Assessing wood procurement management systems in the forest products industry

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Abstract

Nonindustrial private forestlands (NIPFs) are a key supplier of raw materials to the forest products industry in the United States. In response to concerns about the sustainability of harvests on NIPFs, forest products firms are striving to improve their wood procurement operations. An industry-wide survey of the forest products industry was conducted to measure the development of wood procurement management systems designed to improve forest management on NIPFs. The results indicated that operations with production capacities greater than 30 MMBF or with more than 500 employees, as well as those participating in the Sustainable Forestry Initiative standard, had moderately developed or well-developed wood procurement management systems. Sawmills producing less than 10 MMBF, especially those that did not adhere to any forest management standard, had poorly developed or undeveloped wood procurement management systems, which will make it difficult for these sawmills to improve their environmental performance and gain access to NIPFs and future markets.

Increasing concerns about the impact of timber harvesting on forest health, water resources, habitat fragmentation, and declining biodiversity over the last three decades have made the forest products industry the target of intense public scrutiny and government regulation (de Callejon et al. 1998a). In response to these pressures, which include consumer demands and industry-wide competition, forest products firms are adopting sustainable forest management on company forestlands. Sustainable forest management attempts to balance timber production with a range of other forest values including the conservation of biodiversity, watershed and wetland protection, recreation, and wildlife (Vogt et al. 2000, Johnson and Ditz 1997, Upton and Bass 1995). Additionally, firms are looking beyond their own forest holdings and striving to incorporate sustainable forest management on all lands within their wood procurement regions, particularly on the nation's nonindustrial private forestlands (NIPFs).

The recent industry focus on wood procurement policies and practices is largely the result of an increasing reliance on NIPFs for wood supply (Nilsson et al. 1999, Haynes et al. 1993). Of the estimated 16 billion ft.^{3} harvested in the United States in 1996, nearly 60 percent (9.5 billion ft.^{3}) of the volume originated from NIPFs (**Fig. 1**). This figure represents a 25 percent increase from 1991 (USDA 1999). Forest products operations located in the eastern half of the country may procure as much as 80 to 90 percent of their roundwood needs from NIPF owners (AF&PA 2000, Germain 1999, Newman and Wear 1993, Powell et al. 1993). Because most forest products firms procure a majority of their wood fiber on the open market directly from loggers and brokers, the quality of forest management associated with their wood supply is often in question.

These are among the reasons that certification programs, such as the American Forest and Paper Association's Sustainable Forestry Initiative Program (SFI), require participating companies to adopt wood procurement policies and strategies. 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 originate from sustainably managed forests. While these are promising trends, the degree to which forest products firms

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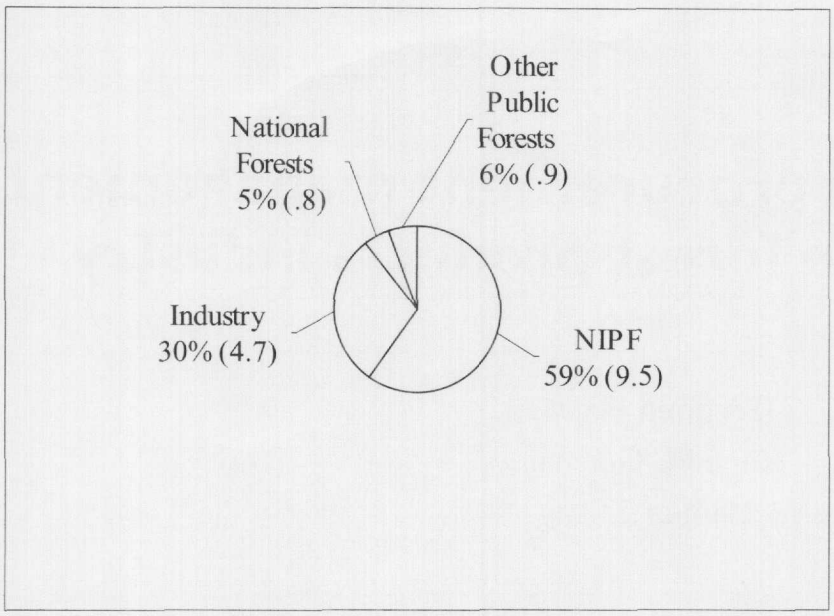

Figure 1. – 1997 breakdown of timber removals per ownership category (based on 16 billion ft.^{3}) (USDA 1999).

are adopting management systems to improve forest management throughout their supply chain is unknown.

