Studies in Management and Accounting for the
FOREST PRODUCTS INDUSTRY

JIT AT OREGON CUTTING SYSTEMS

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INTRODUCTION

This monograph provides information to companies in the forest products industry about the process of implementing a Just-In-Time (JIT) management system, including JIT purchasing and JIT manufacturing. In addition, this monograph illustrates the impact of JIT on organizational accounting and productivity. Many authors have suggested that today's globally competitive marketplace requires companies to be world class competitors in order to be successful. Many companies from a variety of industries around the world have found that JIT can contribute to being a world class competitor. In particular, JIT can enhance manufacturing productivity, product quality, and employee motivation.

This monograph presents a case study of Oregon Cutting Systems (OCS). OCS was formerly known as OMARK Industries, but is now a subsidiary of Blount, Inc. The long relationship of OCS with the forest industry is based on its primary product—saw chain for power saws. OCS has also been one of the most successful American companies in implementing JIT. Forest products companies with any interest in JIT can learn much from how OCS implemented JIT.

Before presenting the case study, explanations of several terms and acronyms can help you understand the OCS experience with JIT.

1. **Just-In-Time (JIT) Manufacturing** - A demand pull production system designed to only produce inventory as required to exactly meet customer demand. Each stage of the production process is scheduled to meet the requirement of the subsequent production stage. JIT manufacturing and purchasing can be viewed as part of an overall business philosophy that includes emphasis on quality, employee involvement, and customer satisfaction — both inside and outside the company.
2. **Just-In Time Purchasing** - The purchase of goods or materials such that the required quantity is received at the time when it is required to be used.
3. **Zero Inventory Production System (ZIPS)** - OCS's name for their JIT program. In 1990, the system was renamed JIT because management realized that Zero Inventory was not the goal of the organization.
4. **Total Quality Commitment (TQC)** - A management strategy in which all business functions work together to build quality into the product or service in order to provide customer satisfaction. In this regard the customer may be internal or external.
5. **Quality Circles** - Small teams of employees working together to identify and solve problems.
6. **Computer Integrated Manufacturing (CIM)** - The use of computers and various advanced manufacturing techniques to perform or assist in activities necessary to order, manufacture, and deliver output to the customer.
7. **World Class Manufacturing (WCM)** - Term coined by Richard J. Schonberger in his book *World Class Manufacturing* to describe companies that are successful in global competition using a management philosophy that emphasizes continuous improvement.
8. **Single Minutes Exchange of Die (SMED)** - A system developed at
Toyota to reduce set-up times in order to execute small lot production.

9. Quality - At OCS, quality is defined as continuous improvement and reduction of the variance around target variability.

10. Activity Based Costing (ABC) - A costing concept that states activities (rather than products) consume resources and products consume activities.

THE ZIPS STORY

The OCS journey to JIT began in the fall of 1981 when OCS was known as OMARK. The company, headquartered in Portland, Oregon, had approximately $250,000,000 from sales of three primary product lines, including cutting chain for chain saws, timber harvesting equipment, and sporting equipment.

In the fall of 1981, Executive Vice President, Jack Warne, went to Japan to observe Japanese manufacturing practices in several companies. He recognized that the JIT practices he saw in Japan would also work for OCS. As a result of Warne’s enthusiasm, the Chairman of the Board appointed a ten person study team made up of corporate staff and manufacturing personnel. The objectives of this team were to study the feasibility and practicality of implementing JIT, and to report their findings within six months.

The Study Group set out to learn as much as possible about JIT. They read the most current literature on JIT and other Japanese management methods; they talked to experts in these fields like William Ouchi and Bob Hall (see Exhibit I for an updated list of references, including the primary references originally used by OCS); they visited several U.S. companies with JIT experience such as Hewlett-Packard and Westinghouse; some members of the group went to Japan to visit fifteen to twenty companies that were using JIT. The Study Group made a concentrated effort to circulate the reference materials gathered and other information learned throughout the organization. By the end of the six month period most of the managers in manufacturing were familiar with many JIT concepts. As a result there was widespread interest in creating a JIT environment at OCS. This process of sharing information, combined with the clearly stated support of top management, can be credited with launching the JIT movement at OCS.

