Forest Products Research and Development Organizations in a Worldwide Setting: A Review of Structure, Governance, and Measures of Performance

by

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February 2006

STAFF PAPER SERIES NUMBER 187

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Agricultural Experiment Station
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FOREST PRODUCTS RESEARCH AND DEVELOPMENT ORGANIZATIONS IN A WORLDWIDE SETTING: A REVIEW OF STRUCTURE, GOVERNANCE, AND MEASURES OF PERFORMANCE

by

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EXECUTIVE SUMMARY

The ability of forest products research programs to contribute to a nation's well-being requires that research organizations be well organized, effectively managed, and held to high standards of performance. In 2004-2005, a review of forest products and related research organizations beyond the boundaries of the United States was carried out. The intent was to obtain a better understanding of how such organizations are structured, administered and their performance judged. Ninety-three research organizations were initially identified for consideration by the review, 40 of which were chosen as case examples (located in 23 countries) and subsequently described in substantial detail. Provided with widely accepted principles of administration and organizational design, the lead administrators of the case-example organizations willingly provided advice about structural, managerial and performance conditions that are necessary if a forest products research enterprise is to effectively accomplish its mission.

The case-example organizations operated primarily as private independent research organizations (25 of 40), although about half of these private organizations were legally authorized by, but operated independently of, government. The remainder was either government organizations or government organizations operating as independent entities. Organizational missions were dominated by interest in industry competitiveness, advancing scientific frontiers, contributing to national economic needs, supporting the technical and managerial needs of clients, and promoting resource utilization and sustainability. Organizational governance was exercised via independently empowered panels, direction from a larger parent organization, and authorities exercised by chief executives. Nearly all the case example organizations operated with one or more advisory committees. Structurally, organizational patterns included traditional hierarchies, horizontal patterns with few organizational layers, orientation around client demand for skills and information, units of strategic alliances such as partnerships and joint ventures, and forest products research entities located within a larger diversified (multi-sector) research organization.

Public and private clients were of interest to the case-example organizations, although many emphasized services to their owners or members. Research was the most common service provided to clients, although the organizations also provide consultation, information, training, testing, education, certification, and pilot scale production. As for research programs, 22 of the case-example organizations focused on forest products research and 11 on forest management research. Fewer than six organizations engaged in solid wood products research as well as pulp and paper research. Those engaged in forest products research tended to directed attention to pulp and paper, wood composites, furniture, engineered structures, and wood processing and preservation. As for forest management research, the focus was primarily on fiber production, forest protection, economics analysis, harvest systems, and fish and wildlife.

Financial information about research investments made by the case-example organizations was uneven in quality and often not publically available (proprietary). However, the 2004 combined investment in forest products and related research made by

27 of the case-example organizations was in the range of US$385 to US$425 million. Forty to 50 percent of these investments were made by private research organizations. The case-example organizations employed an estimated 7,000 to 7,500 scientists and supporting staff, although most employed less than 50 staffs (three organizations report a staff of more than 400). The source of financial support was dominated by membership dues and similar assessments, fees and related charges for services provided, core funding provided by government agencies, in-kind services provided by government and private entities, and grants obtained from competitive processes. Very few organizations relied strictly on annual guaranteed funding by government.

Annual listings of research publications and written highlights of past research accomplishments were widely used as measures of performance. Other performance measures were the number of educational offerings, number and satisfaction of clients, statements of assets-liabilities and profits-losses, number of patents granted, process and product adoption rates, and a parent organization's expressed approval of past performance. Some case-example organizations were especially sensitive to accomplishment of previously established targets (patents granted, seminars sponsored, joint ventures established), managerial and administrative health of an organization (staff turnover, new members), and contributions to broad social and economic conditions that are considered important to a country's well-being (health and safety of employees, minorities and women employed, employee leadership training, support of nonprofit organizations).

The organization and administration of forest products and related research organizations in the United States can benefit from the experiences of similar organizations located beyond the nation's boundaries. In this respect, especially noteworthy among foreign organizations engaged in forest products research are the many ways in which they identify themselves (such as institutes, laboratories, centers); long history of sustained involvement in forest products research; movement from public to private ownership (whole or in part); blurry distinction between public and private sector responsibility for research; public sponsorship, yet private operation and management; wide range of services made available to clients; complex ownership and partnering arrangements; seemingly scrambled organizational structures; extensive use of subsidiaries and joint ventures; forest product research subunits located within larger parent organizations (with broad multi-sector research responsibilities); specialized services to a single major group of clients; intense desire to meet the needs of clients; synthesis of existing information as an important service; fees charged for services provided; strategic interest in clients located throughout the world; engaged in educational and degree-granting activities; multiple sources of income and revenue; diverse standards for measuring performance; adept response to broad economic-social changes; multiple location of physical facilities; and differing degrees of publicly available information describing mission and operation of organizations.

ORGANIZATIONAL CONTEXT AND INTENT OF REVIEW

The United States annually consumes more than 555 million cubic meters of roundwood equivalent and requires the services of a forest products sector that contributes more than $116 billion in gross value added to the nation's economy (1.3 percent of national total) (Howard 2003). These economic contributions are made possible by the employment of nearly 1.2 million persons. Supporting scientific innovation within the forestry and forest products sectors are investments in research and development. An estimated $400 million was so invested in 2002, although the total might well exceed $500 million (National Research Council 2002). These financial resources sustained the research activities of nearly 2,200 scientist full-time equivalents (FTEs) located at universities, forest industry research centers, and various stations and laboratories of the Forest Service, US Department of Agriculture. Investments in research and development are critical to gains in available timber supplies and to the more efficient use of wood as a raw material. Likewise, they are essential to long-term enhancement of environmental quality and to nationwide advances in economic and social welfare generally.

Organization and Managerial Challenges

The ability of forestry and forest products research to contribute to the nation's well-being requires that research organizations be well organized, effectively managed, and held to high standards of performance. There are a number of conditions that suggest the research community may well experience important – possibly dramatic – changes in the way it carries out its future research responsibilities. Consider, for example, possible redefinition of pubic responsibility for research, and likely reductions in the role of the public sector in research generally; greater variety in the clients that seek the products of research, and the subsequent broadening of research and development agendas; increased emphasis on environmental values, and a movement away from commodity focused research to research programs that are systems focused; increased potential for the commercial profitability of research results, leading to more private proprietary initiatives conducted "in-house"; decline in traditional organizational structures based on hierarchy, and subsequent proliferation of organizations "without walls" (worldwide web of researchers); modification of funding sources and funding instruments, leading to less reliance on public funds and more reliance on user-pay systems; recognition of the importance of cooperative arrangements, resulting in the strengthening of public-private partnerships and of private sector joint ventures; and increasingly rapid technological advancements (especially outside the forest products sector) impacting the focus of research programs and the way they are implemented (Alston and others 1997, Arnold and

others 1998, Billings and others 2004, Coccia 2004, Cohen and Kozak 2002, Duysters and others 1999, Goldman and others 1997, Ingham and Mothe 1998, Nair and others 1998).

The design of research organizations in response to changing economic and political conditions is not without challenges. For example, there is always concern over the risks inherent in innovation processes, allocating proper attention to various clients or groups of clients, balancing of public and private sources of funding for research, providing services viewed as peripheral to core research activities, and engaging processes that will lead to relevant strategies and programs for research. Viewed from the perspective of a "to-be-established" research organization and drawn from various sources, a more succinct statement of issues involving the design and operation of research organizations generally is presented as follows.

•*Charter*: Why is the research organization to be established? Are statutory and administrative directives sufficient to give the organization legitimacy? What legal position should the organization assume vis-vi public versus private (or some combination thereof)? Will the organization's legal positioning in this respect define a specific charge and a particular organizational structure? What discretionary authority should be sought for the organization and how should such be subsequently incorporated in the organization's legal and administrative directives (sufficient, insufficient)?

•*Mission*: Why will a mission statement be important to the success of the research organization? How is the mission statement to be developed and by whom? What reasoning (rationale) should be supportive of its content? How useful have past mission statements been in guiding and scoping the future of other research organizations? What client groups (sectors, individual entities) should be made a central focus of the organization's mission statement (and why)? How will the organization's statement of mission promote a more competitive wood-based industry?

•*Clients and Research Focus*: What sectors (forest products sector, forestry sector, or blend of sectors) or groups of clients (small companies, large companies) should be the central focus of the organization's programs? What reasoning should lie behind the selection of these sectors or client groups? Will the organization be legally required to direct attention to some groups or certain industrial sectors? To what extent should the selection of clients be based on the need to market services offered by the research organization (market-driven service decisions)? Will the client groups and resources akin to their interests be sufficient to support the existence of the organization over the long-term?

•*Governance and Organization*: How should the research organization be governed and organized (and why)? Who should be assigned fundamental fiduciary responsibilities for the organization (and why)? What will be necessary to ensure that the organization's governing structure is logical, responsive and viewed as effective? How should executive

staff persons be selected and what responsibilities should they be assigned? How should external advice and counsel on program and technical issues be obtained (consultative committees)? Beyond their governing bodies and executive staffs, why have other research organizations chosen a particular organizational structure (divisions, sections, geographic orientation)? Does their current governance promote centralized decision-making (by executive staff), decentralized decision-making (by scientific staff), or some combination thereof? How should organizational accountability be assured and performance judged (indicators as well as process)?

•*Strategic Program Directions*: What range of programs and types of services should be offered by the research organization? What should be the rationale for their selection (client orientation, interest of research staff)? Will they be traceable to the mission of the organization? Are their legal directives requiring provision of certain services or programs, market driven demands for such services, or a combination of both? What planning processes will be used to define program areas, who will be involved in these processes, and how effective might they be? In what way should programs be oriented to specific client groups (if at all)? How are short-term versus long-term research needs to be sorted out? Will the organization's programs embody specific targets (objectives) to be accomplished during a specified period of time? Will the organization's programs be coordinated with those of other (often competing) organizations? How is the integrity and objectivity of the research organization and its programs to be maintained? Should the organization use intermediaries (other public and private organizations) to obtain and deliver services? How will the organization's programs promote a more competitive wood-based industry?

•*Budgeting and Funding Sources:* What arrangements should be made to ensure that the organization is sufficiently funded over the long-term? Are their legal or related directives that address funding levels and funding sources (earmarked funds, trust funds, endowments)? What is an appropriate blend, and rationale, of public and private funding sources? Are public funds expected to be increasingly more difficult to secure? How might program funding be made more stable and more reliable over the long-term? What processes should be used to allocate financial resources among competing programs? Will special funding arrangements be necessary for large capital type items and for research requiring long time periods to a payoff? Which private funding approaches will be most suitable to the long-term financial health of the organization, yet agreeable to the research organization's clients (member fees, service fees)? How might publicly appropriated monies be most effectively allocated to various programs? How are funds (regardless of the source) to be allocated between project needs and administrative overhead needs?

•*Scientists and Supporting Staff:* What size and range of expertise should be sought for the organization's staff? Should scientists play an active role in marketing their professional talents and in seeking prospective clients? How will scientific staffs be impacted by the implementation of a market driven approach to research (services provided for a fee)? How will the intellectual infrastructure of scientists be sustained and kept relevant when operating in a market-driven research mode?

•*Performance Measures*: Why should there be concern over organization and program performance? Are there legally specified measures and levels of performance that must be met and reported? What indicators of performance are most useful (number of products, number of services provided, commercialization of service, rates of return on investment)? How will measures of performance be related to the organization's research mission and to progress toward agreed to research objectives and targets? How comfortable will research and supporting staffs be with exacting measures of program performance?

The aforementioned challenges and change-inducing conditions involving research organizations and research programs are not unique to the United States – they are occurring worldwide. In some countries, the organizational and operational responses have been remarkably different from that which has occurred in the United States. Such is especially true with regard to the financing of research programs, relationships with client groups, and the formal administrative ties between different research enterprises. Given such a context, forest products and related research organizations in the United States could very well benefit from an organized review of how such organizations in other countries are being organized and administered in response to changes in worldwide technical and institutional conditions.

Intent and Scope of Review

A review of forest products and related research organizations beyond the boundaries of the United States was carried out in 2004-2005. The intent of the review was to obtain a better understanding of how such organizations are structured, administered and judged – with an eye toward identifying conditions that might be of value to similar organizations that operate in the United States. Of special interest were those conditions that seemed especially innovative and forward-looking, and that, if adopted, might improve the way forest products and related research programs in the United States are organized and managed. In order to focus the review, three major topical areas were of interest (Bain 1959, Consultative Group on International Agricultural Research 1997), namely:

> *Structure*: How are research establishments organized? Focus on: authorities (laws, policies, rulings, directives), governance (autonomous, governing body), hierarchy (functional, territorial, service), affiliations (partnerships, joint ventures, alliances), clients (type, number, demands, support for organization), budgets (size, focus, trends), and staff (size, expertise, tenure, education)
>
> *Conduct:* How do research establishments function or operate? Focus on: managing direction (values, mission, issues, planning), exercising leadership

(vison, commitment, tenure, building support), managing budgets (promoting, formulation, documentation, execution), structuring decision-making (ad hoc, centralized, multiple advocacy), human resources (recruitment, evaluation), and managing external environment (networks, coordination).

Performance: How well do research establishments meet standards or benchmarks? Focus on: public acceptance (trust, integrity, fairness), adaptability (developments in economy, technology, policies), competence (professional), decision making (consistency, participation, representation, networking), economic efficiency (time, costs), accountability (directives, clients, higher authority), and service and product quality (focused, useful, current, progressive).

The review, and the observations drawn from it, were sensitive to the reality that research programs in other countries are designed and administered to fit comfortably within each nation's unique economic, political, and natural resource setting. As such, the experiences of the foreign research establishments reviewed here should not be uniformly considered applicable to all conditions in the United States.

Procedures and Methods of Review

The review involved three major tasks, namely identification of research organizations, assessment of their structure and administration, and synthesis and subsequent reporting of important and relevant information. In detail, these tasks were as follows:

A. *Identification and Description of Research Organizations*. Located in countries other than the United States, 93 research organizations were initially identified for consideration by the review. They were identified from a number of sources, including web sites, annual reports, contact with research organization administrators and officers, and examination of various organizational directories and encyclopedias.[1] Forty of the

[1] For example, *Yearbook of International Organizations: 2004-2005* (Union of International Associations. Munchen, Germany. 2004), *Research Centers Directory Vol. One and Two* (Gale Research Publishers. Detroit, MI. 1998), *World Environment Encyclopedia and Directory: 1998* (Europa Publications Limited. London, England. 1997), *Encyclopedia of Associations: International Organizations Vol. One and Two* (Gale Research Publishers. Detroit, MI. 1995), *Directory of Pan-European Organizations: 1992* (Euromonitor PLC Publishers. Devin, England. 1992), *Directory of British Associations and Associations in Ireland* (CBD Research Publishers. Kent, England. 1992), *Encyclopedia of Associations: An Associations Unlimited Reference Vol. Two and Three* (Gale Research Publishers. Detroit, MI. 2004), *World Compendium of Forestry and Forest Products Research Institutions* (Food and Agricultural Organization, United Nations. Rome, Italy. 1986), *Directory of Forestry Research Organizations: 1995* (Food and Agricultural Organization, United Nations. Rome, Italy. 1995), *Forestry Research Capacities in European Countries* (European Community. Luxembourg, Luxembourg. 1999), *Researchers and National Laboratories in Japan* (Research Development Corporation

organizations were subsequently chosen as *case-examples* (located in 23 different countries), 30 were described in an abbreviated manner, and 23 were identified by name only. Organizations in the latter two categories appeared to have innovative organizational and administrative characteristics, yet information about them was limited or the available information was in a language other than English.

The 40 case-example organizations were chosen because they enabled the review to have representation from countries worldwide, provided for a healthy mixture of public and private sponsorship, permitted review of a variety of different missions and research programs, and furnished opportunity for examination of diverse organizational structures and administrative procedures. For each of the case-example organizations, a draft narrative of their structure and administration was prepared. The lead administrator of each organization was subsequently contacted and asked to screen the narrative for accuracy, completeness, and timeliness (administrators from 30 organizations were thoughtful enough to respond with corrections). Changes were subsequently made in the draft narratives. To provide a context for comparison, basic information about three major forest products research and development organizations in the United States was also gathered (but was not made a basic part of the review) (Appendix D).

B. *Identification and Review of Other Potential Structures*. Other (possibly more suitable) ways of structuring and administering research organizations were identified and subsequently reviewed. Doing so involved (a) identification of conceptually sound qualities of an effective organization (relying on literature focused on organizations generally and on forestry and forest products research organizations specifically), and (b) solicitation from experienced administrators, opinions about conditions considered to be important attributes of an effective research organization. For the latter, the lead administrator (having titles such as president, managing director, chief executive office, director general, chief operating officer) of each case-example organization was contacted. Thirty administrators were thoughtful enough to respond with unusually forthright commentaries.

C. *Synthesis and Reporting of Meaningful Information*. With the intent identifying especially promising patterns in the structure, conduct and performance of forest products and related research organizations, the information gathered from the aforementioned sources was organized and subsequently examined. Once identified, meaningful patterns were described in detail and subsequently reported. A significant portion of the information

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of Japan. Tokyo, Japan. 1993). *Compendium of Pulp and Paper Training and Research Institutions* (Food and Agricultural Organization, United Nations. Rome, Italy. 1992).

subject to the synthesis (and considered basic to the review) is presented in detail in the following appendices.

- Comprehensive Description of the Organizational and Operational Characteristics of Case-Example Forest Products and Related Research and Development Organizations (Appendix A).
- Organizational Charts of Case-Example Forest Products and Related Research and Development Organizations (Appendix B).
- Abbreviated Description of the Organizational and Operational Characteristics of Selected Forest Products and Related Research and Development Organizations (Appendix C).
- Comprehensive Description and Organizational Charts of Selected Forest Products Research and Development Organizations in the United States (Appendix D).

The review generated important information that should be useful to administrators of forest products and related research programs in the United States. However, its shortcomings need to be acknowledged. Some research establishments were excluded from consideration because information about them was not publically available (for example, information about financing and employees was often proprietary) or was available in a language other than English. Information about each organization was not always common to a single year, although most information reflects conditions occurring during the period 2003 through 2005. In some cases, request for information from program administrators was ignored (or disregarded) while in other cases administrators were simply unable to interpret and subsequently respond to the requests that were being made of them. As such, information voids occur in certain cases (for example, performance indicators). Separating forest products research from other research programs also posed difficulties for the review. Forest products research is very often described as part of a forest research program generally or as part of a broader research program that encompasses various industrial sectors (construction, packaging, transportation) or many overarching technologies (biotechnology, modeling, simulation). These shortcomings aside, the review is offered as a reasonable description of many of the forest products and related research organizations that are located beyond the boundaries of the United States.

Research Organizations Examined

Organizations and Countries

Forest products and related research organizations considered by this review are located throughout the world. As previously discussed, 40 of these organizations were selected as case-example organizations (Table 1, Appendix A and B). They provide the basis for most of the insights and observations that are expressed by the review. The 40 case-example organizations are located in one of 23 different countries, with most frequent representation being Finland and Sweden (each with four organizations) followed closely by Australia, Canada, and Norway (each with three organizations). Although having engaged in frequent merger and realignment activities over the years, the reported dates of establishment for the case-example organizations are distributed as follows (dates for three organizations not available): 1900-1939 — 7 organizations, 1940-1979 — 17 organizations, and 1980-2004 — 13 organizations. Many of the 40 organizations have long and involved histories. For example, although the Swedish Institute of Wood Technology (TRATEK) merged with the Swedish National Testing and Research Institute (SP) in 2004 to form SP-TRTATEK, TRATEK's roots as an organization can be traced to the mid-1800s. Similarly, FORINTEK Canada can trace its origin to the Canadian Forest Products Laboratory which was established in 1915. And though formally reconstituted in 1945, the origin of the Taiwan Forestry Research Institute can be traced to the late 1890s. Also engaged in research and development for many years are organizations such as the Forestry and Forest Products Research Institute of Japan (established in 1905), KLC (Oy Keskuslaboratorium-Centralboratorium Ab) of Finland (in 1916), Finnish Forest Research Institute (METLA) (in 1917), and the Norwegian Forest Research Institute (in 1917).

The research and development programs of the 40 case-example organizations considered here vary considerably in their focus (Table 1). At the risk of suggesting exclusive operation in one program area, the following distribution of case-example organizations by major program area indicates that some organizations focus primarily on forestry matters, others on forest products initiatives, while yet others blend these major program areas: *forest products* — 21 organizations, *forest products and modest forestry* — one organization, *forest products and forestry* — 10 organizations, *forestry and modest forest products* — four organizations, *forestry* — four organizations. Within these broad categories substantial specialization cvan occur. For example, within the forest products category there are at least three organizations that emphasize specialities involving pulp and paper, namely Finland's KCL (Oy Keskuslaboratorium-Centralboratorium Ab), the

Table 1. Forest Products and Related Research Organizations (case-examples), by Country, Budget, and Program Focus. 2004-2005.

Organization	Country	Date Established	Budget-Income (million US$)	Program Focus
• Cooperative Research Center for Sustainable Production Forestry (CRC)	Australia	1997	2.2	Forestry
• Cooperative Research Center for Wood Innovations (CRC)	Australia	2001	8.1	Forest Products
• ENSIS	Australia	1949	NA	Forest products and forestry
• Holzforschung Austria (HFA)	Austria	1953	4.4	Forest products
• Forest Engineering Research Institute of Canada (FERIC)	Canada	1975	10.2	Forestry
• Forintek Canada Corporation (FORINTEK)	Canada	1979	24.4	Forest products
• Pulp and Paper Research Institute of Canada (PAPRICAN)	Canada	1930	34.0	Forest products, modest forestry
•Research Institute of Wood Industry (CRIWI)	China	1957	NA	Forest products
•European Forest Institute (EFI)	Finland	1993	3.0	Forestry, modest forest products
•Finnish Forest Research Institute (METLA)	Finland	1917	58.9	Forestry, modest forest products
•KCL (Oy Keskuslaboratorium-Centralboratorium Ab)	Finland	1916	28.6	Forest products, emphasis pulp and paper
•Technical Research Center of Finland (VTT)	Finland	1942	NA	Forest products, modest forestry
•Association Forest Cellulose (AFOCEL)	France	1962	7.8	Forestry and forest products
•French Pulp and Paper Research and Technical Center (CTP)	France	NA	13.6	Forest products, emphasis pulp and paper
•Federal Research Center for Forestry and Forest Products (BFH)	Germany	NA	NA	Forest products and forestry
Institute of Wood Technology (IWT)	Germany	1952	6.0	Forest products
•National Council for Forest Research and Development (COFORD)	Ireland	1993	2.1	Forest products and forestry
•Forest Products and Forestry Socio-Economic Research and Development Center	Indonesia	1983	NA	Forest products

NA = Information not available.

Table 1. Forest Products and Related Research Organizations (case-examples), by Country, Budget, and Program Focus. 2004-2005 (continued).

Organization	Country	Date Established	Budget-Income (million US$)	Program Focus
•Forestry and Forest Products Research Institute of Japan (FFPRI)	Japan	1905	90.0	Forest products and forestry
•Hokkaido Forest Products Research Institute	Japan	1950	NA	Forest products
•Forestry Research Institute (SILAVA)	Latvia	1946	NA	Forestry, modest forest products
•Forest Research Institute Malaysia (FIRM)	Malaysia	1985	7.5	Forest products and forestry
•SHR Timber Research	Netherlands	1991	2.9	Forest products
• SCION Crown Research Institute	New Zealand	1947	NA	Forestry and forest products
• Wood Technologies Research Sector, Industrial Research Limited (IRL)	New Zealand	1992	NA	Forest products
• Norwegian Forest Research Institute (SKOGFORSK)	Norway	1917	11.4	Forest products and forestry
• Norwegian Institute of Wood Technology (NTI)	Norway	1949	4.6	Forest Products
• Paper and Fiber Research Institute (PFI)	Norway	1923	4.1	Forest products, emphasis pulp and paper
•Forest Products Research and Development Institute (FPRDI)	Philippines	1954	NA	Forest products
• Research and Development Center for Wood-Based Panels	Poland	1974	NA	Forest products, emphasis on panels
• Forest Research Institute (FRIS)	Slovak Republic	1948	1.8	Forestry, modest forest products
• Forestry and Forest Products Research Center (FFP)	South Africa	NA	NA	Forest products and forestry
• Institute for Commercial Forestry Research (ICFR)	South Africa	1984	2.0	Forestry
• Forestry Research Institute of Sweden (SKOGFORSK)	Sweden	1992	14.0	Forestry
• Swedish Institute for Wood Technology (SP-TRATEK)	Sweden	2004	8.3	Forest products, emphasis milling, housing, furniture, board

Table 1. Forest Products and Related Research Organizations (case-examples), by Country, Budget, and Program Focus. 2004-2005 (continued).

Organization	Country	Date Established	Budget-Income (million US$)	Program Focus
• Pulp and Paper Research Institute-Institute for Packaging and Logistics (STFI-PACKFORSK)	Sweden	2003	31.3	Forest products, emphasis packaging, pulp and paper
• Swedish Wood Ultrastructure Research Center (WURC)	Sweden	1996	2.3	Forest products
• Swiss Federal Laboratories for Material Science and Testing (EMPA)	Switzerland	1938	2.0	Forest products
• Taiwan Forestry Research Institute	Taiwan	1945	NA	Forestry and forest products
• Timber Research and Development Association (TRADA)	United Kingdom	1962	1.1	Forest products, emphasis engineered products

French Pulp and Paper Research and Technical Center (CTP), and the Paper and Fiber Institute (PFI)of Norway. Also within the forest products category are specializations in engineered products (for example, the Timber Research and Development Association [TRADA] of the United Kingdom) and panel products (for example, Poland's Research and Development Center for Wood-Based Panels). In contrast, some of the case-example organizations are quite diversified in their research and development interests. Again in the forest products category, the Swedish Institute for Wood Technology (SP-TRATEK) programmatically addresses researchable problems involving milling, housing, furniture and board products, while Sweden's Pulp and Paper Research Institute-Institute for Packaging and Logistics (STFI-PACKFORSK) directs research attention to a wide variety of packaging issues as well as to a number of very focused subjects involving the manufacture of pulp and paper.

Economic and Resource Context

The 40 case-example organizations considered by the review make substantial public and private investments in research and development. For 27 of the 40 organizations for which budget information is available, the combined 2004 investment in forest products and related research was probably in the range of $385 to $425 million, of which 40 to 50 percent can be traced to investments made by private sector research and development organizations (Table 1). If budget information were available for all 40 organizations, total annual investment would likely exceed $600 million. The 40 case-example organizations employed an estimated 7,000 to 7,500 scientists and supporting staff in 2004. Because of

absent reporting, fluctuating exchange rates, and differences in reporting staff capacity, these estimates should be viewed with caution.

Demographic, economic and resource conditions within a country can be major factors explaining whether or not research and development organizations exist within a country, and, if such organizations do exist, the type and intensity of forest products and related research that is undertaken. Exactly how these factors exert such influence is difficult to fix conclusively. Focusing only on the 40 case-example organizations, it appears that those countries whose forest sector contributes more than 3 percent to their nation's gross domestic product tend to have a greater number of major research and development organizations engaged in forest products and related research (for example, Canada – three organizations, Finland – four organizations, New Zealand – two organizations, Sweden – four organizations) (Table 2). However, this is not always the case. For example, 4.7 percent of Malaysia's gross domestic product is attributable to the nation's forest sector, yet the country has only one (of the 40 reviewed) major forest products and related research organization. Conversely, Norway's forest sector accounts for only 1.1 percent of the nation's gross domestic product yet it has three such organizations. The relationship between other parameters (land area, population, GNP per capita, forest cover, roundwood removal, forest sector employment) and the number of research and development agencies in a country is also inconclusive and risky to judge. In part, identifying hard contextual relationships such as these fail because some countries have chosen to have a number of smaller research organizations rather than one large organization, or they may have established a single research and development organization that views the world as the market for their services — not just clients located within their country's boundaries.

Table 2. Demographic, Economic, Forest Resource and Forest Industry Conditions, by Selected Countries. 2003-2004.

Country	Demographic and Economic Conditions			Forest and Forest Industry Conditions			
	Land Area (000 ha)	Population (000's)	GNP per Capita (US$)	Forest Cover (000 ha)	Annual Roundwood Removals (000 cm)	Gross Value-Added by Forest Sector (million US$)	Forest Sector Employment (000's)
Australia	768,230	18,701	19,689	154,539	29,826	14,930 [0.9]	73
Austria	8,273	8,177	29,309	3,886	17,055	3,744 [2.2]	60
Canada	922,097	30,857	19,267	244,571	194,727	19,843 [3.2]	373
China	932,743	1,274,106	668	163,480	286,107	14,930 [1.3]	3,118
Finland	30,459	5,165	26,020	21,935	53,779	7,914 [7.5]	91
France	55,010	58,886	27,437	15,341	36,850	8,249 [0.7]	165
Germany	34,927	82,178	30,133	10,740	51,182	15,252 [0.9]	372
Ireland	6,889	3,705	17,739	659	2,683	581 [0.7]	13
Indonesia	181,157	209,255	1,096	104,986	112,004	3,977 [2.5]	562
Japan	37,652	126,505	43,574	24,081	15,290	43,477 [0.9]	514
Latvia	6,205	2,389	2,815	2,923	12,916	306 [4.9]	50
Malaysia	32,855	21,830	4,469	19,292	21,337	3,694 [4.7]	189
Netherlands	3,392	15,735	27,402	375	1,044	2,383 [0.7]	35
New Zealand	26,799	3,828	15,233	7,946	21,399	1,837 [3.9]	34
Norway	30,683	4,442	35,947	8,868	8,302	1,632 [1.1]	29
Philippines	29,817	74,454	1,170	5,789	15,988	590 [0.9]	63
Poland	30,442	38,740	3,472	9,047	28,835	1,840 [1.3]	163
Slovak Republic	4,808	5,382	3,645	2,177	6,355	453 [2.7]	46
South Africa	121,758	39,900	3,377	8,917	30,616	1,856 [1.6]	172
Sweden	41,162	8,892	25,685	27,134	67,300	6,912 [3.4]	103
Switzerland	3,955	7,344	46,448	1,199	4,800	3,329 [1.5]	69
Taiwan	56,253	22,894	25,300	3,592	--	--	--
United Kingdom	24,160	58,974	19,946	2,794	7,835	9,696 [0.8]	192
United States	915,895	276,218	28,310	225,993	448,059	116,014 [1.3]	1,154

Note: Land area (1998), population (1999), gross national product (GNP) per person (1997), forest cover (2000) from *Global Forest Resource Assessment: 2000,* Report No. 140, Department of Forestry, Food and Agricultural Organization, United Nations, 2001. Roundwood removal (production) (2003) information from *FAO Yearbook 2003: Forest Products*, Department of Forestry, Food and Agricultural Organization, United Nations, 2005. Forestry sector employment (forestry and logging; manufacture of wood products, and paper and paper products) (2000) from "Trends and Current Status of the Contribution of the Forestry Sector to National Economies," Working Paper FSFM/ACC/07 (Arvydas Lebedys), Forest Products and Economics Division, Department of Forestry, Food and Agricultural Organization, United Nations, 2004. Numbers in [ ]'s are percent contribution of forestry and forest industry sectors to gross domestic product in 2000. Where otherwise not available, information for Taiwan is incorporated in information for China.

STRUCTURAL CHARACTERISTICS AND DESIGN STANDARDS FOR ORGANIZATIONS

Organizations in General

Structural Characteristics

Organizations are assemblies of knowledge, power and will that enable the accomplishment of certain purposes that could not be achieved by individuals acting alone. They embody pervasive systems of beliefs, values, and norms that can promote or detract from an organization's performance. The complex mission of most public or private organizations makes generalizations about their structure, conduct, and performance tenuous at best. However, most students of organizational design agree that how an organization is structured (a formal pattern of how people and jobs are grouped) is directly related to its performance, with important structural attributes being *formalization* (degree to which the means and ends of organizational activities are specified, written, and enforced), *centralization* (extent to which decision-making within an organization is delegated), and *complexity* (degree to which occupational groupings are specified and the extent to which an organization is divided into different units or departments).

Organizational structures are more than the hierarchal patterns displayed by organizational charts. An organization's structure is really the sum of all the formal and informal relationships that develop within an organization, some of which do not fit into traditional hierarchal line structures (Figure 1). For example, a research organization may be described by the many informal personal relationships that exist between researchers (for example, informal links between chemists and statisticians), the cross-boundary organizational units that promote a systems approach to problems (for example, a wood drying systems unit and a wood adhesives unit linking to solve . . .), the traditional hierarchal linkages that establish lines of authority and responsibility (for example, director to assistant director to project leader to researcher), and the regional location of units and their employees (for example, regional research centers or stations). These many overlaying "structures" transcend an organization. How well they are orchestrated ultimately determines the over all performance of an organization.

