Exploring Research Priorities for the North American Hardwood Industry

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With the increase of globalization, the North American hardwood industry is facing many challenges to remain competitive and sustainable, facing drastic changes in the areas of labor, land, manufacturing, markets and marketing, and supply chain. The hardwood industry is especially vulnerable, with the influx of foreign manufacturers and suppliers with greater natural resources and inexpensive labor pools. Specific and actionable research priorities need to be clearly defined to facilitate and encourage the creation of useful knowledge and practices to support the advance of the North American hardwood industry.

Fifteen in-depth interviews and approximately three hundred telephone surveys were conducted in 2006 and used to determine the research priorities for the North American hardwood industry. Research on communication practices between management and the labor force was identified as a key need. The manufacturing area was identified as the most important area, overall, for investment of resources (and by inference, investment in research) to improve business performance. Development and adoption of appropriate technology was viewed as the most important manufacturing enhancement for the wood industry and its research infrastructure. The most important concerns related to markets and marketing and the wood industry's supply chain are related to the dramatic changes in the competitive environment.

Background

The hardwood industry has evolved into a highly fragmented supply chain with many interrelated but distinct industry segments: timber harvesting, sawmilling, secondary manufacturing, distributors, and retailers. Each industry segment has pursued a strategy to become more efficient at managing the costs of producing and distributing a variety of hardwood products. The supply of raw material to these producers depends heavily upon land accessibility, weather conditions, and the geographic location of the sawmill facility. On the consumer side, a growing variety of hardwood products in a growing range of sales and distribution channels have increased the complexity of the supply chain logistics. With the current ease of global outsourcing, the supply chain is being transformed into an even more sophisticated network to process, move, and distribute hardwood products. With such fundamental hardwood industry changes, it is no longer sufficient for a business to be efficient; now it must also develop effective business functions that are quick at innovating and adapting to change.

In the past 35 years, research priorities in the hardwood industry have been assessed by the Hardwood Research Council on four occasions, with the most recent findings being published in 1996 (NHLA 1996)[1]. Findings from previous reports were organized into three research areas: Hardwood management, hardwood utilization, and education. Hardwood management examined issues associated with ecological research, stand management, growth and yield models, and log and tree transport. Hardwood utilization examined research needs associated

[1] National Hardwood Lumber Association (NHLA). Research priorities for North American hardwoods, 1996. D. Meyer, ed. National Hardwood Lumber Research Council. NHLA, Memphis, TN. 29 pp.

with wood properties, structural lumber, drying, automatic defect detection, reconstituted panel products, and hardwood markets and marketing systems. Hardwood education examined issues associated with effective technology transfer to industry and public awareness of forest management (NHLA 1996).

In the 1996 study of research priorities, data were collected from ten focus groups, with a total of 65 focus group participants. These groups were asked to generate researchable problems and to rate these research problems on a 10-point importance scale. These focus group discussions identified 322 research needs, with 41 topics deemed as "high priority."

For hardwood utilization, high-priority items included the need to identify new markets for low-grade lumber, decrease sticker shadow in kiln-drying, and explore new cutting technologies. For hardwood management and silviculture, high-priority research needs included further understanding of the effects of legislation on the industry, genetic engineering, and modifying hardwoods. Educational and other general research priorities included the development of technology transfer processes and the need to reprioritize university forestry curricula.

The size and restricted nature of the sample used in developing the 1996 research priorities document has several limitations that constrain the usefulness of the information. The report relies on data from only industry executives, managers, and foresters, and excluded USDA Forest Service research scientists, academic wood science and forestry researchers, and utilization and marketing professionals. The reason for limiting the sample was to focus a research agenda on more immediate industry concerns. As such, the resulting research agenda was biased more towards short-term efficiency improvements instead of effective, steady, and long-term investment in continuous business innovation.

The single methodology used in the 1996 report also restricts its generalizability. Focus groups are often used to generate ideas and to evaluate new concepts, but in-depth interviews provide a richer source of information, and a broad-scale survey provides more generalizable results. Furthermore, the importance ratings of the 322 research priorities obtained through the focus group discussions does not force the respondent to make trade-offs among the research priorities. Thus, a simple importance rating can result in all research priorities being viewed as important rather than the relative ratings that occur when resource allocations are constrained to only the most important research priorities.

We have expanded the research efforts of the 1987 and 1996 reports to include private landowners, loggers, primary manufacturers, secondary manufacturers, research scientists from the USDA Forest Service, and academics in forestry and wood science to assess the views of all key stakeholders in the industry. The approach used in the current report is designed to be more inclusive and to determine, empirically, whether differences exist among the key stakeholders in the hardwood industry. We focused our analyses on four key stakeholder groups: industry, research scientists, academic researchers, and utilization and marketing professionals.