The report of the Study Group emphasized two recommendations: (1) Re-evaluate the company’s philosophy — especially as it related to quality and employee involvement; and, (2) The company’s own version of JIT, called ZIPS (Zero Inventory Production System), should be implemented throughout the company.

As a result of the Study Group recommendations, top management developed a formal document that clearly showed their commitment to a tri-part organizational philosophy. This is the same philosophy that OCS maintains today. This philosophy promotes the interaction of three factors that reinforce each other: Employee Involvement (EI), Zero Inventory Production System (ZIPS), and Total Quality Commitment (TQC). These three factors are illustrated in Figure 1 below. Total Quality Commitment and Employee Involvement are generally considered an integral part of any JIT program.
OCS felt that defining three programs clearly signalled to employees as to what management considered important.

I. Employee Involvement: Virtually all OCS employees were involved in some way with the JIT program. There were several reasons for a strong push to involve employees throughout the organization. First, the job was too big to be handled by top management and their staff alone. Second, it was necessary to utilize the abilities of a wide variety of employees who had the knowledge and experience to develop creative solutions as implementation problems occurred. Finally, employee involvement created a widespread commitment to the new programs.

At OCS there were two key elements to establishing and maintaining employee involvement. These critical elements were leadership from top management and continuous learning through education.

Top management not only had to show its support for specific programs, but also had to express its visions about achieving world class quality and value for customers. Top management had to communicate the company's commitment to its employees, by emphasizing positive employee relations and retaining current employees. The OCS strategy for commitment to keep current employees has continually emphasized growth and the development of new products. The goal of this strategy was to offset any potential employment reductions that could be related to increased productivity.

Multiple communication channels favorably influenced the success of top management's efforts to provide leadership. These communications included the statement of organization philosophy, personal visits to plant sites, formal annual reports to employees, company-wide conferences, and in-house magazines and newsletters.

Continuous learning through education was a high priority for OCS. This process included reprinting articles, obtaining and developing slide shows and video programs, and bringing in organizational consultants. OCS encouraged study teams and formed quality circles. Today, as a result, there is much small group activity in OCS. One of the major educational programs involved forming study teams to read the famous account of JIT at Toyota written by Shigeo Shingo. This book is titled The Toyota Production System and it was probably the single most influential source of information about JIT for OCS.

II. Total Quality Commitment: Top management at OCS decided to be fanatical about satisfying the customer, the vision of well known author and quality expert, Joseph M. Juran. Organizational development specialists thought that the use of JIT and quality circles would be sufficient to achieve the desired quality. Although these were positive steps for improving quality, a much more
Comprehensive effort was required. Consequently, the education program began to stress the strategic importance of quality. This involved the study of methods such as statistical process control and the identification and elimination of waste such as repairs, rework, and retest. Exhibit II lists wasteful activities identified at OCS. In this area, organizational development specialists relied heavily on the writings of both Juran and Deming.

OCS also began to recognize market research as an important tool to understanding the desires of customers. Developing cross functional teamwork was another important factor. This involved increasing the cooperation between staff and functional departments such as marketing, production, and accounting.

III. Zero Inventory Production System: Although many individuals influenced the company's progress, it was Shingo's book about the Toyota production system that management used for guidance. OCS's managers believed that Toyota set the standard in using JIT as part of an overall commitment to improving manufacturing productivity. For this reason, the ZIPS system OCS adopted was primarily influenced by Shingo's writings about Toyota.

The OCS JIT system, or ZIPS, consists of three components that reinforce and enhance each other.

1. JIT manufacturing
   - Small lot production
   - Setup reduction (SMED)
   - Line balancing and smoothing
   - Pull system of production control
   - Cooperative supplier relationships

2. Continual improvement
   - Education in Statistical Process Control
   - Waste avoidance, i.e., continuous focus on eliminating all activities that do not add value
   - People
   - Continuing education
   - Job security
   - Personal commitment of the employee to the company

After ZIPS, TQC, and EI programs were in place, management tried to improve the systematic sharing of knowledge across divisions. From 1983-1985, an annual one week ZIPS conference was held that included education, opportunities to share experiences, and recognition for progress. The prized award was the traveling Shingo Prize, which was "the green book" encased in plastic with the latest winner's name inscribed on the base. By the end of 1985 it was obvious that JIT was firmly in place at OCS. At that time OCS found that it was no longer necessary to continue the type of JIT promotion illustrated by activities such as the annual conference. However, direct educational programs were continued.