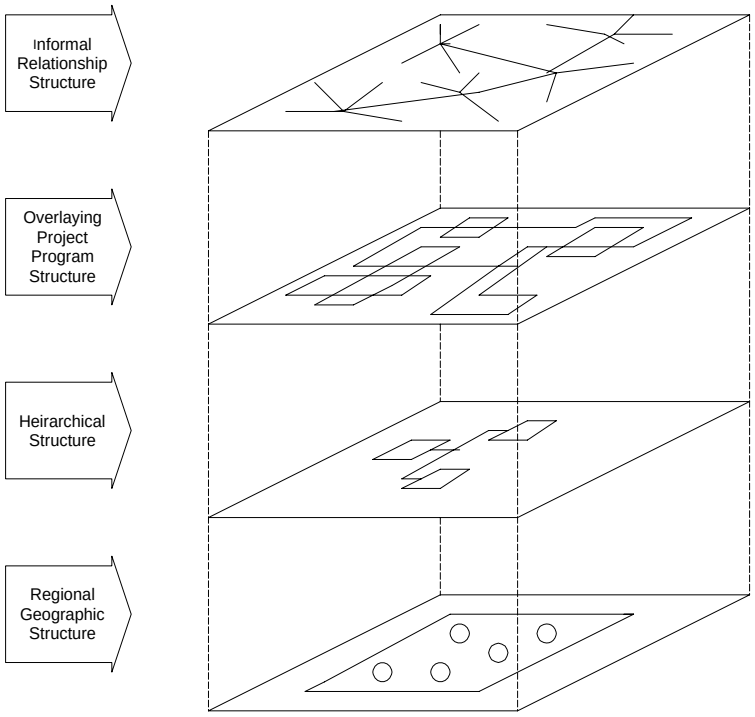

Figure 1. Formal and Informal Relationships Defining Organizations.

An organization's structure is the result of managers' decisions and actions, with the substance of these decisions usually being the same. First, attention must be directed to the division of labor within an organization, namely dividing an undertaking (for example, generating new knowledge) into activities that can actually be carried out by people. In the case of research, activities are typically divided into different professional or occupational specialities (for example, chemist, economist, statistician, engineer) (in contrast to horizontal specialization involving the sequencing of activities), plus some degree of vertical specialization involving a hierarchy of authority. Second, people and their tasks must be grouped so they can be coordinated and focused on an organization's overall goals – they must be divided into units with specific areas of responsibility (departmentalized). The groups may be organized according to *function* (for example, research on transportation systems), *territory* (for example, research on all problems within a region), product or commodity (for example, research on paper making), and *client orientation* (for example, research on issues unique to the lumber industry). And third, the groupings of people must be assigned to managers who exercise various authorities. In this respect, concern is with the number of groups to be assigned to a manager (span of control) and the type and amount of authority vested with a manager. In research organizations, spans of control are typically "small," so as to promote frequent informal contact between researchers and

managers, and authority is decentralized so as to promote individual discretion and innovation among individual scientists (Gibson and others 1994, Johnson 1992).

Design Standards

Designing an organization implies the existence of certain standards against which the goodness or badness of a proposed structure can be judged. For example, an organization's chances of success are more likely if there exist: clear goals and purposes, with decisions centered on them; incentives for persons to join an organization and to work diligently toward its goals; internal efficiency in transforming resources into desired products and services; and maintenance of strong links with supporting constituents and interests. Acknowledging that the missions of organizations are often very different and, therefore, must be judged by standards that are suitable (a mission of research versus a land management mission means different organizational designs), established wisdom suggests that organizations in general should exhibit the following structural and managerial characteristics:

•Mission and goals are socially meaningful, deserving of praise, and are viewed as especially worthy of pursuit. Employees are motivated by mission and goals and are engendered with a sense of personal self-worth because of them (Carnevale 2003).

•Simple and straightforward structure, enabling employees and outsiders alike to understand who performs what functions, who has what authority to take what actions, and why such functions and authorities exist (Gibson and others 1994, Ranson and others 1980).

•Responsibility and accountability are clearly assigned, ensuring that no major decision or action goes without review and possible modification. Integrated ongoing systems exist for evaluating performance and a welcoming attitude toward the need for adjustment in direction and emphasis (Eliadis and others 2005).

•Flexibility in structure and managerial capacity, allowing for redirection of operations and the assumption of new responsibilities, new methods and procedures, and new persons with different specialities. Able to creatively respond to external threats to assigned mission and responsibilities (Gibson and others 1994, Hughes 2003).

•Deliberate communication of accurate and timely information, both within the organization and to clients groups served by the organization. Communication is an integrated part of efforts to consistently work to provide client groups with sought-after services and products (Johnson 1992, Rosenbloom and Goldman 1986).

•Confident and forceful interest in securing a sustainable flow of human and financial resources necessary to accomplish assigned goals and objectives. Able to set for opportunities worthy of investment and base such investment opportunities on good science and sound financial and economic analyses (Gibson and others 1994,Gordon 1992).

•Capacity to resolve ongoing internal disagreement over priority in mission and in goals and objectives. Capable of preserving order and consistency in procedures (Gordon 1992).

Research Organizations

Structural Characteristics

Research organizations are established for purposes of strengthening the scientific basis for decisions regarding the use of resources. Their focus can be on specific sectors of the economy or on the multitude of economic and technical processes that exist within a single sector. Their importance is highlighted by the reality that societies are willing to make major investments in their operation, either by governments or by private concerns. Factors that must be considered when designing research organization are not especially different from those that must be considered when designing a commercial enterprise or a government agency generally, including organizational complexity, centralization of decision making, and formalization of administrative processes. The only difference is that they must be used in the context of innovation related activities typically engaged in by research organizations, including basic and applied research, design and application engineering, provision of technical services, certifying and standardizing products and processes, and management and diffusion of information.

Research organizations must be flexible and willingly capable of assuming the risk of exploring the unknown. Since they seek to employ creative and independent persons for whom innovation is a high priority, rigid hierarchy and precise rules are typically avoided by scientific research organizations. Similarly, although often difficult to avert, excessive complexity in the form of far-reaching compartmentalizing of research specialists (who are usually highly skilled in a narrow range of competence) can fragment an organization and make it lose a focus on its overall mission. In this respect, management generalists, who have broad management and program integrating responsibilities, are challenged to keep an organization's units focused on overall priorities, yet provide for an environment within which individual research units and research specialists are able to contribute to the accomplishment of such priorities.

To be viable in the longer term, research organizations must be adept at reviewing the requirements of their client groups (markets), monitoring the evolution of new technologies, assessing the technical specialities they are capable of supporting, and, as necessary, willing to adjust the service they provide and the clients they serve (for example, large versus small enterprises, one sector versus another). Whether or not a research organization can successfully accomplish such tasks is influenced by a number of conditions, some of which it can control, others it cannot, and still others it must negotiate to the benefit of the organization. Categorized in this manner, conditions influencing the success of a research organization include (Rush and others1996):

•*Internal conditions:* Conditions under meaningful control of the organization. Focus on: leadership, strategic direction, research and support staff, organizational structure, competence, communications, reward systems, and search for new technologies.

•*External conditions:* Conditions outside meaningful control of the organization. Focus on: competition, consistent funding, tax and incentive policies, national economic growth, client interests and needs, and industrial development generally.

•*Uncertain conditions:* Conditions that may or may not be controlled by the organization. Focus on: image and awareness, political influence, client involvement, scientific networking, collaboration activities, performance measures, and acquiring knowledge from client groups.

Design Standards

Standards for judging the features of a well-designed research organization are similar to those used to judge organizations generally. Summed succinctly, an effective research enterprise ". . . knows its client groups, understands its capabilities and limitations, matches the qualities and skills of it staff to clients, understands where new technologies are going and adjusts to them, and tempers its purported knowhow so as to guard its clients' confidence" (Goldman and others 1997, pg 3). In more detail, the following are suggested as important dimensions of a well-performing research organization generally:

•Clear understanding of organization's research "niche" (for example, applied versus basic research, training versus testing) and a secure view (strategic direction) of the technological needs and opportunities in the chosen niche. Continuous monitoring of research organization's strategic and operational plans, giving ample opportunity to adopt to changing technological and business environments (Arnold and others1998, Rush and others 1996).

•Special sensitivity to the research needs of client groups and the relationship of such needs to the expertise available within the research organization. Particular concern with creating awareness of organization's capabilities, maintaining very close (on-site) contact with clients within an industry (or government), and giving special attention to key client groups that are major contributors to the economy or to society (Bremser and Barsky 2004, Grier 1996).

•Unified organization with an overriding mission to serve clients, rather than a collection of loosely-connected technological fiefdoms each going their separate ways. Provide a range of services to clients that incorporate many opportunities for interaction between clients and technical staffs. An assertive search for "feedback" from clients that use new technologies developed by the research organization (Arnold and others 1998, Goldman and others 1997).

•Leadership and managerial staff setting a tone that emphasizes technical excellence and a service orientation. Leadership having background in industry and in a technical field is helpful to organizational performance, but not a necessity (more important to internalize client and researcher linkages)(Goldman and others 1997, Thamhain 2003, von Zedtwitz 2003).

•Quality, hardworking research staff with a high level of expertise that is well ahead of clients and has a penchant for communicating and interacting regularly with industry. Incentives available that promote staff advancements and encourage staff to work for the goals of the organization, both as an individual and as part of teams (Gassmann and von Zedtwitz 1998, Grier 1996, von Zedtwitz 2003).

•Researcher sensitivity to industrial operating priorities and pressures and a willingness to often compromise perfection in technical excellence in order to meet market and production needs. Special concern for relationship of new technologies and the cost to industry of their adoption (Arnold and others 1998).

•Separation of governance responsibilities, especially formal separation of guidance and oversight on strategic matters (responsibility of governing board of directors) from guidance on technical matters (responsibility of technical advisory body). Overall composition of governance boards and advisory groups are strongly weighted in favor of industry (Arnold and others 1998, Ingham and Mothe 1998)

•Extensive linkages (formal or informal) with research supporting organizations, both public and private and within and outside the research organization's chosen niche (for example, universities, foundations, industry, government agencies, special interest groups), and a willingness to enter into partnership with other research organizations (especially partnerships based on trusting relationships, complementary assets, and mutual research experiences) (Ingham and Mothe 1998, Carayannis and Laget 2004).

•Competitively offered funding sources that encourages business-oriented structures and management schemes. Avoidance of total or entire organization funding by government, especially when mechanisms do not exist for ensuring that services are being provided to well-defined client groups. Public funds focused on basic research activities, while applied research (near-market) funded by individual firms or commodity groups (industry levies or check-offs) (Alston and others 1997, Arnold and others 1998,Billings and others 2004, Goldman and others 1997).

•Continuous scanning of broader technological environments, seeking to identify and, as appropriate, acquire and master new advanced technologies. Avoid pushing the technological frontier far beyond the technologies that clients are able to use (Coccia 2004, Goldman and others 1997).

•Aggressive diffusion of new technological capabilities across the economy generally or to especially relevant sectors of the economy (Coccia 2004, Goldman and others 1997).

•Prominent placement of performance measures in a management scheme, especially performance viewed from a financial perspective (return on investments), client perspective (retention rate), business perspective (time to adoption), and growth perspective (budget and revenue) (Alex 1998, Bremser and Barsky 2004, Thamhain 2003).

Forest Products and Forestry Research Organizations

Structural Characteristics

Research organizations focused on forest products and related research seek to improve the technologies associated with the growing, processing and distribution of goods and services associated with forest resources. In many ways their structure and operation are similar to research organizations generally. However, there are certain characteristics of these research enterprises that deserve special consideration from an organizational point of view. For example, long periods of time are often required before the results of research are realized (for example, growth and yield research, hydrology and watershed research, timber stand management research), and a research dimension that implies need for organizational long-term staying power (for example, stable funding, reliable flow of research talent, dependable supportive clients). Also, forest resources and the markets for products from them are not always tightly defined by sharp resource, political and cultural boundaries, a condition implying the need for research organizations that are capable of operating in expansive settings and are willingly to cooperate and engage in partnership arrangements. Furthermore, forest products and related research has long been associated with agriculture generally, and with agricultural research organizations in particular (for

example, universities, federal research agencies), a relationship that often prompts these research organizations to organize around issues involving rural development (for example, new forest products, better resource utilization). And forest products and related research has long recognized the synergy resulting from research and education, a recognition that steers organizations to administratively embrace both research and educational activities. Such is most obvious within universities where research and education are at times one in the same, but also occurs when public and private research organizations provide funding for research carried out through graduate education programs.

Research focused on forestry and forest products is varied in many dimensions, not the least of which are the large number of diverse client groups that seek the services of research and the wide array of public and private organizations that carry out the research being sought by these customers. How forest products and related research entities have organized in order to serve the latter cannot be reliably described by a single model. The variability in structure and operation is simply too great. For example, a federal agency engaged in research may be quite hierarchal, have a strong single foci, and be subject to numerous procedures that are vigorously applied, whereas a university engaged in research may have multiple missions (education, research, service) and may provide opportunity for very wide-ranging expression of research and related interests. Moreover, research units situated within private wood-based companies may be very specific in their research interests (for example, applied orientation, short-term payoffs), whereas private foundations and independent research associations may focus on problems facing a particular sector (for example, pulp and paper, composite wood products).

Design Standards

Standards for designing a well-performing organization generally (or research organization in particular) also apply to forest products and forestry research organizations. However, scientists and administrators familiar with these research organizations have identified a number of design and operational standards that they consider especially relevant to such organizations. Although certainly not exhaustive, most notable is that effective forestry and forest products research organizations:

•Establish clear national and regional priorities for investment in high quality relevant research programs that have a client focus at both the domestic and the international levels. Operate with a long-term strategic view of science as an investment (Aldwell 1998, Fryk and Nordansjo 1998, Lundgren and others 1994, Spilsbury and others 1999).

•Create a high standard of awareness of organization's research programs and encourage periodic critical review and assessment of research priorities, including subsequent strengthening of institutional research capacity that is required to address such priorities (International Task Force on Forestry Research 1988).

•Capable of effectively accommodating major changes in the environment for research, including competition for financial resources and professional talent, attention to performance and accountability (planning, prioritizing, evaluation), justifying reasoning for public research programs, emphasis on collaboration and cooperation, and increased attention to the direction and management of research programs (Blyth and others 1998, Ellefson and Ek 1996).

•Focus on clients to be served by research programs (not unduly on institutional infrastructures). Relate measures of performance to knowledge generated and used by clients, not simply on measures of program inputs (for example, number of staff employed, trends in budgets, number of research publications) (Spilsbury and others 1999).

•Organizationally structured along issues or problems (for example, risk management, product commercialization, manufacturing systems) rather than along disciplines or products (for example, chemistry, composites, pulp and paper) (Aldwell 1998).

•Promote extensive research networking by scientists and program managers, doing so with a strong leadership commitment to networking, ample rewards for long-term engagement in networking activities, emphatic interest in communication and the sharing of materials and experiences, resources sufficient to participate in networking activities (for example, computers, travel), and well-defined issues toward which networking is focused (Bengston and Gregersen 1988, Burley 1989, Hytonen 2001, Lundgren and others 1994, Parker and McFadden 1990).

•Foster and participate in formally structured cooperative research activities (for example, alliances, cooperatives, joint ventures), especially where research interests and goals are similar, multi disciplinary specialized research skills are required, high-cost equipment and facilities are beyond the means of a single organization, and the scale of research programs and research organizations are inadequate (Blyth and others 1998, Ellefson and Ek 1996).

•Embrace progressive research management processes and skills, especially processes that promote efficiency and effectiveness in the interest of improving performance, and that lead to a suitable balance between the short-term needs of clients and the funding required to support the organization's long-term relevance (Blyth and others 1998).

•Promote employee competence and pride in accomplishing organizational goals and objectives. Remuneration and career development are competitive with equivalent fields. Special consideration given to employees with exceptional talents and those that are party

to fields considered to be highly competitive in the marketplace (Blyth others 1998, Lundgren and others 1994).

•Focus on direct and identifiable beneficiaries of the research activities and seek payment for the value of the services provided. Make fee-for-service funding an important (but not exclusive) part of organization's overall funding strategy, recognizing that by doing so the value of research becomes increasingly clear and more appreciated, responsiveness to clients becomes more focused and timely, research becomes more relevant to commercial interests, and attention to financial and project management increases (Aldwell 1998).

•Seek to maintain an appropriate blend of public and private funding of research programs. For research involving a high rate of return, low risk of uncertain results, and a single or a small group of clients, private funding is considered proper. Public funding sought for research where markets are imprecise (dispersed) for the products of research, assignment of intellectual property rights is unclear (for example, uncertain patent conditions), gains by an individual firm or small group of firms are insufficient to cover the costs of research, sustained funding of long-term research is uncertain, and there exists broad public interest in focusing on research that will benefit certain social and economic segments of society (for example, rural economic development) (Hellstrom and others 1998, Hyde and others 1992).

•Recognize the virtues of research funded by private sources, but acknowledges that the long-term consequences of an inordinate emphasis on such sources can be chancy. Long-term consequences may be limited support for research infrastructures, reduced freedom to explore high-risk but large payoff research opportunities, possible compromising research objectivity and neutrality, and a diversion of attention away from important long-term research projects. (Aldwell 1998, Hellstrom and others 1998).

STRUCTURAL AND ADMINISTRATIVE CHARACTERISTICS OF FOREST PRODUCTS RESEARCH AND DEVELOPMENT ORGANIZATIONS

Organization and Governance

Public and Private Position

Forest products and related research organizations exist and operate because they have been granted authority to do so by a free market system or by authority awarded to them by a public governing body. Some are strictly private enterprises (for example, SHR Timber Research [Netherlands]) that are beholden to markets within which clients must be sought for the services that a research enterprise is capable of providing. Others are solidly part of government (for example, Forestry and Forest Products Research Institute of Japan). They must rely on the impulses of government for direction and the generosity of government for financial support. Within these extremes lies most forest products and related research organizations, as do most of the 40 case example organizations reviewed here (Table 3):

- Private independent ---- 12 organizations
- Private independent, government authorized ---- 13 organizations
- Private-public independent, joint venture —- 2 organizations
- Public government, independent ---- 2 organizations
- Public government ---- 11 organizations

The 12 organizations identified above as private independent are not all totally independent of government. For example, the Forestry Research Institute of Sweden (SKOGFORSK) operates as a government sanctioned foundation subject to various laws that govern private companies generally (legal responsibilities, perquisites for membership, financing and accounting, governing board representation) (Table 3). Similarly, France's Association Forest Cellulose (AFOLCEL) is considered a private entity, yet its structure and operations are governed by the 1901 French Law on Associations (specifies structure, reporting, and governance). Research organizations that tend more toward truly private and independent are the German Institute of Wood Technology (IWT) (corporately owned by shareholding organizations composed of 72 private companies and associations), and the United Kingdom's Timber Research and Development Association (TRADA) (annually audited in accord with the Companies Act of 1985 which specifies legal, financial, and regulatory standards for private concerns).

Table 3. Forest Products and Related Research Organizations (case-examples), by Country, Public-Private Position, Mission, and Governance.2004-2005.

Organization	Public-Private Sector	Mission	Governance and Organization
• Cooperative Research Center for Sustainable Production Forestry (CRC) (*Australia*)	Private independent, government authorized	Enhance viability of industry through research	Governing board, center director, advisory bodies, three organizational units for research, and one for education and technology transfer
• Cooperative Research Center for Wood Innovations (CRC) (*Australia*)	Private independent, government authorized	Develop applied technologies to benefit industry	Governing board, center director, three management specialists, director of research, independent intellectual property company
• ENSIS (*Australia*)	Private independent, government authorized	Address complex problems to help sector remain globally competitive	Parent organizations (CSRIO, SCION), chief executive, seven research units, subsidiaries and joint ventures
• Holzforschung Austria (HFA) (*Austria*)	Private independent	Strengthen innovation through research, testing and technology transfer	Institute head, managing director, 11 research units
• Forest Engineering Research Institute of Canada (FERIC) (*Canada*)	Private independent, government authorized	Provide knowledge required to conduct competitive industry operations	Governing board, chief executive, advisory committees, eastern and western divisions, three research directors, 16 research units
• Forintek Canada Corporation (FORINTEK) (*Canada*)	Private independent, government authorized	Advance industry by development of creative concepts, processes and products	Governing board, chief executive, advisory committees, seven research units
• Pulp and Paper Research Institute of Canada (PAPRICAN) (*Canada*)	Private independent	Promote competitiveness of pulp and paper industry	Governing board, chief executive, advisory committees, eight research units
•Research Institute of Wood Industry (CRIWI) (*China*)	Public government	Develop wood technologies to meet national and peoples needs	Parent organization, director, advisory committees, eight research divisions.
•European Forest Institute (EFI) (*Finland*)	Private independent, government authorized	Promote research to advance conservation and sustainability	Governing board, institute director, advisory committee, four research units
•Finnish Forest Research Institute (METLA) (*Finland*)	Public government	Promote economically, ecologically and socially acceptable use and management of forests	Parent organization (federal ministries), governing board, director general, advisory committees.

Table 3. Forest Products and Related Research Organizations (case-examples), by Country, Public-Private Position, Mission, and Governance. 2004-2005 (continued).

Organization	Public-Private Sector	Mission	Governance and Administration
•KCL (Oy Keskuslaboratorium-Centralboratorium Ab) (*Finland*)	Private independent	Support owner companies through research provided innovations, knowledge and technology	Governing board, president, advisory committee, consulting unit, services unit, administration unit
•Technical Research Center of Finland (VTT) (*Finland*)	Private independent, government authorized	Create and apply technology to enhance globally competitive industry	Governing board, director general, six research institutes, eight access portals
•Association Forest Cellulose (AFOCEL) (*France*)	Private independent	Increase competitiveness of wood and paper sectors	Governing board, director general, four research units
•French Pulp and Paper Research and Technical Center (CTP) (*France*)	Private independent	Produce information to improve members' competitive position	Governing board, executive officer, six research units (four direct, two subsidiaries)
•Federal Research Center for Forestry and Forest Products (BFH) (*Germany)*	Public government	Provide scientific basis for decisions involving forests	Ministry, director, advisory committees
•Institute of Wood Technology (IWT) (*Germany)*	Private independent	Provide application-related research on wood use and processing	Parent organization (private company) governing board, managing director, eight research units, one subsidiary
•Forest Products and Forestry Socio-Economic Research and Development Center (*Indonesia*)	Public government	Coordinate and conduct research and development	Parent organization (federal ministry), director, operation division, research division, 12 research units
•National Council for Forest Research and Development (COFORD) (*Ireland*)	Public government	Promote the competitiveness of forest products industry	Parent organization (federal ministry), governing board, director, administrative units, research program unit (three programs)
•Forestry and Forest Products Research Institute of Japan (FFPRI) (*Japan*)	Public government	Promote sustainable forestry and forest resource utilization	Parent organization (federal ministry), president, administrative support units, 23 research departments
•Hokkaido Forest Products Research Institute (*Japan*)	Public government	Promote utilization of forests, provide information to industry	Director, six research units

Table 3.Forest Products and Related Research Organizations (case-examples), by Country, Public-Private Position, Mission, and Governance. 2004-2005 (continued).

Organization	Public-Private Sector	Mission	Governance and Administration
•Forestry Research Institute (SILAVA) (*Latvia*)	Public government, independent	Provide scientific advice on the management and utilization of forest ecosystems	Parent organization (federal ministry), governing board, institute director, nine research units
•Forest Research Institute Malaysia (FRIM) (*Malaysia*)	Private independent, government authorized	Promote sustainable management through knowledge provided by research	Parent organization (federal ministry), governing board, director general, advisory committees, operations unit, research unit (four research divisions)
•SHR Timber Research (*Netherlands*)	Private independent	Carry out research and testing requested by clients	Governing board, director, four research units
• SCION (*New Zealand*)	Private independent, government authorized	Advance utilization of renewable materials and products from plants	Governing board, chief executive, 11 immediate research units (direct, subsidiary, joint ventures), seven indirect business arrangement units
• Wood Technologies Research Sector, Industrial Research Limited (IRL) (*New Zealand*)	Private independent, government authorized	Promote world-class science required for innovative businesses	Parent organization, research unit
• Norwegian Forest Research Institute (SKOGFORSK) (*Norway*)	Public government, semi-independent	Strengthen scientific basis for management of forests	Governing board, director, five research units
• Norwegian Institute of Wood Technology (NTI) (*Norway*)	Private independent	Promote company profitability through research diffusion of knowledge	Managing director, five sections
• Paper and Fiber Research Institute (PFI) (*Norway*)	Private independent	Promote competitiveness of member companies through pulp and paper research	Governing board, director, three departments (two research, one administration)
•Forest Products Research and Development Institute (FPRDI) (*Philippines*)	Public government	Generate and transfer technologies improving industry's competitive position	Parent organization (federal department), director, four divisions (one administration, three research)
• Research and Development Center for Wood-Based Panels (*Poland*)	Public government	Provide research and development for wood industry	Parent organization (federal ministry), director, four research units

Table 3.Forest Products and Related Research Organizations (case-examples), by Country, Public-Private Position, Mission, and Governance. 2004-2005 (continued).

Organization	Public-Private Sector	Mission	Governance and Administration
• Forest Research Institute (FRIS) (*Slovak Republic*)	Public government	Provide scientific knowledge about forest ecosystems and their management	Parent organization (federal ministry), director, advisory boards, research section (six units), services section (five units)
• Forestry and Forest Products Research Center (FFP) (*South Africa*)	Private-public, independent	Maximize value of plantation timber for pulp and paper industry	Director, six research units, two cooperatives
• Institute for Commercial Forestry Research (ICFR) (*South Africa*)	Private independent	Contribute to industry competitiveness through technical innovation	Governing board, director, advisory committees, four research units
• Forestry Research Institute of Sweden (SKOGFORSK) (*Sweden*)	Private independent, government authorized	Contribute to international competitiveness of industry and sustainability of forests	Governing board, managing director, advisory committees, two research program units (three units each)
• Swedish Institute for Wood Technology (SP-TRATEK) (*Sweden*)	Public government, Independent	Strengthen competitiveness of wood and improve industry profitability	Parent organization (federal institute), one research unit (four research areas), advisory committees
• Pulp and Paper Research Institute-Institute for Packaging and Logistics (STFI-PACKFORSK) (*Sweden*)	Private independent	Provide clients with knowledge required to secure competitive advantage	Governing board, president, director, advisory committee
• Swedish Wood Ultrastructure Research Center (WURC) (*Sweden*)	Private-public, independent	Promote wood use by improving understanding of wood ultrastructure	Governing board, director, advisory committees, six research units
• Swiss Federal Laboratories for Material Science and Testing (EMPA) (*Switzerland*)	Private independent, government authorized	Promote sustainability by providing knowledge about materials and system engineering	Parent organizations (federal department, federal council), director general, advisory committees, two research units (six subunits, seven subunits)
• Taiwan Forestry Research Institute (*Taiwan*)	Public government	Conduct research on forests, forestry and forest uses	Parent organization (federal council), director, 10 research units
• Timber Research and Development Association (TRADA) (*United Kingdom)*	Private independent	Provide quality information to maximize benefits from timber	Parent organization (private company), governing board, executive director, four research units

The 13 organizations categorized as private independent, but authorized by government, may be viewed as private yet through complex intertwined connections their authority to exist and operate are solidly within the purview of government. An example is ENSIS of Australia which is a joint venture involving Australia's government authorized CSIRO (Commonwealth Scientific and Industrial Research Organization) and New Zealand's SCION (formally Forest Research, LTD.) which was government authorized by the Crown Research Institute Act of 1992 (Table 3). Similarly for the Swedish Institute for Wood Technology (SP-TRATEK), which is reportedly a government authorized, independent entity (a "limited company"). In reality it is a government organization in that all the organization's corporate shares are owned by the Swedish government. A more exacting example of a private independent, but government authorized, research organization is Ireland's National Council for Forest Research and Development (COFORD), which is authorized by Ireland's National Development Plan (2000-2006) and is organizationally situated within the federal government's Department of Agriculture and Food.

Research entities may also be considered as both a public and a private entity, in that they may be chartered by public and private concerns via a joint venture or similar arrangement (two of the 40 case-examples) (Table 3). In so doing, their right to exist and to operate flows from authority granted by those that are party to the joint venture. An example is the Swedish Wood Ultrastructure Research Center (WURC), which is jointly sponsored by the National Board for Industrial and Technical Development, Swedish University of Agricultural Sciences, Chalmers University of technology, Royal Institute of Technology, Swedish Pulp and Paper Research Institute-Institute for Packaging and Logistics (STFI-PACKFORSK), six companies from the Swedish pulp and paper industry, and one company from the Swedish chemical industry. Another example of a public-private entity is South Africa's Forestry and Forest Products Research Center (FFPRC) which is a joint venture between the University of Kwa Zulu-Natal and the Division of Water, Environment and Forestry Technology of the Council of Scientific and Industrial Research (CSIR) (see Appendix A).

Research organizations may be solely within government, yet may operate as a self-governing autonomous government entity (two of the 40 case-examples) (Table 3). An example is the Norwegian Forest Research Institute (SKOGFORSK) which is organizationally located within the Ministry of Agriculture of the Norwegian federal government. Similarly, the Latvia State Forestry Research Institute (SILAVA) is an independent nonprofit organization responsible in a very limited fashion to the federal government's Ministry of Education and Science. Both of these organizations have

considerable flexibility to determine research directions. The latter does not receive annually guaranteed funding for its programs (see Appendix A).

Research organizations that are solidly part of government and are subject to all the planning, budgetary and operational nuances of government (11 of the 40 case-examples) (Table 3). Some of the more strident examples in this respect are China's Research Institute of Wood Industry (CRIWI) (branch of the Chinese Academy of Forestry), Poland's Research and Development Center for Wood-based Panels (within federal Ministry of the Economy), and Germany's Federal Research Center for Forestry and Forest Products (BFH) (within the federal Ministry of Consumer Protection, Food, and Agriculture) (see Appendix A).

Mission and Strategies

The long-term interests of research organizations are brought to light by statements of mission. It is thorough the latter that the ultimate purpose of an organization is communicated (Why do we exist? What makes us unique? What do we want to do?) and from which flow an organization's vision for the future and strategies that will be used to get there (What do we hope to achieve? Who needs to be involved? What issues need to be confronted?). To some, mission statements are a reflection of what society expects from an organization in exchange for its continuing survival. For forest products research organizations, mission statements range from those that are brief and quite succinct, such as the Finnish Forest Research Institute's (METLA) "build the future of the forestry sector through research," and Norway's Paper and Fiber Research Institute (PFI)'s "be a world brand in pulp and paper research," to those that are comprehensive as is the case with the Swedish Pulp and Paper Research Institute/Institute for Packaging and Logistics (STFI-PACKFORSK)'s mission statement, namely "contribute to the productivity and profitability of clients in the entire value chain by carrying out research at the highest international level, implementing research results in commissions and in consultancy and training services, and providing services utilizing state-of-the art laboratory and pilot plant equipment."

As might be expected, the mission statements of the 40 case-examples reviewed here depict the very different ways that each organization sees its niche in the world of research (Table 3, Appendix A). Some mission states are clearly focused on specific client groups (for example, government agencies, member companies, industrial sectors), while others construe their purpose to be more that of contributing to the knowledge base

generally and the economic and social conditions of a community or a nation as a whole. Some mission statements are presented as legislatively defined mandates while other are corporate directives arrived at after considerable thought and discussion. Recognizing this diversity, common categories (threads) of purpose found in the mission statements of the case-example research organizations reviewed here are as follows.

• *Promote the competitiveness of industry*: “Help sector remain globally competitive,” “provide knowledge needed to conduct competitive operations,” “promote competitiveness,” “enhance globally competitive industry,” “increase competitiveness,” “improve members’ competitive position,” “contribute to industry competitiveness,” “strengthen competitiveness of wood,” “provide knowledge required to secure competitive advantage,” and “generate and transfer technology to improve competitive positions,”

• *Advance science and new technologies*: “Develop applied technologies,” “strengthen innovation through research,” “develop creative concepts, processes, and products,” “provide scientific knowledge about forest ecosystems,” “strengthen scientific basis for forest management,” “promote world-class science,” and “provide scientific advice.”

• *Contribute to national needs and concerns*: “Promote economically and ecologically acceptable management of forests,” “coordinate research and development,” “research to advance conservation and sustainability,” “develop technologies to meet national and peoples needs,” “serve society by contributing towards improving the quality of life and the environment.”

• *Support technical needs of clients*: “Provide research and development for wood industry,” “provide information to industry,” “provide application-related research to clients,” “support owner companies,” and “carry-out research requested by clients.”

• *Support economic and managerial needs of clients*: “Provide information to maximize benefits from timber,” “maximize value of plantation timber,” “promote company profitability through research,” and “enhance economic viability of industry.”

• *Promote resource utilization and sustainability*: “Promote sustainability and utilization through knowledge,” “advance utilization of renewable materials,” “promote sustainable management through research,” and “promote unitization of forests.”

Research organizations frequently set forth core values or philosophies that guide their behavior and give bounds to their actions. These values speak to clients and to the broader public about what the organization believes is important and who it believes deserves respect and concern. As examples, the Finnish Forest Research Institute (METLA) promotes “respect for people and their expertise,” “independence and openness,” “scientific credibility, and “responsibility for the future and for nature,” while Finland’s KLC

(Oy Keskuslaboratorium-Centralboratorium Ab) considers the following values to be especially important: “innovativeness,” “focus on customer with full confidentiality,” “responsibility for the environment,” “mutual respect,” “achieving targets,” and “exceeding customer expectations.” In some cases, a single core value is clearly identified as important to the research entity. For example, the Swiss Federal Laboratories for Material Science and Testing (EMPA) clearly demonstrates commitment to sustainability by stating
“EMPA is committed to the principle of sustainability in processes, products, methods and applications . . . [and] . . . understands sustainability to mean development that meets the needs of today’s society without compromising the ability of future generations to meet their own needs.”