METHODS

We conducted 15 in-depth interviews with senior executives from hardwood-related companies and executive directors of leading industry associations. These organizations were selected to reflect the perspectives of landowners, primary manufacturing, and secondary manufacturing (including furniture and cabinets), as well as industry associations that represent a diverse range of hardwood companies (i.e., the Hardwood Federation, the Wood Components Manufacturing Association, Appalachian Hardwood Association, Hardwood, Plywood, Veneer Association). Based on the interviews, five areas emerged as focal points in the industry: labor, land, manufacturing, markets & marketing, and supply chain.

These interviews informed a broad-based survey and provided an in-depth analysis of the research priorities. Potential participants in the broad-based survey were obtained from a list provided by the Hardwood Federation, consisting of 12 industry associations, with a membership of more than 8,000 members. We contacted academic researchers in the top 20 forest and wood science departments throughout the country and invited them to participate in the survey. We also identified the utilization and marketing professionals in each state and invited them to participate. Finally, we contacted the USDA Forest Service and invited research scientists most involved with hardwood utilization.

Within each of the five areas, we identified four topics based on our in-depth interviews with the senior executives in the hardwood industries: change, technology, communication, and public policy. Change represents a business decision to significantly improve a business model or culture to deal with a critical issue. While education and training are often associated with change, a business that can effectively lead change has the ability to "act" on what they learn. Technology involves retooling capabilities or adopting business process technologies in response to a critical issue. Communication involves creating clear pathways for information exchange. Expectations, assessment, education, and re-training regarding a critical issue would be included as part of the communication pathways. Finally, policy would define and promote a sustainable business climate that is in balance with the general needs of society. In general, the information from the in-depth interviews recognized that these four topic areas are the tools we can use to respond to business.

The executive committee for the project identified key issues within each topic and area. The three most frequently mentioned issues were then used to represent each topic within each area.

The questionnaire contained six sections, one for each of the five major business/resource areas—labor, land, manufacturing, markets/marketing, and supply chain—as well as a section that solicited company/respondent background information. At the end of each of the first five sections, we asked respondents the following question to assess the trade-offs when allocating limited resources to the research priorities within each area:

> "Although all these issues may be important, I would like to learn more about the trade-offs you would make among these labor (*or land, manufacturing, marketing, and supply chain*) priorities. Suppose I were to give you $1,000,000 to divide among the following

issues: your changing workforce, using technology to support your workforce, communicating with your workforce, and government policies.

What percentage of this money would you allocate to improve your labor situation in each of these areas?

Change___ Technology___ Communication___
Policy (Government)___

We also asked respondents how they would allocate a hypothetical million dollars among the five areas: labor, land, manufacturing, markets/marketing, and supply chain.

Results

Sample characteristics

Table 1 contains a summary of the major business functions of respondents who participated in the survey. A total of 244 respondents were from industry, 40 respondents were from academia, 60 respondents were utilization and marketing professionals from state and Federal agencies, and 14 respondents were from the USDA Forest Service. Nearly 40 percent of the industry respondents were owners or presidents of their respective companies.

Our initial analyses focused on possible differences in the importance assigned to different factors (topics) affecting the key stakeholder groups for each of the five business/ resource areas (topics: labor, land, manufacturing, markets/marketing, and supply chain) between the key stakeholder groups. We conducted a 4 (stakeholder: industry, academics, utilization/marketing, Forest Service) x 4 (topics: change, technology, communication, policy) mixed-mode ANOVA, with stakeholder a between-subject factor and topics a within-subject factor.

All measures are listed in the Appendix. The questions with stars were combined into a single composite measure because their significant correlation(s) suggest the questions reflect a similar underlying issue.

Analysis of importance ratings of research priorities

The analyses that we present are a detailed assessment of areas (i.e., labor, land, manufacturing, markets, and supply chain). Our general analytic strategy was to use a 4 (stakeholder) x 4 (topics: change, communication, technology, and public policy) ANOVA with a Bonferroni post-hoc analysis to determine differences among the stakeholders and topic areas. In the summary and conclusions section, we integrate the findings and derive specific recommendations from those findings.

Table 1. — Business function of industry members (companies were allowed to check all that applied so total percentage is greater than 100).

Primary Business Function	Percentage
Primary manufacturer	41
Retailer	29.8
Flooring manufacturer	22.7
Kiln operator	21.9
Lumber broker	17.8
Logger	13.1
Forester	12.2
Forest land owner	11.3
Pallet manufacturer	5.1
Furniture manufacturer	4.7
Cabinet manufacturer	2.8

Table 2. — Analysis of labor for each stakeholder group[1].

Topic	Industry	Academics	Utilization/ Marketing	Forest Service
Change	3.52 A	4.04 B	3.94 B	3.73 AB
Technology	3.53 C	3.67 CD	3.97 D	3.46 CD
Communication	4.16	4.17	4.19	3.88
Policy	3.45	3.68	3.71	3.54

[1]Mean values that do not share a superscript within a row are significantly different.

Table 3. — Analysis of land for each stakeholder group[1].

Topic	Industry	Academics	Utilization/ Marketing	Forest Service
Change	3.77 E	3.31 F	3.63 EF	3.31 EF
Technology	3.91 G	3.33 H	3.49 H	3.42 GH
Communication	3.49	3.19	3.31	3.69
Policy	4.14	4.01	4.21	4.15

[1]Mean values that do not share a superscript within a row are significantly different.

