Chapter 2
Literature Review

The Southeastern U.S. has the lowest logging costs of any region in the country (Bradley 1991). Over the past three decades the Southeast has rapidly implemented technological improvements in harvesting mechanization which have in turn contributed to increased worker safety and improved productivity per man. The tree length harvesting system has played a key role in the cost efficacy of southern loggers (Cubbage and Carter 1994). Grapple skidding, a well-known component of the southern tree length system, working in concert with a shearhead or sawhead feller-buncher has demonstrated significant productivity advantages over cable skidding (Hoffman 1991). The emphasis on even-aged pine plantation forestry has made clearcutting a prevalent silvicultural method in the South. Felling and skidding costs are considerably lower in stands harvested by the clearcut method instead of shelterwood and single tree selection methods (Kluender and Stokes 1994).

The heavy demands on timber supplies and pressures on their availability have high wood costs increasing (Cubbage et al. 1995). Since stumpage, logging and trucking are the primary components of delivered wood costs, industry attention on logging and trucking costs is acute. While foresters have recognized the importance of professional and profitable loggers, the need for low cost wood at the mill has kept downward pressure on logging and trucking rates. Therefore, there is the ever-present question: "What does it cost to log?" and the continuing challenge to reach new levels of efficiency in harvesting and transportation of forest products.

2.1 Logging Cost Analysis

Traditionally logging cost analysis has emphasized the minimization of cost achieved through high efficiency per machine in a balanced system (Matthews 1942). This has led to a branch of harvesting research focusing on the analytical approach to logging costs. Here time studies are used to determine the production rates of individual machines.

These production rates are coupled with assumed fixed costs of ownership (depreciation, interest, insurance, etc.) and estimated variable costs (fuel, lube, tires, etc.) of machine operation determine standard machine rates. Standard machine rates are typically expressed as dollars per unit volume or as dollars per scheduled or productive machine hour. The cost of the whole operation is determined by adding the cost of the parts.

The machine rate has wide spread usage for expressing logging costs because of its ease of calculation. Consequently many cost models have constructed with machine rates. However, because there are many rules-of-thumb, artificial variables, and assumptions, the machine rate approach can be misapplied (Miyata 1980).

The general systems approach is an alternative procedure to logging cost analysis. This approach seeks to understand the job as a whole rather than breaking it down into parts. A basic requirement of this method is cash flow and production information over a designated period of time. The objective is to understand the actual nature of operating expenses faced by a logging job in relation to actual production or revenues.

At one time many forest products companies could use the general systems approach to understand the cost of logging by looking at their own books for their own logging crews. Company crews have largely faded away due in part to increasing constraints on corporate capital investment (Black 1984). They have been replaced by more efficient independent contractors. Even when these company crews were active, cost accounting procedures often made it nearly impossible to determine the true costs, which were mixed in with other company overheads and maintenance costs (Stuart 1998). A contracting mill can not assess the cash flows of the independent contractor. It would challenge the independent status of the contractor by violating the arms length relationship.

The general systems approach is best used by a neutral third party, which can provide confidentiality of cost information. Loving (1991) used the general systems approach to study twenty-four tree-length mechanized Southern loggers in the Coastal Plain,

Piedmont and Appalachian Mountains. He used a personal interview format to understand individual contractor business management styles and production strategies.

2.2 Components of Logging Costs

Loving found that 75% of the total cost for the average logging firm for the years 1988 and 1989 were in the labor, equipment and consumable supplies categories. With the remaining costs in insurance, contract hauling, and administrative overhead. Labor, equipment and consumables accounted for 85 to 90% of the total cost with contract hauling costs excluded. Labor was typically the largest cost component followed by equipment and then consumable supplies. Plotted on a monthly basis, the major cost categories tended to behave as fixed costs.

Loving (1991) found the relative levels of spending in the labor, equipment and consumable supplies categories to tend to reflect business health. If the percentages of total cost of the three categories were nearly equal, the business was in maturity stage. A business in the growth stage was typically spending a high percentage on equipment payments. Businesses in decline tended to have a small percentage in equipment payments and a larger percentage in consumables.

The general systems approach has been used successfully in understanding harvesting costs in a variety of logging environments. Hancock (1991) also used the general systems approach in studying nine contractors in Virginia and West Virginia for two years. Again labor was noted as the largest cost component. He concluded that average costs per ton varied significantly between operations and that costs per ton were significantly lowered by increases in production on an annual basis. Sinclair (1985) studied the businesses of twenty-three of small (average 8,000 tons per year) independent logging businesses in Minnesota using the general systems approach. Each participant was trained to use the same accounting procedures to standardize the cost analysis. After removing stumpage and contract services expenses, labor was the largest cost component, followed by consumable supplies and then equipment. It was noted that many of the

firms in this study were “financially weak”, with exceeding small profits after the owner / operator drew a small salary. Net worth positively correlated with business success indicating the “financially stronger firms.”