Benefits of JIT Philosophy

By 1986 the ZIPS projects in the various plants had produced a number of favorable results.

- The Oregon Saw Chain Division experienced an 80% reduction in defects with no increase in quality costs
- 50% reduction in scrap, sort, and rework
- 40% reduction in floor space
- The largest increases in productivity since the start of the company.
Results from one Canadian plant included:

- Set-up times reduced from 6.5 hours to 1 minute and 40 seconds
- Lead times cut from 21 to 3 days
- Inventory reduced by 50%

(See Exhibit III for a summary of some of the benefits achieved through several ZIPS projects.)

The success of many ZIPS pilot projects influenced most plants in the company to revise their layouts from process-oriented to product-oriented, to emphasize the importance of vendor relationships (e.g., the number of steel suppliers was reduced from seven to one), and to install massive education programs in TQC. By 1990 the overall impact of implementing the JIT philosophy at OCS could be seen through the achievement of a constant level of production while closing two manufacturing plants and reducing the workforce by 50%.

ACCOUNTING IN A JIT ENVIRONMENT

The many changes in the production process created a need for OCS to change their information systems including traditional accounting. Historically, financial and tax reporting criteria have constrained cost systems designers, but today computerized accounting has greatly reduced these constraints. This freedom, however, has not reduced the challenge inherent in designing cost systems; successful system design is still as much an art as a science. This dilemma occurs because dynamic environmental and organizational changes make it difficult for such systems to sustain their design objectives. The 1980's was a period of dramatic internal and external change for OCS, and their cost system had to undergo radical changes in order to maintain its functionality.

Two basic costing procedures are used for capturing and retaining information: (1) events are recognized by transactions, and (2) these events are stored in a manner to facilitate subsequent search and retrieval. In designing or modifying an information system, it is first necessary to identify which events to record, and then to decide when and how to record them. The latter decision relates to whether the transactions are retained as unique events or as aggregations of events (pools). The decision to pool events involves considerations regarding how broadly or narrowly each pool category should be defined. OCS had to resolve these concerns as it moved to adjust its cost system to the new realities of its JIT manufacturing.

All functions of an organization are interconnected. Introduction of ZIPS was bound to have a significant impact on the accounting system at OCS. The JIT dedication to system simplicity and continuous improvement caused a redefinition of cost centers. There was also a reevaluation of depreciation methods, product line costing, and variance reporting. Managers needed reports that focused on strategic and operational measures (e.g., lead times, quality, inventory, actual product cost, and customer satisfaction) rather than strictly financial measures. Operational changes put long-term capital investment decisions on hold as the elimination of waste began to free up capacity. Decision makers could not be sure what capacity was going to be once the benefits of JIT were fully
realized. Decision makers recognized a need for return on investment (ROI) measurement over the entire product life cycle and an increased need for timely feedback. That is, there was now a demand for a cost management system.

The OCS vision for a cost management system included the following:

- Product line focus
- Identification of waste
- Simplified system
- Operational versus financial orientation
- Operational and strategic reporting

**Product line focus:** In order to accomplish the product line focus, costs were identified in cells or subplants. This procedure reduced or eliminated the number and need for allocations because more costs were then directly attributable to the product. The traditional functional costs, such as maintenance, became focused product costs and the cost centers were identified at the product level. The product line focus resulted in less averaging so that cost allocation to individual products was more appropriate.

**Identification of waste:** Waste was identified primarily at the cell level. Waste costs were identified primarily at the subplant and plant level and included costs associated with administering, planning, and supporting the production process. Top management attempted to reduce or eliminate any waste that was identified. (See Exhibit II.)

**Simplified system:** The simplified system had allocations reduced or eliminated, fewer reporting points, less transactional reporting, less variance reporting and fewer and larger cost centers. For example, the production and inventory transactions recorded and reported before JIT included eight transactions, but after JIT this number was reduced to four. Exhibit IV lists these transactions.