A research organization’s statement of mission and values may not be sufficiently complete as a basis for conducting the business of the organization. Needed may be clarification of mission and values in the form of strategies, goals and objectives. Some forest product research organizations are quite complete in this respect. Consider the following.

• *Forintek Canada Corporation*. Vision: Be a world-class research organization committed to our members and the ongoing prosperity of the Canadian wood products sector. Mission: Be the leading force in the technological advancement of the wood products industry, through the creation and application of innovative concepts, processes, products and education. Goals: Lead in the development and balanced application of knowledge and technology to support our members sustainable development goals (economic, environmental and social), and deliver research products and services to the satisfaction of members and clients. Enabling Goals: Implement continuous improvements in internal practices that are critical to Forintek’s success; make Forintek one of the best places to work; and increase member commitment to, and investment in, Forintek. Employee Core Values: Employee commitment to the success of a strong research organization; understand and actively support the organization's goals; uphold the highest standards of ethics and professionalism; treat people with respect and fairness; demonstrate open and honest communication; work in a manner that fosters teamwork, innovation and creativity; have a "can-do" attitude; strive for continuous improvement in everything we do; work in a safe manner and take personal responsibility for the safety of others; be proactive in minimizing our impact on the environment.

• *Forestry Research Institute of Malaysia (FRIM)*. Vision: Promote the sustainable management and optimal use of forest resources by generating knowledge and technology through research, development and application. Objectives: Generate knowledge and

appropriate technology, provide research-based services to meet needs of clients, commercialize results of research and development, acquire and disseminate information, and create environmental and conservation awareness of forestry's roles. Quality Policy: Committed to excellence in scientific research and development and to derive innovations for the benefit of clients. Quality Slogan: Quality is the pillar of excellence, innovation is the key to preeminence. Client Charter: Make available reliable, economically, and timely solutions to problems, create a core of dedicated scientists of high caliber and ability, speedily disseminate reliable scientific and technical information, promote environmental awareness by providing professional advice to the public, and provide a conducive working environment that encourages creativity among scientists and a close rapport with clients.

• *Pulp and Paper Research Institute of Canada* (PAPRICAN). Vision: Be the leading pulp and paper research and technology institute in the world, delivering exceptional value for the benefit of member companies. Goals-Strategies: Provide superior returns for investments made by member companies; integrate research and technology goals with the strategies of member companies as a true business partner in their endeavors; relentlessly pursue customer satisfaction; sustain excellence in science, technology, and education; maintain the link between fundamental science and business value; and empower PAPRICAN people. Guiding Principles: *Customers* – highest priority on customer needs; deliver value by ensuring products and services that address both short-term and strategic needs; through value delivery, inspire new customers to become full members. *Institute* – uphold with pride a reputation for excellence and integrity in all endeavors of science and technology; leading-edge resources drive value delivery; and derive great strength from the vigorous sense of community shared by all who work for the organization. *People* – highly creative and energetic people working in an environment where both teamwork and individual contributions are valued and recognized; and embrace the opportunities provided by constantly evolving environment. Resources – Dedicated to effective use of resources provided by member companies; provide all customers with highly cost-effective services in various lines of business; and run Institute as a progressive business. Accountability – Expect superior performance from everyone; individuals and employees collectively accountable for actions and results; and leaders set clear goals and expectations, are supportive, and promote open communication.

• *European Forest Institute* (EFI). Mission: Conduct, promote and cooperate in the research of forests, forestry and forest products in European countries; make results of research known to all interested parties, notably in the areas of policy formulation and implementation; and promote the conservation and management of forests for producing goods and services in a sustainable way. Means: Conduct research and develop research

methods; provide relevant information for policymaking and decision-making; compile and maintain data; organize and participate in scientific meetings, including forest research training; and publish and disseminate the results of research.

Governance and Advice

Authority to govern an organization emanates from many sources, most of which are embodied in notions of power and the charisma of leadership (Table 3, Appendix A and B). The source of authority to govern an organization may arise from interpersonal (rewards, coercion, knowledge, leadership style) and structural bases (legal assignment of responsibility, control over decision-making processes, access to vital resources [money, technology, clients]), as well as control over important information (finances and budgets, conditions of employment). The essence of these factors plays out in how authority is exercised, namely how decisions regarding the direction and operation of organization are made and implemented. In some cases decisions are programed, in that they address problems that are repetitive and routine (for example, periodic reorder of inventories) and are handled by a well-defined procedure (for example, merit systems for promoting employees), while in other cases the problems are novel, complex, and unstructured (for example, purchase of expensive experimental equipment, movement into a very high risk field of research, major reorganization of a research establishment) and procedures for handling them have not been well developed. Whatever an organization's decision environment may be, it is the exercise of the governance function that determines to a large extent whether it will be successful over the long haul. As for the governance and administrative structure of the case-example organizations assessed here, three major patterns appear as follows.

Independent Empowered Panel. An independent governing panel (board, council, committee) is a common organizational expression of authority for governing the case-example organizations examined here. The panels serve in a governance capacity — not an advisory capacity – and thence engage in the establishment of overall policy and direction for an organization. Responsibility for daily management of the research entity is delegated by the board to the organization's chief executive and various deputies or assistants. Panels vary in size from three to four persons to as many as 20 to 30 persons (Forintek Canada Corporation [FORINTEK] has a 26-member board of directors).

The structure, responsibilities, and appointment processes for governing panels varies widely (Table 3, Appendix A and B). Some are made up of representatives of

member organizations (for example, Australia's Cooperative Research Center for Sustainable Production Forestry [CRC]), while others have more complex representative requirements for their boards, such as Norway's Paper and Fiber Research Institute (PFI) which is governed by a six-person board of directors, three of which represent STFI-Packforsk, one represents the PFI foundation, one represents the four largest industry owners, and one represents PFI employees. Governing panels may be appointed, elected (for example, Timber Research and Development Association (TRADA) which is governed by an 11 person elected board of directors) or some combination thereof (for example, the board of the Forest Engineering Research Institute of Canada [FERIC] is composed of eight appointed and 12 elected persons). In some cases a governing board may include the organization's chief executive office while in others the board and the lead staff person are separate. An example of the latter is STFI-PACKFORSK which is governed by a 15-person board of directors (chair, 10 members and four deputy members), and administered by two officers and eight directors (president, executive vice president and six directors, one from each of STFI-PACKFORSK's divisions).

Hierarchy Position Within an Inclusive Organization. The positioning of research organizations within a larger organization with broader responsibilities is also a common approach to the governing of the case-example organizations examined here (Table 3, Appendix A and B). In such cases there is often a vertical ordering of authority and the establishment of direction by a single director or chief administrator. Examples are the Finnish Forest Research Institute (METLA) which is responsible to the Ministry of Agriculture and Forestry and the Ministry of the Environment; German Federal Research Center for Forestry and Forest Products (BFH) which organizationally resides within the portfolio of the Ministry of Consumer Protection, Food and Agriculture (BMVEL); and the Forestry and Forest Products Research Institute of Japan (FFPRI) which is located within the federal Ministry of Agriculture, Forestry and Fisheries.

Positioned within an organization that has broader responsibilities (such as economic development, natural resources management, comprehensive research obligations) does not imply allegiance to a vertical chain of command. Although many of the case-example organizations reviewed here are parts of a hierarchal structure, they are often afforded considerable flexibility to determine their own research obligations and directions (Table 3, Appendix A and B). An example is the Finnish Forest Research Institute (METLA). Although ultimately responsible to the Ministry of Environment and the Ministry of Agricultural and Forestry, an eight-person management board basically controls and directs all the activities of the Institute, including the overall mission and goals of the Institute; an annual plan of research and associated budgets; appointment of personnel,

including the research director, administrative director, center directors, and professorships (including discipline areas); use and management strategies for research natural areas; and the establishment of advisory boards, including their tasks and membership. The Latvian State Forestry Research Institute (SILAVA) also operates quite independently, being responsible in only a limited way to the Ministry of Education and Science. The Norwegian Forest Research Institute (SKOGFORSK) operates with special independent credentials, although administratively located in the Ministry of Agriculture, and although situated within the federal Department of Agriculture and Food, the National Council for Forest Research and Development (COFORD) is quite self-governing in that it is largely responsible for developing and prioritizing its own research policies and funding sources. In a similar but more distant fashion, the Swiss Federal Laboratories for Material Science and Testing (EMPA) are responsible to the ETH Council which has semi-autonomous status from the Swiss Federal Department of Home Affairs.

Executive Officers. Regardless of whether a research organization is independent or part of a broader organization, all the case-example organizations reviewed here are guided by a chief executive officer, variously known as a director, president, director general, managing director, operating officer, or chief executive officer (Table 3, Appendix A and B). Responsibilities assigned to chief executives are often very substantial, as is the case with the Director General of the Finnish Forest Research Institute (METLA), namely ". . . to lead, control and develop the operations and activities of the Institute and be responsible for attainment of objectives and goals set for the Institute." Exactly how the governing activities of an organization's executive officer are carried out is dependent on the officer's leadership style and the structure and complexity of the organization being governed. In part, such is reflected by the type and size of supporting staffs required by executives. For example, the chief executive of Finland's KCL is supported by vice presidents for research (KCL Science and Consulting) and research services (KCL Services), while the director of the Forest Research Institute Malaysia (FRIM) is supported by deputy directors for operations and for research and development. Some organizations engage a sizable executive management team to support their chief operating officer's governing responsibilities. An example is Japan's Forest and Forest Products Research Institute (FFPRI), which is supported by a director of research planning and coordination, director of general affairs (accounting, human resources), and eight principle research coordinators. Similarly, the chief executive of New Zealand's SCION is assisted in governing responsibilities by a chief financial officer and six group managers.

Advisory Committees. The case-example organizations examined here make extensive use of formally established advisory bodies (committee, council,

commission)(Table 3, Appendix A and B). Although generally not assigned responsibility for overall governance of an organization, advisory bodies can have a significant impact on the direction and manner in which research is carried out. Although sharp lines of responsibility between committee types seldom exists, prominent responsibilities of advisory bodies affiliated with the research organizations examined here are as follows.

•*Scientific advice.* Guidance on scientific knowledge and procedures. For example, the scientific council of the French Pulp and Paper Research and Technical Center (CTP), advisory panel of Australia's Cooperative Research Center for Sustainable Production Forestry (CRC), the scientific board of the Slovak Republic's Forest Research Institute, and the committee of scientific advisors of the Swedish Pulp and Paper Research Institute/Institute for Packaging and Logistics (STIF-PACKFORSK).

•*Research program advice.* Guidance on general long-term research directions. For example, consultative commission of the Swiss Federal Laboratories for Material Science and Testing (EMPA), COFORD council of Ireland's National Council for Forest Research and Development, national research program committee of the FORINTEK Canada Corporation, and the strategic advisory committee of the Forest Engineering Research Institute of Canada (FERIC).

•*Research project advice.* Guidance on design and conduct of specific projects within programs. For example, advisory board of the Swedish Institute of Wood Technology (SP-TRATEK), and the technical advisory committees of FORINTEK Canada Corporation.

•*Performance advice.* Guidance on assessing results and effectiveness of research programs and projects. For example, the research commission of Swiss Federal Laboratories for Material Science and Testing (EMPA), and the value added research advisory committee of FORINTEK Canada Corporation.

•*Managerial operational advice.* Guidance on the administration and operation of an organization. For example, management committee of South Africa's Institute for Commercial Forestry Research (ICFR), managing group of the Swedish Ultrastructue Research Center [WURC], research management committee of Australia's Cooperative Research Center for Sustainable Production Forestry (CRC), and the operational board of the Slovak Republic's Forest Research Institute.

The number of persons and eligibility for service on advisory bodies is far from uniform (Table 3, Appendix A and B). Membership on advisory committees generally falls in the range of 10 to 15 persons, although some of the case-example organizations have see fit to establish advisory bodies that are very large. For example, the Lumber Manufacturing Advisory Committee of FORINTEK Canada Corporation has 160 members and the Composite Products Manufacturing Committee has 67 members. Ninety-three

persons are members of the Advisory Committee on Forest Engineering of the Forest Engineering Research Institute of Canada (FERIC). In some cases, advisory committee membership is limited to representatives of member companies or owners of the organization, while in other cases members represent a broad cross section of industrial sectors or of the academic community. Geographic representation can be especially broad (for example, the Scientific Advisory Board of Finland's European Forest Institute; International Advisory Group of the Swedish Ultrastructue Research Center [WURC]). And advisory bodies do not always neatly follow the functional areas described above. In some cases, they may have a product orientation (Advisory Committee on Lumber Manufacturing of FORINTEK Canada Corporation) or may be issue oriented (for example, Advisory Committee on Wildland Fire Operations research of the Forest Engineering Research Institute of Canada [FERIC].

Structure and Linkages

The organizational structure of the research entities reviewed here ranges from organizations that are carefully arranged (vertically or horizontally) to entities that appear to be organizationally very cluttered (Table 3, Appendix A and B). At first appearance, the latter would seem to defy an administrator's efforts to exercise control and direction – it would seem to make hierarchal directives, such as planning, budgeting, very difficult. Yet "messy organizational maps" may simply describe a research organization that has administratively responded to new and important problems in need of research. Regardless of the outward organizational appearance, all the case-example organizations reviewed here have certain basic internal designs. They have structures that address administrative support functions (for example, accounting, legal advice, human resource management, communications, public affairs, computer systems), planning and reporting functions (for example, program development, monitoring, and evaluation), research and development functions (for example, divisions, sections, programs, branches, subsidiaries), technology transfer functions (for example, publications, workshops), testing and inspection functions (for example, materials testing, certification), and educational functions (for example, graduate education, continuing education). Notwithstanding these basic characteristics, the case-example organizations considered by this review also have certain general patterns of administrative structure that are worth noting as follows.

Vertically structured organizations. Some organizations have assumed a very formal vertical structure that involves many layers of organization and a chain of command that

flows from a chief executive to various subordinate units that are assigned tasks considered necessary in order to accomplish an organization's mission. Accountability rests with "higher authority" within the organization. Nearly all the case-examples reviewed here have some hierarchical component – some more than others (Table 3, Appendix A and B). Examples of what would appear to be organizations with a strong vertical structure are China's Research Institute of Wood Industry (CRIWI), Germany's Federal Research Center for Forestry and Forest Products (BFH), Japan's Forest and Forest Product's Research Institute (FFPRI), and the Philippine's Forest Products Research and Development Institute (FPRDI). In some cases, many layers of administrative structure suggest a strong hierarchy. An example is the Forest Research Institute of Malaysia (FRIM) which has deputy directors for operations (three divisions) and research and development (four divisions). Such also reflects the reality that the Forest Research Institute of Malaysia is quite large (budget, personnel, programs) and requires extensive division of responsibilities.

Horizontally structured organizations. Certain organizations seem to have assumed a horizontal organizational structure, wherein there are relatively few layers of organization, and top management conducts business in a collegial fashion – acting as coordinators and integrators ("linking pins") of an organization's myriad activities (Table 3, Appendix A and B). Examples of such organizations are New Zealand's SCION, Technical Research Center of Finland (VTT), Sweden's Pulp and Paper Research Institute/Institute for Packaging and Logistics (STFI-PACKFORSK), and South Africa's Forestry and Forest Products Research Center (FFP). Also tending toward a horizontal structure is the research program of Canada's Pulp and Paper Research Institute (PAPRICAN).

Information and skills structured organizations. Some organizations seem to place great importance on fields of knowledge and the use of teams of specialists that can apply such knowledge to various problems in need of research (Table 3, Appendix A and B). Emphasis is on respect for expertise rather than on formal rank and hierarchy. Forest products research organizations structured in this fashion make much acclaim of portals or gateways to the variety of technical expertise available within their organization. An example is New Zealand's Industrial Research Limited (IRL) which promotes easy access to areas of technology that cut across various industrial sectors (Figure 2). A similar information and skills organizational arrangement is employed by Finland's Technical Research Center (VTT). The latter has established eight knowledge portals through which clients can gain easy access to the organization's diverse expertise and technologies. The portals are VTT Environment, VTT Materials, VTT Pulp and Paper, VTT Information Technologies (ICT), VTT Nuclear, VTT Renewables, VTT Transport, and VTT Life Science.

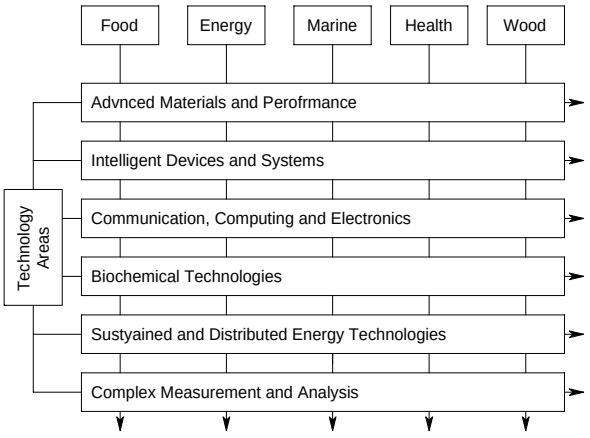

Figure 2. Information and Skills Structured Research Organization.

*Unit within Large diversified organization*s. Organizations performing forest products and related research also may be a small entity (division, center, department) within a much larger research and development organization that has a research interest that is much broader than forest products (Table 3, Appendix A and B). Being part of such a "conglomerate-type" organization enables the forest products unit to draw on the wide variety of talents, experiences and equipment that exist within the larger parent organization. In essence, the forest products unit may appear to be "small," yet in reality it is quite large. Examples of forest products research entities that are part of a much larger research establishment are the Pulp and Paper Research Unit of the Technical Research Center of Finland (VTT), the Wood Technology Research Sector of New Zealand's Industrial Research Limited (IRL), the Institute for Wood Technology of Sweden's SP-TRATEK, and the Department of Materials Systems for Civil Engineering and Department of Advanced Materials Surfaces of Switzerland's EMPA (which is part of the Swiss Federal Institutes of Technology [ETH Domain]).

Strategic alliances and partnerships. Organizations engaged in research and development involving forest products often engage in alliances or unions with other organizations (Table 3, Appendix A and B). Oftentimes operating independently from the parent organization, these partnership arrangements are initiated for various reasons, including avoiding taxes on revenue, externalizing business risk, bringing together unique research talents, accessing new clients, and addressing short-term business opportunities. Some well-known research organizations are themselves business alliances. An example

is Australia's ENIS, which is an incorporated joint venture involving Australia's CSIRO (Commonwealth Scientific and Industrial Research Organization) and New Zealand's SCION (formally Forest Research Limited). The SCION part of the joint venture has 17 joint ventures, subsidiaries or similar independent business arrangements, one of which (PAPRO [pulp, paper and packaging]) is an arrangement involving Australia's ENIS and New Zealand's SCION. Another organization that is, in essence, a joint venture is South Africa's Forestry and Forest Products Research Center (FFP) which is a joint venture between a university (University of KwaZulu-Natal) and a large internationally know research organization (Council of Scientific and Industrial Research [CSIR]).

Forest products research entities may also actively pursue partnerships as part of their operations. Examples of organizations doing so are France's Pulp and Paper Research and Technical Center (CTP) (TECH PAP [paper making sensors] and In TechFibers [pulp and paper research]), and the United Kingdom's Timber Research and Development Association (TRADA) (TTL Chiltern Group of Companies) (Table 3, Appendix A and B). TRADA engages in extensive partnering, including 12 partners focused on calibration, testing, and evaluation of plywood glue bond. In some cases, the business partnership is not give a formal name, but simply involves an agreement to engage formally in collaborate activities (including reporting in each organizations' annual report). An example of the latter involves Norway's Paper and Fiber Research Institute (PFI) and Sweden's Pulp and Paper Research Institute/Institute for Packaging and Logistics (STFI-PACKFORSK).

Business partnership arrangements can also take the form of cooperatives. Such have been initiated by Australia's ENIS (operates nine cooperatives) and South Africa's Forestry and Forest Products Research Center which sponsors two cooperatives, namely the Eucalypt Research Cooperative and the Fiber Research Processing Cooperative (Table 3, Appendix A and B). The latter involves MONDI Corporation (paper and packaging), Sappi Corporation (pulp and paper), Nampak (packaging), and CSRIO (Commonwealth Scientific and Industrial Research Organization).

Forest products research organizations are typically very proactive with the commercialization of their research products. In order to promote this interest, some establish subsidiaries whose sole purpose is to promote the use of a new technology (Table 3, Appendix A and B). An example of a research organization that does so is Australia's Cooperative Research Center for Wood Innovations (CRC). The latter directs its research findings and commercial operations through its management company, IWM Center Management Limited. IWM is assigned all background intellectual property and

owns all new intellectual property on behalf of partners to the Cooperative Research Center for Wood Innovations (CRC).

Educational and University Affiliations. Some forest products research organizations have established formal connections with universities and similar educational institutions (Table 3, Appendix A and B). The arrangements often lead to a number of mutually beneficial results, including boosting the supply of technically competent professionals and exposing students to administrators and researchers that have wide-ranging experiences in their respective fields. Especially noteworthy in this respect is the Pulp and Paper Research Institute of Canada (PAPRICAN) which has formal arrangements with McGill University, the University of British Columbia, and Ecole Polytechnique de Montréal. In partnership, PAPRICAN, University of British Columbia (UBC), and the British Columbia Institute of Technology (BCIT) sponsor an advanced papermaking initiative. Other research organizations that have formally linked with universities are South Africa's Forestry and Forest Products Research Center (FFP), German Federal Research Center for Forestry and Forest Products (BHF), and Australia's Cooperative Research Center for Wood Innovations (CRC).

Geographically Dispersed Operations. Very few of the organizations reviewed here have but a single central location for their operations (Table 3, Appendix A and B). For example, FOTINTEK Canada Corporation has eastern and western regional offices, while the Finnish Forest Research Institute (METLA) has nine research centers and stations. Some organizations have an international orientation for their operations, including the European Forest Institute (EFI) (seven regional project centers throughout Europe) and Australia's ENIS (offices in Australia and New Zealand). The Technical Research Center of Finland (VTT) has offices in the United States (Palo Alto, CA). A number of research organizations are physically located on a university campus, a condition which provides for certain synergisms between the academic community and the research organization.

Administrator Perspectives

The executives and management staff of forest products and related research organizations are often in a position to provide especially noteworthy insight about the design and management of research organizations generally. With such in mind, the directors (or their deputies) of the case-example organizations reviewed here were contacted an asked to provide the following information about the structure of the research organizations for which they were responsible: "Forest products research organizations can

be chartered and organized in many different ways. For example, consideration might be given to ownership (public, private, or some combination), governance (board of directors, chief executive office, advisory committees), partnerships (affiliates, subsidiaries, joint ventures), and decision-making processes (centralized, decentralized). In your judgement, what *three features* of (. . . organization's name . . .) structure enables it to effectively carry out its mission?" With only slight paraphrasing of respondent replies, the administrators identified the following.

Public-Private Positioning

•Regarding ownership, we are privately owned and managed by a board composed of member companies. This private orientation keeps [planning and management] matters simpler and less consuming of our organization's energies.

•Our private research association, composed of [over 100] member companies, gives close contact to industry, and facilitates industry participation in all our research and development projects.

•We are in public-to-private transition. Our state-owned organization is in the process of becoming a commercial company with the participation [ownership] of the state treasury, manufacturers of wood products, and our research organization's staff. We seek to increase our organization's independence from government.

•Private ownership still offers us the highest degree of independence and liberty in identifying the research areas we intend to focus on. With force (authority) we can plan, structure, coordinate and substantiate our own research activities.

• Organizational strength lies in combined ownership (public [state and federal) + private industry + universities) and subsequent financing by all these sources.

Organizational Governance

•As a privately owned organization, of greatest importance for management of the institute are committed owners who set clear objectives for and expectations of the organization. This clarity in direction enables staff to understand why the institute exists and their role in its future.

•Our organization is a privately owned research company which has a board of directors and several kinds of partnerships. Major decisions within the organization are made by a board of directors, president, management team and a research committee. We find such an arrangement to be very effective.

•We are part of a larger parent organization. We can avail ourselves of the competence of our [larger parent owner] in the whole range of topics and technologies within the field of pulp and paper.

•Small [research] companies like us have a short way to go from ideas to decisions. As such, we are not burdened with highly bureaucratic processes. Our governing board is an active board and is a competent part of our decision-making processes.

•Our institute is effectively run by two directors: (1) director of the institute and in charge for scientific, personnel and development questions, and (2) director of financial management and personnel issues. [Even though ultimate responsibility rests with the directors], decision making is quite decentralized.

•As a private organization, our organization's overall governance is by a board of directors, with the structure for managing research involving advisory committees and external reviews of our programs. This governance has proven quite effective.

•We have a very sophisticated governance system. A subset of our member company CEOs comprise the board of directors on a three-year rotation cycle. Generally the largest member companies are always on the board and the smaller ones participate in the rotation. This gives direct oversight of the organization's research agenda by senior industry leaders.

•Our organization is a consortium research organization sponsored by member companies that are producers of pulp and paper products only. Some private research organizations allow non-producers as members, especially the suppliers to the industry. We see a conflict here because we do not want potential commercialization partnerships to be hindered by membership [in our organization] of a supplier who may not be the best commercialization partner, but might want the right of first refusal because of membership [in our organization].

Program Planning and Implementation

• Focus is on our members and the project centers which [conduct] the forest research activities. Being a member driven organization, decision-making is very democratic and stems directly from the members' needs and expectations.

•Important is the way our industry and government members participate in our advisory process in setting strategic direction for our organization making sure the organization is accountable. All members are invited to participate in meetings of our technical committees, and many do.

•Engaged representatives from our owners-members ensure that the organization is dealing with the right (demand driven) topics in need of research.

•We definitely focus on member priorities. However, in tough economic times, as we have seen for the past decade, we tend to be driven to shorter term research objectives and have to struggle to include strategic longer-term priorities. An example is our work to ensure that we have a finger on the pulse of nanotechnology, which has the potential to add entire new long-term features to paper products.

•The organization's board annually establishes general research directions, an annual overall annual budget, and an annual operating plan. These three elements are pulled together by a regularly updated long-range strategic business plan.

•Individual member companies of our organization may act as project liaisons for specific projects, doing so in order to provide guidance to ongoing research and to implement research results in their businesses as soon as results are available.

•We operate on the basis of a program established periodically by an advisory committee composed of representatives of our shareholders. The committee identifies current research needs of industry and assists in the implementation of research results.

•Important to our organization is our overall research program committee which reports to our board of directors. Although the staff of our organization is represented on the committee (chief executive officer and its vice president of research), the research planning committee is very much dominated by industry membership.

•Reporting to the board, and chaired by one of the board members is our research program committee (RPC), which sets the technical directions for the research program and does this through its members, most of whom are senior industry technology leaders. It sets overall industry strategic directions and the members are asked to focus this way rather than to represent their own company viewpoints on priorities.

•Our research program committee (reporting to board of directors) manages through a set of subcommittees (seven) which deal with individual research programs. They address specific details of the research program, identify gaps in the program and recommend the priorities to the full committee. A key point is that all the research priorities are industry-driven. This is a strength and occasionally a drawback.

•Reporting to the organization's governing board is our future awareness committee (FAC), which looks at issues important to the industry 25 years out (such as fibre supply, capital effectiveness, market dynamics and sustainability). The FAC uses the Shell Development Company Scenario Planning Tools to lay out extreme but plausible pathways that are relevant to the particular topic being studied. It then looks at research questions that should be addressed for each scenario, plus some that should only be followed if there is evidence that a scenario is actually occurring. From this set, we choose the most robust research areas for investigation irrespective of which scenario might occur, as well as summarize important business (but nontechnical) factors that might be relevant to our members. The FAC reports back to the board and to the research planing committee with a strategic long-

term view to the research and business issues that need to be assessed.

Partnering and Collaboration

•We are a private organization that operates in a partnership structure based on shared risks, shared costs, and shared benefits. This structure allows the [. . . federal government, state-provincial governments . . .], and companies producing solid wood products to [focus] toward a core research program that is the heart of our organization's research effort.

•We have evolved with our university partnerships from one [university] which gave us a connection to academic research and the education of graduate students, to the current system wherein we use partnerships with many different universities to complement our research program and to provide a fundamental science base (as an organization, we no longer do as much basic science as we did historically).

•We have very close cooperation and networks with relevant industry associations and instruments (promotion body, schools, universities, research and development institutes). All work together with different roles, but with a common main goal of conducting and implementing quality research products.

•Our organization is one that involves flexible partnerships. We have become structured over the years to allow for individual sponsorships with allied industry companies on individual research projects. They participate through grants-in-aid of research. These [grants] allow selected supplier companies to participate, not in a controlling fashion, in the research program, and potentially to become the commercialization partners for the [research] results that are produced. Since we are a research consortium organization, not a manufacturing organization, these partnerships give us a way to take technology right through to final commercial products.

•Partnering is extremely important, simply because it is impossible to have a full range of specialized research expertise within our own organization.

•Our organization has a very well developed member company partnership system in which individual member company employees participate as observers and short term guides for the actual research program at the detail level. This gives direct member company input into each research project, and lays the groundwork for efficient technology transfer as research results become available.

•We are located [on a university campus] which means that education and research goes hand in hand. Thus we have the possibility to attract students to work on our projects and to perhaps offer employment to the best students.

•Our partnership and close cooperation with the four major industrials concerns in our country is important. They have guaranteed us certain work for the next four years.

Administration and Management

Clients and Services Provided

Clients and Patrons. The importance of a research organization's relationship with client groups (customers, patrons, sponsors) cannot be underestimated, irrespective of whether an organization is chartered as public or private. For the case-example organizations reviewed here, the importance of clients is exemplified by the publically made statements which follow.

•Our primary focus is on industry and client needs, including government agencies. In today's markets, relevance is crucial. Market trends and our client needs drive not only the way in which we deliver service and solutions, but also our science planning and investment. ENSIS (Australia).

•Committed to a long-lasting relationship with clients by offering top-quality services . . . first link in chain of collaboration: listen to clients. Meet expectations of clients with efficiency and respect for contractual commitments. Association Forest Cellulose (AFOCEL) (France).

•Client relations are built around each client's needs . . . tailor-made information is a powerful tool and one of the cornerstones of KLC's business success . . . close contacts with clients' production plants are a key element of KCL's work. KCL (Oy Keskuslaboratorium-Centralboratorium Ab) (Finland).

•Primary role is to ensure the application of TRADA's resources in ways that support its membership's needs . . . our goal is to support our members' businesses. Timber research and Development Association (TRADA) (United Kingdom).

•Committed to achieving excellence in scientific research and development . . . and to derive innovations for the benefit of our clients. We shall ensure that those working with clients are committed and adhere to [high] quality standards. Forest Research Institute of Malaysia (FRIM).

As the abovementioned statements suggest, research organizations take clients very seriously – their common concerns that must be nurtured if either is to remain relevant to the advancement of broader public and private interests. The former must maintain their physical infrastructure, nurture talented staffs, purchase new and innovative equipment, and steer investment in research directions that may not prove worthwhile for many years to come. At the same time, client groups seeking information critical to continuation of their operations may become quite dependent on (or impacted by) the services that a research organization is capable of providing. Clients may find themselves holding an important

Table 4. Forest Products and Related Research Organizations (case-examples), by Country, Clients and Services, Research Program, Financing and Staff. 2004-2005.

Organization	Clients	Services Provided	Research Program Directions	Budget and Financing	Scientists and Staff
• Cooperative Research Center for Sustainable Production Forestry (CRC) (*Australia*)	Public and private, owner-member emphasis	Information, research, consultation, training	Genetics, tree improvement, site productivity, resource protection	$3.0 million (AUD), 89 percent from government, $6.9 million (AUD) in-kind contributions	52 total staff: 46 research, six administration
• Cooperative Research Center for Wood Innovations (CRC) (*Australia*)	Public and private, owner-member emphasis	Information, research, consultation, training	Microwave processing, value-added technology, wood surfaces, raw wood enhancement	$2.3 million (AUD)	28 total staff: 12 lead research staff
• ENSIS (*Australia*)	Public and private	Information, research, consultation, training	Genetics, forest sustainability, fiber quality, biosecurity, wood processing, pulp, paper, packaging	NA	350 total staff
• Holzforschung Austria (HFA) (*Austria*)	Public and private	Information, research, consultation, training	Round wood, housing, adhesives, construction, furniture, surfaces, preservation, pulp and paper, bioenergy	3.69 million (EUR), 80 percent commissioned	58 total staff
• Forest Engineering Research Institute of Canada (FERIC) (*Canada*)	Public and private, owner-member emphasis	Information, research, consultation, training	Harvesting, transportation, silviculture, bioenergy, wildland fire, decision support	$11.8 million (CAD), 47 percent member fees, 35 percent contracts, 18 percent government	140 total staff: 100 researchers and engineers
• Forintek Canada Corporation (FORINTEK) (*Canada*)	Public and private, owner-member emphasis	Information, research, consultation, training	Resource assessment, lumber, composites, building systems, codes and standards, marketing, economics	$28.3 million (CAD); 66 percent member fees, 32 percent service fees, 2 percent other	210 total staff
• Pulp and Paper Research Institute of Canada (PAPRICAN) (*Canada*)	Public and private, owner-member emphasis	Information, research, testing, consultation, education	Fiber supply, pulping, papermaking, product performance, development engineering	$39.4 million (CAD), 67 percent member fees, 20 percent government, 13 percent other	340 total staff
•Research Institute of Wood Industry (CRIWI) (*China*)	Public and private	Research, education	Wood properties, processing technology, panels, utilization, marketing	NA	161 total staff: 140 research and technical, 21 administration
•European Forest Institute (EFI) (*Finland*)	Public and private, owner-member emphasis	Information, research, consultation, training	Forest ecology, forest products, policy analysis, information systems	2.5 million (EUR), 79 percent government, 21 percent member fees and special projects	53 total staff
•Finnish Forest Research Institute (METLA) (*Finland*)	Public and private, government emphasis	Information, research, consultation, testing, training	Markets, economics, planning, inventory systems, silviculture	49 million (EUR), 73 percent government, 27 percent commissioned	875 total staff: 321 research

NA = Information not available.

