24 Improving Forest Management Through the Supply Chain: an Assessment of Wood Procurement Management Systems in the Forest Products Industry

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Introduction

Non-industrial private forestlands (NIPFs) are a key supplier of raw materials to the forest products industry in the USA. In response to concerns regarding the sustainability of forest management on NIPFs (Nyland, 1986; Nilsson, 1999), forest products companies are striving to improve their wood procurement policies and practices. These concerns exist because of trends towards smaller ownerships, a general lack of knowledge or interest in forestry by owners of smaller holdings and the lack of forester involvement when these owners decide to harvest and sell their timber. In fact, loggers are often the first, and only, point of contact when a landowner decides to sell their timber (Birch, 1995; DeCoster, 1998). In addition, because most forest products firms procure a majority of their wood fibre on the open market directly from loggers and brokers, the quality of forest management associated with their raw material supply is often unknown.

These are among the reasons that certification programmes, such as the Sustainable Forestry Initiative Program (SFI), require participating companies to adopt wood procurement policies and strategies. For example, the SFI standard requires participating companies to increase their use of professionally trained loggers. It also encourages companies to initiate or renew public outreach and landowner assistance programmes as a means to improve forest management on NIPFs. Similarly, the Forest Stewardship Council (FSC) developed the concept of chain-of-custody as a means to assure consumers and the public that the wood products they purchase were procured from sustainable forests.

While these are promising trends, the degree to which forest products firms are adopting management systems to improve forest management throughout their supply chain is unknown. Environmental management systems (EMS) are formal policies and procedures that define how an organization will manage its potential impacts on the environment and are critical for systematically maintaining, adapting and continuously improving environmental performance (ISO, 1998; Welford, 1998; Darnall *et al.*, 2000). Through a nationwide survey, this study measured the development of wood procurement management systems designed to improve forest management on NIPFs and describes operations at different levels of development. We also provide some insight into which forest products operations have the greatest capability to improve forest management throughout their supply chain.

 Forest Policy for Private Forestry: Global and Regional Challenges (eds L. Teeter, B. Cashore and D. Zhang)

Methods

Selection of wood procurement practices

To measure wood procurement management systems, wood procurement practices that lead to improved forest management were identified using the SFI standard and available literature (Stier *et al.*, 1986; Lones and Hoffman, 1990; SFI, 1999). Informal interviews with wood procurement managers throughout the nation bolstered or added to the selection of wood procurement practices. The following practices guided questionnaire development.

1. Maintain written wood procurement policy.
2. Implement landowner assistance programmes.
3. Implement public outreach programmes.
4. Use professionally trained loggers.
5. Select wood dealers or timber brokers based on their use of professionally trained loggers.
6. Participation of procurement staff in continuing education.
7. Use defined standards when harvesting standing timber.
8. Monitor percentage of supply delivered by trained loggers and coming from lands managed with forester involvement.

Questionnaire development

Corporate strategy research proposes that environmental policies, programmes and actions develop along a continuum from non-existent to highly formalized as a firm becomes more proactive in managing environmental issues (Hunt and Auster, 1990; GEMI, 1993; Darnall *et al.*, 2000). The survey measured this development through summated rating scales. Summated rating scales combine several indicators to measure a broader latent concept that is assumed to have an underlying quantitative measurement continuum (Spector, 1992). Scales are more reliable than single questions because they can thoroughly describe complex concepts, whereas single questions oversimplify them. Furthermore, a series of questions measuring the same concept are more precise because they more accurately differentiate between respondents.

The wood procurement management system consisted of three distinct but interrelated attributes of an EMS drawn from the ISO 14001 Environmental Management System Standard. These attributes were: (i) *policy and planning*, (ii) *implementation and operation*, and (iii) *monitoring and evaluation*. Individual questions measured the implementation of every practice within each attribute, contributing to the overall development of that attribute (Table 24.1). Each attribute contributed to the overall development of the management system.