An environmental management system (EMS) contains formal policies and procedures that define how an organization will manage its potential impacts on the environment. An EMS facilitates an organization's ability to systematically maintain, adapt, and continuously improve environmental performance. Though the primary reason that many firms implement an EMS is to improve compliance with environmental regulations, an EMS can also help an organization move beyond compliance. In short, an EMS ensures that a forest products company has the system in place to implement on-the-ground management activities consistent with sustainable forest management (ISO 1998). Since the early 1990s, several organizations have initiated the development of EMS standards at the national, regional, and international level to facilitate international trade and maintain environmental performance. Published standards include the International Organization for Standardization's (ISO) 14001 EMS Series, the British Standards Institutes BS–7750, and the European Union's Eco-Management Audit Scheme (Darnall et al. 2000, ISO 1998, Welford 1998).

There is little research addressing the adoption of an EMS for wood procurement by the forest products industry. Through a nationwide survey of the forest products industry, this study measured the level of development of EMSs for wood procurement practices. The results describe the level of EMS development by industry sector, and provide insight into the operational characteristics associated with various levels of EMS development.

Methods

Survey design and development

To measure wood procurement management systems through a survey instrument, wood procurement practices that contribute to sustainable forest management were identified using existing standards in the industry (SFIS 1999, Lones and Hoffman 1990, Stier et al. 1986). Informal phone interviews with wood procurement managers throughout the nation, plus discussions with foresters at the 1999 National Society of American Foresters Conference, provided supplemental information to generate the following list of wood procurement indicators for the survey: 1) maintaining written wood procurement policy; 2) implementing landowner assistance programs (i.e., distributing educational materials on forest management to private landowners, and having company staff and resources dedicated to assisting private landowners with management plans, silvicultural activities, and timber sale administration); 3) implementing public outreach programs (i.e., distributing educational materials on forest management to the general public); 4) using professionally trained loggers; 5) selecting wood dealers or timber brokers based on their use of professionally trained loggers; 6) offering annual continuing education opportunities to procurement staff; 7) using defined standards when harvesting standing timber; and 8) monitoring percent of supply delivered by trained loggers and coming from lands managed with forester involvement.

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

The wood procurement management system consisted of three distinct but interrelated attributes of an EMS based on the ISO 14001 Environmental Management System Standard: 1) policy and planning; 2) implementation and operation; and 3) monitoring and evaluation. Individual statements associated with each of the eight wood procurement indicators measured the implementation of wood procurement practices within each attribute, contributing to the overall development of that attribute. Each attribute contributed to the overall development of the management system score (**Table 1**).

Responses to the statements were based on 6- and 7-point scales. The underlying premise of the scale was the presence of 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. The 6-point

scale was chosen for the policy scale because it lacked a neutral point, forcing respondents to decide their level of agreement with the statement (Bishop 1987). 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 statement applied to their operation: 1 = strongly disagree; 2 = disagree; 3 = mild disagreement; 4 = mild agreement; 6 = strongly agree. Responses to the implementation/operation and monitoring/evaluation statements were on a 7-point scale that measured frequency: 1 = never; 2 = rarely; 3 = seldom; 4 = sometimes; 6 = almost always; 7 = always.