Table 4. Forest Products and Related Research Organizations (case-examples), by Country, Clients and Services, Research Program, Financing and Staff. 2004-2005 (continued).

Organization	Clients	Services Provided	Research Program Directions	Budget and Financing	Scientists and Staff
•KCL (Oy Keskuslaboratorium-Centralboratorium Ab) (*Finland*)	Public and private, owner-member emphasis	Information, research, consultation, testing, training	Fiber evaluation, papermaking, printing surfaces, printing technology, packaging	23.8 million (EUR)	300 total staff, 130 research, 141 service, 29 administration
•Technical Center of Finland (VTT) (*Finland*)	Public and private	Information, research, consultation, testing, training	Pulp, paper, structural design, manufacturing, biotechnology, environmental technologies	218.5 million (EUR) total for center; funding 31 percent government base, 69 percent other	200 scientists pulp and paper portal, staff number in other portals not available
•Association Forest Cellulose (AFOCEL) (*France*)	Private, owner-member emphasis	Information, research, consultation	Wood supply, wood processing, forest management, regional issues	6.5 million (EUR), estimate 50 public, 50 percent private	96 total staff: 44 research, 52 administration
•French Pulp and Paper Research and Technical Center (CTP) (*France*)	Public and private	Information, research, consultation, testing, training	Fiber resources, pulping, coating, calendering, emission control, monitoring systems	11.3 million total (EUR), 7.8 million research; 42 percent government, 58 percent contracts	155 total staff: 49 scientists, 62 technicians, 44 administration
•Federal Research Center for Forestry and Forest Products (BFH) (*Germany)*	Public and private, government emphasis	Information, research, consultation, certification, raining	Forest management, genetics and tree breeding, economics and policy analysis, wood chemistry and physics, forest ecology, resource assessment	NA	120 total staff (est): 108 research, 12 administration
•Institute of Wood Technology (IWT) (*Germany)*	Public and private, owner-member emphasis	Information, research, consultation, testing certification	Wood anatomy, panels, adhesives, processing technology, surface coatings, chemical analysis, furniture, construction technology	Five million (EUR), 60 percent government, 40 percent industry	80 total staff (est)
•Forest Products and Forestry Socio-Economic Research and Development Center (*Indonesia*)	Public and private	Information, research, testing, consultation, training	Wood anatomy, biodeteration, wood properties, wood preservation, sawmilling, panels, drying, harvesting, economics	NA	160 total staff: 143 research, 17 administration
•National Council for Forest Research and Development (COFORD) (*Ireland*)	Public and private	Information, research, consultation, training	Nurseries, silviculture, harvesting, transportation wood products, economics, carbon sequestration	1.7 million (EUR), 68 percent research	714 total staff (70 FTEs)
•Forestry and Forest Products Research Institute of Japan (FFPRI) (*Japan*)	Public and private	Information, research, consultation	Biodiversity, remote sensing, harvesting systems, recycling, policy analysis	10.4 billion (JPY), 86 percent public	661 total staff: 453 scientists, 208 administration and support staff
•Hokkaido Forest Products Research Institute (HFPRI) (*Japan*)	Public and private	Information, research	Timber engineering, wood utilization, wood processing, mushroom culture	NA	Not available

Table 4. Forest Products and Related Research Organizations (case-examples), by Country, Clients and Services, Research Program, Financing and Staff. 2004-2005 (continued).

Organization	Clients	Services Provided	Research Program Directions	Budget and Financing	Scientists and Staff
•Forestry Research Institute (SILAVA) (*Latvia*)	Public and private	Research	Silviculture, genetics, regeneration, forest protection, harvest machinery, game management, chemicals, economics	NA.	100 total staff (est): 80 research, 20 administration
•Forest Research Institute Malaysia (FRIM) (*Malaysia*)	Public and private, owner-member emphasis	Research, consultation, education	Industrial development, information infrastructures, eco-tourism, commercialization of wood products	28.2 million (MYR), 56 percent government. Intend to be financially self-sufficient	160 total research staff
•SHR Timber Research (*Netherlands*)	Public and private	Research, testing, consultation	Adhesives, windows and doors, wood preservation, wood anatomy, furniture, coatings	2.4 million (EUR), 100 percent from clients served	35 total staff
• SCION (*New Zealand*)	Public and private	Information, research, consultation, training	Genetics, fiber quality, biosecurity, pulp and paper, packaging, composites, biotechnology, life cycle assessment, renewable consumer products	NA	380 total staff (est)
• Wood Technologies Research Sector, Industrial Research Limited (IRL) (*New Zealand*)	Public and private	Information, research, consultation, pilot scale production, training	Materials and materials performance, sensing and detecting, biochemical technologies, energy technologies, measurement and analysis	Not available; IRL total funding $62 million (NZD), 46 percent private, 54 percent public	15 total staff wood technology research unit (est)
• Norwegian Forest Research Institute (SKOGFORSK) (*Norway*)	Public and private	Information, research, consultation	Forest ecology, forest management, economics, wood utilization	76 million (NOK), various sources	107 total staff: 75 research, 32 administration
• Norwegian Institute of Wood Technology (NTI) (*Norway*)	Private, owner-member emphasis	Information, research, consultation, certification, training	Wood utilization and durability, production technology	31million (NOK), member fees (11 percent), service fees (89 percent)	36 total staff: 27 research, nine administration
• Paper and Fiber Research Institute (PFI) (*Norway*)	Public and private, owner-member emphasis	Information, research, consultation, training	Fiber, pulp, paper, novel materials	27.1 million (NOK), 72 percent from private industry	25 total staff: 12 research, nine engineers, four administration
•Forest Products Research and Development Institute (FPRDI) (*Philippines*)	Public and private	Information, research, consultation, testing, training	Furniture and handicrafts, construction materials, material science, paper, biomass energy	NA	238 total staff: 161 research, 77 administration
• Research and Development Center for Wood-Based Panels (*Poland*)	Public and private	Information, research, consultation	Panel products, manufacturing safety, instrumentation systems, information management	NA	30 total staff: six research, 24 management administration

Table 4. Forest Products and Related Research Organizations (case-examples), by Country, Clients and Services, Research Program, Financing and Staff. 2004-2005 (continued).

Organization	Clients	Services Provided	Research Program Directions	Budget and Financing	Scientists and Staff
• Forest Research Institute (FRIS) (*Slovak Republic*)	Public and private, government emphasis	Information, research, consultation, testing, training	Genetics and tree breeding, silviculture, protection, game management, economics and policy, monitoring systems, harvest engineering	56.2 million (SKK), 51 percent for research; 14 percent from contract activities	170 total staff: 78 research, 92 support administration
• Forestry and Forest Products Research Center (FFP) (*South Africa*)	Public and private	Information, research, consultation, education, training	Site and terrain classification, remote sensing, geographic information systems, resource evaluation, wood properties, pulp and paper analysis, software development	NA	11 total lead staff contacts
• Institute for Commercial Forestry Research (ICFR) (*South Africa*)	Public and private, owner-member emphasis	Information, research, consultation, education, training	Tree improvement, applied silviculture, wood utilization, harvesting impacts, forest management	12.5 million (ZAR), 100 percent industry	59 total staff: 40 research, 19 administration
• Forestry Research Institute of Sweden (SKOGFORSK) (*Sweden*)	Public and private	Information, research	Tree improvement, silviculture, wood utilization, forest harvest technologies	110 million (SEK), 50 percent services, 50 percent government and industry	100 total staff: 60 research, 40 administration
• Swedish Institute for Wood Technology (SP-TRATEK) (*Sweden*)	Public and private	Information, research, consultation, testing, training	Processing and processes, materials and products, building and housing, furniture, quality and testing	54.6 million (SEK), 14 percent federal government, 35 percent third party, 51 percent services	56 total staff: 36 scientists, 20 support administration
• Pulp and Paper Research Institute-Institute for Packaging and Logistics (STFI-PACKFORSK) (*Sweden*)	Public and private, owner-member emphasis	Information, research, consultation, testing, training	Paper, pulp, energy, packaging	274 million (SEK)	250 total staff (est): 200 research, 50 support administration
• Swedish Wood Ultrastructure Research Center (WURC) (*Sweden*)	Public and private, owner-member emphasis	Research, consultation, training	Wood chemistry, wood mechanics	18.1 million (SEK), 33 percent each industry, universities, federal government	70 total staff(est)
• Swiss Federal Laboratories for Material Science and Testing (EMPA) (*Switzerland*)	Public and private	Information, research, consultation, training	Wood structure and properties, wood composites, wood safety and durability,	EMPA Wood Laboratory 1.7 million (EUR); 60 percent government, 40 percent services-third party sources	21 total staff assigned to Wood Laboratory
• Taiwan Forestry Research Institute (*Taiwan*)	Public and private	Information, research, consultation	Forest biology, silviculture, economics, forest protection, wood utilization, wood chemistry, papermaking	NA	338 total staff: 137 research-technical, 210 support administration
• Timber Research and Development Association (TRADA) (*United Kingdom)*	Public and private, owner-member emphasis	Information, research, consultation, certification, training	Structural construction and engineering	628,000 income (GPB)	50 total staff (est)

stake in the type and intensity of the research being carried out by a research enterprise. This interdependence of clients and research organizations can lead to important reciprocity relationships. Whereas a research entity may seek stable support from clients (expressed by market transactions or by the actions of government), clients seek from research organizations various services that are required in order for them to effectively compete in private markets (or to serve the information demands made of them by government organizations). An example of this reciprocity relationship is suggested by the Pulp and Paper Research Institute of Canada (PAPRICAN), namely ". . . the driving belief is that if PAPRICAN delivers real value to its members, the funding to support the organization will be a natural outcome of this business success."

The 40 case-example research organizations reviewed here provide services to a variety of different organizations (Table 4, Appendix A). Some have a major focus on government as a client (for example, Slovak Republic's Forest Research Institute), while others seek to serve a wide range of clients that exist within both the public and the private sector (for example, the Technical Research Center of Finland [VTT]). Some of the case-example organizations have as their primary clients the organizations that are members (or owners) of the organization (for example, France's Association Forest Cellulose [AFOCEL], and the Norwegian Institute of Wood Technology [NTI]). Most of the case-example organizations reviewed here provide services to both public and private clients as indicated by the following:

- Public (government) clients only – None
- Public and private clients, government emphasis – 2
- Public and private clients – 21
- Public and private clients, owner-member emphasis – 14
- Private clients, owner-member emphasis – 3

There is considerable variation in the exactness with which the case-example organizations specify the client groups they seek to serve. For example, the Slovak Republic's Forest Research Institute "conducts research at the request of the Ministry of Agriculture" (for example, research on soil properties, tree species biodiversity, forest protection), while customers of the Swedish Institute for Wood Technology (SP-TRATEK) include "sawmills, joinery companies, manufacturers of timber house and other buildings, furniture manufacturers, producers of boards and other wood-processing products, producers of input materials and equipment for the industry, as well as institutional customers." Norway's Paper and Fiber Research Institute (PFI) reports that its "research is directly related to the needs of large industrial concerns, although small and medium-

sized businesses may also use our laboratory facilities for quality testing and product development." The Netherlands's SHR Timber Research indicates its target client groups to be the joinery industry (windows and doors), board material industry, pallet and packaging industry, manufacturers of laminated beams, wooden frame constructions and roof elements, wood preservation industry, wood preserving agents industry, suppliers of wood adhesives materials, furniture industry, paint industry, wood trade companies, governments, associations, builders and contractors, and building supervisors.

The absolute number of clients served by a research organization can be substantial. Although not all situated within the scope of the wood-based industry, the Technical Research Center of Finland (VTT) reports serving more than 5,000 clients annually. Some organizations have a long tradition of serving the research needs of the wood-based industry, yet the latter may not always be the primary focus of their research programs. An example is New Zealand's SCION, which in 2003 reported that half of its top ten clients were non-forestry companies. The clients served by research organizations often require that the information generated in response to their request be given proprietary status. Although such arrangements for confidentiality are common, they do have an impact on the extent to which the results of research enter the public domain. An example is the position of South Africa's Institute for Commercial Forestry Research (ICFR), namely ". . . since the ICFR is fully funded by private companies, our research outputs are not always placed in the public domain, rather classified as proprietary to the contributing [company] members of the ICFR."

Forest products research organizations often view the market for their services to be beyond the nation in which they happen to be formally chartered and headquartered. Organizations with a worldwide interest in clients include Australia's ENIS (seven offices in Australia, two in New Zealand), New Zealand's SCION, French Pulp and Paper Research and Technical Center (CTP), and the Swiss Federal Laboratories for Material Science and Testing (EMPA). In addition to offices in Finland, the Technical Research Center of Finland (VTT) serves clients through an office in the United States (California). Approximately 25 percent of revenue generated by the Norwegian Institute of Wood Technology (NTI) comes from projects and services performed for foreign clients. Some organizations are very bold in their future interest in clients worldwide. The Paper and Fiber Research Institute (PFI) of Norway specifically states its aim is "to carry out research and contract work for customers world wide."

Services Provided. The case-example research organizations reviewed here provide an extensive array of services. Acknowledging that a single organization may provide more

than one service, major categories of service are as follows (Table 4, Appendix A):

- •Research (products, processes, new technologies) – 40 organizations
- •Consultation (expert advice, guidance) – 36 organizations
- •Information (reports, synthesize information) – 35 organizations
- •Training (conferences, workshops, continuing education) – 27 organizations
- •Testing (examination of quality, performance, reliability) – 12 organizations
- •Education (basic college-level experiences) – five organizations
- •Certification (achievements, documentation of facts) – four organizations
- •Pilot scale production (prototype guidance) – one organization

None of the organizations provide services in all eight of the categories listed above. One organization provides six of the services, 16 provide five, 11 provide four, eight provide three, three provide two, and one provides services in only a single category.

The nature of the services provided in the a-fore-mentioned categories is best appreciated by illustration with an example organization.

•*Research*: Australia's Cooperative Research Center for Wood Innovations (CRC) provides its owner-members with research generated information involving microwave processing of wood (reducing growth stress, wood drying, wood composite, fundamental science), value added technologies (wood surface finishes, technology-led design, wood bending, extending lifespan), and raw wood enhancement (pyrolysis bio-products).

•*Consultation*: Holzforschung Austria (HFA) provides consulting and expert reports in a variety of fields, including timber structures, wood residues, furniture, and adhesives.

•*Information:* FORINTEK Canada Corporation provides free or fee-based library research services, using its extensive library resources (access to over 500 in-house scientific and technical journals, extensive international online and CD-ROM databases, as well as a collection of over 100,000 documents).

•*Training:* Pulp and Paper Research Institute of Canada (PAPRICAN) offers short courses for professional development involving the engineering of papermaking, printing processes, marketing of pulp, and wet-end papermaking chemistry.

•*Testing*: The Netherlands's SHR Timber Research provides for the building industry sector on-site testing of material characteristics and testing of the performance of semi-finished and finished products for characteristics such as durability (rapid ageing), wind and water tightness, resistance to burglary, and the bonding of adhesives.

•*Education*: South Africa's Forestry and Forest Products Research Center (FFP) offers graduate research study opportunities (Masters and PhD programs) in various fields in conjunction with the University of KwaZuLu-Natal.

•*Certification*: United Kingdom's Timber Research and Development Association (TRADA) offers certification services in a number of areas, including CE Marking (European Trade Certification), EMAS (Eco-Management Assessment Scheme), environmental management certification to ISO 14001, health and safety management certification to OHSAS 18001, Integrated Management Systems (IMS) Certification, Q-Mark product certification schemes (product quality), quality management systems certification to ISO 9001, and TRADA Trak - FSC Chain of Custody certification.

•*Pilot scale production*: Finnish Pulp and Paper Research Institute (KCL) offers pilot trials involving mechanical pulp preparation, experimental newsprint production, coating and surface sizing, machine calendering trials, and sheet-fed offset printing.

Research Program Directions

The research mission of forest products research and development organizations is made workable when strategies and objectives are established. It is at that time that distinct goals, external support, and organizational capacities are established and brought together — the result being a research strategy. Usually in response to issues or problems, the practical expressions of a research strategy are the programs (sets of related activities) that an organization seeks to implement. For example, the Swedish Institute for Wood Technology (SP-TRATEK) has a mission of engaging in research in order to strengthen the competitiveness and long-term profitability of the Swedish wood-based industry. This mission is to be accomplished by activities occurring in four major research and development program areas, namely processing and processes, materials and products, building and housing, and quality and testing. Similarly, the mission of Australia's ENSIS is to address complex problems at a scale that will help the wood-based sector remain globally competitive, an intention that is brought to life by research in seven program areas, namely genetics, sustainable forests, environment, wood and fiber quality, biosecurity and protection, wood processing, pulp-paper-packaging.

The research programs of interest to an organization are not always uniformly labeled across the forest products research sector. Considering the case-example organizations reviewed here, some choose to label their research programs as "fields of research," while others prefer labels such as "target areas," "research clusters," "core research fields," "topical areas," "problem areas," and "entry portals," In some cases,

research programs align with the administrative structure of an organization, such as the departmentally grouped programs of Poland's Research and Development Center for Wood-based Panels, or the Taiwan Forestry Research Institute which groups its research programs into 10 divisions. Also, the specificity with which research programs are identified is quite diverse. At one extreme is the Swedish Wood Ultrastructure Research Center (WURC) which identifies "fiber chemistry of wood polymers at the molecular level" as a research program area, while at the other extreme New Zealand's SCION reports three major research areas, namely "commercial forestry research and development," "biomaterials research, " and "sustainable consumer products." In between this range of specificity is Japan's Hokkaido Forest Products Research Institute which labels four research program areas, namely "timber engineering," "wood unitization," "wood processing," and "mushroom culture."

The research program directions implemented by the case-example organizations reviewed here vary significantly in focus, scale and breadth (Table 4, Appendix A). To say that all such organizations are uniform in their research interests would be misleading. Yet for the most part, they tend to focus research on forest products, forestry and forest management, or some combination of these two broad subject areas. Twenty-two of the organizations appear to have *forest products* as a primary focus, 11 have *forestry and forest management* as a primary focus, and seven conduct research in both areas. As for the 22 organizations that focus primarily of forest products, only four or five appear to engage in both solid wood products research and in pulp and paper research. Some organizations have administratively divided their research programs in order to respect geographic differences in research needs. An example is the Forest Engineering Research Institute of Canada (FERIC) which has eastern and western operational divisions.

The organizations engaging in forest products research tend to be involved in one or more of the following subjects: *pulp and paper* (for example, the French Pulp and Paper Research Technical Center [CTP]), *wood composites* (for example, Poland's Research and Development Center for Wood-based Panels), *furniture* (for example, Germany's Institute of Wood Technology [IWT]), *engineered structures and mechanics* (for example, United Kingdom's Timber Research and Development Association [TRADA]), and *wood processing and preservation* (for example, the Taiwan Forestry Research Institute). As for those with a forestry and forest management focus, the subject matter of concern tends to involve *fiber production* (for example, South Africa's Institute for Commercial Forestry Research [ICFR]), *forest protection* (for example, Slovak Forest Research Institute [FRIS]), *marketing and economics* (for example, Finland's European Forest Institute), *harvest*

systems (for example, the Forest Engineering Research Institute of Canada [FERIC]), and *fish and wildlife* (for example, the Latvia Forestry Research Institute [SILVA]).

Financing and Budgets

An activity of special importance in the administration of all research organizations is raising and allocating money. For private research entities, the challenge is one of offering information and services for which customers are willing to pay. For public entities, financial and budget issues center on an ability to make a strong case (to legislative systems or to hierarchal leadership) that the research opportunities being recommended are in the broader public interest and therefore worthy of public support. The case-example research organizations reviewed here have a number of special characteristics regarding financing and budgets, of which revenue sources, financial allocations, and pricing of services are especially noteworthy (Table 4, Appendix A).

Source of Income. The finances required to operate research organizations can originate from many sources, both public and private. For the case-example organizations for which information is available, these sources are depicted as follows (by type of organization [private, public, or some combination] and income sources for each organization):

A. Private Independent Organizations

Income Sources Organization A:
Member companies – 67 percent
Grants and contracts – 12 percent
Federal government – 20 percent
Royalties and other – 1 percent

Income Sources Organization B:
Owner company' fees – 40 percent
Contract for services – 51 percent
Government funding – 9 percent

Income Sources Organization C:
Government (federal) – 44 percent
Pulp and Paper Industry – 26 percent
Other Contracts (public and private) – 30 percent

Income Sources Organization D:
Ministry of Industry – 29 percent
Associated contracts – 19 percent
Private contracts – 14 percent
Diagnosis and consulting – 31 percent
Other income sources – 7 percent

Income Sources Organization E:
Services-project provided fees – 89 percent
Member fees – 11 percent

Income Sources Organization F:
Contract for services – 100 percent

Income Sources Organization G:
Private industrial sources – 72 percent
Government sources – 28 percent

Income Sources Organization H:
Nationwide industry organization – 50 percent
Member direct funding – 50 percent

Income Sources Organization I:
Member fees – 68 percent
Investment Income – 6 percent
Other Income – 26 percent

Income Sources Organization J:
Services and commissioned work – 50 percent
Government and forest industry – 50 percent
- federal government grants – 50 percent
- forestry and forest industry – 50 percent
  - fixed member fees – 25 percent
  - research grants – 75 percent

Income Sources Organization K:
Industry funding – 50 percent
Public agency funding – 20 percent
Contract work and services – 30 percent

B. Private Independent, Government Authorized Organizations

Income Sources Organization A:
Government – 89 percent
University – 7 percent
Private – 4 percent
(plus in-kind contributions)

Income Sources Organization B:
Industry Members – 47 percent
Contract, grants, other – 35 percent
Canadian Forest Service – 14 percent
Provincial Governments – 4 percent

Income Sources Organization C:
Commissioned research – 40 percent
Business commissions – 40 percent
Member contributions – 3 percent
Other sources – 17 percent

Income Sources Organization D:
Member assessment – 66 percent
Contract fees for services – 32 percent
Other income – 2 percent

Income Sources Organization E:
Government – 58 percent
Services provided – 15 percent
Third-party industry and government – 27 percent

Income Sources Organization F:
Industry funding – 50 percent
Public agency funding – 20 percent
Contract work and services – 30 percent

Income Sources Organization G:
Basic government funding – 31 percent
Private sector, domestic – 33 percent
Public sector domestic – 25 percent
Public and private foreign – 11 percent

Income Sources Organization H:
Government (operating) – 56 percent
Development – 15 percent
Research – 13 percent
External agencies – 7 percent
Investment income – 3 percent
Other sources – 6 percent

Income Sources Organization I:
Government – 40 percent
European Commission – 39 percent
Special Project funding – 13 percent
Membership fees – 6 percent
Other sources – 2 percent

C. Private-public, Joint Venture Organizations

Income Sources Organization A:
Industry – 34 percent
Universities – 33 percent
Federal Research Agency – 33 percent

D. Public Government, Independent Organizations

Income Sources Organization A:
Government basic grants – 25 percent
Government administrative support – 12 percent
Commissioned research – 41 percent
Strategic institute programs – 15 percent
Fund for forestry development – 5 percent
Other revenues – 2 percent

Income Sources Organization B:
Federal funds – 14 percent
Third-party funds – 35 percent
Services provided – 51 percent

E. Public Government Organizations

Income Sources Organization A:
Government (federal, other levels) – 100 percent

Income Sources Organization B:
Ministry of Agriculture and Forestry – 73 percent
Other ministries, service fees – 27 percent

Income Sources Organization C:
Government competitive grants – 71 percent
Government ordered projects – 23 percent
Government other sources – 6 percent

Income Sources Organization D:
Direct government allocations – 86 percent
Other sources – 14 percent

As is readily apparent, the organizations identify their sources of income with a plethora of descriptors, including “member fees,” “contract work,” “grants,” “commissioned research,” “consulting,” “royalties,” “industry funding,” “member contributions,” and “third-part-funding.” These diverse labels are indicative of the diverse sources of financing they rely on in order to implement their research and related programs. For purposes of examination, however, these diverse sources can be meaningfully grouped into five major categories, namely government funding, membership fees, payments for services, investment income, and in-kind support. For the research organizations that are considered to be private independent, 35 to 40 percent of their income comes from payments for services, 20 to 25 percent from member fees, 15 to 20 percent from government, and 15 to 20 percent from a variety of other sources. For private independent, government authorized organizations, the proportion is 45 to 50 percent government, 25 to 30 percent payments for services, 15 to 20 percent other revenue sources, and five to 10 percent member fees. The limited information available for describing the other major categories of research organizations makes generalizations about their funding somewhat risky.

The 40 case-example organizations have a number of noteworthy characteristics regarding their funding. In some cases, a stable core of funding is provided to research organization by government, as is the situation with the European Forest Institute (EFI) which receives 40 percent of its funding from the federal government of Finland. Core funding provided to an organization can be used for a variety of purposes, including financial support for its programs generally (as is the case with EFI), support for “basic research” that would not be undertaken by the private sector (for example, university support of the Swedish Wood Ultrastructure Research Center [WURC]), or funding (whole or in part) of basic operational activities of an organization (for example, the Norwegian Forest Research Institute [SKOGFORSK], and the Forest Research Institute of Malaysia [FRIM]).

Some research organizations rely on national consortiums of companies for financial support. An example is the Institute for Commercial Forestry Research (ICFR) of South Africa which secures half of its operating funds from Forestry South Africa (a nationwide company-sponsored industry organization). Research organizations may become discouraged with the source of their financial support. Some have become especially disheartened with the increasing uncertainty of government as a source of stable financial support and have in turn set out to become financially self sufficient. An example is the Forest Research Institute of Malaysia (FRIM) which has a stated policy of “. . . achieving 70 percent self financing by year 2008,” doing so by increasing revenue from the sale of products and technical services, and increasing income from royalties, licenses,

investment, and rental property.

Research organizations can also be active competitors for research money managed by large science-promoting agencies of government and distributed by such agencies through competitive grant programs. An example is the Latvian State Forestry Research Institute (SILVA) which must seek operating and program funds from government agencies via various competitive bidding processes. Also engaged in competitive grant seeking activities is New Zealand's Industrial Research Limited (IRL), which looks for funds from the New Zealand Ministry of Research, Science and Technology, as does the Technical Research Center of Finland (VTT) which competitively seeks funds from Finland's Ministry of Trade and Industry and from the National Technology Agency (Tekes). The latter is Finland's main public funding organization for research and development. In addition to funding various industrial projects, the agency seeks to fund research programs that are risk-intensive but that will promote innovation in processes and products.

A greater appreciation of the funding sources accessed by forest products research organizations can be attained through examples. Consider the following.

•*Forestry Research Institute of Sweden* (SKOGFORSK). With annual income in 2004 of approximately 110 million (SEK) (US$14.0 million), that income originated from the following sources:

- – Services and commissioned work – 50 percent (55 million SEK)
- – Government and forest industry – 50 percent (55 million SEK)
  - ▫ federal government grants – 50 percent (27.5 million SEK)
  - ▫ forestry and forest industry sector – 50 percent (27.5 million SEK)
    - ○ fixed member fees – 25 percent (6.9 million SEK)
    - ○ research grants – 75 percent (20.6 million SEK)

A "framework" agreement (for a four-year period) guides the development of 50 percent of the Institute's budget. The agreement is the result of negotiations between the federal government and the private forestry sector, with each contributing 50 percent of the funding necessary to cover the research activities agreed to by the two sectors (however, there is no upper limit on contributions of the private forestry sector). The portion (50 percent) contributed by the forestry and forest industry sectors is derived from (a) a fee assessed member companies and organizations (25 percent of sector's contribution; fee is based on ownership of productive forest area and site productivity) and (b) variable research grants (75 percent of sector's contribution; levy of 0.60 SEK per cubic meter of harvested timber and pulpwood).

•*Pulp and Paper Research Institute of Canada* (PAPRICAN). With annual income in 2003 of $39.4 (CAD)(US$34.0 million), that income originated from the following sources:

- •Member companies – 67 percent ($26.6 million CAD)
- • Grants and contracts – 12 percent ($4.6 million CAD)
- • Federal government – 20 percent ($7.7 million CAD)
- • Royalties and other – 1 percent ($0.5 million CAD)

In 2003, PAPRICAN received significant financial or other tangible support from 33 allied industry partners and from four major governments (Government of Quebec [Ministry of Science and Technology Research, Ministry of Natural Resources], Government of British Columbia, Government of Canada [Environment Canada, Industry Canada, National Research Council Canada, Natural Sciences and Engineering Canada], and the U. S. Department of Energy).

•*Swedish Pulp and Paper Research Institute/Institute for Packaging and Logistics (STFI-PACKFORSK).* With annual income in 2004 of approximately 274 million (SEK)(US$31.3 million), that income originated from the following sources (estimated):

- • Industry funding – 50 percent (117 million SEK)
- • Public agency funding – 20 percent (47 million SEK)
- • Contract work and services – 30 percent (70 million SEK)

The major part of STFI-PACKFORSK's research program is funded jointly by partner companies and by government. Example public funding sources are European Commission, Nordic Industrial Fund, Swedish Environmental Protection Agency, Swedish Waste Research Council, and the Foundation for Strategic Environmental Research. Primary public funding sources are the Swedish Energy Agency [STEM], and the Swedish Agency for Innovation Systems [VINNOVA]). Private non-company research funding originates from sources such as the Swedish Pulp and Paper Research Foundation and the Forest Industry's Water and Air Pollution Research Foundation. STFI-PACKFORSK also receives service and contract revenue from a large customer base outside the partner companies.

•*Forest Products Research and Development Institute* (FPRDI) (Philippines). Although specific amounts of funding by source are not available for the FPRDI, the diversity of funding sources is well depicted as follows: Government of the Philippines (GOP), International Organizations [International Tropical Timber Organization (ITTO); Australian Center International Agricultural Research (ACIAR); Agri-Technological Institute (ATO)],

local funding agencies, Philippine Council for Industry and Energy Research and Development (PCIERD), and DOST-Grants-in-Aid (DOST-GIA).

•*Norwegian Forest Research Institute (SKOGFORSK).* With annual income in 2003 of approximately 76 million (NOK)(US$11.4 million), that income originated from the following a variety of sources as follows:

- Commissioned Research (such as Ministry of Agriculture, Research Council of Norway) – 41 percent (31.2 million NOK)
- Basic Grants (Research Council of Norway) – 25 percent (19.0 million NOK)
- Strategic Institute Programs (NFR) – 15 percent (11.4 million NOK)
- National responsibilities, administrative support (Ministry of Agriculture) – 12 percent (9.1 million NOK)
- Fund for Forestry Development – 5 percent (3.8 million NOK)
- Other revenues (such as teaching assignments) – 2 percent (1.5 million NOK)

Financial Allocations. The case-example organizations reviewed here are challenged by the need to allocate income among many competing programs, not all of which involve research (for example, consultation, testing, training, certification). For private organizations, the allocation of income among program areas is typically decided by an organization's executive staff with guidance from research planning and technical advisory committees. In some cases, member companies have appreciable control over how their membership fees are invested. Such is the case with the Pulp and Paper Research Institute of Canada (PAPRICAN), which allows member companies to direct up to 35 percent of company fees to specific program areas and up to 15 percent of fees to applications of technologies in company-owned mills. For government organizations, executive staffs have considerably less flexibility in allocating income, in that legislative and other higher authorities may attempt to focus funding on specific programs.

Generalizations about the financial allocations of the case-example organizations reviewed here are risky, since so few organizations report expenditures by program area(proprietary interests are often claimed) (Table 4, Appendix A). Only two organizations report expenditures among broad program categories. They indicated 70 to 80 percent of their revenue was spent on research, five to 10 percent on education and technology transfer, and 10 to 20 percent on general administration. One of the case-example organizations reported that 28 percent of its revenue was spent on exploratory research, while 46 percent was invested in applied industrial research (remaining 26 percent was administration). Reporting in a detailed line-item fashion, two other case-example

organizations reported spending 60 to 70 percent of their revenue on salaries and related benefits and 20 to 30 percent on laboratory and related infrastructure. Greater appreciation of financial allocation can be obtained by the examples which follow.