Labor. **Table 2** contains a summary of the means for the 4 x 4 ANOVA related to labor issues. We found a significant main effect for topics ($F = 12.87$; $df = 3,780$; $p < .001$) and stakeholder ($F = 4.35$; $df = 3,260$; $p < .05$) as well as a significant interaction between stakeholder and topics ($F = 1.95$; $df = 3, 780$; $p < .05$).

We conducted a Bonferroni[2] post-hoc analysis to determine the locus of the differences among the topics and found communication was significantly *more* important across all stakeholders than any of the other topics ($\bar{x}$ = 4.1, 3.8, 3.66, 3.59 for communication, change, technology, and policy respectively)[3]. None of the other topics were significantly different from each other.

The significant interaction indicates that different stakeholder groups assessed the different topics to be of varying importance as factors impacting labor.

Table 2 contains a summary of this interaction. We conducted a one-way ANOVA treating the stakeholder group as the independent variable and each topic as the outcome variable. Based on a Bonferroni post-hoc analysis, mean values that do not share a superscript within a row are significantly different.

Industry respondents viewed the changing labor force as significantly *less* important than academics (faculty)

[2] The Bonferroni procedure adjusts the α level based on the number of comparisons to reduce the likelihood of a Type I error.

[3] We defined communication as the flow of information within a company and with potential employees and we asked questions regarding regular meetings to discuss manufacturing or processing issues and employee teamwork.

and utilization/marketing professionals. Industry ratings of the importance of technology[4] among labor issues were significantly *lower* than the ratings assigned by the utilization/marketing respondents. Importance ratings of communication and policy concerns were not significantly different among the sample groups.

Land. **Table 3** contains a summary of the means for the 4 x 4 ANOVA related to land issues. As was the case for labor, there was a significant main effect for both topics ($F = 20.77$; $df = 3,252$; $p < .001$) and stakeholder ($F = 3.91$; $df = 3, 254$; $p < .01$), as well as a significant interaction between topics and stakeholder ($F = 2.46$; $df = 9, 762$; $p < .01$.)

Based on a post-hoc analysis using a Bonferroni adjustment for experiment-wise error, policy was significantly more important across all stakeholders. Policy questions focused on the impact of government regulations on the value and use of land[5]. Across the four samples, policy issues associated with land were *more* important than technology, change, and communication respectively ($\bar{x} = 4.13, 3.54, 3.50, 3.42$). None of the other topics were significantly different from each other.

Industry respondents viewed changes associated with land as significantly *more* important than did academic respondents, although the perspectives of industry did not differ from those of utilization/marketing and USDA Forest Service respondents. Industry respondents viewed technology[6] as *more* important for land issues than academics and utilization/marketing respondents. Communication and policy issues were not significantly different among the groups.

Manufacturing. **Table 4** contains a summary of the means for the 4 x 4 ANOVA related to manufacturing issues. There was a significant main effect of topics ($F = 7.40$; $df = 3, 762$; $p < .001$), but not for sample. There was no significant interaction between topics and sample.

Technology[7] was significantly *more* important across all stakeholders than policy ($\bar{x} = 4.15, 4.02, 3.98, 3.79$ for technology, change, communication, and policy respectively; $p < .05$). No other contrasts were significantly different.

Markets and Marketing. **Table 5** contains a summary of the means for the 4 x 4 ANOVA for the markets/marketing area. There was a significant main effect of topics ($F = 14.49$; $df = 3,262$; $p < .001$), but no significant differences among the four types of respondents. There was a significant interaction between topics and stakeholder ($F = 2.14$; $df = 9,792$; $p < .05$).

Based on a post-hoc analysis, change[8] in markets was significantly more important across all stakeholders than was technology, communication, or policy-related market factors ($\bar{x} = 4.39, 3.88, 3.84, 3.82$ respectively; $p < .05$). Moreover, industry representatives viewed change as more important than utilization/marketing representatives. Technology considerations related to markets were judged to be more important by respondents from academia than from industry.

Supply Chain. **Table 6** summarizes the means of the 4 x 4 ANOVA for the supply chain area. There was a significant main effect of topics ($F = 3.847$; $df = 3,239$; $p < .001$), but no significant differences among the four respondent groups. There was also a significant interaction between topics and stakeholder ($F = 3.09$; $df = 9,723$; $p < .01$).

Change was significantly *more* important across all stakeholders than were the other topics ($\bar{x} = 4.24, 3.8, 3.78, 3.65$ for change, policy, communication, and technology respectively; $p < .05$). The interaction between topics and stakeholders reflected differences in the importance of technology and change for the four groups. Academics

Table 4. — Analysis of manufacturing for each stakeholder group[1].

Topic	Industry	Academics	Utilization/ Marketing	Forest Service
Change	4.06	4.13	4.11	3.79
Technology	4.05	4.37	4.19	3.96
Communication	4.05	4.11	3.98	3.79
Policy	3.99	3.79	3.94	3.43

[1]Mean values that do not share a superscript within a row are significantly different.