Likert-scale responses allowed questions to be measured at some level of magnitude or strength not directly observable (DeVellis, 1991). The responses to the questions were based on 6- and 7-point scales. The underlying premise of the scale was the presence of formalized policies, operating procedures and methods for monitoring and evaluating performance within a given management system. Thus, a higher score was an indication of a more developed management system.

Policy-related questions asked respondents to indicate, by their level of agreement with the statement, if the magnitude of policy and planning development described in the question applied to their operation. A '1' indicated strongly disagree and '6' strongly agree. Points '2' and '5' represented disagree and agree, while '3' and '4' represented mild disagreement or agreement. A 6-point scale was chosen because it lacked a neutral point, forcing people to decide their level of agreement with the statement (Presser and Schuman, 1980; Bishop, 1987). Responses to the implementation and operation and the monitoring and evaluation questions were on a 7-point scale that measured frequency, where '1' meant never and '7' always. Points '2' and '6' represented rarely and almost always, while point '3' represented seldom and point '5' most of the time. A '4' represented a response of sometimes.

Because the scales for each attribute were different, a proportion (the average proportion of the three attributes) served as the overall management system score. A higher proportion indicated more highly developed management systems. Four categorical thresholds were established to represent different levels of management system development.

Table 24.1. Wood procurement management system with attributes and management practices in the questionnaire.

	Attributes		
	Policy and planning 1. Policies 2. Objectives	Implementation 1. Training and competence 2. Responsibilities and programmes	Monitoring and evaluation 1. Long-term monitoring 2. Review policies and procedures
Practices	3. Communication	3. Ongoing monitoring	
1. General policy issues	Detailed, written procurement policy Communicate policy to suppliers Communicate policy to public		Review and set new objectives yearly
2. Landowner assistance	Formal landowner assistance programme	We have staff positions dedicated to landowner assistance	Evaluate effectiveness of landowner assistance programme
3. Public outreach	Formal public outreach programme	Systematically distribute educational materials on forest management to landowners Systematically distribute educational materials on forest management to the general public	Evaluate effectiveness of outreach programmes
4. Forester throughout supply chain		Logs purchased by our operation come from lands managed by a forester	Track percentage of wood supply from lands managed by a forester
5. Supplier selection	Purchase from loggers based on environmental performance requirements Timber brokers selected based on skill of loggers from which they buy wood	Loggers supplying gatewood are paid more if professionally trained Loggers supplying gatewood have completed professional logger training	Track percentage gatewood from trained loggers Track total supply from trained loggers
6. Continuing education		Forestry staff participates in continuing education yearly	Staff evaluated for meeting environmental performance goals
7. Standards for harvesting standing timber	Detailed, written standards for harvesting standing timber	Loggers harvesting stumpage have completed professional logger training Our operation uses foresters or forest technicians to purchase standing timber Logging contracts require BMP compliance	Inspect harvests of standing timber

Level of development	*Score range*
Undeveloped	0.0–0.35
Poor	0.36–0.60
Moderate	0.61–0.85
Well-developed	0.86–100.0

These thresholds correspond with the average response on the Likert scale. They are not absolutes, but guidelines along a continuum of development. Operations with undeveloped management systems rarely or never implement the practices measured within the survey. Poorly developed management systems are characterized by minimal policy development, inconsistent levels of implementation, and minimal monitoring and evaluation. Operations with moderately developed systems will implement most of the practices measured in the survey with some level of consistency within all three attributes. Operations with well-developed management systems will 'always' or 'almost always' implement every practice throughout the management system framework. Such operations will maintain defined policies and systematically implement, monitor and evaluate their wood procurement practices.

The validity of the scales was assessed through expert review on two different draft surveys. The survey also collected data on categorical operations-specific characteristics to facilitate the descriptive analysis including participation in a forest management standard, ownership structure (e.g. public or private ownership), production capacity, number of employees and manufacturing type (e.g. sawmill, pulp and paper mill, or engineered forest products mill).