A. Forest products and related research. *Swiss Federal Laboratories for Material Science and Testing (EMPA)*: basic wood sciences – 19 percent, wood protection – 31 percent, wood technology – 31 percent, timber engineering – 19 percent: *Swedish Wood Ultrastructure Research Center (WURC)*: mechanical and physical properties of fiber materials – 31.9 percent, cell wall ultrastructure – 27.5 percent, fiber chemistry at molecular level – 15.1 percent, wood and pulp fiber models – 11.0 percent, managerial expenses – 8.2 percent, WURC joint expenditures – 6.3 percent; and the *Swedish Institute for Wood Technology (SP-TRATEK)*: processing and processes – 18 percent, materials and products – 23 percent, building and housing – 28 percent, and quality testing – 31 percent.

B. Forestry and related research. *European Forest Institute (EFI)*: forest ecology and management – 30 percent, forest products and socio-economics – 15 percent, policy analysis – 20 percent, forest resources information – 35 percent; *National Council for Forest Research and Development (COFORD)* (Ireland): environmental aspects of forestry – 38 percent, silviculture and forest management – 35 percent, reproductive material and forest nurseries – 10 percent, socioeconomic aspects of forestry – 8 percent, wood products and process development – 5 percent, harvesting and transport – 4 percent; and the *Finnish Forest Research Institute (METLA)*: forest ecosystems – 31 percent, forest growing and utilization – 20 percent, forest genetics – 11 percent, monitoring and inventory – 9 percent, forest policy and economics – 9 percent (3.0 million), information systems – 6 percent, and research forest and laboratory services – 14 percent.

Pricing of services. Many of the research organizations reviewed here enter into contractual arrangements to provide services and products to interested parties (Appendix A). Virtually all the private independent organizations are so involved, as are many government research organizations which are authorized to engage in fee for service activities. In most cases, the services to be provided are configured individually and the fee for services to be provided is determined by negotiation. In some cases, fees are guided by state law as is the case in Finland where services provided by the Finnish Forest Research Institute (METLA) are charged according to principles established by the Act on the Basis for Determining Payments for State Services (Valtion maksuperustelaki).

The pricing of services becomes especially challenging when the services offered are many and wide-ranging in type and complexity. For example, Finland's KCL (Oy

Keskuslaboratorium-Centralboratorium Ab) offers extensive laboratory services in 18 different categories (for example, testing of mechanical pulp, optical properties of paper, packaging materials safety, biofuel and waste fiber analysis, microbiological testing), some categories of which have 50 or 60 subcategories (for example, 11 subcategories within mechanical pulp testing, including testing of fiber and fines properties, sorption properties, strength properties, stiffness and compression, and pulp permanence). The Forest Research Institute of Malaysia (FIRM) has one of the more sophisticated publically advertised structures for service fees (which can be charged to credit cards). Fees for services are clearly specified for more than 85 service areas and more than 500 specific services within these areas. Example services are evaluation of adhesive quality – $330 (Ringgit [RM]) per test, fire resistance tests for doors or walls (30 minute test) – $3,300 (RM), prototype testing of timber structures – $880 (RM) per structure, wood preservation consultation – $550 per person per week, and tree improvement planning – $330 (RM) per person per week.

Scientists and Staff

Scientists and staff are among the most important resources of a research organization. Recruiting and retaining well-educated and experienced persons that can successfully work in support of an organization's mission is essential to attaining high levels of organizational performance. The case-example research organizations reviewed here range in staff size from less than 20 staffs to organizations that can claim access to more than 6,000 staffs worldwide (Australia's Commonwealth Scientific and Industrial Research Organization [CSIRO]). For the case-example organizations for which information is available here (39), the distribution of staff size (combined scientist, researcher, technician, management, administrator) is as follows (approximately 7,000 total staffs) (Table 4):

- 1 to 50 staff: 19 organizations (14 percent of total staff)
- 101 to 200 staff: nine organizations (20 percent)
- 201 to 300 staff: four organizations (14 percent)
- 301 to 400 staff: four organizations (20 percent)
- 401 or more staff: three organizations (32 percent)

On average, 65 percent of an organization's staff is considered to be scientists or researchers, while the remaining portion is assigned to managerial and administrative activities. As for educational attainment of research staff, many have advance degrees. For example, 47 percent of the 321 researchers employed by the Finnish Forest Research Institute (METLA) have the PhD degree, as do 48 percent of 453 scientists at the Forestry

and Forest Products Research Institute of Japan (FFPRI). Fifty-three percent of the 75 researchers at the Norwegian Forest Research Institute (SKOGFORSK) have completed requirements for the PhD degree. Some organizations engage the research and educational interests of graduate students as an important part of their research program. Examples are the French Pulp and Paper Research Technical Center (CTP), Forestry and Forest Products Research Center (FFP) (South Africa), Swiss Federal Laboratories for Material Science and Testing (EMPA), and Norway's Paper and Fiber Research Institute (PFI).

Some of the case-example organizations have research programs that involve both forestry and forest products. For these few, the distribution of staff between these two major program areas is highlighted by the following examples:

•German Federal Research Center for Forestry and Forest Products (BFH): forest products 55 percent and forestry 45 percent.

•Taiwan Forestry Research Institute (TFRI): forest products 25 percent and forestry 75 percent.

•Forest Research Institute Malaysia (FRIM): forest products – 62 percent and forestry 38 percent.

The allocation of staff research efforts among various problems or issue areas is in all likelihood quite variable for the case-example organizations reviewed here. Unfortunately, such information is not uniformly reported across these organizations. Examples will have to suffice as follows (percent distribution of staff).

A. Forest products and related research. *FORINTEK Canada Corporation*: composites – 21 percent, lumber manufacturing – 12 percent, building systems – 29 percent, drying and protection – 18 percent, resource assessment – 6 percent, and value added manufacturing – 14 percent; *Forest Products Research and Development Institute (FPRDI)* (Phillippines): furniture and handicrafts – 28 percent, housing materials and construction technologies – 24 percent, material science – 22 percent, handmade paper – 13 percent, and chemical products and biomass energy –13 percent; and *SHR Timber Research* (Netherlands): timber products for building construction – 50 percent, wood technology – 34 percent, coatings – 10 percent, and furniture – 6 percent.

B. Forestry and related research. *Institute for Commercial Forestry Research* (ICFR)(South Africa): administration (director, financial, personnel)– 27 percent, functional support

(publications, computers, library)– 17 percent, forest nutrition research – 12 percent, eucalypt tree improvement research – 10 percent, forest productivity research – 17 percent (10 staff), plantation reestablishment research – 10 percent, acacia tree utilization research – 7 percent; *Forestry Research Institute of Sweden* (SKOGFORSK): forest-timber production – 55 percent, wood supply -- 45 percent; *Latvian State Forestry Research Institute* (SILAVA): forestry -- 78 percent of research staff, game management -- 12 percent of research staff, and forest products and harvesting -- 10 percent of research staff.

Administrator Perspectives

The executives and management staff of forest products and related research organizations were also asked for their insight on the administration and operation of research organizations generally. Specifically, they were asked to provide the following information about the organizations for which they were responsible: "Forest products research organizations can conduct (or carry-out) their operations in many different ways. For example, special attention may be focused on clients and customers (a strong focus on service), leadership (appointment of creative and enterprising executives), sources of finances (government, private, or some combination), research and supporting staff (employment of talented and energized persons), communication (promotion of information flows within and outside the organization), risk taking (welcoming challenges and new opportunities), blend of programs (focus on research, or service, or some combination), and orientation of research (focus on basic, or applied, or some combination; forestry, or forest products, or some combination). In your judgement, what *three features of* (. . . organization's name . . .) administration and management enable it to effectively carry out its mission?" With only slight paraphrasing of respondent replies, the administrators identified the following.

Clients and patrons

•Being a private, applied research institute, clients and customers needs and their satisfaction must always be focused on and given high priority. Orientation of research must harmonize with owners/members/customers demands. A research result is of little value until it is known and applied. Hence, significant efforts and measures must be taken to communicate new findings and relevant knowledge to different target/customer groups.

•Our organization is expected to contribute to real economic growth . . . so attention to user needs is critical. Our program is a careful blend of research and commercialization-utilization activities that are focused on clients.

•Success requires a focus on customers, focus on competencies most needed in the future, and strong networking both inside and outside the science community and with strong global players.

•[Our national research plan] links the attributes that are demanded by clients in the marketplace to processing technologies and the characteristics of the wood resource.

•Success is embodied in a strong focus on member company satisfaction. [Our organization] has been an early adopter of what was popularly known as 3rd generation R&D management when it was first promulgated by Arthur D. Little in the early 1990s. Our governance processes ensure that we work on member company priorities, and that we actually deliver the results of our research program to our members. This was one of the big differences in 3rd generation R&D approaches compared with earlier forms in which research organizations were funded on the basis that they would do good work.

•Characteristics that enable [our organization] to effectively carry out its mission: client-focused, talented and committed staff, multi-disciplinary approach to problem solving, and demonstration of valuable return on research investments.

•As an industry-related institute, our three main activity centers are clients and customers (we do quite a lot of industrial research), blend of programs (to guide our partners from the industry to relevant research programs), and risk taking (by engaging in and applying financially risky research, often through use of industrial trials and experimentation).

•Being client-focused means fully understanding the needs and priorities of [our organization's] members, including their need to see value from research and development. In addition to actively seeking input and guidance from industry and government members through a member advisory process, our organization has a market and economic group that works with universities, industry associations, and customers of wood products to examine market issues, changing customer preferences, competitive intelligence and market trends. This provides a higher level of analysis to guide [or national research program], making it proactive and responsive to change.

•Emphasis is on client-oriented user-friendliness, namely providing information in user-friendly databases; publishing reports, especially reports aimed at decision makers.

•To have satisfied customers is a must. We are now asking our customers to evaluate our performance (short questionnaire) in order to constantly improve our performance and our communication systems.

•Focus is on clients and customers. We have changed what we offer our members - making our membership offering much more commercially focused. This also helps when we sell our commercial services.

•It is extremely important to deliver expected results to our clients, especially when it comes to quality products and meeting client time schedules.

Communication

•Communication with clients is very important. Through our website program, we have increased the frequency and reach of our communication several fold, which is greatly increasing our ability to achieve our goals.

•We believe in communication of research results. Approximately 20 percent of total budget is allocated to communication of knowledge.

•All research results are communicated effectively: a special emphasis is on the dissemination of research results to various clients and target groups. Publications and seminars are an integral part of research activities.

•We place huge emphasis on communications with our member companies, including on-line, web accessible research reports, research project plans and interim results, conference reports (we are the watchdog for many research areas on behalf of our members), and more. We also have developed a very powerful interaction reporting system which is also on-line for individual company access to [our organization]. It is like a customer relationship management system. All interactions with each member company mill (other than those of a trivial nature) are captured electronically. These are then available for all [our] research staff to see and use, and are also available for each company for their own interactions so that they will be aware of the nature, frequency, and details of all contacts with member mills, whether driven by [our] staff or member company staff.

Blend of Services

•Success for us means a clear focus on basic and applied research (60 percent of time and budget), and a limitation of [time and resources] devoted to services testing (20 percent) and education (10 percent to teaching, workshops, conferences).

•To better orient our research, we are going into partnership with [another major research organization] so we can focus on those areas where [our] expertise is best and complementary to that of the [other organization].

•Orientation of our research is on applied research and the further refining of the results of basic research.

•By applying a multi-disciplinary approach to problem solving, [our organization] is able to add more value through providing multifaceted solutions. When a particular expertise is not

available in-house, [our organization] forms research alliances with others to add that capability in problem solving.

•A very important factor for our organization is balance of research and application. We often say that without research we have no product to sell, and without application, we have no customers to pay for the research. We work hard as a management team to keep these two in balance.

•Research is oriented to solving current needs of the industry connected with manufacturing processes, updating technology, applying new auxiliary measures appearing on the market (for example, adhesives, measures to make boards water-repellent), and expanding the use of wood-based panels.

•Most private companies have relatively short future time horizons (many see only the current operational year), yet the type of research we do is often of a much longer term.

•One way to ensure research relevance is to assess potential value return from a piece of research up-front, at the planning stage. This information is shared and discussed [by our advisory committees] so members could make informed decisions on a balanced portfolio of low-risk and high-risk research projects.

•Companies that are members of our institute also have significant in-house research operations. As such, there is movement of staff from institutions like ours to the companies. We therefore play a human resource development role for industry, which has an effect of slowing progress with our own research programs (time-consuming mentoring of young researchers, lack of long-term continuity in our research skills).

•Research is conducted in consortia with the best suited partners – for each project, the best partners are looked for. Our organization plays a key role in identifying the network and bringing partners together to address a problem.

•[We work to] satisfy the requirements of clients by providing information within the scope of manufacturing technology and the usage of products; evaluating the quality of manufactured products, especially taking into consideration their compliance with [government] standards and directives; measuring and inspecting the emission of pollutants into the atmosphere; measuring values of harmful factors on particular work stations; and working out construction and implementation of unique apparatus and equipment in accordance with the needs of the industry.

Employees and leadership

• Brains is the core of our research business – and let there be no doubt about it!

•We are a flat, non hierarchic organization [which is administratively] demanding, but effective. All employees, including management, are measured on results every month. Good results (earnings and individual performance) will influence the wage level.

•Our staff is highly trained and committed to serving the wood sector. They welcome challenges and new opportunities and are responsive to client needs. They maintain a "can do" attitude and are ready to offer expert advice.

•[We have moved to] change our staff focus away from support staff towards a higher percentage of research persons.

•We must invest in research to have the world-class staff needed by our member companies. We also need the results of the research program as the basis for our products and applications five to 10 years down the road. However, without the applications, our customers will not be happy. We have managed to motivate our research staff now so that (unlike academic researchers who are recognized for their publication record) our scientists are measured by the technologies they have applied in the field. [However, we do] encourage publication so that our scientists become recognized internationally by their academic peers, and we are proud of our patent portfolio and applications which gives our applied scientists the same recognition by their counterparts in the commercial world.

•Talented research and supporting staff is a must. People make the difference – it's true and as simple as that. To have researchers who are also able to market and sell research is absolutely necessary, but they are not so easily found.

•Our plans are to expand the scientific background of our staff, away from exclusively wood specialists toward chemists, physicists, and material scientists.

•Leadership is critical to ensuring constant development of the industry and its updates, [especially with regards to] expanding the base of raw materials, improving manufacturing technology, working out new directions for the use of manufactured products, adjusting properties of products to the needs resulting from their application, improving working conditions, and protecting the natural environment.

•A world-class research staff is critical to success. The quality of our research staff gives us both breadth of coverage over many technologies of relevance to our members, and depth for individual technical areas. The combination gives [our organization] a systems capability when it comes to applications of technology and for examples when member companies come to us with complex problems to solve. It means, for example, that we can tie an apparent low performance of a paper product back to the fundamental properties of individual fibre species, or we can relate a corrosion problem in a mill to the chemistry of the wet end of the paper machine or the bleach plant. The quality of the research staff means that we can attract scientists from all over the world to work, and we generally have a very low attrition rate with many, many staff having spent upwards of 25 years [with our

organization]. This gives superb corporate memory and adds to the strengths of our scientific capabilities.

Financing and budgets

•Our organization is a nonprofit organization that is not dependent on one financier alone. This means that we have relatively high flexibility to use funds and can act quickly to arising research needs.

• Public ownership of our research organization is especially important as regards funding. Without access to a continuing flow of public funds the volume of our research would be much less.

•An adequate funding structure is essential. In our case, the model is a four-year frame of work [program] jointly funded by the private forestry sector and government (50 percent of total budget). This safeguards continuity in our program. A portion of the funds are allocated to more long-term oriented research and development.

•Financing of projects for particular clients is provided directly by the clients themselves. In contrast, research and development works of general importance are carried out thanks to subsidies from forest industry, government, and from a special fund for the development of science.

•Our research has changed considerably because government funding has virtually disappeared. However, when the funding did exist it encouraged us to research topics which weren't really the most important. Now we need to rely almost entirely on our own funds. We will be focusing on those things that most need researching, rather than those topics for which you can obtain funds.

•To have a guaranteed income from four large industrial concerns is a blessing (formerly they were ever-changing members that paid a membership fee). However, we need to find funds for projects on our own. The public sector is a source for more basic research if you are able to come up with good research proposals. It is also necessary to attract short-term projects from various customers (such gives us contact with and appreciation for their daily problems).

•We are an economically healthy private organization with no public funding. We have a large scope for maneuvering and can make allocation decisions quickly and efficiently.

•A balance of funding (long-term sustained funding versus short-term operational funding) is critical to a successful research program. Government funds need to be available to ensure long-term continuity in our research programs.

•We are a private organization that operates in a partnership structure based on shared risks, shared costs, and shared benefits. This structure allows the [. . . federal

government, provincial governments . . .], and companies producing solid wood products to provide financing toward a core research program that is the heart of our organization's research effort. The original funding formula was 50 percent federal, 25 percent provincial and 25 percent industry. This has changed over time – today the ratio is 33/25/42.

•The articles of our incorporation and our not-for-profit status allows industry members to benefit from any research and development tax benefits that are offered [by government]. The leveraging effect is an incentive for industry to join our research partnership and pay dues based on their product production.

•Our sources of finances are more and more private industry (now about 40 percent) and less government financing (about 60 percent).

•Although the support from our members has been excellent, the industry is subject to a range of economic pressures (global pulp price fluctuations, currency fluctuations) and local economic and political pressures (labor, environmental). This inevitably places pressure on company research and development budgets and has a direct effect on the finances of our institute.

•A split of financing (60 percent federal, 40 percent third party moneys) forces us to line up part of our activities to industry and industrial research programs.

•Nearly all research and development projects are dependent on industry participation (and often leadership), and at least 50 percent [of our] finances are from industry. Therefore we have to understand and identify with the research and development needs of the industry. This is crucial in order for our organization to succeed.

•Our members provide the bulk of our operating budget, although some revenue comes from contract research, some from sale of intellectual property, and some from sponsorships of various forms.

•Our organization is financed almost entirely from subscriptions. Therefore, we only have one type of stakeholder to service, making it easier to be focused.

•Our director makes final decisions on current matters concerning financial operations for the research needs of clients. Research connected with the industry as a whole is financed by subsidies on the basis of a program established periodically by an advisory committee composed of representatives of industry. [The committee] identifies current needs of both the industry and the market, including possibilities for implementation of the research products.

Performance and Outcomes

Managers of forest products research organizations, and the clients that seek the services of such organizations, have more than just a passing interest in how well a research enterprise performs. Their interest in performance is motivated by a number of concerns, including a desire to strengthen the planning and management of research programs, making sure that research goals are relevant to broader goals involving national development, expanding and strengthening political support for research programs, and identifying promising future directions for the investment of limited resources available for research. Interest in performance can also be motivated by a desire to learn more about an organization's operation and the goods and services it provides, an interest in controlling or influencing the behavior of those that are directly responsible for leading and directing a research organization's programs, and a desire to influence the behavior of broader collections of persons and entities that can exert influence over an organization's mission and the way it is being pursued. In recent years, scare resources and budget deficits have increased attention to performance, forcing public and private officials to often justify their organization's very existence and to logically rationalize the usefulness of the programs that are included within its purview.

Measures and Standards

Performance evaluations (determining worth, value, or merit) are useful to the extent that they are systematically undertaken, are grounded in accurate information, and base their judgements on explicit standards (criteria). Often included among the latter is an organization's public acceptance (trust, integrity, fairness), adaptability (response to economic, technical, and policy changes), competence (technical and professional proficiency), decision making (consistent, participatory, representative), economic efficiency (maximizing net benefits), accountability (client, directives, higher authority), and service and product provided (usefulness, current, progressive). These performance categories suggest the broadness with which performance is to be viewed (more than just application of analytical techniques). For research organizations, standards of this nature can be especially difficult to define, let alone measure. Given such a reality, judgements about the performance of research organizations are usually focused on research processes (appropriateness of goals, reasonableness of time schedules, adequacy of staff and funding, comparison of planned and actual accomplishments) and on the impacts that the results of research have on science, the economy and society in general (new knowledge, improved economic efficiency, increased well-being of people).

The case-example organizations reviewed here were not subject to a sophisticated analysis of performance (far beyond the intent of the review and the resources available to it). Although far more performance standards probably exist than are publically reported by research organizations, an effort was made to systematically identify and synthesize the performance measures that the case-example organizations publically reported via their web sites, annual reports and various special documents. The result was identification of more than 100 different performance standards, the most frequently cited of which were the following categories (Table 5, Appendix A).

- List of research publications – 28 organizations
- Highlights of research outcomes– 16 organizations
- Educational offerings – 11 organizations
- Number and satisfaction of clients – seven organizations
- Statement of assets-liabilities, profits-losses – seven organizations
- Patents granted – four organizations
- Product and process adoption rates – four organizations
- Accountable to a parent organization – three organizations

Although less frequently noted, other performance standards cited by the case-example organizations were potential clients, consultancy frequency, earnings targets, contribution to knowledge, contribution to citizen skill levels, member recruitment, member retention, upholding reputation, effective resource use, superior staff performance, return per FTE, research peer review, analyses undertaken, processes developed, attainment of organization plans, statements of progress, revenue per FTE, social responsibility, number of staff, staff turnover, staff development, services delivered, accidents prevented, management advances, and research and education focused on minority or disadvantaged segments of society.

Publications and Research Highlights. Nearly all the case-example organizations draw attention to progress since their last reporting period by issuing short summaries of carefully selected accomplishments and by individually naming reports and publications that present in detail the results of research and related activities (Table 5, Appendix A). Most highlights and publication lists are presented in annual reports, although some organizations refer readers to web sites or to special reports (for example, “Brilliant Ideas at Work” [30+ pgs.] issued by New Zealand’s Industrial Research Limited [IRL]; “Progress and Achievements” issued annually to members by FORINTEK Canada Corporation). Some organizations present research highlights and lists of publications in newsletters and magazines that are issued periodically during the year (for example, the Norwegian Institute of Wood Technology’s [NTI] *Treteknisk Informasjon* is distributed to member

Table 5. Forest Products and Related Research Organizations (case-examples), by Country and Performance Measures. 2004-2005.

Organization	Performance Measures
• Cooperative Research Center for Sustainable Production Forestry (CRC) (*Australia*)	Potential clients, adoption rates, client satisfaction, consultancy frequency, research publications
• Cooperative Research Center for Wood Innovations (CRC) (*Australia*)	Research publications, adoption rates
• ENSIS (*Australia*)	Client satisfaction, earnings targets, adoption rates, contribution to knowledge, contribution to citizen skill levels, accountable to parent organization
• Holzforschung Austria (HFA) (*Austria*)	Research highlights, research publications
• Forest Engineering Research Institute of Canada (FERIC) (*Canada*)	Research highlights, research publications, member recruitment, member retention
• Forintek Canada Corporation (FORINTEK) (*Canada*)	Research highlights, patents granted, assets-liabilities, profits-losses
• Pulp and Paper Research Institute of Canada (PAPRICAN) (*Canada*)	Client satisfaction, uphold reputation, effective resource use, superior staff performance
•Research Institute of Wood Industry (CRIWI) (*China*)	Research publications
•European Forest Institute (EFI) (*Finland*)	Research highlights, research publications
•Finnish Forest Research Institute (METLA) (*Finland*)	Research highlights, research publications, research peer reviews
•KCL (Oy Keskuslaboratorium-Centralboratorium Ab) (*Finland*)	Assets-liabilities, profits-losses
•Technical Center of Finland (VTT) (*Finland*)	Research highlights, research publications, educational offerings, patents granted
•Association Forest Cellulose (AFOCEL) (*France*)	Clients served, client satisfaction, research publications
•French Pulp and Paper Research and Technical Center (CTP) (*France*)	Research publications, clients served, analyses undertaken, processes developed, educational offerings, assets-liabilities, profits-losses
•Federal Research Center for Forestry and Forest Products (BFH) (*Germany)*	Research highlights, research publications, educational offerings
•Institute of Wood Technology (*Germany)*	NA
•Forest Products and Forestry Socio-Economic Research and Development Center (*Indonesia*)	Attainment of organization plan
•National Council for Forest Research and Development (COFORD) (*Ireland*)	Research highlights, research publications, educational offerings, accountable to parent organization
•Forestry and Forest Products Research Institute of Japan (FFPRI) (*Japan*)	Research highlights, research publications
•Hokkaido Forest Products Research Institute (HFPRI) (*Japan*)	NA
•Forestry Research Institute (SILAVA) (*Latvia*)	Research publications

NA = information not available.

Table 5. Forest Products and Related Research Organizations (case-examples), by Country and Performance Measures. 2004-2005 (continued).

Organization	Performance Measures
•Forest Research Institute Malaysia (FRIM) (*Malaysia*)	Research highlights, publications, statements of progress
•SHR Timber Research (*Netherlands*)	NA
• SCION (*New Zealand*)	Assets-liabilities, profits-losses, revenue per FTE, research publications, patents granted, educational offerings, consultancy frequency, social responsibility
• Wood Technologies Research Sector, Industrial Research Limited (IRL) (*New Zealand*)	Research publications, patents granted, staff numbers, staff turnover, staff development, social responsibility, assets-liabilities, profits-losses
• Norwegian Forest Research Institute (SKOGFORSK) (*Norway*)	Research highlights, research publications, educational offerings
• Norwegian Institute of Wood Technology (NTI) (*Norway*)	Clients served, client satisfaction
• Paper and Fiber Research Institute (PFI) (*Norway*)	NA
•Forest Products Research and Development Institute (FPRDI) (*Philippines*)	Research highlights, research publications, educational offerings, services delivered.
• Research and Development Center for Wood-Based Panels (*Poland*)	NA
• Forest Research Institute (FRIS) (*Slovak Republic*)	Research highlights, research publications, educational offerings
• Forestry and Forest Products Research Center (FFP) (*South Africa*)	Research publications
• Institute for Commercial Forestry Research (ICFR) (*South Africa*)	Research publications, client-member satisfaction, adoption rates, educational offerings, projects in process
• Forestry Research Institute of Sweden (SKOGFORSK) (*Sweden*)	Research highlights, research publications
• Swedish Institute for Wood Technology (SP-TRATEK) (*Sweden*)	Research publications
• Pulp and Paper Research Institute-Institute for Packaging and Logistics (STFI-PACKFORSK) (*Sweden*)	Assets-liabilities, profits-losses, research publications, services delivered
• Swedish Wood Ultrastructure Research Center (WURC) (*Sweden*)	Research publications, educational offerings, management advances
• Swiss Federal Laboratories for Material Science and Testing (EMPA) (*Switzerland*)	Research highlights, research publications, patents granted, educational offerings, accountable to parent organization
• Taiwan Forestry Research Institute (*Taiwan*)	Research highlights, research publications
• Timber Research and Development Association (TRADA) (*United Kingdom)*	Assets-liabilities, profits-losses

companies and selected target groups three times each year). Most organizations present a combined list of publications, while some, such as the Swedish Institute for Wood Technology (SP-TRATEK), report publications for each major program area (for example, more than 150 publications in 2003-2004 for SP-TRATEK's buildings and housing program area). Publications of some organizations are not available to the public at large. For example, distribution of FORINTEK Canada Corporation's publications is largely limited to FORINTEK members. And even though all the publications issued by the Forest Engineering and Research Institute of Canada (FERIC) are publically listed, many are proprietary since they were prepared in response to a client's request (of 46 FERIC publications in 2004, 26 were restricted in their distribution [56 percent]).

Parent Organization Performance Standards. Performance standards are in some cases imposed on research entities by an entity's parent organization (Table 5, Appendix A). For example, Australia's ENSIS is accountable to its parent organizations, namely SCION and CSIRO. CSIRO and other Australia Commonwealth science agencies established (1995) six performance indicators that are to be used as indicators of commitment to continuing organizational improvement, namely: (a) resources are consistent (in line) with customer demands, (b) income from external earnings exceeds 30 percent (research, services), (c) organization is responsive and directed to customer needs, (d) practices, processes, and products are adopted by clients, (e) contributions are made to world knowledge base (publications, patents), and (f) contributions are made to improving the skill levels of citizens (training, education).

Ireland's National Council for Forest Research and Development (COFORD) reports to the Monitoring Committee of the Productive Sector Operational Program (2000-2006) (Department of Enterprise, Trade and Employment). Among the many performance standards specified are that the research initiatives of COFORD lead to improvement in:

- Share of home-grown wood in export markets
- Cost-competitiveness of the forest industry
- Forest products that have local use and application
- Cost-effective production facilities inline with environmental standards
- Research competence, including researcher training
- Collaboration between research institutions in Ireland and abroad.
- Quality and effectiveness of research programs

The Swiss ETH Domain has also established system wide performance standards that must be adhered to by each of the Domain's separate research entities. An example is the Swiss Federal Laboratories for Material Science and Testing (EMPA) (part of the

ETH Domain) which must adhere to standards such as excellence in teaching and research by international standards, pole position in international research, attractive working conditions and equal opportunities for women and men, creation of innovative teaching programs, increased cooperation with the Swiss universities, and technological and economical implementation of new knowledge and techniques.

Asset-liability and profit-loss statements. Organizations employing asset-liability and profit-loss statements often provide significant detail about their financial performance (Table 5, Appendix A). Whether operating as a public franchise, or as an independent private entity, the intent of these statements is to promote financial accountability and, ultimately, to increase shareholder value and the promotion of a fair return on investments. As an example, the United Kingdom's Timber Research and Development Association (TRADA) publishes an annual financial report that presents detailed income and expenditures' accounts (income, expenditures, operational deficit) and a balance sheet for the association (fixed assets, current assets, creditors, capital and reserves, member funds). Likewise, the Technical Research Center of Finland (VTT) annually issues an internal statement of profitability which presents information (current and preceding years) about operating income (external income, government funding, adjustments), expenses (for example, personnel, travel, materials, rents, external research services), operating margins (depreciation, financial expenses, extraordinary expenses), and financial year results (profit, net income). Similarly, the annual report of FORINTEK Canada Corporation sets forth similar information in a consolidated balance sheet (assets, liabilities, balance) and in consolidated statements describing cash flows, change in net assets, and in operations and fund balances. The financial statements for New Zealand's Wood Technologies Research Sector, Industrial Research Limited (URL) are especially detailed. Not only do they set forth typical accounting details (financial performance, movements of equity, financial position, cash flows), they also present statements of actual versus expected financial performance (revenue, return on equity, return on assets, equity ratios).

Social Responsibility Standards. Organizations also judge their performance in meeting various social, economic and environmental standards (Table 5, Appendix A). An example is New Zealand's SCION (prior to 2005 known as Forest Research Limited) which is required by the Crown Research Institutes Act (1992) to annually report progress in both financial and nonfinancial measures. Among the latter are such measures as avoidance of accidents, student scholarships granted, contribution to community interests (financial and volunteer support of nonprofit organizations), protection of national interests (biosecurity services provided, indigenous forest protection, Montreal Process convener), advancement of employee conditions, (health and safety, rewards and recognition,

leadership training), and furtherance of various cultural matters (scholarships, awards, involvement of Maori, women and certain ethnic groups in grant programs and research and development proposals). As a Crown Research Institute, the Wood Technologies Research Sector of New Zealand's Industrial Research Limited (IRL) also is required to annually report such noneconomic performance information.

Organization Overall Health. Organizations are concerned about their management and their ability to continue as viable enterprises. Many case-example organizations have established performance standards against which to measure progress in this respect. For example, the Pulp and Paper Research Institute of Canada (PAPRICAN) places notable emphasis on standards such as upholding a reputation for excellence and integrity, rewarding highly creative and energetic people, effectively using resources provided by member companies, and expecting superior performance of everyone (individually and collectively). Some organizations, such as the Forest Engineering Research Institute of Canada (FERIC), use recruitment and retention of members as a measure of organizational success, and prominently identify new members in their annual reports. Others monitor staff turnover as a measure of organizational health, as is the case with the Wood Technologies Research Sector of New Zealand's Industrial Research Limited (IRL). The latter annually reports turnover of permanent staff as a percentage of total staff, the rationality being that the rate at which employees leave an organization's workforce may be an indication of employee dissatisfaction with working conditions.

The Swedish Wood Ultrastructure Center (WURC) emphasizes a number of broad principles that are considered indicative of the center's managerial and organizational health. Such include the occurrence of industry-academia interactions (understanding), networking leading to recruitment of quality scientists, suitable size (scale) of research projects, systematic planning of research projects, international cooperation and collaboration, progress toward long-term organizational goals, international reputation as a center of excellence, and staff mobility between academia and industry. In a similar fashion, Australia's Cooperative Research Center for Sustainable Production Forestry (CRC) reports on the following measures of organizational health:

- Participation by member institutions in major decisions concerning research directions of the Center.
- Interchange of personnel among institutions participating in the Center.
- Publications jointly authored with persons from other research groups and organizations.

•Visitors to the Center (number and duration of stay)(especially from overseas).
•Interaction among scientific staff at dispersed locations, especially regards Center's core programs.