Table 5. — Analysis of marketing for each stakeholder group[1].

Topic	Industry	Academics	Utilization/ Marketing	Forest Service
Change	4.65 [I]	4.29 [IJ]	4.31 [J]	4.31 [IJ]
Technology	3.84	3.98	3.79	3.74
Communication	3.96	3.87	4.00	3.69
Policy	3.84	3.87	4.04	3.54

[1]Mean values that do not share a superscript within a row are significantly different.

Table 6. — Analysis of supply chain for each stakeholder group[1].

Topic	Industry	Academics	Utilization/ Marketing	Forest Service
Change	4.34	4.23	4.40	4.00
Technology	3.35 [K]	3.91 [L]	3.77 [KL]	3.56 [KL]
Communication	3.63 [M]	4.22 [N]	3.83 [MN]	3.44 [MN]
Policy	3.97	3.91	3.92	3.71

[1]Mean values that do not share a superscript within a row are significantly different.

[4] We measured technology by asking questions regarding using technology (such as distance learning) to train your labor force and providing on-going technical training,

[5] We asked questions regarding regulations and legislation on timber availability, forest management, and land use decisions, and environmental protections laws.

[6] We measured technology by asking about advances in genetically improved growth and quality of hardwoods and treatment of invasive species.

[7] We asked questions about the ability to customize manufacturing processes to consumer orders rather than forecasted consumer demand, and flexible manufacturing processes (i.e. an effective and efficient method to reconfigure equipment)

[8] We asked about the importance of changes in the domestic hardwood market.

viewed technology and communication[9] as *more* important than industry representatives.

Analysis of trade-offs among the research priorities

An important element when assessing the importance of the research priorities is to evaluate the trade-offs respondents will make among the topics within each of the five business/resource areas (labor, land, manufacturing, markets/marketing, supply chain). We will also assess the trade-offs that respondents made across the five areas. This information is valuable because we will be able to determine the relative importance of these factors and the priorities that should be assigned when allocating scarce resources among areas. In the areas where all groups concur, there is a clear need for research. In the areas where groups differ, an opportunity exists for discussions among stakeholders to lead to a better understanding of the issues and opportunities (both those that already exist and those that need to be developed).

Labor. **Table 7** contains a summary of percentage allocation of resources across the five topics when considering labor optimization (each column sums to 100%). We found a significant main effect for topics ($F = 20.21$; df = 3,311; $p < .001$), but no stakeholder effect. There was no significant interaction between stakeholders and topics.

We conducted a Bonferroni post-hoc analysis to determine the locus of the differences among the topics. Technology was significantly *more* important across all stakeholders than any of the other topics ($\bar{x}$ = 37.53, 25.11, 22.33, 15.04 for technology, communication, change, and policy respectively; $p < .05$). Technological issues such as distance learning were viewed as areas in which all stakeholders believed investments were essential to address the challenges

Land. **Table 8** contains a summary of the mean percentage allocation of resources within the land issues arena based on a 4 x 4 ANOVA. We found a significant main effect for stakeholders ($F = 1.95$; df = 9,957; $p < .05$) but no effect for topics. Industry and utilization/marketing rated change as significantly *more* important than academics for land-based issues.

Manufacturing. **Table 9** contains a summary of the mean percentage allocation of resources within the manufacturing issue area base on analysis using a 4 x 4 ANOVA. We found a significant main effect for both topics ($F = 16.53$; df = 3,311; $p < .001$) and stakeholders ($F = 2.54$; df = 9,939; $p < .01$), but no significant interaction.

Based on a Bonferroni post-hoc analysis, technology was significantly *more* important across all stakeholders than any of the other topics ($\bar{x}$ = 32.44, 28.42, 21.97, 17.17 for technology, change, communication, and policy respectively; $p < .05$).

Industry rated change as a significantly *more* important research area in manufacturing issues than academics and utilization/market workers. Academics viewed technology as a *more* important manufacturing issue than did industry

Markets and Marketing. **Table 10** contains a summary of the mean percent allocation of resources for research related to markets/marketing issue based on a 4 x 4 ANOVA.

Table 7. — Analysis of labor for the trade-offs among topics for each stakeholder group[1].

Topic	Industry	Academics	Utilization/ Marketing	Forest Service
Change	25.85	22.60	21.79	19.09
Technology	34.48	38.43	39.02	38.18
Communication	21.51	25.60	26.07	27.27
Policy	18.21	13.37	13.13	15.47

[1]Mean values that do not share a superscript within a row are significantly different.

Table 8. — Analysis of land for the trade-offs among topics for each stakeholder group[1].

Topic	Industry	Academics	Utilization/ Marketing	Forest Service
Change	31.85 ^{O}	21.76 ^{P}	23.28 ^{O}	25.77 ^{OP}
Technology	25.14	28.68	25.78	30.77
Communication	19.10	23.97	23.88	24.23
Policy	23.92	25.59	27.07	19.23

[1]Mean values that do not share a superscript within a row are significantly different.

