MAJOR BREAKTHROUGHS AS A MEANS OF PROGRESS

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INTRODUCTION

"There are three roads to ruin: women, gambling and technology. The most pleasant is women, the quickest is gambling, but the surest is technology (Tynan 1984)."

Quotations abound on the perils of technology or change. However, like it or not, technology has, and will continue to be a key factor, as society strives for increased prosperity and "quality of life". The free market system rewards those who utilize technology wisely to reduce cost and/or improve quality. Conversely, it penalizes those who apply technology inappropriately or neglect it entirely. In logging, in addition to the factors of competition, we have the need to deal effectively with:

- Changing resource characteristics and terrain
- Environmental and multiple use concerns
- Safety and human factor concerns.

If change is inevitable, where do we look to find the seeds or concepts that will lead to incremental or even radical change? Historically they have come from innovations to logging's fundamental operational components of materials handling and manufacturing. In parallel the role for information, (its collection, transmission and communication) has expanded to provide the measurements necessary for effective management. "Logging inventions" of a mechanical nature will provide some breakthroughs, but it will be the identification, modification and application of non-logging technological developments that will lead to the most profound change. The challenge will be to link the enabling technology with our problems. The developers of the micro-computer did not have loggers in mind when they embarked upon the development road -- yet look around to see how it has changed this business.

TIME

Courteau (1910), gives two examples of the time and patience required for technology developments necessary to transfer dreams into reality. Chainsaws, first conceptualized in Germany in 1850, did not become a useful tool until the late 1940's when lightweight materials, developed for the aircraft industry, became available. The articulated skidder progressed from a dream in 1916 to commercial reality in the 1950's when mobile hydraulics were developed. Fortunately, the wait now need not be so long. The explosive growth in technologies such as: electronics, computer software, robotics, materials and manufacturing significantly reduces the lead time for development. Much of the technology we need is here or on the horizon - - the future is much closer then we think! The challenge is to effectively manage and apply technology without being buried by it.

PROCESS

The three researchers at MacMillan Bloedel's, Wood Harvesting Research (WHR) department focus the research program on improving safety, and the economic margin for the MB logging divisions. To maximize the potential for success (profitable application of the results) and leverage our effort, projects are undertaken using a "networked" or "collaborative" model. We try to bring together persons representing the problem (WHR or logging division), applicable knowledge (eg. University, Institute or consultant) and potential commercial supplier of the product. Each bring a unique resource to the project and has a key role to play. Their representation maximizes the speed of transfer and the opportunity for long term support of the projects result, be it a piece of equipment or a change in management action.

EXAMPLES

COORDINATED CONTROL

In 1985, Dr. Lawrence of the University of British Columbia (UBC) in cooperation with MacMillan Bloedel (MB), RSI Research and Ergo Systems Canada, embarked upon a project to develop a logical control interface between the operator and machine. The perceived advantages resulting from such a control system included:

- Unified/standardized machine operation and control
- Reduced learning time
- Enlarged population of potential operators
- Improved productivity
- Reduced maintenance
- Reduced product damage
- Improved safety.

The objective is to provide a logical and natural link between the operator and the machine's end-point or tool (eg. earth-moving bucket, log grapple or felling head). Instead of multiple joysticks controlling individual machine components, control is achieved via the manipulation of a multi-degree-of-freedom joystick. Its deflection or motion directly controls the velocity and trajectory of the machine's end-point. Raising/lowering the joystick causes the end-point to move vertically, forward/back motion causes the end-point to move horizontally and sideways motion causes rotation of the machine. The magnitude of joystick deflection controls end-point velocity. Lower level control and regulation of the machine's individual components is achieved via a computer, algorithms and joint angle sensors.

The initial demonstration of coordinated controls was via a graphical simulation presented on a Silicon Graphics Iris system. Consistent positive results were measured for coordinated control for all tasks. The simulation showed that coordinated controls would promote accuracy and skill without compromising speed of operation and would significantly reduce the learning time for new operators (Wallersteiner et al 1988).

In 1985, a Caterpillar 215 excavator was retrofitted with a coordinated control system (Lawrence et al 1990). This machine was later equipped with a log grapple to allow repetitive human factor testing. From 1985 to present, a number of refinements have been made based on comments made by operators and the maturation of the technology. Tests for novice operators showed that, on average, coordinated control improved performance by 20% (Wallersteiner 1991). Initial testing of experienced operators identified that there were no significant performance differences for the joint and coordinated control strategies (Lawrence et al 1990). Subsequent studies of experienced operators showed that, with moderate training (approximately 10 hours), they could perform as well or better with coordinated controls (Wallersteiner et al 1992).

In June of 1990, the existing controls of a Madill 044 grapple yarder were replaced with a one-hand controller and computer designed and manufactured jointly by RSI Research and MB. Initial tests indicated that the fine control required for grappling the log was not achievable utilizing the system. Further refinement was required including the sensing of cable lengths and utilization of grapple location data in the winch control program. Drum rotation sensors were installed on the machine's three drums in the spring of 1992.