Educational offerings. Organizations with formal educational programs often report performance in terms of students supported or advanced degrees granted. An example is the Philippine Forest Products Research and Development Institute (FPRDI) which reports the number of scholars supported, as does Australia's Cooperative Research Center for Wood Innovation (CRC) which reports the number of students seeking the Center's Advanced Diploma in Wood Products Management. The Center also reports on students engaged in advanced degree programs (PhD and Masters) and the research guidance provided them by the Center (advanced degrees are granted in cooperation with the University of Melbourne, Swinburne University of Technology, and the University of Tasmania). Similar reporting is made by the European Forest Institute (EFI), Pulp and Paper Research Institute of Canada (PAPRICAN), German Federal Research Center for Forestry and Forest Products (BFH) (in cooperation with the University of Hamburg), South Africa's Forestry and Forest Products Research Center (FFP), and the Swiss Federal Laboratories for Material Science and Testing (EMPA) (notably the EMPA Academy). Some research organizations report important educational activities involving advanced training, although such may not lead to a formal university-granted degree (for example, Swedish Pulp and paper Research Institute/Institute for Packaging and Logistics [STFI-PACKFORSK]).

Plan-Target Accomplishment. Research organizations also judge their performance by the extent to which established plans and targets have been accomplished. Noteworthy in this respect is Indonesia's Forest Products and Forestry Socio-Economic Research and Development Center which documents progress in accomplishing each of the Center's five year plans. Similarly, the Forest Research Institute of Malaysia (FIRM) reports progress in accomplishing each of the objectives (35 total) specified within each of its seven plan-of-action strategies. As a Crown Research Institute, New Zealand's SCION annually provides significant detail about corporate intent and the actual accomplishment of established targets. For SCION, actual versus intent information is provided for more than 36 target areas, including gross revenue, return on assets, patented inventions, research papers in journals, seminars and field days sponsored, and staff time in training. Also a Crown Research Institute, the Wood Technologies Research Sector of New Zealand's Industrial Research Limited (IRL)also reports on accomplishment of targets established for key

indicators of performance (such as capital expenditures, permanent staff turnover, joint ventures established, and speaking invitations to scientists).

Administrator Perspectives

The executives and management staff of case-example research organizations were also asked to provide information about the performance of the organizations for which they were responsible. Specifically, the following request for information was made: "The performance of forest products research organizations can be judged according to attainment of various standards. For example, clients are satisfied, organization is profitable, scientific contributions are being made, products and services are numerous (publications issued, tests conducted, conferences sponsored), achievements are being recognized (publicly and professionally), and operations are being conducted in professional and ethical manners. In your judgement, what *three conditions* are most important for determining how well (. . . organization's name . . .) is carrying out its mission?" With only slight paraphrasing of respondent replies, the administrators identified the following.

Client Satisfaction

•Key performance indicator is delivery of successful research products that produce the economic impacts predicted for a client. Satisfied industry partners is a very important indicator of our success.

•Since education of the next generation of scientists is also part of our responsibilities, we expect to produce a cohort of industry-ready graduate researchers who will find ready employment.

•Members are satisfied with [our research and service] activities. They give positive feedback on our activities on a continuous basis.

•Client satisfaction, more particularly, member company satisfaction is critical. We have been very fortunate that over many years most of our member companies have stayed with us. We have also been able to attract new member companies, even over the past few years where the economic climate has been so dismal that many companies have greatly restricted their expenditures on research and development.

•Most important performance criterion is client satisfaction (member-owner-customer). To enable this, products and services have to be numerous, of high quality, and well adapted to various customer categories. And of course, this can only be achieved if research and

development is conducted professionally with skilled and competent staff – and is well communicated.

•Returns on member company investments in our organization [is a very important measure of performance]. We work with member companies to develop a summary of the returns that they have actually realized from [our research developed] technologies. In general terms, the returns to our members range from 200 percent to 1000 percent annually on their net fees to our organization. We also report the average of all member returns to [our governing board and at the annual meeting of all our members].

•Because of our programs, our members' businesses have grown over and above any general increase in industry-wide growth.

• Satisfied clients is the most important measurement of how we carry out our mission.

•Successful work of our institute is to be found in satisfaction of our clients. Did the developed technology work and bring the financial success that was expected? Did the institute provide the service in a timely and cost-effective manner?

Recognition and Appreciation

•As many research organizations do, we seek world-class recognition of our research staff. For this we track external scientific awards and recognition, numbers of publications in peer-reviewed journals, numbers of patents, invited lectures and so on.

•Success is embodied in our organization's achievements being recognized by high-level policy makers and by policy making processes.

•Achievements of our organization are being widely recognized – satisfied customers will buy again.

•Recognition externally for some of the functions we carry out [is an important measure of performance]. For example, we are an ISO certified research laboratory in a number of areas and maintain sole or joint responsibility for a number of world standards in our industry.

•Invitations our organization receives to international policy making processes, where we become the representative of the research community on a particular forest resource issue.

•Being a member-focused organization, the most important measure of success is member and client satisfaction. This is measured through surveys and by an ability to retain existing (paying) members and attracting new members. Clients are satisfied when they perceive that they have received something of value in return for the investment they have made. [Success also occurs] when members recognize (and are proud of) our organization's achievements.

•Preparing and presenting reports during national and international conferences, especially within the scope of activities of the European Union.

• Success means wide acknowledgment of the contribution of our scientific results (papers, presentations, reports).

Economic and Scientific Contributions

•Most important measure of success is creation of new knowledge and the successful application of new and existing knowledge to current problems.

•Did we help grow and maintain markets for timber through our research and information programs? This is the most important performance measure for us.

•Scientific quality of our products is high. This is measured by the number of peer reviewed publications that we produce.

•Very important to contribute to visual results such as new innovative products, new processes, new market opportunities, etc. This is of interest to media and helps create pride and self-confidence in industry and in our institute.

•Scientific output is especially important to our success, especially as measured by number of patents or licences, reviewed papers, citations indexed, and completed PHD student programs.

Operational Success

•Positive funds have been maintained for the operation of our organization (for obvious reasons). We would like to see membership increasing, which would (a) pay for more future work and (b) demonstrate that what we are doing is appreciated.

•Our organization is profitable – a condition for our very existence. We have to prove our competitiveness by showing a positive result.

•Percentage of our total budget that is provided by external sources. Such is a measure of our success in accessing and selling the products of research in the marketplace.

•Success is embodied in our mix of being a business company and an academic institution, a mix that we believe is essential to our success. Academic success measures of success involve recognition on a world basis, having articles printed in the international journals, presenting papers at international conferences, being widely quoted, and winning various awards. This we are not.

•Even if our goal is not profit maximizing, we have to have positive financial results if we have to be a profitable organization in the long run. Otherwise, we will represent [be considered] a problem to the industry and to our members.

•We are not a typical academic research and development organization. To carry out our mission, we are dependent to a large degree on our own earnings. Therefore, we are more focused on concrete results than on international publishing with referees, etc., etc., etc. But nevertheless we do not compromise on the scientific requirements.

•Research alliances are important to our success, and peer recognition is important because it has a direct impact on how often and how well our organization can form meaningful research alliances with others.

•No research could be carried out without money. Financial stability and sustainability means having adequate financial resources to evolve over time and to maintain and strengthen our core competencies that enable us to deliver our mission. Despite a high degree of member and client satisfaction, our organization has found securing adequate financing to be a constant challenge.

•Carrying out orders commissioned by particular clients and achieving profits from those activities is a bottom line measure of success.

•The success of our organization is built on company values, namely confidentiality, neutrality, and top quality professional products and services.

•An important performance measure is the care with which we manage highly confidential information from our member companies, making sure not to divulge information as we work with one member company or another. This is so significant (given the many corporate scandals in the past few years) that we have totally updated our corporate governance guidelines, taking pride in our professional and ethical operation of all aspects of our organization’s business.

SUMMARY AND OBSERVATIONS

Summary of Review

The ability of forestry and forest products research organizations to contribute to a nation's well-being requires that such organizations be well structured, effectively managed, and held to high standards of performance. In 2004-2005, a review carried out of forest products and related research organizations beyond the boundaries of the United States. The intent of the review was to obtain a better understanding of how such organizations are structured, administered and judged. Ninety-three research organizations were initially identified for consideration by the review. Forty of the organizations were subsequently chosen as case-examples (located in 23 different countries), 30 were described in an abbreviated manner, and 23 were identified by name only. Provided with widely accepted principles of administration and organizational design, the lead administrators of the case-example organizations freely provided advice about structural, managerial and performance conditions that are necessary if a forest products research enterprise is to effectively accomplish its mission.

Organization and Governance

The case-example organizations operated primarily as private independent research organizations (25 of 40), although about half of these private organizations were legally authorized by, but operated independently of, government. The remainder were either government organizations or government organizations operating as independent entities. As for the missions of the case example organizations, dominate was an interest in promoting the competitiveness of industry, advancing scientific frontiers and developing new technologies, contributing to the economic and social needs of a nation, supporting the technical and managerial needs of clients, and promoting resource utilization and sustainability. The organizations were governed in various ways, including by independently empowered panels (boards, councils), larger parent organizations of which an entity was part (division, sector), and authorities exercised by chief executives and supporting staffs. Nearly all the organizations operated with one or more advisory committee. As for organizational structure, patterns included strong, traditional hierarchal (vertical) structures; horizontal structures with few layers of organization; structure oriented around skills and information resources available to clients; entities that are part of larger very diversified research enterprises; and organizations that are units of strategic alliances such as partnerships and joint ventures.

Administration and Management

The case-example organizations serve both public and private clients (21 of 40), although many (14 of 40) emphasis service to their owners or members. Services provided to clients were many and very diverse in their makeup, although the most common was research and development (all 40 organizations). Other services offered by the case-example organizations were (in declining order of frequency): consultation, information, training, testing, education, certification, and pilot scale production. The programs implemented by the case-example organizations focused on: forest products — 21 organizations, forest products and modest forestry — one organization, forest products and forestry — 10 organizations, forestry and modest forest products — four organizations, and forestry -- four organizations. As for research programs, 22 of the organizations focused on forest products research and 11 on forest management research. Only four or five organizations engaged in *both* solid wood products research and in pulp and paper research. Those engaged in forest products research directed attention to pulp and paper, wood composites, furniture, engineered structures, and wood processing and preservation. As for forest management research, the focus was on fiber production, forest protection, economics, harvest systems, and fish and wildlife.

Financial information about research investment made by the case-example organizations is uneven and often not publically available (proprietary). However, the 2004 combined investment in forest products and related research made by 27 of the case-example organizations was in the range of $385 to $425 million. Forty to 50 percent of these investments were made by private research organizations. The case-example organizations employed an estimated 7,000 to 7,500 scientists and supporting staff, most of which have less than 50 staff each, although three organizations report a staff of more than 400. Although the source of financial support for any one organization can be especially diverse, dominant sources are membership dues and similar assessments, fees and related charges for services provided, core funding provided by government, in-kind services provided by government and private entities, and grants obtained from competitive processes. Few of the organizations rely strictly on annual guaranteed funding by government. As for the pricing of services provided, some organizations have especially sophisticated sets of established fees that can be accessed through an organization's web site.

Performance and Outcomes

Publically reported information suggesting the degree to which the case-example organizations are accomplishing their mission and goals are dominated by annual listings of research publications and by written highlights of past research accomplishments. Other performance measures are (in declining order of frequency): number of educational offerings, number and satisfaction of clients, statements of assets-liabilities and profits-losses, number of patents granted, rates at which processes and products are adopted, and approval expressed by the parent organization of a research enterprise. Although not especially common among the case-example organizations, some appear to be especially sensitive to accomplishment of previously established targets (patents granted, seminars sponsored, joint ventures established), managerial and administrative health of an organization (staff turnover, new members), and contributions to broad social and economic conditions that are considered important to a country's well-being (health and safety of employees, minorities and women employed, employee leadership training, support of nonprofit organizations). In some cases, the latter two categories are part of the legal frameworks giving an organization the right to exist.

Observations and Interpretations

The way in which forest products and related research organizations structure themselves, and how they conduct business and subsequently judge performance, is an especially important topic in today's climate of scare budgets and concern over the appropriate role of public agencies generally. For forest products and related research organizations in the United States, the experiences of research organizations located beyond the nation's boundaries can be especially useful. With such a purpose in mind, what follows are observations that are based on information from a number of sources, including publically available information describing the organizations reviewed here, insights provided by persons responsible for the administration of the case-example organizations, especially noteworthy literature concerning the management of research and development enterprises (Ellefson 2005), and information provided through personal contact with administrators of forest products and related research organizations in various countries.

Diverse Organizational Labels. A variety of different names (or labels) are used to identify research organizations, including institute, laboratory, and center. Some names have a long tradition, such as "institute" which is a very common label assigned to many

research enterprises in Europe. Research organizations often assign themselves names (or logos) that seem to have little meaning in substance (not an acronym for a more complete name); they are abstract symbols that are used to define an organization and the services it is capable of providing. The plethora of different names and labels (and their different meanings) may be confusing in the broader worldwide research community.

Long History of Research Involvement. Many research organizations have a long history of sustained involvement in forest products research, some having been established in the mid and late 1800s. To their credit, they have survived major social and political upheavals, yet have managed to continue to purse their research and development missions. Their long-term existence probably has much to do with organizational leadership, perseverance in the face of hardship, and the importance a country places on its forestry and forest products sectors.

Movement from Public to Private Ownership. Private assumption of responsibilities for research organizations that were previously public organizations has been common. Some private organizations were "spun off" (privatized) by government as a government cost saving measure, or as a means of promoting a political ideology of "less government." In many cases, these spinoffs to private ownership have been followed by a great deal of organizational "soul searching" (what's the mission, who will provide the funding), much of which is reflected in their subsequent active record of mergers and acquisitions with other organizations. Some research organizations appear to have made the transition from government to the private sector quite well (embraced a culture of flexibility), while others seem to be steeped in tradition and lack a culture of flexibility that is needed to adapt to new circumstances. Aspirations to become "private" are especially strong among some Eastern European research organizations.

Blurry Distinction Between Public-Private Responsibilities. Sharp distinctions between public and private responsibilities for research are blurry in many countries. Attempts to define the ever elusive razor-sharp line of separation between public and private duties and responsibilities are not common — and no one seems to be concerned about it. In many cases, a country defines a problem in the forest sector (such as high unemployment, opportunity to explore innovative technology) and then proceeds to rally the necessary research support without regard (or limited regard) to what part of the effort should be a public agency's responsibility and what part should be assigned to a private concern. The focus is on the problem and how to address it most effectively and with the public and private resources at hand. Further blurring the public-private distribution is the reality that some strictly private research organizations often claim to be a "nation's

premier" forest products research establishment that has been assigned national responsibilities.

Government Authorized Yet Privately Operated. Although some public research organizations may appear to be solely sponsored (and often owned) by government, many have been legally granted the authority to operate like a fully independent private sector organization. They have a governance structure (board of directors, chief executive) that has full discretionary responsibility for allocating and distributing money, changing program direction, and employing executive and research staffs (including executive directors). Such an arrangement seems to promote the efficiency of the private sector while at the same time ensuring that government's concern over broader measures of social performance is addressed.

Complex Ownership and Partnering Arrangements. Research organizations often have complex ownership arrangements that involve government, private companies, universities, and other research organizations (public or private). Even different research entities that are strictly private often come together in ownership of a research enterprise. Again, the focus seems to be on carrying out research to solve a problem, less so on the ideological differences between public and private responsibilities. Some research organizations may publically depict themselves as "private," yet closer scrutiny can reveal that complex government laws actually make the "private" organization a wholly-owned government agency.

Scrambled Organizational Structures. The administrative structure of many research organizations is seldom neat and tidy; they often lack hierarchical structure and the usual vertical lines of authority. Appearing cluttered and messy as an organization, such would seem to defy an administrator's efforts to exercise control and direction (would appear to make hierarchal directives [planning, budgeting] very difficult). However, the "messy organizational maps" seem to work. They may simply reflect a research organization willingness to exercise the flexibility necessary to refocus resources on new problems that are in need of research. Not all organizations are organizationally "messy," some are very structured (especially research organizations in China and Japan).

Extensive Subsidiaries and Joint Ventures. Complex sets of subsidiaries and joint ventures are willingly engaged in by many research organizations. Their formation seems to be motivated by a desire to "fill" a void in research capacity, by a desire to address new problems or new opportunities, and by a need to "move quickly" (in an organizational sense). They are often looked to as ways of overcoming inertia that often exists within

some research organizations. Extensive partnering via cooperatives is also common, but they are less formal in arrangement than subsidiaries and joint ventures.

Entity within an Umbrella Parent Organization. Some organizations engaged in forest products research are subunits (divisions, centers, departments) of research organizations that are very large and very diverse in their research offerings. Such provides a competitive edge, in that the forest products entity can often draw on a wide variety of talents, experiences and equipment that exist throughout the larger parent organization. In essence, the forest products entity appears “small,” yet in reality its capabilities are potentially quite large.

Services for a Single Major Client Group. Although services provided may be expansive, most research organizations focus on a single major client group (such as the paper and board industry, solid wood products industry, or building and construction industry). Very few provide services to all these client groups. Similarly, very few provide both forestry and forest product research services (although the distinction between the two sectors is often unclear).

Intense Focus on Serving Clients and Customers. Research organizations often make the point that their services are “demand-drive,” in that they are driven by an intense interest in providing customers with information that can actually be used and that is available at a time when such information is actually needed. They also seem to achieve (or seek to achieve) a competitive advantage by portraying (selling) themselves as “practical” and “down-to-earth” in their approach to meeting the needs of clients. An overly intense focus on the immediate needs of clients and a dominating interest in generating pragmatic research results can skew research investments away from important long-term basic research needs.

Synthesizers of Information. Although research is often a major activity of most research organizations, many assume the broader mantel of being “providers of information” – regardless of source and form. They see a major role in synthesizing existing information (from various sources, not just their own outputs) and presenting it in a form that is useful to clients. In pursuing the role of information synthesizer, some organizations have acquired extensive data bases and have developed sophisticated ways of managing information that originates from many sources. Such activities may not involve research per se.

Services Provided for a Price. Many research organizations regularly engage in the offering research and related services for a fee. In the case of government research enterprises, payment for services is often part of a broader government effort to promote efficiency, redirect programs, and cover budgetary shortfalls. The pricing (sale) of services (research, information, consultation) by public and private research organizations is often guided by very specific and quite detailed pricing arrangements (specific fees set for specific services). For government organizations, such pricing structures are often established by law.

International Client Orientation. Many research organizations have aggressively expanded the orientation of their operations beyond the country in which they are headquartered. Some cruise the world for customers, having expanded their ability to address problems that occur beyond geographic boundaries that have traditionally limited their operations. Furthermore, many research organizations have members (owners) that operate in global markets; they need a "global scale" research organization that will meet their worldwide information needs.

Educational Degree-Granting Activities. Professional education activities, including graduate education in cooperation with degree-granting universities, are clearly within the purview many research organizations. Such are especially common in the field of pulp and paper research. By affiliating with research organizations that engage in educational pursuits, many clients (companies) have access to a ready-made supply of talented researchers over whose research and education they have had considerable influence.

Multiple Sources of Income and Revenue. Most research organizations rely on multiple sources of income for their operations, although noticeable is an increase in revenue from fees charged for services. Some organizations have a stable core of funding provided by government or by a core group of members. Core funding by government is often looked to as supporting "basic research" that would not be undertaken by the private sector. Both public and private research organizations are active competitors for research money controlled by large federal science agencies that allocate funds through competitive grant programs. In some cases, organizations have gotten discouraged with uncertainties over government funding and have set goals of being financially self sufficient (although this may also have been forced on an organization by government funding reductions generally).

Diverse Standards for Judging Performance. Performance information guiding investment in research organizations is diverse in both type and substance. That which is

publically reported varies widely, from a simple listing of publications and conferences sponsored, to a detailed set of asset and liability statements, and from specific measures of success in the marketplace (number of clients served), to statements of how an organization contributed to the broader social and economic well-being of the public. In some cases, performance-type information for an organization is virtually nonexistent (at least to the general public). This disparity in performances measures, and outright voids in reporting performance-type information, makes it very difficult to judge the efficiency and effectiveness of some research organizations. Some research organizations periodically engage outside consultants to review their structure and operations.

Adept Response to Broad Economic-Social Changes. Some research organizations seem to be able to comfortably accommodate changes occurring in the broader economic and political environments of which they are a part. Exactly why they are able to do so is subject for conjecture. In part, the answers may lie with visionary leadership, flexible organizational structure (for example, use of partnering arrangements), and creative management and administration (for example, budgetary flexibility). These attributes enable them to cope quite well with ups and downs in the economy and in the income base of their clients. However, this is not a universal trait. Some research organizations have great trouble responding to broader swings in the economy and in a country's changing political sentiments (such as moves toward fiscal conservatism).

Multiple Location of Physical Facilities. Although most organizations have a headquarters office in a single location, many have research facilities that are spread across a nation or in other nations (each doing research on problems unique to a geographic region). A number of research organizations are physically located on the campus of a university, a condition which provides for certain synergisms between the academic community and the research organization.

Publicly Available Information about Organizations. Organizations differ greatly in the extent to which the public has access to information about their operations (how organized, size of budgets, source of income, expertise of staff). Part of the problem is that some are private enterprises and information about them is proprietary (except for certain legal prescribed reporting requirements). In other cases, some organizations simply do not have the resources that are necessary to make public the type of information that accurately describes their operations (web sites, annual reports).

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APPENDIX: A

Comprehensive Description of the Organizational and Operational Characteristics of Case-Example Forest Products and Related Research and Development Organizations[2]

Australia

- **Cooperative Research Center for Sustainable Production Forestry (CRC)***

Date Established: Established in 1997.

Public-Private Sector: Combination public-private organization coordinated by the Cooperative Research Centers Program (CRC) of the Australian Ministry of Education, Science and Training (intent of program is to strengthen collaborative research links between industry, research organizations, educational institutions and relevant government agencies). The CRC for Sustainable Production Forestry is one of about 70 centers (including, medicine, manufacturing, agriculture, environment) that operate as collaborative entities for Australian forestry companies, the Commonwealth Government, State Government enterprises and Universities. The center has 19 members (11 private, four universities, and four governments). The Center accomplishes its mission by coordinating the research efforts of a variety of research organizations; keeping its in-house staff researchers at a minimum.

Mission: Ensure the long-term viability of Australia's forestry industry through high quality, relevant research in sustainable plantation forestry; produce research outcomes which improve the competitiveness of industry partners; through cooperative research, improve the efficiency and effectiveness of applied research and development carried out by industry partners; provide access to international science so as to ensure that relevant new approaches and techniques are available in Australia; provide innovative education that meets the skill formation needs of forestry industry and national forestry objectives; and ensure that all stake holders capture the benefits of research through technology transfer.

Primary Research Focus: Forestry, especially on plantation species with particular emphasis on genetic improvement, sustainable management, and resource protection.

Governance and *Organization*: Governing board (executive director is ex officio) composed of 15 member organizations. Advice and counsel is provided by an advisory panel (overall scientific advice; seven members, including three coordinating committee chairs), a management committee (center operation advice; eight members), and program advisory committees (one for each of the three program areas; nine to 10 members each, plus program directors). Three organizational units for research, and one for education and technology transfer. Center operation is the responsibility of a center director. Organization's headquarters located in Hobart, Tasmania, Australia.

Strategic Program Directions: Research focused on genetic improvement (tree breeding, wood quality), sustainable management (site productivity, silvicultural systems), and resource protection (insects and diseases). In addition, program focused on education and technology transfer.

Client Groups: Public and private organizations, with special emphasis on owners-members.

[2] Asterisk indicates that information describing an organization was reviewed by the organization's staff. Adjustments were subsequently made so as to correctly describe the organization.

Services Provided: Information (library, software), research (direct delivery of products, joint research activities), consultation (advice), and training. Special emphasis on technology transfer and meeting the needs of clients and members.

Budget and Funding Sources (2004) (Australian Dollars):

A. Income:[#]

$ 426,000 – Members
2,468,000 – CRC grant
99,000 – Other
$2,993,000 – Total (US$ 2.2 million)

[#] Additional $6.9 million in-kind contributions.

B. Source of Income:

89 percent – Government
7 percent – University
4 percent – Private
100 percent – Total

C. Expenditures:[#]

$ 2.7 million – Cash (including carryover cash)

[#]Additional $6.9 million in-kind contributions.

D. Focus of Expenditures (cash):

Research – 82 percent ($2.2 million)
Education – 7 percent ($0.2 million)
Administration – 11percent ($0.3 million)

Scientists and Supporting Staff: Total staff of 52, 89 percent of which are researchers and 11 percent are engaged in administration. Twenty-eight staffs are cash funded while 24 represent in-kind contributions.

Measures of Performance: Number of clients seeking services, extent to which research is properly planned (expected research outcomes defined, acquired and delivered on time), client satisfaction with research, extent to which research results are adopted, number of consultancies occurring, and number of research publications prepared.

▪ Cooperative Research Center for Wood Innovations (CRC)

Date Established: Established in 2001

Public-Private Sector: Combination public-private organization coordinated by the Cooperative Research Center Program (CRC) of the Australian Ministry of Education, Science and Training (intent of program is to strengthen collaborative research links between industry, research organizations, educational institutions and relevant government agencies). The CRC for Wood Innovations is one of about 70 centers (including, medicine, manufacturing, agriculture, environment) that operate as collaborative entities for Australian forestry companies, the Commonwealth Government, State Government enterprises and Universities. The center has 12 members (seven private, two universities, and three governments). The Center accomplishes its mission

by coordinating the research efforts of a variety of research organizations; keeping its in-house staff researchers at a minimum.

Mission: Develop functional applied technologies to benefit the forest products industries. Intent is to establish wood as the sustainable product of choice, by making available improved processing technologies using microwaves, technologies that add value to wood products, and products from raw wood.

Primary Research Focus: Forest products

Governance and Organization: Governing board of nine member organizations and a chief executive officer. Center directs its research and commercial operations through its management company, IWM Center Management Limited. IWM has been assigned background intellectual property and owns all new intellectual property on behalf of the CRC partners. Organization's headquarters located in Melbourne, Victoria, Australia.

Strategic Program Directions: Research focused on microwave processing of wood (reducing growth stress, wood drying, wood composite, fundamental science), value added technologies (wood surface finishes, technology-led design, wood bending, extending lifespan), and raw wood enhancement (pyrolysis bio-products).

Client Groups: Public and private organizations, with special emphasis on owners-members.

Services Provided: Information (library, software), research (direct delivery of products, joint research activities), consultation (advice), and training.

Budget and Funding Sources (2001/2002) (Australian Dollars):

A. Income:[#]

$ 2,300,000 – CRC grant
8,600,000 – Other sources

$10,900,000 – Total (US$ 8.1 million)

[#] Total of $76.4 million ($16.3 million CRC grant) over seven year period.

B. Source of Income: (unknown)

C. Expenditures: (unknown)

D. Focus of Expenditures: (unknown)

Scientists and Supporting Staff: Full-time equivalent research staff of 28. Total of 12 lead researchers.

Measures of Performance: Number of research publications prepared, adoption of products and processes.

▪ ***ENSIS****

Date Established: Established in 2004 as an unincorporated joint venture involving Australia's CSIRO(Commonwealth Scientific and Industrial Research Organization, including the Division of Forestry and Forest Products Research) and New Zealand's SCION (formerly Forest Research, Ltd.). CSIRO was formally organized by the Australian federal government in early 1900s and was given independent statutory authority in 1949 (Science and Industry Research Act of 1949).

Public-Private Sector: Private independent organization operating as an unincorporated joint venture of CSIRO and SCION. ENSIS is accountable to CSIRO and SCION, its parent organizations.

Mission: Enable formation of large expert teams capable of tackling complex problems at a scale that will help the sector (forestry and forest products) remain globally competitive. The mission of CSIRO (one of ENSIS's parent organizations) is to carry out scientific research for purposes of assisting industry, furthering community interests, contributing to national objectives, and facilitating and encouraging the application of new science that results from research.

Primary Research Focus: Forestry (tree improvement and germplasm, and wood and fiber quality) and forest products (wood and wood products, and pulp, paper and packaging).

Governance and Organization: Governed by a management committee which is composed of members from the parent organizations (SCION and CSIRO). Lead by a chief executive and a lead team (eight persons), of which six persons are also SCION unit leaders. ENSIS is organizationally grouped into the following units (each lead by a lead team manager):PAPRO unit, Forests unit, Wood Processing Unit, Environment unit, ENSIS Biosecurity and Protection unit, Wood Quality unit, and Genetic unit. ENSIS also engages in research via various cooperatives (for example, Douglas-fir Cooperative, Forest Site Management Cooperative, Wood Drying Multi-Client Group). ENSIS is headquartered in Rotorua, New Zealand.

An important business unit of ENSIS (and SCION) is PAPRO, which is a unit engaged in supplying pulp, paper and packaging technology. The PAPRO's mission is to develop value-adding solutions for the pulp, paper and packaging industries through innovative science, applied research and specialized professional services. It's strategic aims are to: (a) perform long term research in key science areas for the fiber-based industries, (b) seek innovation in wood fiber, paper and packaging products from New Zealand resources, and (c) maintain internationally recognized science capability in fiber-based technology and product development. PAPRO is organized into three key business areas: mechanical fiber processing, chemical and enzymatic technologies, and paper and paperboard. Staff numbers unknown.

Strategic Program Directions: Engaged in research and service in seven major areas, namely: genetics, sustainable forests, environment, wood and fiber quality, forest biosecurity and protection, wood processing and products, and pulp, paper and packaging.

Client Groups: Public and private organizations.

Services Provided: Information (library, software), research (direct delivery of products, joint research activities), testing, consultation (advice), and training.

Budget and Funding Sources:

A. Operating Income: Not available.

B. Source of Income: Not available.

C. Focus of expenditures: Not available.

In 1996-1997, the CSIRO Division of Forestry and Forest Products (merged in 2005 to form ENSIS)budget was estimated to be $26.7 million (AD), all of which was from external sources. For CSIRO's Environment and Natural Resources Group (of which the Division of Forestry and Forest Products was a part in 2003), revenue sources (total of $246 million) were as follows: government revenues – 6 percent, sale of goods and services – 30 percent, and other sources – 5 percent. Seventy-one percent of the CSRIO parent organization's total income in 2003 was from the Australian federal government.

Scientists and Supporting Staff: Estimated 300 staffs located at eight different sites (six in Australia, two in New Zealand). Staff includes CEO ENSIS, nine members of lead team, and five key contacts (CEO CSIRO Forestry and Forest Products, CEO SCION, marketing manager, human resources advisor). Number of researchers and supporting staff assigned to various ENSIS units is not available. The parent organization CSIRO has over 6,500 staff in 21 research divisions (for example, health, minerals, transportation) located throughout the world.

Measures of Performance: ENSIS is accountable to its parent organizations, namely SCION and CSIRO. CSIRO and other Commonwealth science agencies established (1995) six performance indicators to be used and an indication of commitment to continuing organizational improvement, namely: (a) resources are consistent (in line) with customer demands, (b) income from external earnings exceeds 30 percent (research, services), ©) organization is responsive and directed to customer needs, (d) practices, processes, and products are adopted by clients, (e) contributions are made to world knowledge base (publications, patents), and (f) contributions are made to skill levels of citizens (training, education).

Austria

▪ ***Holzforschung Austria (HFA)***

Date Established: Established in 1953.

Public-Private Sector: Private independent nonprofit organization. The Austrian Wood Research Society (established in 1948) (formerly the Austrian Institute of Wood Research) is the supporting organization of Holzforschung Austria.

Mission: Mission is to strengthen innovations in the wood industry through research and development, promotion of quality assurance through testing and supervision, and the transfer wood-technology know-how to the wood-based industry.

Primary Research Focus: Forest products

Governance and Organization: Administered by an institute head and an institute director (presumably responsible to a governing board of directors). Organized into 11 working modules, each of which is lead by a program director.

Strategic Program Directions: The organization groups its activities into 11 working modules, each of which encompasses various activities (including, research, testing, expert reports, standardization and certification). The modules are as follows:

- Round wood and sawn timber (for example, wood anatomy, wood drying, wood storage)
- Timber construction (for example, laminated construction, timber connectors)
- Timber housing (for example, construction physics, multistoried housing)
- Windows and doors (for example, performance evaluation, thermal insulated profiles)
- Furniture and joinery (for example, gluing and lacquers)
- Wood-based products and adhesives (for example, glues, discoloration, tropical timbers)
- Surface (for example, electronic scanning, wood floor surfaces)
- Wood preservation (for example, insects and fungi, wood preservative evaluation)
- Ecotxicology and analysis (for example, biological degradability, anaerobic treatments)
- Pulp and paper (for example, bleaching processes, de-inking procedures)
- Bioenergy and environment (for example, transport of wood pellets, recycling residues)

Client Groups: Public and private organizations.

Services Provided: Information (library, software), research (direct delivery of products, joint research activities), consultation (advice), and training. The organization groups its activities into six major service packs, namely research and development, testing and supervising, expertise, standardization, seminars, library, publications, and quality management.