Because the Likert scales were based on both 6 and 7 points, an average proportion (on a 0 to 1 scale) of the three attributes served as the overall management system score. The proportion was calculated by dividing the average score for each attribute by the total possible score for that attribute. A higher proportion indicated more highly developed management systems. Four categorical thresholds were established to represent different levels of management system development with the range of scores in parentheses as follows: 1) undeveloped (0.0 to 0.35); 2) poorly developed (0.35 to 0.60); 3) moderately developed (0.60 to 0.85); and 4) well developed (0.85 to 1.00). These thresholds correspond with the average score within each attribute 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.

Sampling design

The survey instrument was sent to a random sample of 700 pulp and paper, engineered forest products, and sawmill operations drawn from 37 state forest products and 3 state industry directories, following techniques developed by

Table 1. – Wood procurement management system attributes and management indicators used in the survey.

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

Dillman (1978). To maintain the focus of the study on year-round operations, only mills producing more than 1 million board feet (MMBF) or volume equivalent (in tons) were included in the study.

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 landownership patterns, forest type, and the state's regulatory atmosphere based on the comprehensiveness of policies and level of enforcement (Ellefson et al. 1995; Dillon and Fischer 1992).

The survey collected data on six forest products operational variables to facilitate the analyses. The six variables had two to four categories, consisting of the following: 1) participation in a forest management standard; 2) ownership structure (e.g., public ownership and private ownership); 3) production capacity (e.g., 1 to 5 MMBF, 5 to 10 MMBF, 10 to 30 MMBF, and >30 MMBF annually; 4) species mix (softwood, hardwood, mix); 5) number of employees (e.g., < 25, 25 to 100, 100 to 500, and >500); and 6) manufacturing type (e.g., sawmill, engineered forest products mill, and pulp and paper mill). The adoption of sustainable forest management standards, the first operational variable, is becoming increasingly important as a way to improve forest management and give proof of good environmental performance. The standards vary in their scope, intensity of evaluation, and definition. The following standards were used in this study: 1) third-party assessment through SFI, ISO, or FSC; 2) SFI participant; 3) Tree Farm participant; and 4) no standard.

Statistical analysis

The validity of the scales was assessed through expert review on two different draft surveys. The reliability of all scales was evaluated by the Cronbach's alpha coefficient for the three attributes of the wood procurement management system (policy/planning, implementation/operation, and monitoring/evaluation) and Cronbach's alpha may range from zero to one, where higher values indicate greater reliability. Depending upon the characteristics of the survey, as well as the needs of the research, acceptable alphas can range from .60 to 1.00 (Carmines and Zeller 1979, Nunnally 1978). The scales associated with this study had Cronbach's alpha coefficients of 0.8 or higher (**Table 2**).

One-way analysis of variance (ANOVA) was used to compare the mean scores across the categories of the six operational variables. An alpha level of 0.05 established statistical significance. The frequencies across the four levels of management system development and the categories of the six operational variables were presented.

Correspondence analysis was then used to graphically explore the relationships between the development of wood procurement management systems and the different levels associated with the operational variables. Correspondence analysis is a useful multivariate technique for analyzing cross-tabular survey data. The technique presents the frequency table visually by placing the categories of the row variable (each operational variable in the study, i.e. forest management standard, production capacity, species mix, number of employees, and manufacture type) and column variables (level of management system development) as points in a two-dimensional correspondence analysis plot. If the operational variable is highly associated with the level of the management system, the corresponding points will be in close proximity in the plot. In contrast, if the operational variable is weakly associated with the level of the management system, the corresponding points will be positioned further apart in the plot (Brown and Harris 1998, Clausen 1998, Greenacre 1993). Correspondence analysis was conducted for all operational variables with more than two categories.

Table 2. – Summated ratings scales for wood procurement with their associated Cronbach's alpha coefficient.

Scales	Number of items	Cronbach's alpha
Policy and planning	7	.8376
Implementation and operation	11	.7938
Monitoring and evaluation	8	.8775

Results

Out of 668 deliverable surveys, 265 usable surveys were returned for a response rate of 40 percent. There were a few missing values in some categories; therefore, the total number of surveys used in the analysis varied for the six operational variables. To assess the potential for non-response bias, all variables were tested for differences between early and late respondents as defined by the return date of the surveys. 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.