Table 9. — Analysis of manufacturing for the trade-offs among topics for each stakeholder group[1].

Topic	Industry	Academics	Utilization/ Marketing	Forest Service
Change	34.98 ^{R}	25.16 ^{S}	25.09 ^{S}	28.46 ^{RS}
Technology	27.22 ^{T}	36.56 ^{U}	33.27 ^{TU}	32.69 ^{TU}
Communication	18.80	22.34	23.27	23.46
Policy	19.00	15.94	18.36	15.38

[1]Mean values that do not share a superscript within a row are significantly different.

Table 10. — Analysis of markets and marketing for the trade-offs among topics for each stakeholder group[1].

Topic	Industry	Academics	Utilization/ Marketing	Forest Service
Change	33.75	25.09	25.64	30.38
Technology	25.29	30.87	27.18	24.62
Communication	21.79 ^{V}	28.09 ^{W}	28.27 ^{W}	25.77 ^{VW}
Policy	19.17	15.94	18.91	19.23

[1]Mean values that do not share a superscript within a row are significantly different.

[9] We assessed change by questions regarding increasing energy costs and increasing costs of logistics. We asked questions regarding integrated/compatible database systems with your suppliers; automated quality/defect recognition systems for the successful management and distribution of wood raw materials; and automated tracking technologies (e.g. bar coding, RFID) to measure technology

We found a significant main effect for both topics ($F = 7.66$; $df = 3,312$; $p < .001$) and stakeholders ($F = 2.14$; $df = 9,942$; $p < .05$).

We conducted a Bonferroni post-hoc analysis and found change was significantly *more* important across all stakeholders than any of the other topics ($\bar{x} = 28.72, 26.99, 25.98, 18.31$ for change, technology, communication, and policy respectively; $p < .05$). Academics and utilization/market rated communication as a higher priority than did industry with regard to optimization of markets and marketing.

Supply Chain. **Table 11** contains a summary of the mean percent allocation of resources for research related to the wood supply chain based on a for the 4 x 4 ANOVA. We found a significant main effect for both topics ($F = 6.54$; $df = 3,313$; $p < .001$) and stakeholders ($F = 2.14$; $df = 9,945$; $p < .001$).

Technology was significantly more important across all stakeholders than any of the other topics ($\bar{x} = 29.48, 26.93, 25.08, 18.51$ for technology, change, communication, and policy respectively; $p < .05$). Academics and utilization/market rated technology as a high priority in supply chain issues; this differed significantly from industry respondents. Utilization/marketing representatives rated communication significantly higher than industry, while industry rated policy as significantly higher than did utilization/marketing respondents.

Final Question. **Table 12** contains a summary of the means for the 4 x 5 ANOVA used to address the responses given to the question concerning trade-offs among the five areas: labor, land, manufacturing, markets/marketing, and supply chain. We found a significant main effect for both topics ($F = 10.87$; $df = 4,302$; $p < .001$) and stakeholders ($F = 2.46$; $df = 12,912$; $p < .01$).

Manufacturing was significantly *more* important across all stakeholders than any of the other topics ($\bar{x} = 25.60, 22.93, 20.59, 16.03, 14.85$ for manufacturing, markets and marketing, labor, supply chain, and land respectively; $p < .05$).

Industry viewed labor issues to be significantly *more* important than did academics and utilization/marketing representatives. Academics and utilization/marketing representatives rated markets and marketing issues significantly higher than industry.

Summary and Conclusions

The importance of each topic (change, technology, communication, and public policy) varied across the five areas (i.e., labor, land, manufacturing, markets and marketing, and supply chain). Interestingly, each topic was significantly more important than the other three in at least one of the five areas.

- **Communication** with *labor* (i.e., regular meetings and employee teamwork) was significantly more important across all the stakeholder groups than change, technology, or public policy issues.

- **Public policy** regarding *land* (i.e., regulations and legislation on timber availability and environmental protection laws) was significantly more important across all stakeholder groups than the other topics.

Table 11. — Analysis of supply chain for the trade-offs among topics for each stakeholder group[1].

Topic	Industry	Academics	Utilization/ Marketing	Forest Service
Change	31.18	23.91	25.56	27.08
Technology	23.45 [X]	34.06 [Y]	30.00 [Y]	30.42 [XY]
Communication	21.22 [A]	26.09 [AZ]	28.43 [Z]	24.58 [AZ]
Policy	24.16 [B]	15.94 [BC]	16.02 [C]	17.92 [BC]

[1]Mean values that do not share a superscript within a row are significantly different.

Table 12. — Analysis of trade-offs among topics for each stakeholder group[1].

Topic	Industry	Academics	Utilization/ Marketing	Forest Service
Labor	27.52 [D]	15.45 [E]	18.85 [E]	20.54 [DE]
Land	16.23	12.94	15.60	14.62
Manufacturing	20.55	26.45	25.42	30.00
Markets	18.96 [F]	27.10 [G]	24.13 [FG]	30.71 [FG]
Supply Chain	16.74	18.06	16.00	13.31

[1]Mean values that do not share a superscript within a row are significantly different.

