New tree-trimming concepts

Table 1. Economic summary

	Benefit/cost ratio				*Individual utility summary*	
Product	*Estimated development costs*	*Increase in daily production of chips*	*Increase in operating costs*	*Benefit cost ratio*	*Potential No. of crews equipped*	*Estimated 5-year saving on revenue requirement*
Pantograph-tool support	$170,000	20%	1.7%	11.7	8	$ 674,000
Mobile platform	360,000	56%	7.2%	7.8	4	689,000
Boom-mounted tools	720,000	88%	3.4%	25.8	4	1,027,000
Servo-assisted pole saw	600,000	36%	2.4%	15.0	4	611,000
Cut/bundle/chip	960,000	146%	7.6%	19.2	4	1,314,000

separate those with potential from those with little or no potential for success. Concepts were then subjected to a decision analysis which tested each concept for its practical contribution to program objectives. Only nine, of more than 40 ideas for new tools and equipment that merited screening, were worthy of complete analysis.

Conclusions and Recommendations

After the decision analysis and study of adverse consequences, five concepts emerged (Figure 4) as potential improvements on line clearance equipment:

- Pantograph-Type Linkage — support for powered pole saws and pruners.
- Mobile Platform Lift — similar to those used in the orchard industry.
- Boom-Mounted Tool — replacement of the bucket on existing lift trucks.
- Servo-Assisted Pole Saw — for trimming from the ground in backlot locations.
- Cut/Bundle/Chip Vehicle — mechanized vehicle for continuous operations of tree trimming.

The estimated development cost, benefit/cost ratio, and savings to an average size utility for these concepts are shown below.

The pantograph concept, in conjunction with higher horsepower pole tools, is recommended for short-term development. The adaptation of this concept to existing lift trucks insures a high probability of success.

An engineering study should precede development of other recommended concepts to substantiate their benefits to utilities throughout the United States.

There are unknowns in all development programs such as market demand, operating costs, and actual productivity of the concept after development. Regardless of the unknowns, the economic analysis supports the belief that the development of equipment for tree trimming has the potential for high return on investment.

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ABSTRACT

Shigo, A.L. 1982. **Cabling and bracing: how to minimize internal injury.** Arbor Age 2(1): 16-20.

Cabling and bracing, like injections, implants, cavity fillings, and pruning, can be very beneficial for trees but only when done properly! When done improperly, these treatments will cause a great deal of injury to the tree. In professional tree work, many factors must be considered to do a proper job. Proper cabling and bracing requires not only a high degree of skill in working with types and placement of hardware, but also a sound working knowledge of how a tree is constructed and how defects develop in trees. When a screw, rod, or bolt is inserted into healthy wood, the injured wood surrounding the metal will be walled off by the tree. In healthy wood, the column of discolored wood associated with the injury will be no wider than the diameter of the hole. The column of discolored wood may extend above or below the hole, but the length of the column will differ in different tree species, and with individuals within a species. The discolored wood may be caused by the tree's response to the injury. This is a normal response to injury and infection. Cabling and bracing cause wounds. But the injury caused by a wound must be weighed against the added time that the tree will remain safe, attractive, and healthy. There always will be times when the rules must be bent because of many other factors. But it is always best to know the rules before bending them. The more you know about the basics, the more you will be able to help trees.