Sampling design

Questionnaires with cover letters were sent to a random sample of 700 pulp and paper, engineered forest products, and sawmill operations drawn from 37 state forest products and three state industry directories, following techniques developed by Dillman (1978). To maintain the focus of the study on year-round operations, only mills producing more than 1,000,000 board feet or volume equivalent were included in the study. The required sample size was based on a desired sampling error of 5% and a sample frame population of 3498. The operations level, referring to an individual mill or a production complex of mills, was chosen rather than the firm or subsidiary because operations of the same company can vary based on manufacturing technology and product mix (Stier *et al.*, 1986). In addition, regional location can affect wood procurement and forest management practices, depending on land ownership patterns, forest type and the state's regulatory atmosphere based on the comprehensiveness of policies and level of enforcement (Dillon and Fischer, 1992; Ellefson *et al.*, 1995).

Statistical analysis

One-way ANOVA was used to compare the mean wood procurement management system score across categorical demographic variables. An α value of 0.05 established statistical significance. When the ANOVA *F*-ratio indicated a significant difference in means, individual group differences were tested using Tukey's honestly significant differences method. Contingency tables between the different levels of system development and categorical independent variables facilitated further descriptive analysis.

Cronbach's α coefficient was used to measure the reliability of the scales (Carmines and Zeller, 1979). Cronbach's α may range from 0 to 1, where higher values indicate greater reliability. The reliability of all three scales was deemed sufficient (Table 24.2).

Results

Out of 668 deliverable surveys, 264 usable surveys were returned, giving a 40% response rate. To assess the potential for non-response bias, 20 variables were tested for differences between early and late respondents as defined by the return date

Table 24.2. Summated ratings scales for wood procurement with their associated Cronbach's α coefficient.

Scales	Number of items	Cronbach's α
Policy and planning	7	0.8376
Implementation and operation	11	0.7938
Monitoring and evaluation	8	0.8775

of the questionnaires. Three variables revealed significant differences. Early respondents were more likely to be publicly owned than late respondents ($P < 0.005$). Late respondents were more likely to have lower overall EMS scores within their wood procurement operations ($P < 0.027$) and less likely to adhere to a forest management standard ($P < 0.032$). Therefore, we suspect that our non-respondents generally have less developed management systems than our sample.

Demographic description of the sample

Of the respondents, 81% were sawmills ($n = 216$). The remaining operations were split among pulp and paper mills ($n = 24$) and engineered forest products mills ($n = 24$). The average production was around 5–10 million board feet annually. The average number of employees was about 25–100. Forty-five respondents were from the Northeast, 135 from the Southeast, 53 from the Midwest, and 31 from the West. Of these 142 (54%) of the operations did not participate in a forest management standard, although 55 operations adhered to the Tree Farm programme standards. Of the 58 operations participating in the SFI Standard, 27 had also undergone a third-party assessment of their conformance to either the SFI Standard (10 operations), the International Organization for Standardization's 14001 Environmental Management System standard (13 operations), and the Forest Stewardship Council's principles and criteria for good forest management (4 operations).

Characterizing levels of development

The distribution of EMS scores ranged from a low of 12 to a high of 99 (Fig. 24.1). Most of the operations (81%) fell in the middle range (poor to moderate) of management system development; 29 operations had undeveloped wood procurement management systems while 107 operations had poorly developed ones. In total, 111 operations were in the moderate stage of development and 14 operations in the well-developed stage.

Operations participating in the SFI Program, or that had undergone a third-party conformance assessment to a forest management standard, had more developed wood procurement management systems than operations participating in the Tree Farm system or in no forest management standard (Table 24.3). Tree Farm participants had more developed management systems than operations that did not participate in any forest management standards. Operations adhering to the SFI standard and which underwent third-party assessments of conformance to SFI or ISO or the FSC standards were predominantly in the moderate stage (81 and 67%, respectively) of wood procurement management system development. Operations participating in the Tree Farm programme possessed poorly (50%) and moderately (40%)