- **Technology** issues in *manufacturing* (i.e., customized manufacturing processes and flexible manufacturing processes) were significantly more important across all the stakeholder groups than the other topics.

- **Change** in *markets and marketing* (i.e., changes in the domestic market) was significantly more important across the stakeholder groups than the other topics.

- **Change** in the *supply chain* (i.e., increasing energy costs and the increasing costs of logistics) was significantly more important across all stakeholder groups than were the other topic areas.

For the analysis of the trade-offs among the topic areas, technology is perceived to be more important related to labor, manufacturing, and supply chain, whereas change is more important for markets and marketing. Overall, manufacturing issues were viewed as more important than the other four areas. Trade-off analysis did not detect a dominant topic area related to land issues.

We also find more nuanced differences among the stakeholder groups in their evaluation of each topic within the five areas and their trade-offs in the allocation of resources. These differences highlight the need for the stakeholder groups to communicate with each other to understand their priority differences. For example, separate task forces might be convened to address differences in stakeholder perceptions of the importance of:

- Change as it relates to issues surrounding labor in the wood industry

- Technology as it relates to land and land-based resource issues
- Changes related to manufacturing processes given significant differences in the trade-offs among the stakeholder groups
- Communication surrounding markets and marketing (i.e., benchmarking and consumer education about products) given significant differences in the trade-offs among the stakeholder groups
- The importance of communication in addressing supply chain issues and opportunities

Collectively, these findings highlight the importance of targeted investments in research over the next ten years. Rather than focus on a single area (such as technology), the results support the notion that investments in research should focus on different topics within each of the five areas.

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Appendix

We will ask you questions about issues dealing with labor, land, manufacturing, markets and marketing, and supply chain.

We will use the following scale for many of the questions:

0 = not at all important;
1 = slightly important;
2 = moderately important;
3 = quite important;
4 = extremely important;
9 = not applicable

First, we will start out with questions about ***labor***.

As you know, there have been many changes in the workforce for the hardwood industry during the past 10 years. How important are the following priorities to help your company manage the changing nature of your workforce?

Educational programs such as short courses:
0 1 2 3 4 9

Hiring from a local or regional workforce rather than transient labor:
0 1 2 3 4 9

Recruiting and continuing human resource development:
0 1 2 3 4 9

The next few questions look at the impact of technology on your workforce. How important are the following technology priorities to help your company manage the changing nature of your workforce?

Adopting new manufacturing technology or manufacturing processes to reduce your labor costs:
0 1 2 3 4 9

* Using technology (such as distance learning) to train your labor force:
0 1 2 3 4 9

* Providing on-going technical training:
0 1 2 3 4 9

The next few questions look at the flow of information within your company and with potential employees. How important are the following priorities to help your company manage the changing nature of your workforce?

Employee empowerment (giving employees tools to gather appropriate information and autonomy to make decisions):
0 1 2 3 4 9

* Regular meetings to discuss manufacturing or processing issues:
0 1 2 3 4 9

* Employee teamwork:
0 1 2 3 4 9

Government policies have an impact on the changing workforce. How important are the following policies to the success of your company?

Immigration laws:
0 1 2 3 4 9

Regulated/mandated health and retirement employee benefits:
0 1 2 3 4 9

An increase in mandatory minimum wages:
0 1 2 3 4 9

Although all these issues may be important, I would like to learn more about the trade-offs you would make among these labor priorities. Suppose I were to give you $1,000,000 to divide among the following issues: your changing workforce, using technology to support your workforce, communicating with your workforce, and government policies.

What percentage of this money would you allocate to improve your labor situation in each of these areas?

Change _____ Technology _____ Communication _____ Government _____

The next set of questions will look at *land* issues.

There have been many changes in land ownership, land management and land utilization in the past 10 years. How important are the following priorities to the success of your company?

Knowledge and use of best land management and forest practices:
0 1 2 3 4 9

Forest certification:
0 1 2 3 4 9

Maintaining commercial access to government-owned timberlands (national and state forests):
0 1 2 3 4 9

The next few questions examine the role of technology on land issues. How important are the following priorities to the success of your company?

* Advances in genetically improved growth and quality of hardwoods:
0 1 2 3 4 9

* Treatment of invasive species:
0 1 2 3 4 9

Increasing the energy efficiency of your equipment and transportation-related technology:
0 1 2 3 4 9

Communication or information flow is a part of land issues. How important are the following priorities to the success of your company?

The application of web-based technologies to support land cooperatives:
0 1 2 3 4 9

Easy access to best management and forest practices through electronic media
such as the internet:
0 1 2 3 4 9

Creating a partnership between land owners, local, state, and federal governments,
and businesses (such as LandCare):
0 1 2 3 4 9

Government policies have an impact on the value and use of land. How important are the following policies or actions to the success of your company?