**Operational versus financial orientation:** The emphasis on operations directed accounting system reports to provide management with direct non-financial performance indicators (e.g., lead times, production to schedule, quality, inventory, customer satisfaction). No financial data was allowed. The reports went to the appropriate level on a more timely basis than previously possible with financial type reports. The use of charts and graphs rather than traditional detailed reports gave rise to the term "Management by Eye."

**Operational and strategic reporting:** There were two objectives for cost management:

- Cost management would be used to support information needs though an emphasis on timeliness, accuracy, and understandability.
- Cost management should be able to support strategic decision-making without additional data gathering.

For an example of the impact of JIT on cost management implications, see Exhibit V.

When JIT was adopted, OCS had a complex process cost system using standards with an emphasis on variance analysis. There were forty-six manufacturing centers, twenty manufacturing service (MS) cost pools, and five internal service (IS) cost pools. In addition, each cost center had several indirect labor cost pools (clean-up, coffee breaks, materials handling). Transactions for inventory and for labor (at standard) were generated whenever a product...
moved between any of the forty-six cost centers, and cost pool allocations were made whenever a critical event occurred.

Before JIT, management evaluations occurred in a formal four-step sequence:
- weekly detailed performance reports
- monthly performance summaries
- monthly meetings where cost personnel gave line supervisors a formal financial review
- after each financial review, the supervisors met to project the next month’s variances for each of their cost centers

The plant manager stated that,

"The detailed cost system really worked. When there was so much as a burp on the production floor we knew it! We were on top of everything."

By the end of 1984, the cost system reflected the new JIT production system. Transaction processing was drastically reduced with only fifteen production centers generating transfers. Periodic cost allocations were also reduced substantially since there were now only ten manufacturing service cost centers rather than twenty-five. Separate indirect labor reporting was eliminated as it was included with direct labor. In another change, actual costs rather than variances from standard were used by supervisors for their monthly reports.

Eventually three more cost pools were eliminated when all three IS departments were dropped and their costs were included in the fifteen cost centers. With all of the simplifications to product costing, month-to-month adjustments to the Work-in-Process (WIP) account for production labor and MS became estimates of the swings in output and mix of WIP residual inventory.

In addition to the major changes listed above, a number of other modifications were made. For example, OCS management recognized that the manufacturing cost centers had no control over certain costs. For this reason the applications of factory salaries, fringe benefits, floor space, and property taxes were now charged to the MS cost pool.

In 1986 OCS management realized that some of their cost system changes were too drastic. Some fine tuning adjustments to its cost system included: (1) reinstating the three IS cost centers, (2) charging supervisor salaries, fringe costs, and property taxes directly to cost centers again, and (3) reinstating monthly departmental performance reviews for supervisors (after a three year absence). Another change required explanations from supervisor’s whenever their actual versus planned budget comparison was negative. Documentation from supervisors included, for example, labor rate, labor efficiency, fixed spending, and volume variances.

OCS recognized that the changes wrought during the 1984-86 period were too aggressive in eliminating indirect cost categories, and that supervisors needed more detailed breakdowns in order to correct performance deficiencies. OCS made further adjustments to the cost system. For example, OCS management discovered that the performance number, derived by
dividing a period’s actual cost of finished goods by total goods completed, was misleading. This error was corrected by excluding fluctuations in WIP, thereby eliminating distortions when the current month’s expenditures have not yielded finished goods.

The fine tuning of the performance control cost system emphasized using actual costs. After the adoption of ZIPS, standard costs were used only for inventory valuation and income determination. Actual costs were used for performance evaluation by everyone down to the level of cost center supervisor. The variances that appeared in a performance control document compared annual budgeted unit costs to actual unit costs. If the variances were due to changing circumstances, then the budget was revised to restore relevance. Each of the quarterly performance evaluation reports from managers of three product lines were sufficiently consistent with their regular reports so that there were discrepancies, and consequently, no surprises.

Although OSC has evolved an actual cost system that is working effectively in the JIT environment, there are further changes being considered.

THE FUTURE: ACTIVITY-BASED COSTING?