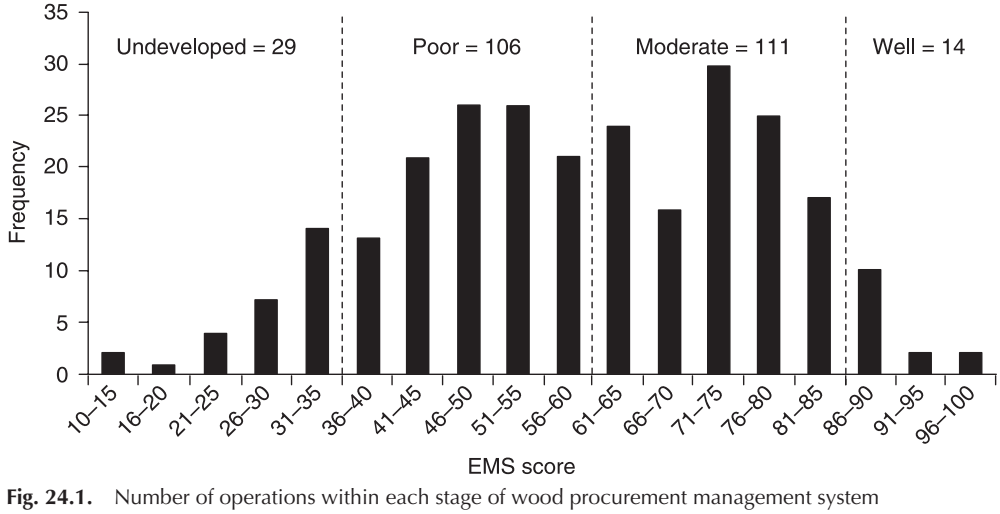

Fig. 24.1. Number of operations within each stage of wood procurement management system development.

Table 24.3. Level of wood procurement management system development by category.

Operations specific variables		Level of management system development					Management system scale	
		Undeveloped	Poor	Moderate	Well	*n*	Mean	Standard deviation
Forest Management Standard	None	25	72	44	1	142	0.52[a]	0.16
	Tree Farm	4	30	24	2	60	0.58[b]	0.16
	SFI	–	2	25	4	31	0.73[c]	0.11
	Third-party	–	2	18	7	27	0.79[c]	0.13
Ownership	Private	29	103	79	5	216	0.55[a]	0.10
	Public	–	4	32	9	45	0.75[b]	0.17
Production	1–5 mmbf	20	35	17	5	77	0.50[a]	0.19
	5–10 mmbf	4	22	23	–	49	0.57[a]	0.14
	10–30 mmbf	3	27	16	1	47	0.56[a]	0.15
	> 30 mmbf	2	21	47	7	77	0.68[b]	0.13
Employees	< 25	20	34	20	3	77	0.50[a]	0.19
	25–100	6	48	36	4	94	0.58[b]	0.15
	100–500	3	20	35	2	60	0.63[b]	0.15
	> 500	–	5	19	4	28	0.72[c]	0.11
Manufacturing type	Saw	27	99	82	4	212	0.56[a]	0.16
	Engineered	2	6	11	5	24	0.67[b]	0.20
	Pulp and paper	–	2	18	4	24	0.74[b]	0.9

Within a category, mean scores with shared letters are not significantly different.

developed management systems, while firms that did not participate in any standard were predominantly in the poor stage (51%).

Privately owned operations had less developed wood procurement management systems than publicly owned operations (Table 24.3). Privately owned operations generally possessed poorly developed wood procurement management systems (48%), while publicly owned operations were moderately developed (71%). It is important to note that the majority of sawmills are privately held companies, while engineered wood products and pulp and paper operations are more likely to be publicly owned.

Operations with a production capacity greater than 30 million board feet (mmbf) had significantly more developed wood procurement management systems than all other operations with 61% in the moderate stage of development (Table 24.3). There were no differences between all other production levels. Operations with lower production capacities were predominantly in the poor stage of system development. In terms of number of employees, operations with more than 500 employees had the most developed management systems, with 68% in the moderate stage of development. Operations with less than 25 employees had the least developed management systems, with 70% in the poor or undeveloped stages. In addition, 50% (15 operations) of the undeveloped group do not purchase standing timber, while 42% (12 operations) rely completely on the open market for their wood supply.