Ponce (1978) studied pulpwood harvesting operations in Brazil. He noted productivity levels of labor intensive systems and compared these with mechanized systems as well as mixed systems. He showed that the cost of the harvesting system was a trade off between capital costs and labor costs. Depending on the cost and availability of capital and labor in a particular area, the most efficient mix of the two could be combined to design a harvesting operation. Haggard (1981) used the general systems approach to study whole-tree chipping contractors in Southern Ohio. Cost data collected from contractors were matched to production and tract information to perform break-even analysis to determine equitable cut and haul rates. He noted that costs showed less variation than production on a month to month basis.

Labor is usually the largest cost center in modern logging, making up a third to a half of total costs, as indicated in these general systems studies. There have been substantial gains in labor productivity in the industry. Watson et. al. (1989) noted a 25% increase in production per man-hour between 1980 and 1988. Increased labor productivity has been due to mechanization, of course, but that is not the only factor involved. Competitive logging rates have forced inefficient loggers out of the industry. Often these were the less mechanized smaller producers. The net effect is a raising of the average output per worker in the mid-sized, mechanized firms that remain (Rummer 1994). Loggers across the country are experiencing increasing difficulty finding and retaining good labor. Other sectors of the economy compete strongly for qualified workers and cause wages to increase (Tankersley 1997).

Changing social and economic environments have affected the way a logger adds on labor to his business. In the past logging laborers could be hired on for short term needs to take advantage of production opportunities and then laid off when no longer required. The type of worker that could do logging work for a week and then go back to farming

until called upon again is rare. The tactic of using short-term labor to adjust production to fit demand is no longer a feasible in most rural communities. Farming has mechanized and no longer holds a fluid short-term labor pool. With 2% unemployment, there are very few people available who are willing to work in demanding physical jobs on a temporary basis (Stuart 1998).

Capital as a component in total logging costs for the firm has steadily increased with increased mechanization. Capital does not necessarily replace labor, it is often blended into the cost structure of the firm to make better use of the labor. (Stuart et al. 1996) Equipment purchases are by nature long-term costs and perhaps more reflective of the owners business strategy. As described above it is very difficult to add or take away labor as a tactical measure to cope with production environment changes. Once capital is added it too can not be taken away easily. If the equipment can not be adapted to suit a particular production environment and can not be used, the costs still accumulate.

Capital is not just a fixed cost but an investment. A businessman demands a return on his investment. When profits of the firm are low, only the bankers reap a financial return on the capital (Mäkinen 1993). Recognizing the contractor as an *entrepreneur* investing capital in a variety of ways both within and outside the logging business takes into account the full spectrum of a logger's choices for gaining a desirable return on investment. On a cash flow basis, capital costs are payments to principal and interest on a note. For tax purposes, assets are depreciated commonly by a procedure known as the accelerated cost recovery system or by straight-line depreciation (Kamoroff 1982).

2.3 Production Strategies

In the profit equation, revenues count as much as costs. Revenues are directly correlated with production for the cut-and-haul contractor. The modern mechanized contractor is faced with many weekly and monthly fixed costs. There is little he can do to change or "minimize" his costs over the short term, instead he pursues high production to reap high revenues.

In the analytical approach to logging costs, cost minimization on a per unit basis is a key outcome. This strategy is often accomplished, at least in theory, by high utilization of each individual machine. The concept of "balancing the system", involves understanding the production rates of each machine, the cost to run each machine per hour and combining the right number of machines or size of machines to work together at each individual machine's optimum output level. Machine rate costing has stressed balancing the felling, skidding, loading and hauling components to achieve total system efficiency.

Balancing the separate production components of a system seems feasible in a controlled manufacturing setting. However in the raw natural environment, loggers are faced with a constantly changing production setting in terms of stand conditions, hauling distance and product sorting. The cost of equipment prohibits adding or taking away machines for a particular tract. A balanced system has utility for those conditions for which it was balanced. Any change of inputs or environment can cause it to become unbalanced almost immediately (Stuart 1998).

Consequently, Loving's research revealed a contractor force less concerned with balance and more concerned with *flexibility* and *elasticity*. Some of the loggers could rely on a fairly homogenous cutting assignment from tract to tract, however many had to be prepared to cut both hardwood and pine, a variety of products, be able to cut a certain species/product from a tract, or do salvage harvesting. They must be *flexible* to approach a logging job in a way that maximized production with the machines they owned. Most contractors surveyed by Loving preferred to clear-cut pine pulp or chip n' saw, however were able to "redeploy" their crew as needed. Furthermore, some contractors were *upwardly elastic*, taking advantage of any opportunity to surge production to increase revenues. Loving noted that many well-mechanized crews were capable of 27 cords per man-day at full production, which was usually limited by trucking capacity.