In 1990 a new multidisciplinary pilot team was formed to report on the feasibility of OCS implementing Activity-Based Costing (ABC). This new team’s charge was to identify the cost drivers in General and Administrative (G&A), Marketing, and Research, Development & Engineering (RD&E). OCS management was aware that not all costs were being identified with related decisions. The ABC pilot team has a full-time member from Accounting, Manufacturing, and MIS, as well as part-time members from Marketing and Support.

OCS believes that world-class competitors must integrate all aspects of meeting customer needs such as marketing, design, manufacturing, and service. Furthermore the objective of their cost control system should be to identify those factors generating costs that are related to each decision in the competition to satisfy customer needs. The relevant cost dimensions are more than the historical classification of fixed and variable costs generated on the factory floor. Cost dimensions should include the full range of costs associated with design, engineering, marketing, and customer service. OCS management recognizes that the informed decision maker needs to know the cost drivers within the service areas as well as within the manufacturing area. As part of the continuous improvement philosophy that OCS adopted with JIT, the company is now studying ABC to see if it has the potential of providing service departments with many of the benefits that TOC and ZIPS have already provided to manufacturing area. For example, ABC may lead to the elimination of waste in service departments by identifying the cost drivers in those areas.

CONCLUSION

During the decade of the 1980s, OCS met the challenge of worldwide competition through adopting a JIT management philosophy. This involved an emphasis on quality, waste reduction, employee involvement, and above all, customer satisfaction. The key factors in
implementing JIT were top management commitment, and employee education. The result was a dramatic improvement in overall productivity for OCS.

Although this case study covers many years, it demonstrates the dynamics of the JIT philosophy. OCS did not stop with arranging the plant in dedicated line format and using statistical control to try to reduce cost variability. In 1991 OCS has already done an ABC pilot project and they are now considering the relevance of life-cycle accounting in the OCS environment.

If OCS is to maintain the competitive advantage of a JIT philosophy into the future, they will have to continually evaluate their operations throughout the company. OCS management recognizes the importance of improving service areas, as well as manufacturing.

The impact of one company adopting JIT has far reaching affects in the economic community. As OCS implemented JIT, suppliers like Weyerhaeuser Corrugated Box Plant (WCBP) had to adopt a similar philosophy to remain competitive and to assure they were the single source of boxes for OCS. According to Bob Britt, General Manager of WCBP, WCBP invited employees to visit Japan with OCS personnel to learn the JIT process from the same Japanese companies that OCS visited. The philosophy of the right supplies at the right time is ingrained into the WCBP plant. WCBP’s implementation of JIT required an increase in manufacturing flexibility, gained by reduction of set-up times and worker education in such areas as statistical process control and critical measures of success for quality. Britt views the relationship between WCBP and OCS as a partnership. Similar relationships will also be required of WCBP’s suppliers. The ripple effect of JIT is affecting the forest products industry.
EXHIBIT I

REFERENCE BOOKS RELATED TO JIT, TQC AND EI


Hall, Robert W., *Zero Inventories* - (Homewood: Dow-Jones-Irwin, 1983)


EXHIBIT II

EXAMPLES OF WASTEFUL ACTIVITIES AND COSTS

| * Repairs                          | * Unnecessary conveyors        |
| * Repair facilities               | * Unnecessary material handling|
| * Scrap                           | * Inefficient layout           |
| * Retest                          | * Unnecessary automation       |
| * Rework                          | * Indirect support            |
| * Returned sales                  | * Packaging                    |
| * Premium freight                 | * Service departments         |
| * Excess building                 | * Excess equipment and tooling|
| * Storage areas                   | * Spare parts                  |
| * Equipment failure downtime     | * Inspection                   |
| * Unnecessary fork trucks         |
EXHIBIT III

REPORTED IMPROVEMENTS RELATED TO JIT PROJECTS AT VARIOUS OCS SITES

* Die change cut from 6-1/2 hours to one minute and forty seconds
* Space requirement cut 40%
* Lead times cut from 21 days to 3 days
* Inventories down 50%
* Reduction of 30% to 40% in the amount of floor space required for manufacturing
* Set-up time for a punch press was reduced from 3 hours to 4-1/2 minutes
* An 80% reduction in defects with no increases in quality costs
* A 50% reduction in scrap, sort and rework
* A 40% reduction in floor space
* A 10% productivity increase during a 12 month period
* An 85% reduction in work-in-process
* A 58% reduction in product-flow distance
* A 32% reduction in floor space
* A 35% reduction in manufacturing costs
* A 90% improvement in shipping productivity
* Order turn-around time improved from 10 to 14 days with a 75% order fill rate to 1 to 2 days with a 97% order fill rate
* A 94% reduction in product-flow distance
* A 75% to 90% reduction in lot size
* Throughput time on a major sub-assembly was reduced from 30 days to 3 days
An overall 50% reduction in combined purchased parts and WIP inventory