Development by manufacturing type

Operations with undeveloped and poorly developed wood procurement management systems are predominantly privately owned sawmills (mean development score = 0.56) (Fig. 24.2), particularly if they have fewer than 100 employees and a production capacity of less than 30 million board feet (Table 24.3). The weaker performers do not adhere to any forest management standards or participate in the Tree Farm programme. Sawmills producing more than 30 million board feet and employing more than 100 employees account for most of the operations at the moderate stages of development. Operations in this stage are more likely to participate in the SFI Program or third-party certification. Of the three manufacturing types, this was the only sector in which

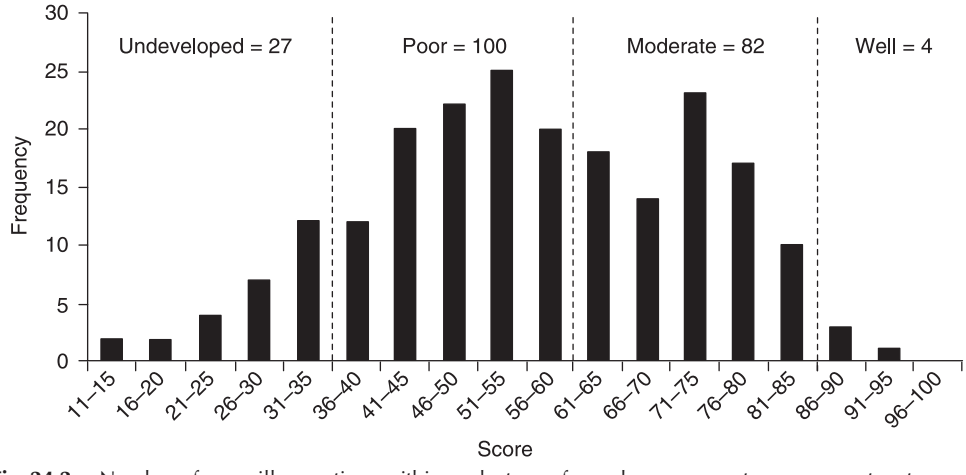

Fig. 24.2. Number of sawmill operations within each stage of wood procurement management system development.

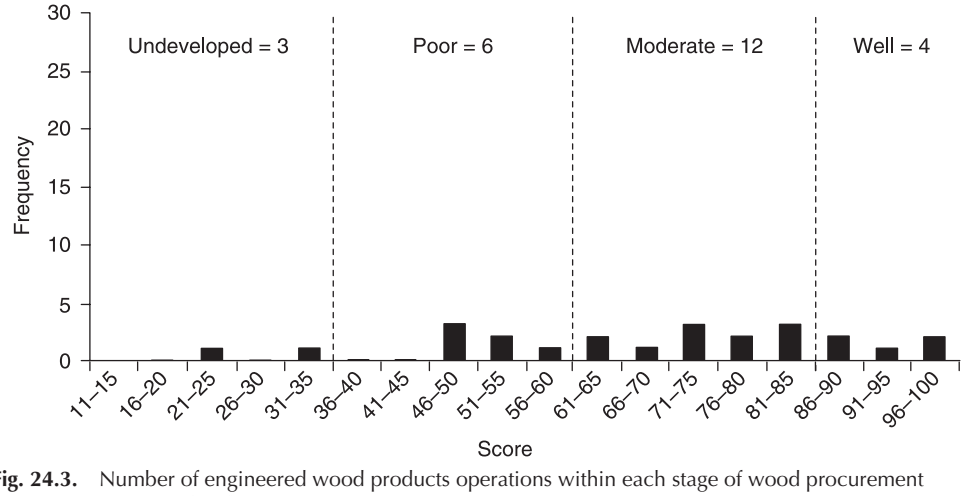

Fig. 24.3. Number of engineered wood products operations within each stage of wood procurement management system development.

publicly held operations (mean score = 0.72) out-performed privately owned operations (mean score = 0.55) (Table 24.3).