Budget and Funding Sources:

A. Operating Income (2003) (Euros):

3.69 million – Total (US$ 4.4 million)
(2002: 3.73 million; 2001:2.97 million)

B. Source of Income (2003) (Euros) (estimated):

Commissioned research – 40 percent (1.5 million)
Business commissions – 40 percent (1.5 million)
Member contributions – 3 percent (0.2 million)
Other – 17 percent (0.7 million)

Total expenditures and focus of expenditures by program areas not available.

Scientists and Supporting Staff: Total of 58 employees in 2003. Distribution by functions (research, extension, supporting staff) not available.

Measures of Performance: Research highlights and listing of publications.

Canada

▪ Forest Engineering Research Institute of Canada (FERIC)*

Date Established: Established in 1975.

Public-Private Sector: Private independent, nonprofit research and development organization constituted under the *Canada Corporation Act* (Part II).

Mission: Provide members with the knowledge and technology needed to conduct cost-competitive, quality operations that respect the forest environment. An organizational goal is to improve Canadian forestry operations related to the harvesting and transportation of wood, and the growing of trees, within a framework of sustainable development. The program is known for being intensely practical and field oriented.

Primary Research Focus: Forestry, with special emphasis on problems encountered by small-scale forestry operations.

Governance and Organization: President-chief executive office and a governing board of directors (eight appointed and 12 elected) that represent the organization's membership (92 industrial members [represent 70 percent of wood harvest in Canada], 21 associate members, Canadian Forest Service, nine provinces and territories). In 2004, FERIC had advisory committees as follows: Strategic Advisory Committee (Eastern Region) (18 members), Advisory Committee on Forest Engineering Research (ACFER) (Western Region), (93 members), and Advisory Committee on Wildland Fire Operatins Research (ACFIRE) (Western Region) (25 members). Organized into an Eastern Division near Montreal, Quebec (location of head office) and a Western Division in Vancouver, British Columbia.

Strategic Program Directions: Research and development covering various engineering, human, operational and environmental aspects of forestry operations. In 2005, the program areas were as follows:

Eastern Division: Harvest and regeneration systems, partial cutting systems, stand tending, environmental impacts, value recovery, bioenergy, transportation systems, road construction and maintenance, decision support software and logistics, data acquisition and monitoring, and exploratory research.

Western Division: Harvest engineering, silvicultural operations, harvesting operations, transportation and maintenance, wildland fire operations, and extension services.

Client Groups: Public and private, owner-member emphasis.

Services Provided: Information (library, software), research (direct delivery of products), consultation (advice), and training. Special emphasis on technology transfer, especially extension staff located in the field and regional liaison officers.

Budget and Funding Sources (2004) (Canadian dollars):

A. Income:

$11.8 million – Total (US$ 10.2 million)

B. Source of Income:

Industry Members – 47 percent ($5.5 million)
Contract, grants, other – 35 percent ($4.1million)
Canadian Forest Service – 14 percent ($1.7 million)
Provincial Governments – 4 percent ($0.5 million)

C. Expenditures:

$11.8 million – Total

Expenditures by program area not available, although allocation between the Eastern Division and the Western Division is about equivalent.

Scientists and Supporting Staff: Approximately 140 staffs, of which an estimated 100 are forestry and engineering professionals. In addition to seven administrative staffs at FERIC's headquarters office, staff (by area of emphasis) in regional offices is as follows. Each division also accommodates students and trainees, the number of which varies each year.

Eastern Division: Staff of 45 assigned variously as multidisciplinary teams to the division's 12 (harvest and regeneration systems, partial cutting systems, stand tending, environmental impacts of forestry operations, value recovery from forestry operations, transportation systems, road construction and maintenance, decision-support software and logistics, data-acquisition and monitoring systems for forestry equipment, and exploratory research (energy efficient operations). Division staff also includes an estimated 13 administrators(for example, division vice president, research director, technical communications director, director of administration) and regional liaison staff assigned to the division.

Western Division: Staff of 48 grouped as follows: harvest engineering – eight researchers, silvicultural operations – three, harvesting operations – seven, transportation and maintenance – seven, and wildland fire operations – seven, extension – six extension specialists. In addition, there are an estimated 10 administrators and technicians assigned to the division.

Measures of Performance: General description of research results and listing of publications. Success in member recruitment and retention is also used as a measure of success.

▪ ***Forintek Canada Corporation (FORINTEK)****

Date Established: Established in 1979 as a result of the Government of Canada's decision to privatize the government-owned Canadian Forest Products Laboratory. The latter was established in 1915 and through privatization initiatives became FORINTEK Canada, Corporation (**For**est, **In**dustry, **Tech**nology).

Public-Private Sector: Private not-for-profit, government authorized.

Mission: Seeks to be a leading force in the technological advancement of the wood products industry, doing so through the creation and application of innovative concepts, processes, products and education. Improve the quality of forest products, add value in the manufacturing chain, reduce production costs, expand market share, and monitor market trends – to be achieved through applied research and development projects, common-good contracts, and client-specific proprietary contracts. Goals are to (a) lead in the development and balanced application of knowledge and technology to support member sustainable development goals (economic, environmental and social), and (b) deliver research products and services to the satisfaction of members and clients. Organization also has established a set of "core values."

Primary Research Focus: Forest products, notably add value along each step of the value chain for wood products and systems: from resource assessment (resource characteristics impacting processing and marketing), lumber manufacturing (sawmilling, wood drying and wood protection), composites products manufacturing (veneer, plywood, oriented strand board, particleboard and medium density fibreboard), value-added products (product design and manufacturing), building systems (acoustics, fire resistance and structural performance), codes and standards (grading, durability), and marketing and economics (global trade, market potential research).

Governance and Organization: Chief operating officer (President and CEO) and a 26-member board of directors. research direction is provided by a national research program committee (between 15 and 20 members), four technical advisory committees (various number of members, although in 2003-2004 as follows: resource assessment – 54 members, lumber manufacturing – 160 members, composite products manufacturing – 67 members, and building systems – 91 members), a value-added research advisory committee (24 members), and a hardwood manufacturing working group. Administratively organizaed into seven program areas. Organization has more than 200 member organizations (2004), classified as primary-secondary wood processing companies (141), associate (54), and government (10). Member organizations pay annual fees based on product production or percentage of gross sales. Extensive partnering occurs with various organizations (150+ organizations). Major facilities are located in Vancouver, British Columbia and Quebec City, Quebec. Satellite centers situated at 11 other locations (some on university campuses).

Strategic Program Directions: Program focus is on key program areas, namely: resource assessment, lumber manufacturing, composites products manufacturing, value-added products, building systems, codes and standards, and marketing and economics. A strategic plan (stated as mission, goals and purpose) is developed by the Board of Directors, national research program committee, and technical advisory committees, working with Forintek management and staff. At the project level, strategies and plans are guided by representatives of member companies through their interactions with Forintek's management and research staffs.

Client Groups: Public and private, owner-member emphasis.

Services Provided: Research (direct delivery of products, joint research activities), technology transfer (implementation of research results in mills), consultations (mill visit program, technology monitoring, special technical missions, commercialization of technologies), training sessions (seminars, workshops, software demonstrations). Preferential member rates for services provided. Fee-for-service available to nonmembers.

Budget and Funding Sources:

A. Revenue (2004) (Canadian dollars)(fiscal year ending March 31, 2004):

$28.3 million (US$ 24.4 million)
($1.4 million excess of revenue over expenditures)

B. Source of Revenue (2004) (Canadian dollars):

Government contributions and industry member assessment – 66 percent ($18.8 million)
Contract fees for services – 32 percent ($9.1 million)
Other income – 2 percent ($0.4 million)

C. Expenditures (2004) (Canadian dollars)(fiscal year ending March 31, 2004):

$15.5 million – Staff
8.3 million – Laboratories
2.1 million – Premises
1.0 million – Administration
$26.9 million – Total

Expenditures by program area and services provided are not available.

Scientists and Supporting Staff: Staff of 210 (complete listing is proprietary). Estimated professional staff distribution as follows (2002-2003): composites (21 percent) lumber manufacturing (12), building systems (29), drying and protection (18), resource assessment (six) and value added manufacturing (14). Staff competencies include wood science and technology, wood products engineering, mechanical, civil and electrical engineering, physical chemistry microbiology, organic chemistry, environment, forestry and forest economics and library science. Extensive expertise in forest resource characterization, wood product manufacturing (for example, lumber, panels, engineered wood product, flooring, furniture), woods drying and protection, wood product development and performance evaluation (for example, structural and appearance), building systems (for example, structural performance, fire resistance, seismic, durability and environmental attributes), and wood product markets and economics.

Measures of Performance: Research highlights, asset-liability and profit-loss statement, and patents granted (69) of which 44 are being maintained (listing is proprietary).

▪ Pulp and Paper Research Institute of Canada (PAPRICAN)*

Date Established: Established in about 1925 (has existed in some form for 80 years).

Public-Private Sector: Private independent nonprofit research and educational organization. Membership open to companies producing pulp and paper. In 2003, the organization had 32 member companies, three associate member companies, and one program element partner.

Mission: Within the context of a mission to deliver innovative economic solutions through research, the organization's mission is to create competitive advantages by working in partnership with global member and clients in the pulp and paper and related renewable resource industries through the generation and application of knowledge. Mission is to be accomplished by providing superior returns on member company investments in the organization; integrating research programs with the strategies of member companies; relentlessly pursuing member company satisfaction; sustaining excellence in science, technology and education; promoting links between fundamental science and business value and needs; and empowering the employees of the organization.

Primary Research Focus: Forest products, especially pulp and paper. Modest emphasis on forestry, through the Fibre Quality and Value research program in which specific attributes of individual species and their growing environments can add value to targeted pulp and paper products.

Governance and Organization: Governed by a 21 person board of directors, and administered by a chief executive officer (president and chief operating officer) and two vice presidents (research and education, administration-secretary treasurer). Research program advised by a 30 person research program committee. Research programs located in Quebec and British Columbia (two programs) and education programs located at McGill University (Montreal, Quebec), University of British Columbia (Vancouver, British Columbia), and Ecole Polytechnice (Montreal, Quebec).

Strategic Program Directions: Focus on fiber supply and quality, chemical and mechanical pulping, papermaking, environmental performance, product performance, development engineering, analytical sciences, and education. In partnership with three universities and member companies, the educational program is focused on advanced training in pulp and paper sciences and on professional career development. The overall research program reflects virtually all technologies relevant to pulp and paper manufacturing from the forest to final products, including processes related to the environment and sustainability.

Client Groups: Public and private, owner-member emphasis.

Services Provided: Information (library services), research, testing (calibrations, quality assurance services), consultation (advice), piolet plant applications, education and training (short-courses, postgraduate education).

Budget and Funding Sources:

A. Income (2003) (Canadian dollars):

$39.4 million – Total (US$ 43.0 million)

B. Source of Income (Canadian dollars):

Member companies – 67 percent ($26,600,000)
Grants and contracts – 12 percent ($4,600,000)
Federal government – 20 percent ($7,700,000)
Royalties and other – 1 percent ($500,000)

Member companies are allowed to direct their membership fees to specific program areas (up to 35 percent of company fees) and to applications of technologies in company mills (up to 15 percent of company fees).

The organization received significant financial or other tangible support from 33 allied industry partners and from four major governments (Government of Quebec [Ministry of Science and Technology Research, Ministry of Natural Resources], Government of British Columbia, Government of Canada [Environment Canada, Industry Canada, National Research Council Canada, Natural Sciences and Engineering Canada], and the U. S. Department of Energy).

C. Focus of Expenditures:

Employee salaries and benefits – 70 percent
Services – 12 percent
Utilities and taxes – 6 percent
Travel – 5 percent
Supplies – 5 percent
Royalty repayment – 2 percent

D. Program Focus of Expenditures: Expenditures distributed approximately equally across organization's eight major strategic research program directions, namely $5 million (CD) or 12.5 percent each program area (fiber supply and quality, chemical and mechanical pulping, papermaking, environmental performance, product performance, development engineering, analytical sciences, and education).

Scientists and Supporting Staff: Approximately 340 scientists, engineers, and support staff distributed approximately equally across organization's eight major strategic research program directions, namely 42 staff or 12.5 percent each program area (fiber supply and quality, chemical and mechanical pulping, papermaking, environmental performance, product performance, development engineering, analytical sciences, and education). Expertise partially reflected by organization's strategic direction and project plans.

Measures of Performance: Performance conditions are specified as: place high priority on customer needs, uphold reputation for excellence and integrity, reward highly creative and energetic people, effectively use resources provided by member companies, and expect superior performance of everyone (individually and collectively).

China

▪ ***Research Institute of Wood Industry (CRIWI)****

Date Established: Established in 1957.

Public-Private Sector: Public government organization. The institute is a branch of the Chinese Academy of Forestry. Other units within the Academy involved in forest products research are Research Institute of Chemical Processing and Utilization of Forest Products, National Bambo Research Center, National Engineering Research Center of Wood Industry, and the National Engineering and Technology Research Center of Forest Chemical Industry.

Mission: Develop technologies for utilizing wood raw materials rationally and economically so as to make better use of forest resources and meet the needs of national economy and people's livelihood.

Primary Research Focus: Forest products.

Governance and Organization: Administered by a director and three deputy directors. In addition to four administrative (office of general affairs, and divisions of personnel and education, planning and management, finances), the organization is structured into five research divisions, namely division of wood properties, wood-based panels, adhesives and panel surface finishing, wood protection, and equipment and automation. Also administratively parts of the institute are the following: Department of Civil Engineering Design, National Quality Monitoring and Testing Center for Wood-based Panels, Technical Committee for Wood-based Panels Standardization, Chinese Society of Wood Industry, and the Basic Committee of China Technical Committee for Wood Standardization. The institute is headquartered in Beijing, China.

Strategic Program Directions: Primary fields of research focused on by the Institute are:

•Wood Science (including wood anatomy, wood chemistry, wood mechanics, and wood physics as well as the relationship between silviculture and wood processing).
•Wood Processing Technology (including wood drying, wood preservation, wood fire-retardation, wood modification and wood finger-jointing).
•Wood-based Panels Manufacturing Technology(including plywood, fiberboard, particleboard, medium density fiberboard, laminated veneer lumber, wood-based composite materials and recycling of wood-based materials).
•Wood Resource Utilization Policy and Market Research.

Client Groups: Public and private.

Services Provided: Research (direct delivery of products) and consultation (advice). The institute is also offers programs leading to masters and PhD degrees.

Budget and Funding Sources: Not available.

Scientists and Supporting Staff: In 2003, 161 staffs, including 140 research and technical personnel. Of 15 highly qualified researchers identified, areas of their research were as follows: wood and nonwood-based panels (five researchers), wood properties (three), forest machines (two), wood adhesives (two), wood composites (two), and wood preservation (one).

Measures of Performance: Listing of publications.

Finland

■ ***European Forest Institute (EFI)****

Date Established: Established in 1993.

Public-Private Sector: Private independent organization authorized by Finnish federal law (legally identified as an association). Twenty European governments signed the Convention on EFI in 2003, and as of May 2005 six countries have ratified the Convention. Once ratified by 8 countries, the Convention will enter into force and the EFI will become and an international organization established by European countries.

Mission: Conduct, promote and cooperate in research involving forests, forestry and forest products at the pan-European level so as to advance the conservation and management of forests for producing goods and services in a sustainable way. Also make the results of research known to all interested parties, focusing especially on information needs in areas of policy formulation and implementation.

Primary Research Focus: Forestry, with limited forest products research.

Governance and Organization: Governing council of 9 persons and an institute director. Also a scientific advisory board (10 persons) that counsel on research directions for the Institute. In addition to the headquarters (Joensuu, Finland), the Institute has seven regional centers through which research can be focused on special regional problems (centers do not receive funding from the Institute). As of 2004, the Institute had 136 member organizations from 37 countries.

Strategic Program Directions: The institute has more than 30 research and development priorities occurring in four major program areas, namely *forest ecology and management* (nine projects, including carbon sequestration, forestry impacts of environmental changes, management of forests under various pressures, forests as an energy source, and forest biodiversity), *forest products and scoio-economics* (seven projects, including rural development, economics of multi functional forest uses, supply and demand of timber and forest products, forest products trade analysis, and forest sector competitiveness), *policy analysis* (five projects, including efficiency and effectiveness of public policies, forest science and policy making interface, forest policy development processes, goals and values of shareholders, and cross-sectoral policy impacts on forest and environment), and *forest resources information* (seven projects, including future development options for European forest resources, and information for decision-making in forestry).

Client Groups: Public and private, owner-member emphasis.

Services Provided: Information, research (direct delivery of products), consultation (advice), and training activities. Specifically, the Institute provides information for forest policymaking in European countries, develops research methods and conducts research, compiles and maintains data, organizes and participates in training activities and scientific meetings, and publishes and disseminates knowledge. Acts as a coordinator European le el research activities.

Budget and Funding Sources:

A. Income (2004) (Euros):

2.5 million – Total (US$ 3.0 million)

B. Source of Income (2004) (Euros):

Government[#] – 40 percent (1,000,000)
European Commission – 39 percent (986,000)
Special Project funding – 13 percent (341,000)
Membership fees – 6 percent (149,000)
Other sources (seminars, publications) – 2 percent (58,000)

[#]Core annual funding by the government of Finland, an amount that has been nearly constant from 1998 through 2004. Funding from other sources has increased about 1.8 million Euros during the same period.

C. Focus of Expenditures

Although focus of research investments varies considerably according to annual projects undertaken, the estimated distribution for 2002 (excludes regional centers) was as follows:

Forest ecology and management – 30 percent
Forest products and socio-economics – 15 percent
Policy analysis – 20 percent
Forest resources information – 35 percent

Scientists and Supporting Staff: In 2004, Institute staff was 53 from 15 different countries. (total of 34 person years). Although staff research focus varies considerably according to annual projects undertaken, allocation of staff by major research area and research support in 2002 was estimated to be as follows:

Forest ecology and management – 31 staffs (12 researchers and 19 scholars, research associates and trainees)
Forest products and socio-economics – 14 staffs (seven researchers and seven scholars, research associates and trainees)
Policy analysis – 12 staffs (four researchers and eight scholars, research associates and trainees)
Forest resources information – 14 staffs (five researchers and nine scholars, research associates and trainees)
Research administration and communication – 18 staffs

Measures of Performance: Research highlights and listing of publications.

■ ***Finnish Forest Research Institute (METLA)****

Date Established: Established in 1917.

Public-Private Sector: Public government organization authorized by Finnish federal law.

Mission: Through research, promote economically, ecologically and socially acceptable management and utilization of forests. Mission is pursued by focusing on five target areas, namely: research activities, research forests and laboratory activities, communication and information services, international activities, and administrative services.

Primary Research Focus: Forestry, modest forest products emphasis

Governance and Organization: Organization is responsible to the Ministry of Agriculture and Forestry and the Ministry of Environment. A management board provides strategic direction to a director general that is the organization's lead administrator. In addition, a six person management team provides assistance to the administrator and a research expert group (appointed by the director general) evaluates project proposals and gives advice and support on research matters. An international scientific advisory board serves as a generator for new research ideas and promotes cooperation and networking with other leading forest research organizations around the world. Research is conducted at nine different locations throughout Finland (two centers and seven research stations). General management and coordination of programs are conducted from the headquarters office in Helsinki, Finland.

Strategic Program Directions: Organization focuses on four target areas, namely research, research forest and laboratory activities, international activities, and administrative services. Research is organized into problem-oriented projects (each managed by a principal research officer)oriented toward the information needs of customers and the problems they face. Program research areas (involve five to 15 individual projects each for a total of 150 total projects in 2003) are: market potential for roundwood products, socioeconomic implications of carbon pools in Finnish forests, planning for management of forest resources, monitoring and inventory, and the effect of silvicultural practices on forest production. Examples of past research projects involving forest products involve timber trade (sector worldwide outlooks), wood processing and energy use (energy-wood harvesting), and wood use and measurement (hardwood utilization, structure of wood).

Client Groups: Public and private, government emphasis.

Services Provided: Information (library, photo-archive, software [forest statistics, timber prices, forest growth]), research (direct delivery of products), consultation (expert services, forecasting, presentations), laboratory services, testing and inspection (pesticides, tree breeding), and training and education. Organization is also responsible for a number of research forests. Commissioned services are charged according to the principles established by the Finnish "Basis for Determining Payments for State Services Act."

Budget and Funding Sources:

A. Income (2004) (Euros):

49 million – Total (US$ 58.9 million)

B. Source of Income (2004) (Euros):

Ministry of Agriculture and Forestry – 73 percent (36 million)
Foundations, other ministries and commissioned services – 27 percent (13 million)

C. Focus of Expenditures (2005) (Euros):

- Forest eco-systems and changes of environment – 31 percent (11.0 million)
- Forest growing and utilization – 20 percent (7.0 million)
- Forest genetics and forest tree breeding – 11 percent (4.0 million)
- Monitoring and inventory of forest resources – 9 percent (3.0 million)
- Forest politics and international affairs – 9 percent (3.0 million)
- Information systems and services – 6 percent (2.0 million)
- Research forest and laboratory services – 14 percent (5.0 million)

Scientists and Supporting Staff: Total staff (2004) estimated to be about 875, of which 321 are researchers (150 with Ph.D.). Two-thirds of the researchers hold a degree in forestry while the remaining portion has academic expertise in fields such as business economics, social sciences, natural sciences and various

technologies. Organization has 21 professors that are senior scientists responsible for developing their own disciplines or related fields of expertise.

Measures of Performance: In addition to research highlights and listing of publications, research projects and programs are evaluated (set intervals and at the end of project) by recognized national and international experts.

▪ ***KCL (Oy Keskuslaboratorium-Centralboratorium Ab)****

Date Established: Established in 1916

Public-Private Sector: Private independent organization (company)

Mission: In the context of a vision to be the leading research company for the global paper and pulp industry, the organization's mission is to support the competitiveness of its owners by delivering innovations, knowledge and technology to its customers. The mission is based on a set of five key values, namely innovativeness, customer confidentiality, mutual respect, environmental responsibility, and exceeding customer expectations. To accomplish the KCL mission, the organization's goal is to develop, maintain and command the knowledge and skills required to:

- •Acquire unique top-level expertise in selected areas of the pulp and paper industry supply chain.
- •Secure comprehensive knowledge and know-how across the entire spectrum of the forest industry.
- •Maintain the wide range of skills demanded by unique approaches to research.

Primary Research Focus: Forest products, especially pulp and paper.

Governance and Organization: Board of directors (seven persons from owning companies) and a managerial group composed of a president and two vice presidents. The vice presidents are as follows: research (KCL Science and Consulting), and research services (KCL Services). In addition, there is an administrative support unit. The organization is advised by a research committee of seven persons affiliated with owner companies as well as nonmember organizations (for example, universities). KCL is owned by four major Finnish companies, namely: Metsäliitto-Group, Myllykoski Oyj, Stora Enso Oyj, and UPM-Kymmene Corporation. KCL is headquartered in Espoo, Finland.

Strategic Program Directions: KCL focuses on three cores areas, namely research, services, and information.

The research program is formalized by KCL Science and Consulting. Philosophies guiding research include a focus on challenging technical and scientific problems, and on solutions that directly address the priority needs of clients in a meaningful way. The research program focuses on:

- •Fibers (for example, physical and chemical processing of fibers, and evaluation of new fibers and pulp).
- •Papermaking solutions (processes) (for example, detecting process disturbance conditions, and process operational efficiency).
- •Printing surface (for example, behavior of paper and board webs in various end uses, and interaction between paper and color coatings).
- •End-use (products) environment (for example, printing technology, and food products packaging).

The services program is formalized by KCL Services (including administrative units involving marketing, patents, and standardization), and is composed of two major groups, namely:

- •Pilot plant services (for example, integrated machine trials starting with wood chips and ending up with 4-color printed products).

•Laboratory services (for example, mechanical and chemical pulp testing, cooking and bleaching testing, and print quality testing, chemical characterization of pulp, paper and board, suitability of packaging materials for food, and laboratory trials from pulping to printing).

The research services program also engages in advice on standardization. In this respect, KCL has its own products (for example, KCL Eco [life cycle assessment], KCL Wedge, and KCL Printing School).

The information and library program provides extensive information resources, including publications, journals, and patent information. Specific prices are specified for access to information sources.

Client Groups: Public and private, owner-member emphasis. The organization's research program is focused primarily on the information needs of KCL owners, while KCL services are geared toward a broader array of clients (other research companies, suppliers of raw materials and equipment, engineering and design companies, and the pulp, paper and board industry generally). One of the reported cornerstones of the organization's business success is tailor-making information to fit client needs.

Services Provided: Information (library, software), research (direct delivery of products, joint research activities), consultation (advice), testing, and training and education.

Budget and Funding Sources:

A. Income (2004) (Euros):

23.8 million – Total (US$ 28.6 million)

B. Source of Income (Euros):

Owner companies' fees – 40 percent (9.5 million)
Contract for services – 51 percent (12.1 million)
Government funding[#] – 9 percent (2.2 million)

[#]Government funding consists of project specific funding from various Finnish, Nordic, and European sources.

Total expenditures and focus of expenditures by program areas not available.

Scientists and Supporting Staff: In 2004, KCL employed 300 persons that were assigned to its main operating units as follows: 130 staffs – KCL Science and Consulting (43 percent), 140 staffs – KCL Services (47 percent), and 30 staffs – administration and other units (10 percent). The staff breakdown by education is as follows: 47 Ph.D. and 18 licentiate degrees, 124 other academic degrees, 129 technical and vocational college degrees.

Measures of Performance: Consolidated profit and loss statements and consolidated balance sheets (assets and liabilities).

▪ ***Technical Research Center of Finland (VTT)****

Date Established: Established in 1942.

Public-Private Sector: Private independent contract research and development organization authorized by Finish federal law. Originally responsible to the Ministry of Trade and Industry, the center was granted nearly full autonomy in 1972.

Mission: Through the creation and application of technology, actively seek to enhance the global competitiveness of industry and other business sectors, and thus increase the welfare of society.

Primary Research Focus: Forest products, with modest emphasis on forestry

Governance and Organization: Governed by a seven person board of directors, including a chair and a vice chair. Executive staff of eight, including a director general, administrative director, and six executive directors (electronics, information technology, industrial systems, processes, biotechnology, building and transport). Organizationally, VTT (Valtion Teknillinen Tutkimuskeskus) has eight major research institutes (including electronics, biotechnology, building and transport) and eight major knowledge portals through which expertise in these various institutes can be accessed (VTT Environment, VTT Materials, VTT Pulp and Paper, VTT Information Technology, VTT Nuclear, VTT Renewables, VTT Transport, and VTT Life Science). Each research institute has a research advisory committee. The center's research institutes are located mainly at Espoo, Tampere, Oulu and Jyvskylä, Finland, and in Palo Alto, CA USA.

Strategic Program Directions: Research involving forestry and forest products focuses on a number of topical areas (portals), of which the following are especially relevant:

- •Pulp and paper (raw materials and chemicals, paper and printing products, control and operations [measurements, process control], and process development).
- •Materials (structural design, services [testing, analyses]), production and manufacturing [building materials, machines and equipment], and materials performance [wear, corrosion, fire]).
- •Renewables (bioenergy [forest biomass], wind energy, systems [energy saving systems], waste to energy [recoverable fuels]).
- •Environment (clean products and processes [closed water-cycles], environmental technologies [waste treatment], environmental services [biodegradability], environmental management [environmental modeling])
- •Life science (biotechnology for health, bioproducts, safety, food design).

Client Groups: Public and private (annually serves 5,000 customers). Clients occur at a worldwide scale, with specific interest in serving information needs regarding building products industries, wood-based industry, public agencies, and research institutes and universities.

Services Provided: Information (library services), research (direct delivery of products), consultation (advice), testing (certification, quality control), and training (sponsorship of seminars and conferences).

Budget and Funding Sources:

Income and source of income information is not available for the forest products research and service activities of the Technical Research Center of Finland. As such, the information below describes information for the Center generally.

A. Income (2003) (Euros):

218 .5 million – Total (US$ 262.6 million)

B. Source of Income (2003) (Euros):

Basic government funding – 31 percent (67.7 million)
Private sector, domestic[#] – 33 percent (72.2 million)
Public sector domestic – 25 percent (54.6 million)
Public and private foreign – 11 percent (24.0 million)

[#]Of the center's total income, six percent originates from the forest industry sector and two percent from the building and construction sector.

Total expenditures and focus of expenditures by program areas not available.

Scientists and Supporting Staff: The center employs over 2,800 persons, of which over 80 percent are considered research scientists or research staff. Forty-two research staff are identified as "contact staff," and are assigned to the following portals:

VTT Pulp and paper: nine research contact staff
VTT Materials: five research contact staff
VTT Renewables: 12 research contact staff
VTT Environment: 10 research contact staff
VTT Life Science: six research contact staff

Contact staff are but a portion of the total research staff employed by the organization. For just the VTT pulp and paper portal, the organization's administrators report employment of about 200 scientists and technicians. The total number of staff assigned to other portals is not available. Support staff are not included in any of the aforementioned estimates.

Measures of Performance: Extensive reporting of services rendered (research, education, publications, patents granted) and detailed accounting of the organization's financial condition (operating income and expenses, fixed assets, long-term investments, liabilities).

France

▪ *Association Forest Cellulose (AFOCEL)*

Date Established: Established in 1962.

Public-Private Sector: Private independent organization, governed by the French Law on Associations of 1901.

Mission: Increase competitiveness of the industry's fiber supply and of the overall wood and paper sector. Committed to a long-lasting relationship to clients by offering top-quality services.

Primary Research Focus: Forestry and forest products.

Governance and Organization: Board of directors (15 representatives) and a director general. The director general is also the general-research manager of the French Pulp and Paper Research and Technical Center (CTP). The board is composed of an at-large chair, three persons representing member companies, nine persons in a personal capacity, and two other members (assistants). The organization's headquarters is in Paris, France. Membership in AFOCEL is made up of fourteen (2004) pulp and paper industry companies. Organizationally, AFOCEL is structured as follows:

•Management: Director General, General Manager, Manager Administration and Finance.
•Regional Stations: Four regional stations.
•Specialist Laboratories: Wood Process, Biotechnology, and Economics and Competitiveness.

Strategic Program Directions: The organization engages in research and development, provision of various services, and education and training activities. AFOCEL's research program is strategically focused around four macro-objectives, namely (a) wood supply (trade, energy wood, mechanization of logging, logistics and transportation), (b) processes and products (paper quality, fiber processes), (c) forest (forest plantations, forest management, breeding and biotechnology, field-testing networks), and (d) territories (stakeholder needs in a local, national or international geographic setting). These macro objectives are expressed as cross-disciplinary fields of activity in which AFOEL carries out applied research, namely:

Biotechnology	Wood processing
Silviculture	Economics
Tree improvement	Forest resource studies
Forest harvesting	Sustainable forest management
Procurement and transport	

Client Groups: Private, owner emphasis.

Services Provided: Information (library, publications), research (direct delivery of products), software development, and consultation (advice).

Budget and Funding Sources:

A. Income (2003) (Euros)

6.5 million – Total (US$ 7.8 million)

B. Source of Funds[#] (2003) (Euros):

Government (federal) – 44 percent (2.9 million)
Ministry of Agriculture, Food, Fisheries,
and Rural Affairs – 20 percent (1.6 million)
Ministry of the Economy, Finance
and Industry – 24 percent (1.3 million)
Pulp and Paper Industry – 26 percent (1.7 million)
Other Contracts (public and private) – 30 percent (1.9 million)

[#]AFOCEL has a strong public dimension that is explained by the responsibilities state and regional authorities have assumed in the "forest-wood-paper" sector. The result is a mixed and balanced funding from both public and private sources.

C. Expenditures (2003) (Euros)

Salary expenses – 64 percent (4.2 million)
Operating Expenses – 28 percent (1.8 million)
Depreciation – 8 percent (0.5 million)

D. Focus of Expenditures (2003) (Euros):

Wood supply – 28 percent (1.8 million)
Process and products – 14 percent (0.9 million)
Forest – 50 percent (3.3 million)
Territories – 8 percent (0.5 million)

Scientists and Supporting Staff: Staff of 96 permanent employees (2003), 46 percent of which were researchers. Allocation of staff among program areas in not available.

Measures of Performance: Clients served and listing of publications. Strong statements of seeking to be a "value creation" organization with an interest in strengthening of a "result oriented organizational culture."

▪ ***French Pulp and Paper Research and Technical Center (CTP)****

Date Established: Not available.

Public-Private Sector: Private independent organization

Mission: Provide the pulp, paper and board industries technical and scientific support that will increase their productivity and competitiveness, in due respect of the environment and of European and French laws and regulations. To accomplish this mission, CTP has established the following objectives: bring scientific and technical support to the papermaking industry, maintain a strong potential for specific research at the laboratory level, develop high-performance semi-industrial pilot plants, have experts on-call at production sites, provide technical monitoring for machine builders and suppliers, and promote cooperation within broader business and social environments.

Primary Research Focus: Forest products, especially pulp, paper and board.

Governance and Organization: Board of directors and chief executive officer. Organized into four divisions, namely fiber resources, product quality, environment, and control processes. In addition, administrative services for the organization are assigned to two units, namely functional services (documentation, communication, human services, data processing, and engineering and security services) and research and development services (quality management, contacts management). Specializing in the marketing of software and instruments, TechPap is a subsidiary of the French Pulp and Paper Research and Technical Center. The Center is headquartered in the Grenoble University Campus, Saint-Martin d'Heres, France.