Eighty-two percent of the respondents 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 between 5 MMBF to 10 MMBF annually. The general species breakdown based on softwood and hardwood classifications was well distributed among the manufacturing types. The species breakdown for each manufacturing type was as follows:

Sawmill operations – 90 softwood, 104 hardwood, 22 mixed.

Pulp mill operations – 8 softwood, 5 hardwood, 11 mixed.

Engineered wood products – 12 softwood, 11 hardwood, 1 mixed.

The average number of employees was 25 to 100. Forty-five respondents (17%) were from the Northeast, 135 (51%) from the Southeast, 53 (20%) from the Midwest, and 31 (12%) from the West. One hundred and forty-two of the operations (55%) did not participate in a forest management standard. Sixty operations (23%) adhered to the Tree Farm program 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 EMS development

The distribution of EMS scores ranged from a low of 12 to a high of 99 (**Fig. 2**). Most of the operations (84%) fell in the middle range (poor to moderate) of management system development. Twenty-nine operations (11%) had undeveloped wood procurement management systems, while 107 operations (41%) had poorly developed ones. One hundred and eleven operations (43%) were in the moderate stage of development and only 13 operations (5%) in the well-developed stage.

Forest products operations participating in a third-party conformance assessment to a forest management standard were closely associated with a well-developed wood procurement EMS, while the operations adhering to the SFI standard without third-party assessment had moderately developed EMS (**Table 3**, **Fig. 3a**). However, there was no statistical difference between the mean EMS score for the SFI standard (mean score = 0.73) and the third-party assessment (mean score = 0.79). Operations participating in the Tree Farm program or in no forest management standard tended to be associated with poorly developed or undeveloped management systems (**Fig. 3a**). Operations that did not participate in any forest management standard had the least developed management systems (mean score = 0.52) (**Table 3**). The correspondence analysis reflects the relationships between the level of management system development and the forest management standard. Note the spatial association between third-party conformance and a well-developed EMS (**Fig. 3a**).

Privately owned operations had less developed wood procurement management systems than publicly owned operations (**Table 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.

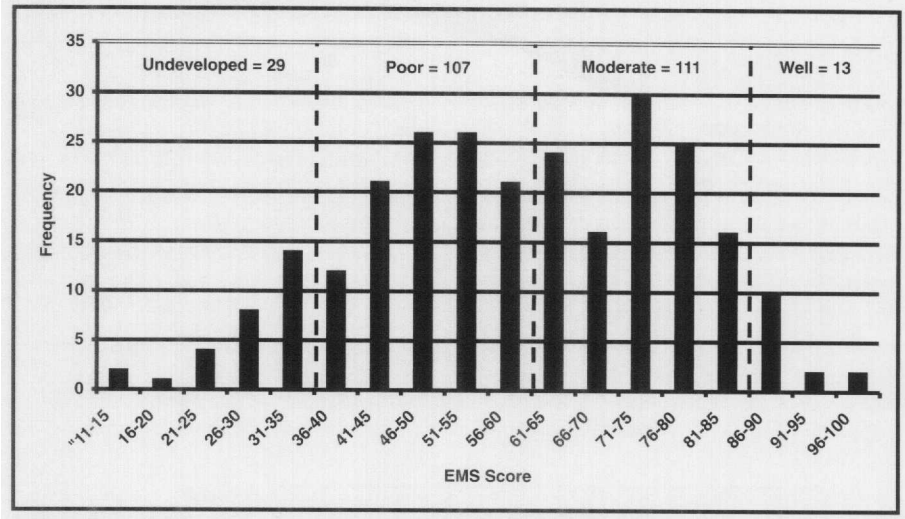

Figure 2. – Number of operations within each stage of wood procurement management system development.