The engineered wood products sector performed significantly better than the sawmills (Table 24.3), exhibiting a wide distribution of EMS scores (Fig. 24.3). Engineered wood products operations participating in the SFI Program or third-party certified had moderately developed EMS for wood procurement. The limited number of respondents ($n = 24$) did not produce significant results in terms of production levels and number of employees. Noteworthy, however, was the significantly higher EMS score for privately (mean score = 0.79) versus publicly (mean score = 0.61) owned operations.

The pulp and paper sector also performed significantly better than the sawmills, but not significantly different from the engineered wood products operations (Table 24.3). Whereas the sawmills were normally distributed across the continuum (Fig. 24.2), and the engineered wood products were widely distributed (Fig. 24.3), the pulp and paper sector was skewed to the moderate to well developed location of the continuum (Fig. 24.4). Similar to the other sectors, participation in the SFI Program or third-party certification yielded significantly higher EMS scores versus participation in

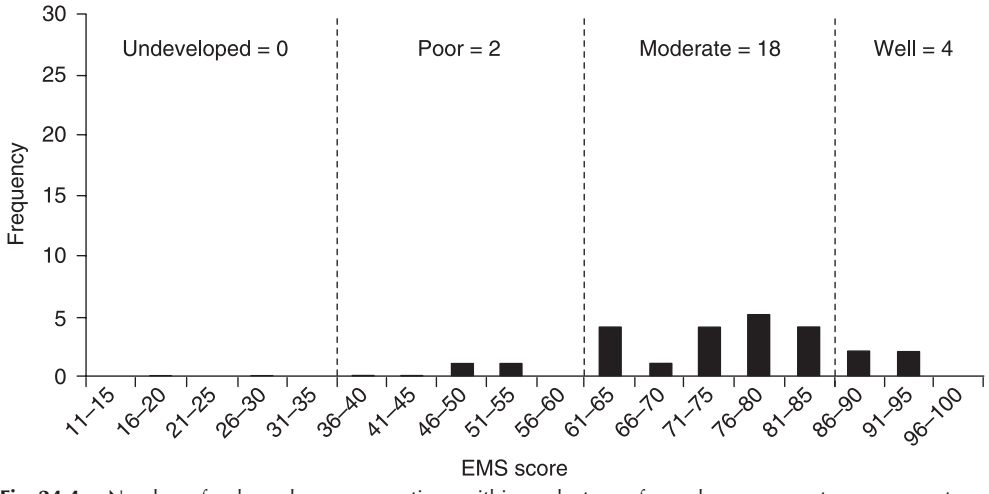

Fig. 24.4. Number of pulp and paper operations within each stage of wood procurement management system development.

Tree Farm or no participation. We suspect that the limited number of respondents ($n = 24$) contributed to the lack of significant differences in terms of production level and number of employees categories. The EMS scores were nearly identical for privately (mean score = 0.74) versus publicly (mean score = 0.75) owned operations.

Discussion

The distribution of EMS scores across the industry suggests that management systems for wood procurement operations are still a relatively new phenomenon. Few operations have well-developed management systems, while half of the sample is collectively in the poor and undeveloped stage. Given that the non-respondent bias analysis indicated that non-respondents were more likely to have lower overall EMS scores within their wood procurement operations, we suspect that this study may actually overstate EMS development for wood procurement.

The results are consistent with the history of supply chain management, which has traditionally focused on the 'ends' of securing and maintaining wood fibre rather than the 'means'. Forest products industry managers have only recently begun to evaluate the 'means' by which they secure inventory, a trend similar in all industries (Porter, 1985; Riggs and Robbins, 1998; Welford, 1998). Much of this has to do with the relative ease of obtaining their wood fibre supply during most of the 20th century. Today, however, a wide host of factors such as the increasing demand for wood products, societal demands for sustainable forest management, increasing fragmentation and parcelization of timberlands, further conservation of private lands, and growing evidence of diameter limit cutting and high-grading are all conspiring to limit available wood supplies (Fajvan *et al.*, 1998; Nilsson *et al.*, 1999; Alig *et al.*, 2000). 'Just getting the wood to the yard' is no longer an effective procurement strategy. The study results suggest that wood procurement managers are beginning to incorporate a systems approach.