* Regulations and legislation on timber availability, forest management, and land use decisions:
0 1 2 3 4 9

* Environmental protection laws:
0 1 2 3 4 9

Government programs that provide incentives
to maintain land as working forests:
0 1 2 3 4 9

Although all of these issues may be important, I would like to learn more about the trade-offs you would make among these land priorities. Suppose I were to give you $1,000,000 to divide among the following issues: changes in land management and utilization, the role of technology in land management and utilization, communication or information flow, and government policies and land management and utilization.

What percentage of this money would you allocate to improve your land situation in each of these areas?

Change _____ Technology _____ Communication _____ Government _____

Our next set of questions examine *manufacturing* issues related to research priorities

Managing change is an important component of the manufacturing process. How important are the following priorities to the success of your company?

Applying continuous improvement strategies:
0 1 2 3 4 9

Adopting manufacturing processes to accommodate increasing energy costs:
0 1 2 3 4 9

Designating a person/department to address
and manage technology advances:
0 1 2 3 4 9

The next few questions examine the role of technology in manufacturing. How important are the following priorities to the success of your company?

* Your ability to customize manufacturing processes to specific consumer orders rather than forecasted consumer demand:
0 1 2 3 4 9

* Flexible manufacturing processes (i.e. an effective and efficient method to reconfigure equipment)
0 1 2 3 4 9

Automated, robotic processes:
0 1 2 3 4 9

Communication or information flow is a part of manufacturing processes. How important are the following priorities to the success of your company?

Customer-specified product/material/quality requirements to your manufacturing processes:
0 1 2 3 4 9

Coordinating and sharing information with your suppliers and consumers to support your manufacturing processes:
0 1 2 3 4 9

Real-time visual display of process information with your employees to help manage and control your manufacturing processes:
0 1 2 3 4 9

Government policies have an impact on the effectiveness of manufacturing processes. How important are the following policies to the success of your company?

Tax incentives to support capital investment in new manufacturing equipment:
0 1 2 3 4 9

Government support for technology transfer of manufacturing innovations:
0 1 2 3 4 9

Government support for manufacturing innovations:
0 1 2 3 4 9

Although all these issues may be important, I would like to learn more about the trade-offs you would make among these manufacturing priorities. Suppose I were to give you $1,000,000 to divide among the following issues: changes in manufacturing processes, the role of technology in manufacturing, information flow, and government policies?

What percentage of this money would you allocate to improve your manufacturing/processing capability in each of these areas?

Change _____ Technology _____ Communication _____ Government _____

Our next set of questions deal with ***markets and marketing***

Domestic and global markets are rapidly changing. How important are each of the following markets to the success of your company?

* The domestic hardwood market:
0 1 2 3 4 9

The global hardwood markets:
0 1 2 3 4 9

Niche markets:
0 1 2 3 4 9

The next few questions examine the role of technology on your markets and marketing. How important are these technology issues to the success of your company?

Customer relationship management systems:
0 1 2 3 4 9

The development and implementation of a company website for information and sales:
0 1 2 3 4 9

Marketing research and research about your markets:
0 1 2 3 4 9

Communication or information flow is a part of markets and marketing. How important is information flow to the success of your company?

Customer-specified product/material/quality requirements to your marketing efforts:
0 1 2 3 4 9

Bench-marking information that allows your company to compare yourself with your competition:
0 1 2 3 4 9

Consumer education about your products and their various configurations:
0 1 2 3 4 9

General promotion of hardwoods, both domestically and internationally:
0 1 2 3 4 9

Government policies have an impact on the effectiveness of your company to reach your markets and your marketing efforts. How important are each of these policies to the success of your company?

Proper classification of imports by customs officers:
0 1 2 3 4 9

Elimination of trade barriers imposed by foreign governments:
0 1 2 3 4 9

Green building standards:
0 1 2 3 4 9

Although all these issues may be important, I would like to learn more about the trade-offs you would make among these marketing and market priorities. Suppose I were to give you $1,000,000 to divide among the following issues: changes in markets and marketing, the role of technology in markets and marketing, communication or information flow, and government policies.

What percentage of this money would you allocate to improve your marketing position in each of these areas?

Change _____ Technology _____ Communication _____ Government _____

The final set of questions look at ***supply-chain management***

Supply chain in the hardwood industry is changing rapidly. How important are the following issues to managing changes in your supply chain to the success of your company?

The ability to adjust your manufacturing processes to different wood species:
0 1 2 3 4 9

The ability to adjust your manufacturing processes to changing and more diverse customer requirements:
0 1 2 3 4 9

* Increasing energy costs:
0 1 2 3 4 9

* Increasing costs of logistics:
0 1 2 3 4 9

The next few questions examine the role of technology in supply-chain management. How important are these technology issues to the success of your company?

* Integrated/compatible database systems with your suppliers:
0 1 2 3 4 9

* Automated quality/defect recognition systems for the successful management and distribution of wood raw materials:
0 1 2 3 4 9

* Automated tracking technologies (e.g. bar coding, RFID):
0 1 2 3 4 9

Communication or information flow is a part of supply-chain management. How important are each of the following priorities to the success of your company?