Operations with a production capacity greater than 30 MMBF (or volume equivalent) annually had significantly more developed wood procurement management systems (mean score = 0.68) than all other operations. Correspondence analysis revealed that operations producing greater than 30 MMBF were more closely associated with a moderate level of EMS development (**Fig. 3b**). There were no significant differences between all other production capacity levels (**Table 3**). Operations with lower production capacities were predominantly in the poor stages of system development. For example, operations with a production capacity of 1 MMBF to 5 MMBF were closely associated with undeveloped management systems, and operations with a production capacity of 5 MMBF to 30 MMBF tended to be closely associated with poorly developed management systems (**Fig. 3b**).

The species mix variable, based on whether operations use primarily softwood, hardwood, or mixed species, was not a determinant factor in EMS development (**Table 3**). Even when examined within the sawmill manufacturing type, the 90 softwood sawmills (mean score = 0.57) were not significantly different in EMS development from the 104 hardwood sawmills (mean score = 0.56). The correspondence analysis plot confirms the lack of association between the species categories (**Fig. 3c**).

In terms of the number of employees, forest products operations with more than 500 employees had the most developed management systems (mean score = 0.72). Operations with less than 25 employees had the least developed management systems (mean score = 0.50). Operations with 25 to 100 employees tended to be associated with poorly developed systems, while operations with 100 to 500 employees were closer to moderately developed systems. However, the difference between the latter two categories was not statistically significant (**Table 3**). Correspondence analysis clearly reveals the continuum of relationships between well-developed to undeveloped management systems (**Fig. 3d**).

Operations with undeveloped and poorly developed wood procurement management systems are predominantly privately owned sawmills (mean score = .56) (**Figs. 3e and 4**), particularly if they have less than 100 employees and a production capacity of less than 30 MMBF (**Table 3**). The weaker performers do not adhere to any forest management standards or participate in the Tree Farm program. Sawmills producing greater than 30 MMBF and employing greater 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 publicly held operations (mean score = .72) out-per-