Specifically, larger scale operations adhering to the SFI or a third-party standard had the most developed wood procurement management systems. The positive role of the SFI Program is not surprising as it is the only standard that explicitly addresses wood procurement practices. Many of the individual wood procurement practices within the SFI Program, particularly the use of trained loggers to deliver wood fibre, are fast becoming accepted practices within the industry. However, the state of wood procurement management systems within this group should be viewed in light of the type of operation that is a member of the American Forest and Paper Association – mostly large pulp and paper operations, many of which have undergone third-party assessments of their conformance to a forest management standard. Furthermore, it is important to note that these large firms have been under the most public and

government pressure to improve their environmental performance, from air and water emissions in the 1970s to forest management issues in the 1990s (Lent *et al.*, 1998). The SFI Program is now serving as a primary vehicle for these firms to regain public confidence in how they manage both their own forestlands as well as the increasingly strategic NIPFs.

In addition, the human, financial and organizational resources available to larger operations enable them to make the investments in time and money needed to implement improved wood procurement practices. Mills with production capacities greater than 30 mmbf (or volume equivalent) require more sophisticated management systems to support and maintain a larger procurement staff. In contrast, mills producing less than 30 mmbf, particularly operations in the 10 mmbf range, tend to be small, family-owned sawmill businesses with a thin layer of management that must focus their resources on maintaining the technology required to maximize productivity and ultimately profitability (Barrett *et al.*, 1996). Wood procurement staff are often too consumed with the day-to-day challenges of securing high quality logs to dedicate resources towards developing an EMS for wood procurement. Exacerbating the matter, rising stumpage and log costs are translating into narrowing profit margins, making it increasingly difficult to focus on improving wood procurement practices. This lack of financial and people resources is a major reason why smaller firms in most industries are resistant to environmental regulation and initiatives (Harris, 1985; O'Laoire and Welford, 1998).

The opportunity for movement up the developmental scale seems limited since procurement, in general, puts more strain on earnings than most anything else in a business, including labour and overhead (Porter, 1985). Again, this is particularly so for sawmills, due to the high cost of logs and the fact that sawmills have a narrower range of options to meet their supply needs compared with pulp and paper and engineered forest products mills. The later two can utilize a wide spectrum of resources to meet their needs, such as low-grade roundwood, recycled fibre, chips and fibre from short-rotation, high-yield plantations. In contrast, sawmills are limited to sound logs capable of producing marketable wood products such as spruce–fir framing lumber, white pine boards or hardwood dimensional lumber. However, even small incremental improvements in wood procurement management systems can make a positive contribution to long-term supply issues for sawmills. Improved stewardship and increased productivity on NIPFs within a mills' woodshed will provide greater assurance of a reliable supply of higher quality wood from sustainably managed forests in the future. This is important, since sawmill operations customarily serve one geographical region and depend on that area for their timber supply (Propper de Callejon *et al.*, 1998).

Relevant to all industries is the fact that improving general environmental performance is gradually becoming a standard business-to-business requirement (Tibor and Feldman, 1998; Darnall *et al.*, 2000). For example, large corporations (e.g. in the automobile or chemical industries) are requiring their suppliers to implement and certify environmental management systems. At the retail end of the forest products industry, the home improvement sector is beginning to develop procurement policies that favour wood products that come from forests known to be sustainably managed (Lober and Eisen, 1995). If such policies become common throughout the retail sector of forest products, than the quality of wood procurement practices may dictate market access (Jenkins and Smith, 1998).

Wood procurement practices will continue to become increasingly relevant to the sustainable management of forest resources for all segments of the forest products industry. Those forest products operations that continue to develop their wood procurement management systems to improve forestry practices on all forestlands will improve their productivity as well as short- and long-term competitiveness. To further facilitate the improvement of wood procurement management systems across the industry, future research efforts should focus on testing wood procurement strategies that simultaneously lead to costs savings and improved forest management. This will be particularly critical to the sawmill operations that currently lack the resources to incorporate EMS for wood procurement.

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