Exhibit IV
REPORTED AND TRACKED
PRODUCTION AND INVENTORY TRANSACTIONS

**Before JIT**

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<thead>
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<th>Collection Point for Measure</th>
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<td>Issue</td>
<td>Order</td>
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<tr>
<td>Receipt</td>
<td>Order</td>
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<tr>
<td>Labor or Machine Hours</td>
<td>Operation</td>
</tr>
<tr>
<td>Move</td>
<td>Operation</td>
</tr>
<tr>
<td>Inspection</td>
<td>Operation</td>
</tr>
<tr>
<td>Ship</td>
<td>Customer order</td>
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<td>QC disposal</td>
<td>As required</td>
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**After JIT - Simplified System**

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<td>Receipt</td>
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<tr>
<td>Cell Hours</td>
<td>Cell</td>
</tr>
<tr>
<td>Ship</td>
<td>Customer order</td>
</tr>
<tr>
<td>Team Attendance</td>
<td>Shift or part change</td>
</tr>
</tbody>
</table>
## EXHIBIT V

### JIT CONCEPTS

* Focused manufacturing Around Products (Cells/Subplants)
* Simple, Flexible Equipment
* Producible Product Design
* Multifunctional Workers and Decision making
* First-Time Quality at The Source
* Small Lot Sizes (Production and Transfer)

### COST MANAGEMENT IMPACT

* Eliminate allocations
* Simpler data collection
* Cost center definition changes
* Condensed bills and simplified routings
* Depreciation life
* JIT/CIM justification
* Lower warranty costs
* Closer relationship between design and product engineering
* Less scrap waste
* Simplified labor reporting (not time clocks)
* Team reporting
* Direct/indirect labor distinction blurred
* Labor-based allocations not practical
* Timely cost/performance reporting required to:
  - Facilitate team decision making
  - Encourage appropriate behavior
* Fewer cell worker classifications
* Fewer nonvalue-added departments (e.g., inspection, rework)
* Less emphasis on tracking rework/scrap/warranty costs
* Cost of quality tied directly to product
* Less WIP inventory to track
* Increased transaction volume (potentially)
* Financial accounting effects of reduced inventory and space
* Cost of material handling tied directly to product
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<tbody>
<tr>
<td>1</td>
<td>&quot;The Rush to LIFO: Is It Always Good for Wood Products Firms?&quot; (1976).</td>
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<td>11</td>
<td>&quot;LIFO Inventories in the Forest Products Industry,&quot; (July 1980).</td>
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<tr>
<td>16</td>
<td>&quot;Boise Cascade's Productivity Improvement Program,&quot; (January 1982).</td>
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<tr>
<td>18</td>
<td>&quot;Developing a Strategic Plan for a Forest Products Company: A Case Study,&quot; (March 1983).</td>
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<td>20</td>
<td>&quot;Productivity Improvement Programs of Knowledge Workers in the Forest Products Industry,&quot; (November 1983).</td>
</tr>
<tr>
<td>23</td>
<td>&quot;Accounting for Buying Back Timber Cutting Contracts,&quot; (December 1984).</td>
</tr>
<tr>
<td>26</td>
<td>&quot;Improving Productivity Through Internal Contracting,&quot; (March 1986).</td>
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<tr>
<td>27</td>
<td>&quot;Perspectives on the Timber Industry From a Lender's Standpoint,&quot; (October 1986).</td>
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<tr>
<td>28</td>
<td>&quot;Long-Term Timber Supply and Its Importance in Strategic Planning,&quot; (March 1987).</td>
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The views expressed herein are those of the author(s), and do not necessarily represent those of Oregon State University.

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