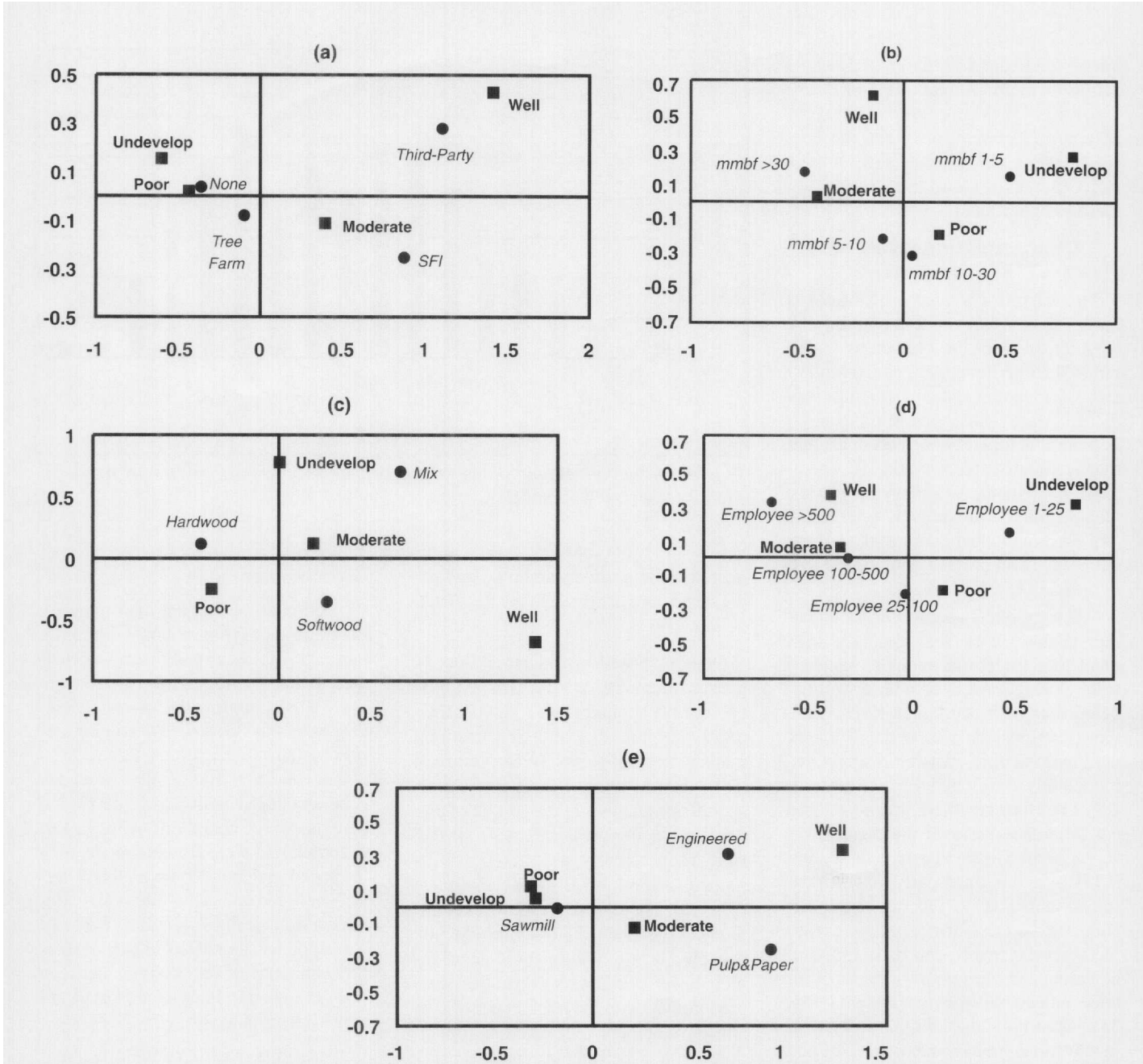

Figure 3. – Correspondence analysis plots show the relationships between the levels of management system development and the operational variables: a) forest management standard; b) production capacity; c) species mix; d) number of employees; and e) manufacturing type.

formed privately owned operations (mean score = .55) (**Table 3**).

The engineered wood products sector performed significantly better than the sawmills (**Table 3**), exhibiting a wide distribution of EMS scores (**Figs. 3e** and **5**). Engineered wood products operations participating in the SFI program or third-party certification 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 private (mean score = .79) versus public (mean score = .61) operations.

The pulp and paper sector also performed significantly better than the sawmills, but not significantly different from the engineered wood products operations (**Table 3, Fig. 3e**). Whereas the sawmills were normally distributed across the continuum (**Fig. 4**), and the engineered wood products were widely distributed (**Fig. 5**), the pulp and paper sector was skewed to the moderate to well developed part of the continuum (**Fig. 6**). Similar to the other sectors, participation in the SFI program or third-party certification yielded significantly higher EMS scores versus participation in Tree Farm or no participation. We suspect 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 private (mean score = .74) versus public (mean score = .75) operations.

Discussion

The distribution of EMS scores (**Fig. 2**) suggests that incorporating environmental concerns into wood procurement operations is still a relatively new phenomenon.

Table 3.– Frequencies by level of wood procurement management system development and the statistical tests for the group means by the six operational variables.