The machine has now been moved into a woods setting and testing/demonstrating is now underway. Concurrently, RSI Research has announced the availability of a commercial control system. Final acceptance of the completed MB system is anticipated by September 1992.

Ultimately, coordinated controls will be applied to most forest machines - implementation is only retarded by the hesitation of the major equipment manufacturers to embrace this development. Non-forestry applications range from the construction industry to space. The speed at which achievements were realized for this project are a result of the quality of the project team and their interaction and utilization of recent developments in hydraulics and electronics.

ARRAYTAG FOR LOG IDENTIFICATION

The impetus to develop a specialized tag for log marking came in 1988, when MB Woodlands Regional Manager, Bill Cafferata, stated at a B.C. Advanced Systems Institute Forest Technology Seminar in Victoria, "what we need is a cheap way to mark each log so we can see where they go". Dr. Warren Little of the University of Victoria took up the challenge and reviewed the possible alternatives, including bar codes, magnetic strip tags, coded-wire tags, radio frequency tags and surface acoustic wave tags. For a variety of reasons all of these alternatives were dismissed. During the course of the study, Dr. Little conceived a checker-board patterned arraytag and surmised that it would overcome most of the problems encountered by other tags. The next step, to develop the specific tag format and decoding system (software and hardware), resulted in the description and demonstration of a tagging technology (Figure 1) that:

- allows identification from virtually any distance, within a substantial depth of field, under varying light conditions and at any orientation
- is adaptable to almost any physical scale
- requires low contrast
- allows high information density (many different numbers possible in a small sized tag)
- uses low cost tags.

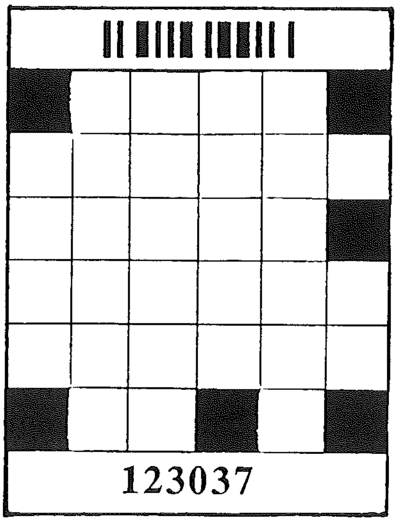

Figure 1: **Sample Arraytag**

The opportunity to develop the system further to allow decoding of multiple tags within a field of view was also identified. The use of off-the-shelf hardware components (video cameras, frame grabbers and personal computer boards) was also an advantage making the system relatively inexpensive and adaptable.

In late 1990, a contract was awarded to ArrayTech, a spin-off company from the University of Victoria, to provide a system to automatically record tagged logs as they are being made into bundles. (Having a reference number on each log will allow recall of scale information for both individual logs and associated bundles.) The project has stimulated significant development in the area of tag size reduction and increased decoding speed and reliability. Decoding speed still is an issue, but installation of the system is planned for late 1992.

Concurrent with the development of the log marking system ArrayTech, working with MB's Sawmill Divisions, confirmed the feasibility of tracking lumber packages with this technology. As the first step towards testing the arraytag technology in continuous production, MB's Chemainus Sawmill Division has agreed to apply arraytags to packages leaving the primary sorter for the secondary sorter. Equipment performance and inventory data accuracy will be monitored for an extended period.

The Arraytag is a good example of how the forest industry can stimulate "high tech" developments which have multi-industry applications. Non-forestry application of this technology include the tracking and identification of rail cars, trucks, motor vehicles, baggage, cargo and toxic waste.

DISCUSSION

Coordinated controls and arraytag applications are only two examples of many potential "focuses" for technology application and collaborative development teams in logging and forest management. Other areas offer significant opportunities including:

- remote sensing
- harvest planning/land management
- equipment development
- equipment and personnel management/scheduling
- wireless communication (voice and data).

Many of these areas in fact, were addressed at the recent FS 2000 conference "The Application of Advanced Informatics to the Forest Industry" held in Vancouver. Of particular interest were remarks made regarding the application of robots or walking machines in the forest. A dream of many, a commercially available manned walking platform adaptable to stand tending, harvesting and processing functions could be just around the corner. Autonomous stand tending robots will not be far behind.

CONCLUSION

The application of technology will have significant impact on the tools we use to harvest and manage our forests. Solutions to our "opportunity areas" will require a focused, interdisciplinary approach, created by strategic alliances between industry staff, university faculty, industrial researchers and suppliers. Careful priorization is required to provide a balance between financial viability and technology implementation. Technology should not be viewed as the missing ingredient. Rather, define a goal, buy into technological development and implementation and enthusiastically work to make your goals a reality!

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