The ability to track raw material or component part supplies in your supply chain in "real-time":
0 1 2 3 4 9

The ability to track the transportation of your finished product to your customer in "real-time":
0 1 2 3 4 9

Integrated and synchronized communication across all parts of your supply chain (i.e. from your suppliers to the final end consumer):
0 1 2 3 4 9

Government policies have an impact on the effectiveness of your company's supply-chain management. How important are each of these priorities to the success of your company?

Transportation regulations:
0 1 2 3 4 9

Government policies to support international trade:
0 1 2 3 4 9

Government policies to protect domestic hardwood companies from global competition:
0 1 2 3 4 9

Although all of these issues may be important, I would like to learn more about the trade-offs you would make among these supply chain priorities. Suppose I were to give you $1,000,000 to divide among the following issues: changes in supply chain management, the role of technology in supply chain management, information flow and government policies?

What percentage of this money would you allocate to improve your supply chain effectiveness in each of these areas?

Change _____ Technology _____ Communication _____
Government _____

Finally, now suppose I gave you $1,000,000 again. What percentage of the money would you allocate to labor, land, manufacturing, markets and marketing, and supply chain issues to improve your business's overall effectiveness?

Labor _____ Land _____ Manufacturing _____
Markets & Marketing ____ Supply Chain _____

Company-specific information

Company Enterprise(s): Select all that apply

Forest Land Owner ___ Forester ___ Logger ___ Primary Manufacturing ___ Kiln Operator ___

Secondary
Furniture ___ Cabinetry ___ Flooring ___ Pallet ___
Lumber Broker
Retailer

Number of employees: _____

Please rate the relative importance in the future of your company the following issues. Use this importance scale:
0 = not at all important
1 = slightly important
2 = moderately important
3 = quite important
4 = extremely important

Trained/motivated workforce:
0 1 2 3 4

New technologies:
0 1 2 3 4

Forest/logs/lumber inventories:
0 1 2 3 4

Strength of supply chain:
0 1 2 3 4

Please rate your company's key barriers for greater success. Use the 0-4 importance scale again.
Incompatible labor supply:
0 1 2 3 4

Raw material costs:
0 1 2 3 4

Overseas competition offering the same product for less:
0 1 2 3 4

Final customers' needs changing:
0 1 2 3 4

Government policy:
0 1 2 3 4

RESPONDENT INFORMATION

Name:_____

_____

Position:_____

_____

Company:_____

_____

Years in Position:_____

Years at Company:_____

Years in Wood industry:_____

What is your highest level of education?

- ❑ Some high school, no degree
- ❑ High school graduate
- ❑ Some college, no degree
- ❑ Associate degree, occupational
- ❑ Associate degree, academic
- ❑ Bachelor's degree
- ❑ Master's degree
- ❑ Professional degree
- ❑ Doctorate degree

Please tell us the names of the professional associations do you belong to?

- ❑ AF&PA (American Forest & Paper Association)
- ❑ AHEC (American Hardwood Export Council)
- ❑ AHMI (Appalachian Hardwood Manufactures, Inc)
- ❑ ALC (Appalachian Lumbermen's Club)
- ❑ AWFS (Association of Woodworking and Furnishing Suppliers)
- ❑ ESFPA (Empire State Forest Products Association)
- ❑ HDA (Hardwood Distributor's Association)
- ❑ HMA (Hardwood Manufacturers Association)
- ❑ HPVA (Hardwood Plywood & Veneer Association)
- ❑ IHLA (Indiana Hardwood Lumbermen's Association)
- ❑ KFIA (Kentucky Forest Industries Association)
- ❑ KCMA
- ❑ LSLA (Lake States Lumber Association)
- ❑ LAHLC (Los Angeles Hardwood Lumbermen's Club)
- ❑ LCM (Lumbermen's Club of Memphis)
- ❑ MFMA (Maple Flooring Manufacturers Association)
- ❑ NHLA (National Hardwood Lumber Association)
- ❑ NWFA (National Wood Flooring Association)
- ❑ NWP&CA (National Wooden Pallet & Container Association)
- ❑ NOFMA (The Wood Flooring Manufacturers Association)
- ❑ NLA (Northeastern Loggers' Association)
- ❑ PCWHDA (Pacific Coast Wholesale Hardwood Distributors Association)
- ❑ PFPA (Pennsylvania Forest Products Association)
- ❑ PYLC (Penn-York Lumbermen's Club)
- ❑ SCMA (Southern Cypress Manufacturers Association)
- ❑ SHMC (Southwestern Hardwood Manufacturers Club)
- ❑ SAF
- ❑ TPA of MI and WI (Timbers Producers Association of MI and WI)
- ❑ WCMA
- ❑ WHA (Western Hardwood Association)
- ❑ WHC (Westside Hardwood Club)
- ❑ Other:_____

_____

_____

_____

This is the end of the survey. Thank you very much for your time and information. This information will be very useful to us as we create the research priorities report. Thank you and have a nice day.