Operation variables	Categories	Level of management system development					Statistical test for group means	
		Undeveloped	Poor	Moderate	Well	*n*	Mean score[a]	Standard error
Forest management standard	None	25	72	44	1	142	.52A	.014
	Tree farm	4	30	24	2	60	.58B	.021
	SFI	0	2	25	4	31	.73C	.015
	Third party	0	2	18	7	27	.79C	.015
Ownership structure	Private	29	103	79	5	216	.55A	.012
	Public	0	4	32	9	45	.75B	.016
Production capacity	1 to 5 MMBF	20	35	17	5	77	.50A	.023
	5 to 10 MMBF	4	22	23	0	49	.57A	.020
	10 to 30 MMBF	3	27	16	1	47	.56A	.023
	>30 MMBF	2	21	47	7	77	.68 B	.015
Species mix	Softwood	10	44	45	7	106	.61A	.017
	Hardwood	14	52	49	4	119	.57A	.016
	Mix	5	11	16	2	34	.59A	.032
Number of employees	<25	20	34	20	3	77	.50A	.022
	25 to 100	6	48	36	4	94	.58B	.016
	100 to 500	3	20	35	2	60	.63B	.020
	>500	0	5	19	4	28	.72C	.022
Manufacturing type	Sawmill	27	99	82	4	212	.56A	.012
	Engineered	2	6	11	5	24	.67B	.042
	Pulp and paper	0	2	18	4	24	.74B	.020

[a] Within the categories of an operation variable, the mean scores with shared capital letters are not significantly different at $\alpha = 0.05$ according to the Turkey's Honestly Significant Differences method.

Few operations have well-developed management systems, while half of the sample is collectively in the poor or undeveloped stages. 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 fiber 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 (Welford 1998b, Riggs and Robbins 1998, Porter 1985). Much of this has to do with the relative ease of obtaining their wood fiber supply during most of this century. Today, however, a wide host of factors such as the increasing demand for wood products, societal demands for sustainable forest management, reductions in harvest levels on national forests, increasing fragmentation and parcelization of NIPFs, further conservation efforts on private lands, and growing evidence of diameter limit cutting and high-grading are all conspiring to limit available wood supplies (Nilsson et al. 1999, DeCoster 1998, Favjan et al. 1998, Nyland 1986). "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 a third-party standard or participating in the SFI program had the most developed wood procurement management systems. What does this mean? It suggests that these operations are more likely to adopt, either fully or partially, wood procurement EMS attributes (**Table 1**) such as written procurement policies, formal landowner assistance and public outreach programs, written standards for harvesting timber, means to monitor wood supply sources, and mechanisms to monitor whether foresters and/or trained loggers are involved in management activities. 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 (de Callejon et al.

1998b). Third-party certification and the SFI program are now serving as a primary vehicle for these firms to regain public confidence in how they manage 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 profitability (Barrett et al. 1996). Wood procurement staffs are often too consumed with the day-to-day challenges of securing high quality logs to dedicate resources toward 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 (O'Laoire and Welford 1998, Harris 1985).

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 labor 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 when compared to pulp and paper and engineered forest products mills. The latter two can utilize a wide spectrum of resources to meet their needs, such as low-grade roundwood, recycled fiber, chips, and fiber 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 depend on one geographic region for their timber supply (de Callejon et al. 1998a).

Relevant to all industries is the fact that improving general environmental performance is gradually becoming a standard business-to-business requirement (Darnall et al. 2000, Tibor and Feldman 1998). For example, large corporations (e.g., in the automobile or chemical industry) 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 favor 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, then

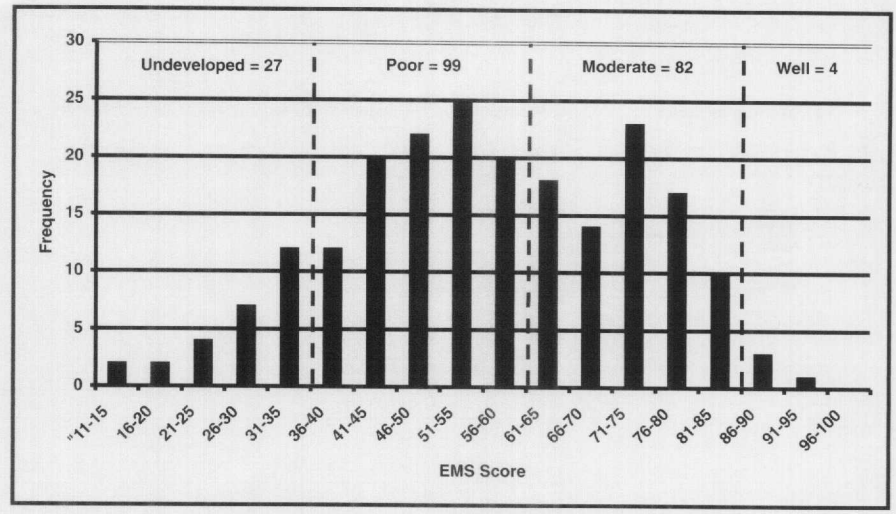

Figure 4. – Number of sawmill operations within each stage of wood procurement management system development.