Loving's observations of upward elasticity and excess production capacity verified the assertions of Laestadius (1990), who contrasted trends in the Southern wood supply system with those in Scandinavia. Laestadius explained that the Southern wood supply system's emphasis on low wood inventories at the mill had created high levels of idle capacity in the contractors supplying the mill. This idle capacity meant contractors were forgoing opportunities to produce and therefore their ability to cover fixed costs and make a profit was greatly diminished. Mäkinen (1993) identified capacity utilization as a key factor in the success of highly leveraged logging contractors.

LeBel (1993) studied the disparity between the maximum production capacity of Southern loggers and actual achieved production. Wet weather was the largest barrier to production, followed by mill imposed quotas. Combined with mechanical downtime, labor problems and moving between tracts, an average capacity utilization of 70% was observed. Loggers in the piedmont seemed to show the best capacity utilization with a median of 81% and loggers in the Appalachian Mountains showed the poorest capacity utilization at only 63%. LeBel (1996) also asserted that loggers could greatly increase production by eliminating in-woods sorting.

Loving identified four major business survival strategies: 1) equity dissolution, 2) diversification, 3) no changes from current operating conditions, and 4) flexibility / opportunity / efficiency. Production trends usually indicated which survival strategy the contractor chose. Furthermore it was recognized that a linkage could be seen between survival and production strategy and the policies of the contracting company.
The strategy of equity dissolution was viewed as a way for contractors to reduce fixed costs during periods of tight quotas or eventually exit logging as a business. Here a production strategy of downward elasticity comes into play. Equipment is older and requires more repairs. Consumable supply costs are greater than capital costs (Loving 1991).

2.4 Increasing Regulation

The need to improve public perception is arguably the most important issue facing the forest industry. The Sustainable Forestry Initiative (SFI) has been promoted by the large forest products companies as a significant step forward in public perception of the forest industry. Logger education and training programs were organized quickly in most states to comply with the self-imposed deadline of compliance in 1996. Many contractors agreed to forgo production to engage in training. Like any businessperson, the logger seeks to understand the future operating environment to plan a strategy for a profitable business. Most contractors are positive about the SFI but want to know the benefits that will accrue to them for participation in logger training and education programs (Knight 1996).

Harvesting guidelines are an important part of the SFI and logging contractors are feeling the effects. Production losses due to wet weather may be further aggravated by compliance with Best Management Practices (LeBel 1993). The South Carolina Forestry Association (1993) estimated the cost of voluntary BMP compliance based on lost production time to be about $1.77 per ton. Certainly the true costs are difficult to assess. Costs will vary operating strategies on the contractor and procurement organizations, weather and soil conditions. Without substantial capital investment in "weather resistant" equipment as well as excellent tract planning, contractors face increasing levels of weather related downtime. Production variability can lead to cash flow variability, causing a myriad of financial difficulties for the contractor (Loving 1991).

The SFI has forced many larger forest products companies to examine more closely the excess capacity issue for at least two reasons. Part of the excess capacity is in the form of "rogue" contractors. These contractors remain competitive in the wood supply system by cutting corners. Cutting corners can take many forms: running overloaded trucks, bringing mud onto public roads, disregarding best management practices causing erosion and sedimentation and other problems that seriously harm efforts to improve public relations. If the industry can use SFI to remove "rogue" loggers without antitrust

complications, then more professional contractors can do business on a level playing field (Lewis 1996).

Secondly, improving capacity utilization may be a way to improve logger profitability, and therefore professionalism, without increasing wood costs at the mills. The "preferred supplier" policy is being considered by some forest products companies as a solution to having both highly professional contractors represent them and a reliable and steady supply of low-cost wood (Knight 1996).

The regulatory environment has gotten tougher for the modern mechanized contractor in other areas as well. Increased OSHA regulations, the CDL, and other highway regulations are part of the "tightening up" of the environment for timber harvesting.

2.5 Summary

Logging costs consist of labor, equipment, consumable supplies and overhead costs. The labor component tends to be the greatest cost for mechanized logging operations. Costs for capital intensive operations tend to be fixed. Therefore production trends of the firm play a key role in profitability.

The Sustainable Forestry Initiative combined with other new and more stringent regulations are affecting the independent contractor force. Monitoring long-term trends in costs and production using a holistic general systems approach can help the industry understand the changing wood supply system.