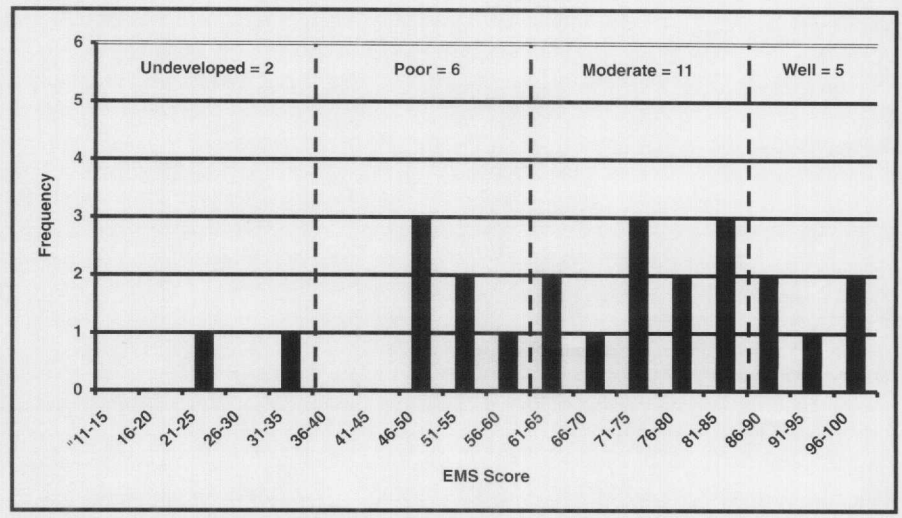

Figure 5. – Number of engineered wood products operations within each stage of wood procurement management system development.

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 cost 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.

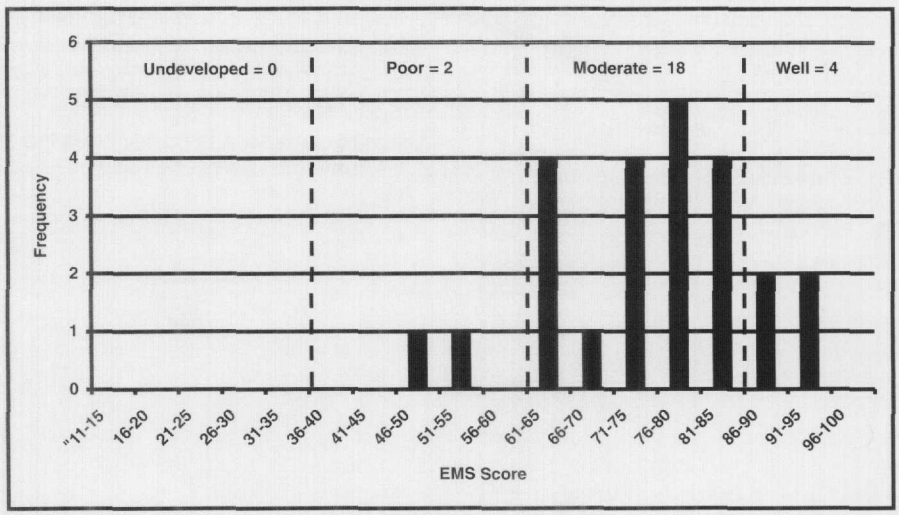

Figure 6.–Number of pulp and paper operations within each stage of wood procurement management system development.

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