Strategic Program Directions: The organization focuses on research and development, provision of various services, and education and training activities. The research program is focused on four major areas (consistent with the organization's divisional structure) as follows:

- •Fiber Resources – Chemical and mechanical pulping, naturally diverse virgin fibers, frationation and refining, paper and board recycling, de-inking, and pollutants and contaminates.
- •Product Quality – Coating and calendaring, technologies of impression, and paper and board properties.
- •Environment – Waste and emission control, environmental health and hygiene, chemical analysis, and energy management.
- •Process Control – Sensor and simulation technology, software development, and analyses and data processing. Once developed, instruments are passed ln to TechPap.

Client Groups: Public and private. Serves clients worldwide.

Services Provided: Information (library, software), research (direct delivery of products, joint research activities), consultation (advice), testing, and training and education. The testing and analysis services of CTP are provided by four major laboratories, namely Physical Testing Laboratory, Chemical Analyses Laboratory, Microbiological Laboratory, and Paper Fiber Characterization Laboratory (the Physical Testing Laboratory is accredited by the French Committee of Laboratory Accreditation). CTP also offers extensive training courses and seminars focusing on the science and technology of papermaking.

Budget and Funding Sources:

A. Income (2004) (Euros):

11.3 million – Total (US$ 13.6 million)

B. Source of income (2004) (Euros):

Collective research – 69 percent (7.8 million)
French Ministry of Industry – 42 percent (3.3 million)
Associated contracts – 27 percent (2.1 million)
Private contracts – 21 percent (1.6 million)

Diagnosis and consulting – 10 percent (0.8 million)
Other income sources – 31 percent (3.5 million)

C. Expenditures (2004) (Euros):

11.3 million – Total (including 1.3 million for equipment and renovation)

D. Focus of expenditures (estimated) (2004) (Euros):

Research programs – 69 percent (7.8 million)
Fiber resources – 44 percent (3.4 million)
Product quality – 20 percent (1.6 million)
Environment – 17 percent (1.3 million)
Other[#] – 19 percent (1.5 million)
Other programs – 31 percent (3.5 million)

[#] Basic research (3 percent), technology watch (3 percent), standards (2 percent), and quality insurance (2 percent)

Scientists and Supporting Staff: In 2004, CTP employed 155 persons distributed as follows: 49 research scientists (including eight doctoral students and doctoral trainees) (32 percent), 62 research technicians (40 percent), and 44 managers and administrators (28 percent). In 2001, the research staffs (engineers and technicians) were distributed across the organization's divisions approximately as follows: fiber resources – 35 percent, product quality – 20 percent, environment – 21 percent , and process control – 24 percent.

Measures of Performance: Extensive listing of publications, customers served, analyses undertaken, pilot processes developed, private contracts initiated, and educational activities conducted. Also, reports about the organization's receipts and expenditures.

Germany

▪***Federal Research Center for Forestry and Forest Products (BFH)***

Date Established: Not available.

Public-Private Sector: Public government organization

Mission: Assist the federal government by providing a scientific basis for political decisions involving forests, and provide scientifically reliable information of benefit to the forestry and forest products industry as well as to society as a whole.

Primary Research Focus: Forest products and forestry.

Governance and Organization: Organizationally resides within the portfolio of the Ministry of Consumer Protection, Food and Agriculture (BMVEL). The center is administered by a head who is advised by a board of directors and a research advisory panel. The center is organized into seven institutes plus two administrative units (information and documentation, and administrative services). The seven research institutes are the institutes for world forestry, forest genetics and forest tree breeding, economics, wood biology and wood protection, wood chemistry and chemical technology of wood, wood physics and mechanical technology of wood, and forest ecology and forest assessment. The center is located in Hamburg, Germany and cooperates with teaching and research programs at the University of Hamburg.

Strategic Program Directions: The center's research programs are organized in accord with the center's institutes as follows: world forestry (forest ecosystems, forest development, forest management), genetics and tree breeding (provenance research, ecological genetics, resistance research, genomics), economics (policy,

marketing, business economics), wood biology and wood protection (wood formation, structure and quality, biodeterioration, protection), chemistry and chemical technology (cellulose, lignin, adhesives, pulp, paper and fiber boards), and forest ecology and forest assessment (ecological fundamentals, forest inventories, wildlife ecology). The center and the University of Hamburg have established a joint research and teaching program for the period 2002-2005.

Client Groups: Public and private, government emphasis (especially federal government).

Services Provided: Information (library resources, on-line data bases), research (direct delivery of products), consultation (advice), and education and training.

Budget and Funding Sources: Not available.

Scientists and Supporting Staff: Not available, although the number is estimated to be more than 120 persons (research and support staff). The number of researchers assigned to each institute is estimated to be as follows:

- •World forestry – one researcher
- •Forest genetics and forest tree breeding – 16 researchers
- •Economics – 16 researchers
- •Wood biology and wood protection – 26 researchers
- •Wood chemistry and chemical technology of wood – 18 researchers
- •Wood physics and mechanical technology of wood – 17 researchers
- •Forest ecology and forest assessment – 17 researchers

Measures of Performance: Research highlights, sponsored conferences, and listing of publications.

▪ ***Institute of Wood Technology (IWT)****

Date Established: Established in 1952 as a government research organization. Privatized in 1992.

Public-Private Sector: Private independent organization. Owned by Trägerverein Institut für Holztechnologie Dresden e. V. (a share holding organization)which is composed of more than 72 companies, associations and institutions.

Mission: Undertake application-related research on the use of wood and its processing. Focus is on small and medium-sized enterprises in the wood and furniture industries and related branches.

Primary Research Focus: Forest products.

Governance and Organization: Via the parent organization (Trägerverein Institut für Holztechnologie Dresden e. V.), the institute is governed by a four-person board of directors and is administered by an institute managing director plus a financial manager and a manager of marketing and sales. Organized into nine program areas, including the Development and Test Laboratory for Wood Technology (subsidiary) which provides testing services involving materials and products (for example, adhesives, flooring material, windows and doors), chemicals (for example, glues, wood protection materials), and biological conditions (for example, wood durability, preservatives). The Development and Test Laboratory for Wood Technology works as a notified body for testing and technical approvals worldwide. Organization's headquarters is located in Dresden, Germany.

Strategic Program Directions: The institute's research programs focuses on nine major areas, namely:

- •Wood anatomy, preservation, modification (for example, wood structures, wood drying)

•Wood-based materials (for example, fiber board, laminated board, particleboard, orientated strand board, plywood, and solid wood panels)
•Binder and additives for wood-based materials.
•Processing technology (for example, cutting, smoothing, joining)
•Surface coating and material (for example, varnishes, veneers)
•Chemical analytics (for example, volatile emissions)
•Furniture (for example, design, construction, recycling)
•Construction products (for example, shape, stability, fire resistance)
•Biotechnology testing (for example, mechanical testing of products)

Client Groups: Public and private, owner-member emphasis.

Services Provided: Information (library, software), research (direct delivery of products), consultation (advice), data bases, and testing and certification of products. The institute publishes the professional periodical "Holztechnologie."

Budget and Funding Sources: Total 2004 expenditures was 5 million Euro (US$ 6.0 million), of which 60 percent was from public sources and 40 percent from industry for research and services provided.

Scientists and Supporting Staff: Estimated 75 to 80 total staffs (administrative and technical).

Measures of Performance: Not available.

Indonesia

▪ ***Forest Products and Forestry Socio-Economic Research and Development Center***

Date Established: 1983.

Public-Private Sector: Public government organization.

Mission: Coordinate and to conduct research and development on forest products utilization and socio-economics of forestry. In pursuit of this mission, the center is to
conduct and coordinate research, evaluate research programs and projects, and distribute information that results from research activities.

Primary Research Focus: Forest products, with modest emphasis on economics.

Governance and Organization: The center is organizationally one of two centers (other center being the Forest and Nature Conservation Research and Development Center) within the federal Agency for Forestry Research and Development (FORDA) within the federal Ministry of Forestry and Estate Crops. The center is headed by a director to which report two divisions, namely:

•Operational System of Research Division, which in turn is divided in four sub-divisions, namely research planning, reporting, administration and service.

•Research and Development Division, which in turn is divided into four sub-divisions, namely development of research results, publications and library management, monitoring and evaluation, 12 researcher groups.

The center is located in Bogar, Indonesia. The Agency Forest Research and Development operates 10 regional research institutes.

Strategic Program Directions: The research program focuses on the following areas: wood anatomy, wood biodeteration, wood preservation, wood physical and mechanical properties, wood drying, sawmilling and wood working, wood based panels, fiber technologies, wood chemistry and energy, non-wood forest products, forest engineering and harvesting, and economics and forest administration.

Client Groups: Public and private.

Services Provided: Information (library), research (direct delivery of products), testing, consultation (advice), and training.

Budget and Funding Sources: Not available.

Scientists and Supporting Staff: As of 1999, the center had an estimated staff of more than 160 persons (includes administrators, researchers and support staff). The research staff totaled 143 (74 researchers [12 PhD's], 69 technicians) and was divided among disciplines as follows:

- •wood anatomy – 8 staffs (three researchers and five technicians)
- •wood biodeteration – 12 staffs (seven researchers and five technicians)
- •wood preservation – 12 staffs (six researchers and six technicians)
- •wood physical and mechanical properties – 7 staffs (two researchers and five technicians)
- •wood drying – 8 staffs (three researchers and five technicians)
- •sawmilling and wood working – 14 staffs (five researchers and nine technicians)
- •wood based panels – 13 staffs (seven researchers and six technicians)
- •fiber technologies – 12 staffs (four researchers and eight technicians)
- •wood chemistry and energy – 10 staffs (six researchers and four •technicians)
- •non-wood forest products – 7 staffs (four researchers and three technicians)
- •forest engineering and harvesting – 21 staffs (14 researchers and seven technicians)
- •economics and forest administration – 19 staffs (13 researchers and six technicians)

The center also has a library staff of four.

Measures of Performance: Research results are documented according to each of the center's five year plans.

Ireland

▪ ***National Council for Forest Research and Development (COFORD)****

Date Established: Established in 1993 as an initiative of the Irish government and funded under the European Commission's STRIDE programme..

Public-Private Sector: A government organization funded by the Irish Government through the National Development Plan 2000-2006.

Mission: Conduct research that will promote the competitiveness of the forest products industry and allow it to become a major economic resource for future generations. Emphasis is also on research that will lead to environmental safeguards and practices to ensure continued and sustainable development of forest resources. COFORD pursues its mission primarily by competitive granting money in support of various research (categorized as applied, strategic, or desk studies) and technology transfer activities. The organization also plays a major role in the coordination of research and technology transfer activities generally.

Primary Research Focus: Forestry and forest products.

Governance and Organization: Organizationally situated within the federal Department of Agriculture and Food. A council (14 persons) is responsible for developing and prioritizing research policy and funding areas,

while organizational management is the responsibility of COFORD's director. Supported by an operations manager, the director oversees an administrative unit, technical support unit, and a research program (tree improvement and nonwood products, wood products and processing, and forest environment). The organization is headquartered in Dublin, Ireland.

Strategic Program Directions: Research is directed at six major problem areas, namely: reproductive material and forest nurseries (for example, birch tree improvement), silviculture and forest management (for example, birch stand improvement), harvesting and transport (for example, harvesting systems for small scale forestry), wood products and process development (for example, heat treatment of fast-grown softwood, treating of roadway posts), socioeconomic aspects of forestry (for example, development of marketing cooperatives), and environmental aspects of forestry (for example, carbon sequestration). Research in these areas is promoted primarily by competitive grant making oriented around strategically important information needs within the aforementioned areas.

Client Groups: Public and private.

Services Provided: Information (publications, software), research (direct delivery of products), advice to government, and training (seminars, conferences, workshops)

Budget and Funding Sources:

A. Income (2003) (Euros):

1.75 million – Total (US$ 2.1 million)

B. Source of Income (2003) (Euros):

Irish Government under the Operational Program for the Productive Sector of the National Development Plan of 2000-2006 – 100 percent (1.75 million).

C. Expenditures (2003) (Euros):

Research – 68 percent (1.19 million)
Technology transfer – 10 percent (0.18 million)
Salaries – 22 percent (0.38 million)

D. Focus of Expenditures (2003) (Euros) (estimated)

Environmental aspects of forestry – 38 percent (0.66 million)
Silviculture and forest management – 35 percent (0.61 million)
Reproductive material and forest nurseries – 10 percent (0.18 million)
Socioeconomic aspects of forestry – 8 percent (0.14 million)
Wood products and process development – 5 percent (0.09 million)
Harvesting and transport – 4 percent (0.07 million)

Scientists and Supporting Staff: In addition to administrative staff (estimated at five persons), research and related activities of COFORD involved employment of 143 persons equating to more than 70 full-time equivalents.

Measures of Performance: Research highlights, sponsored conferences, and listing of publications. COFORD also reports to the Monitoring Committee of the Operational Programme for the Productive Sector against a set of financial, impact, social and other performance measures.

Japan

■ ***Forestry and Forest Products Research Institute of Japan (FFPRI)****

Date Established: Initially inaugurated in 1905. After various name and organizational changes, the institute was designated an incorporated administrative agency in 2001 (part of nationwide administrative reform).

Public-Private Sector: Government research organization

Mission: Through research on forest, forestry and forest products, contribute to development of science and technology that will promote sustainable forest management and resource utilization.

Primary Research Focus: Forestry and forest products

Governance and Organization: The unit is within the federal Ministry of Agriculture, Forestry and Fisheries. Supported by vice-presidents for research planning, forest research, and forest products research, an institute president is responsible for organization's administration. The institute is organized into divisions (research planning and coordination division [responsible for planning, coordination and evaluation of research], and general affairs division [responsible for accounting, human resource management], and 23 research departments, namely:

Plant Ecology
Forest Vegetation
Forest Site Environment
Soil and Water Conservation
Meteorological Environment
Forest Microbiology
Forest Entomology
Wildlife Biology
Forest Genetics
Molecular and Cell Biology
Forest Chemistry
Applied Microbiology
Forest Operations & Techniques
Forest Machinery
Chemical Utilization
Wood-based Materials
Wood Properties
Wood Improvement
Wood Processing
Wood Engineering
Forest Management
Forest Policy and Economics
Global Forest Research

Eight principal research coordinators are responsible for coordinating the organization's research activities. Institute facilities include a headquarters location (Tsukuba, Lbaraki Prefecture, Japan) and six regional research centers.

Strategic Program Directions: Research is focused on 11 core areas of research, namely: conservation of biodiversity in forests; conservation of land, water resources, and living environments; techniques to avoid and control biological agent damages and meteorological disasters; remote sensing, inventory, and modeling; conservation and rehabilitation of forests in changing global environments; construction of efficient timber production and harvesting systems; public concern involving development of rural communities; recycling and eco-friendly technologies for the utilization of wood resources; processing and utilization technologies for wood materials intended to enhance safety and comfort; mapping biological functions for developing new materials (genome analysis); and analysis required for the formulation of forest sector policies.

Client Groups: Public and private.

Services Provided: Information (wood properties, inventory data bases), research (direct delivery of products), consultation (wood identification), and training

Budget and Funding Sources:

A. Income (budget) (2003) (Japanese yen)

10.4 billion – Total (US$ 90.0 million)

B. Source of Income (2003) (Japanese yen):

Government – 86 percent (8.9 billion)
Other Sources – 14 percent (1.5 billion)

Scientists and Supporting Staff: In 2005, 453 scientists and 208 supporting staff. Academic attainment of scientist staff estimated to be distributed as follows: PhD – 48 percent, Master of Science – 26 percent, Bachelor of Science – 24 percent, and other degrees – two percent.

Measures of Performance: Research highlights and listing of publications.

■ ***Hokkaido Forest Products Research Institute (HFPRI)***

Date Established: Established in 1950.

Public-Private Sector: Government research organization

Mission: Through research, promote the effective utilization of forest resources and support the information demands of the wood-based industry.

Primary Research Focus: Forest products

Governance and Organization: Director general and a deputy director general are responsible for the organization's operations. The institute is headquartered in Asahikawa, Hokkaido Prefecture, Japan. Responsibilities and activities of the Institute are divided among six divisions (some of which are further divided into sections), each of which is headed by a senior researcher. The divisions are:

•General Affairs (operations, accounting, personnel)
•Planning and Coordination (design, extension, information)
•Timber Engineering (sections on timber construction, fire protection, wood preservation, gluing and finishing, wood product development)
•Wood Utilization(sections on wood anatomy and physics, physical utilization, wood chemical components, wood recycling, chemical treatment and processing)
•Wood Processing(sections on sawmilling and drying, wood processing, plywood, board, wood working machines)
•Mushroom (sections on breeding, cultivation)

Strategic Program Directions: Research is focused on four major areas, namely:

•Timber engineering – Development of synthetic technology for housing and related materials, development of stable and comfortable wooden structures, development of decay resistant wooden materials, development of technologies for fire improving resistance, and development of gluing and surface treatment technology for wood.

•Wood utilization – Development of high-level technology using charcoal products and biomass resources, development of technology for outdoor application wood chemical treatments, development of technology for recycling resources from waste wood.

•Wood processing – Improvement of technology involving generic production processes, development of new technologies for sawmills, drying, wood processing, plywood, and boards, and development and promotion of more efficient wood manufacturing techniques on an industrial scale.

•Mushroom culture – Culture of edible mushrooms and the development of efficient cultivation technologies.

Client Groups: Public and private.

Services Provided: Information and research.

Budget and Funding Sources: Not available.

Scientists and Supporting Staff: Staff total in 1999 was 91 distributed as follows: 16 PhD, 19 Masters, 53 Bachelors, three other degrees.

Measures of Performance: Not available.

Latvia

▪ ***Latvian State Forestry Research Institute (SILAVA)****

Date Established: Established in 1946, with earlier history to 1928.

Public-Private Sector: Public government organization operated as an independent nonprofit organization under supervision of the Ministry of Education and Science.

Mission: Research on forest ecosystems and their components, especially the development of recommendations for sustainable forest management and rationales for effective utilization of forest resources and forest products.

Primary Research Focus: Forestry, with some forest products emphasis

Governance and Organization: The institute is independent, although responsible in a limited way to the Ministry of Education and Science. An institute director, guided by a council of scientists, is responsible for overall institute administration, including research carried out in nine project groups (forest ecology and silviculture, forest tree breeding and genetics, forest regeneration and establishment, forest protection, forest operations, game management, forest products processing, woodworking, forest economics). The institute has eight operating stations and laboratories, including a woodworking laboratory and a laboratory of forest products processing. The institute is located in Salaspils, Latvia.

Strategic Program Directions: The institute carries out research in nine subject areas, namely: ecology and silviculture, tree breeding and genetics, regeneration and stand establishment, forest protection, forest operations and machinery (for example, logging technologies and machinery evaluation), game management, forest biomass processing (for example, bark chemical composition), hydrothermal and chemical processing of wood, (for example, low toxicity antipyrene compounds), forest economics and forest policy (for example, calculation of optimal harvesting ages), and forest resources monitoring.

Client Groups: Public and private.

Services Provided: Primarily research (direct delivery of information)

Budget and Funding Sources: Total budget not available. The institute does not receive annual and automatically allocated funding from government. Institute funds result from competitive government-

sponsored grants (71 percent), government ordered projects (23 percent), and other miscellaneous sources (six percent).

Scientists and Supporting Staff: Total staff of about 100, of which about 80 are researchers or research assistants. The research staffs (and assistants) are distributed among the following research subject areas: forestry -- 62 staffs, game management -- 10 staff, and forest products and harvesting -- eight staffs.

Measures of Performance: Listing of publications.

Malaysia

▪ ***Forest Research Institute Malaysia (FRIM)***

Date Established: Established in 1929. In 1985, the Institute became a statutorily authorized body governed by the Malaysia Forestry Research and Development Board under the Ministry of Primary Industries. Since 2004, the Institute has been statutory body governed by the Ministry of Natural Resources and Environment.

Public-Private Sector: Authorized by the federal government under authorities specified in national statutes.

Mission: Promote the sustainable management and optimal use of forest resources by generating, through research, knowledge and technology and their application. Within the mission, objectives are to provide research-based services to meet the needs of clients, to commercialize research and development results, to acquire and disseminate information, to create awareness of environmental and conservation roles of forestry, and to generate knowledge and technologies for the conservation, management, development and forest resources. Committed to excellence in scientific research.

Primary Research Focus: forestry and forest products

Governance and Organization: Director general responsible to the Malaysian Forestry Research and Development Board (16 members, including a chair) (in turn to the Ministry of Natural Resources and Environment). Director general supported by deputy director for research and development and a deputy director for operations. Organized into three research divisions, namely forestry and conservation division (data and standards for managing forests), product development division (development of forest-based industries), and biotechnology division (improved plant material through tree improvement and molecular techniques). In addition, there is a division focused on research management (planning, publications, consulting)Six field research centers are located throughout Malaysia, including a national research center and headquarters (Kuala Lumpur, Malaysia).

Strategic Program Directions: The institute overall direction guided by seven strategies (specified in extensive detail, including time lines for their implementation), namely financial self-finance of programs, expanded research and development (including wood processing and utilization technologies, development and utilization of bio-composite technologies), commercialization of research and development products (including, procedures for commercialization, collaborations with other institutions), development of centers of excellence (including, a timber technology center, wood composite center, forest biotechnology center), enhancement of research and development infrastructures (including forest research information system), development of human resources (including research skill enhancement, technology transfer processes), and growth in support for eco-tourism.

Client Groups: Public and private, owner-member emphasis.

*Services Provided***:** Information (library services), research, testing, consultation, education and training. A more detailed listing of services offered by divisions is as follows:

Forestry Division: *Research and development* (for example [34 examples provided], ecological assessment of recreation impacts, cost effective and ecologically sound harvesting systems, regeneration patterns of commercial tree species), *consultancy* (for example [27 examples] revision of public forest revenue systems, environmental impact assessment, production of charcoal using special combuster), *testing* (for example [six examples] forest mapping with satellite imagery, aerial photo interpretation), and *training* (for example [13 examples] geographic information systems concepts, timber tree identification, road engineering)

Product Development Division: *Research and development* (for example [27 examples provided] resistance of timber to marine borers and fungi, development of oriented strand board from plantation thinnings, quality development of high-valued bamboo material), *testing* (for example [18 major category examples] wood anatomy density assessment, quality control of wood preservative applications, mechanical properties of structural lumber), and *training* (for example [20 examples] kiln operation, wood preservation techniques, pulp and paper technology)

Biotechnology Division: *Research and development* (for example [22 examples provided] genetic transformation of herbicide resistance, chemical and biological properties of certain timber species, performance of selected tree progenies), *testing* (for example [10 examples] seed germination levels, nuclear magnetic resonance, identification of disease infected seedling samples), and *training* (for example [10] tree improvement practices, molecular marker techniques for conservation, development of herbal medicines).

Budget and Funding Sources:

A. Income (2004) (Malaysian ringgit):

28.2 million – Total (US$ 7.5 million)

B. Source of Income (2004) (Malaysian ringgit)

Government (operating) – 56 percent (15.7 million)
Development – 15 percent (4.3 million)
Research – 13 percent (3.7 million)
External agencies – 7 percent (2.0 million)
Investment income – 3 percent (0.9 million)
Other sources– 6 percent (1.6 million)

Total expenditures and program focus of expenditures are not available.

The Institute is strategically focused on being 70 percent self-financed by year 2008. Such to be accomplished by increases in revenue from technical services, sales of products, rental property, royalties and licences, and return on investment of short term funds. Fees for services are clearly specified for more than 85 service areas and more than 500 specific services within these areas. For example, evaluation of adhesive quality – 330 (MYR) per test, fire resistance tests for door or wall (30 minutes) – 3,300 (MYR), prototype testing of timber structures – 880 (MYR) per structure, wood preservation consultation – 550 (MYR)per person per week, and tree improvement planning – 330 (MYR) per person per week.

Scientists and Supporting Staff: Estimated 160 researchers and experts distributed as follows:

Forestry Division: estimated 60 researchers in 24 different fields, including silviculture of natural forests, forest hydrology, and natural resources planning and policy analysis.

Product Development Division: estimated 35 researchers in 14 different fields, including wood identification and timber engineering, pulp and paper and wood composite technologies, and furniture technology and primary wood processing.

Biotechnology Division: estimated 65 researchers in 22 different fields, including tree breeding and improvement, chemistry of natural products, and tissue culture and toxicology.

Measures of Performance: General description of research results and number of publications. Also, general statements regarding progress in achieving institute-wide strategies.

Netherlands

▪ ***SHR Timber Research****

Date Established: 1991.

Public-Private Sector: Private independent nonprofit organization.

Mission: Carry out research and testing as requested by industry, branch associations, government, and private individuals.

Primary Research Focus: Forest products

Governance and Organization: Governance by a board of directors and administered by a director and a vice director. Organized into four major sections, namely coatings, furniture, wood technology, and timber products for building industry. Organization's headquarters located in Wageningen, The Netherlands.

Strategic Program Directions: Organization focuses on four major areas, namely:

- Product research (for example, adhesives, sheet materials, windows and doors)
- Wood technology (for example, wood preservation, wood modification, wood anatomy)
- Coating (for example, radiation coatings, paint testing and application)
- Damage Assessment and Arbitrage

Client Groups: Public and private. The organization specifically identifies its main target groups as: the joinery industry (windows and doors), board material industry, pallet and packaging industry, manufacturers of laminated beams, wooden frame constructions and roof elements, wood preservation industry, wood preserving agents industry, suppliers of materials (for example, wood adhesives and sealing profiles), furniture industry, paint industry, wood trade, governments, branch associations, builders, contractors, and building supervisors.

Services Provided: Research (direct delivery of products, joint research activities), testing, and consultation (process and quality control).

Budget and Funding Sources:

A. Income (2004) (Euros)

2.4 million (US$ 2.9 million)

B. Source of Income:

Contract for services sought by industry and government – 100 percent

Scientists and Supporting Staff: In 2005, total staff of 35 persons (administrative, technical, administrative support). Although staff may have expertise in more than one section, staff (managers and project assistants)is distributed as follows:

•Timber Products for Building Construction – 50 percent (18 staff)
•Wood Technology – 34 percent (11 staff)
•Coatings – 10 percent (four staff)
•Furniture – 6 percent (two staff)

Measures of Performance: Not available.

New Zealand

▪ ***SCION***

Date Established: Established in 1947 as part of New Zealand Forest Service. In 1992, authorized as a Crown Research Institute by the Crown Research Institutes Act of 1992 (other institutes include AgResearch, Industrial Research Ltd., Institute for Crop and Food Research Ltd., Institute of Water and Atmospheric Research Ltd., Institute of Geological and Nuclear Research Ltd. Institute of Environmental Science and Research Ltd.). Part of a three segment New Zealand Science and technology System, namely Ministry of Research, Science and Technology (MoRST) (provides science policy advice), Foundation for Research, Science and Technology (FRST) (responsible for funding science outputs), and Crown Research Institutes (CRIs) (perform actual scientific research). Prior to 2005, known as Forest Research Ltd. (FRL).

Public-Private Sector: Private independent organization authorized by national statute. Operates via various joint ventures, notably ENSIS.

Mission: Through applying the creative intelligence of researchers, advance the widespread utilization of renewable materials and products from plants for economic, environmental and social returns. Create plant-based biomaterials and new manufacturing processes as a basis for sustaining the consumer markets of future generations.

Primary Research Focus: Forestry (commercial forestry) and forest products (biomaterials, consumer products).

Governance and Organization: Board of directors (seven members), chief executive officer, and an executive management team (seven persons, including chief executive officer). SCION is organizationally grouped into the following units (each lead by a unit leader),of which seven persons are also member of ENSIS's lead team: ENSIS PAPRO unit, Built Environment unit, ENSIS Forests unit, Biomaterials Engineering unit, ENSIS Wood Processing Unit, ENSIS Environment unit, ENSIS Biosecurity and Protection unit, ENSIS Wood Quality unit, Cellwall Biotechnology unit, Eco-Smart Technologies unit, and ENSIS Genetic unit. SCION considers the following to be commercial business units: COHFE, VIGIL, VERITEC Laboratories, and ATLAS Technology. SCION is headquartered in Rotorua, New Zealand.

SCION has established or become affiliated with the following subsidiaries, joint ventures, or business units which operate in concert with, but with significant autonomy, from the parent organization:

•*VIGIL* (Vigil Forest Health Advisory Services, Ltd.)– Wholly owned subsidiary engaged in forest health monitoring, forest pest detection, and eradication of forest pests. Staff of nine persons.

•*ATLAS TECHNOLOGY* – Software development subsidiary engaged in the development of software tools spanning the entire forestry value chain (for example, forest land management, resource assessment, harvest planning).

• *COHFE* (Center for Human Factors Ergonomics) – Business subsidiary of engaged in research and services that promote workplace safety, health, and performances. Staff of four persons.

•*VERITEC* - Analytical chemistry laboratory specializing in forestry and biomaterial related activities. Provides a variety of component level tests focused on soil, foliage, waste water, wood and wood preservation. Staff numbers unknown.

• *ENSIS* – Unincorporated joint venture of SCION and Commonwealth Scientific and Industrial Research Organization – Forestry and Forest Products (CSRIO-FFP). Engaged in research and service in the following strategic business areas: genetics, forests, environment, wood and fiber quality, forest biosecurity and protection, wood processing and products, and pulp, paper and packaging. ENSIS employees approximately 300 persons at eight sites in Australia and New Zealand.

SCION is also affiliated with PAPRO (through ENSIS) which is a business unit engaged in supplying pulp, paper and packaging technology. The PAPRO's mission is to develop value-adding solutions for the pulp, paper and packaging industries through innovative science, applied research and specialized professional services. It's strategic aims are to: (a) perform long term research in key science areas for the fiber-based industries, (b) seek innovation in wood fiber, paper and packaging products from New Zealand resources, and (c) maintain internationally recognized science capability in fiber-based technology and product development. PAPRO is organized into three key business areas: mechanical fiber processing, chemical and enzymatic technologies, and paper and paperboard. Staff numbers unknown.

In addition to the above subsidiary entities, SCION in 2004 reported involvement with the following subsidiaries (FHS Limited, Liro Limited, N-Fix Technologies Limited, Forest Research [Australia] Pty Limited, Forest Research [Australia] #2 Pty Limited, Atlas Technology Limited, FR Properties Limited, Forest Research Trans-Tasman Limited) and associate arrangements in three other organizations (Center for Advanced Composite materials Limited [CACM], Frontline Biosecurity, and Beacon Pathway Limited).

SCION also is responsible for administering four national organizations or facilities, namely: National Forestry Herbarium, National Forestry Library, National Quarantine Center, and the National Wood Collection unit.

Strategic Program Directions: Research focus is on three major areas, namely:

•Commercial Forestry Research and Development – Activities are carried out via the ENSIS subsidiary (including PAPRO) with a focus on genetics, forests, environment, wood and fiber quality, forest biosecurity and protection, wood processing and products, and pulp, paper and packaging. Various cooperatives also engage in research (for example, Douglas-fir Cooperative, Forest Site Management Cooperative, Wood Drying Multi-Client Group).

•Biomaterials Research – Activities carried out in biomaterials engineering (for example, composite materials), eco-smart technologies (for example, molecular bioprocesses, intra-cell research), and cell wall biotechnology (for example, gene discovery and screening).

•Sustainable Consumer Products – Activities carried out in the built environment (for example, product development, life cycle assessment), and bioenergy (for example, wood pellet manufacturing, energy systems analysis).

Client Groups: Public and private (half of top ten clients in 2003 were non-forestry companies).

Services Provided: Research services (direct delivery of products), physical products (fertilizer dispensers, testing devices), material testing (pulp and paper), consultations (advice and guidance), education and training (workshops, seminars), information (image library [timber frame construction, wood processing hi-tech control systems], publications [trade and marketing, resource facts and figures], video [cable logging], and software [kiln drying, pre-harvest assessment]).

Budget and Funding Sources:

A. Revenue: Not available.

B. Source of Revenue: Not available.

C. Focus of Expenditures: Not available.

In 2003, NZ Forest Research Ltd. (renamed SCION in 2005) total revenue was $39.6 million (NZD), the source of which was government – 58 percent, commercial – 42 percent, and interest income – less than 1 percent.

Scientists and Supporting Staff: Staff of approximately 380 (researchers and supporting staff), including five principle scientists, 11 unit leaders, and four key contacts (human resources, sales, legal, and information management). Number of researchers and supporting staff assigned to various SCION units is not available.

Measures of Performance: Financial (revenue, equity ratio, return on equity and total assets), staff co position (research staff), science output (reviews, papers, books, confidential reports), technology (patents, licenses), scientific application (seminars, workshops, field days), human resources (full-time-equivalents, staff turnover, staff professional development), social benefits (time in training, avoidance of accidents), and contribution to Maori culture (consultation, scholarships, proposals incorporating Maori). Yearly performance targets are established and compared with actual accomplishments.

▪ ***Wood Technologies Research Sector, Industrial Research Limited (IRL)****

Date Established: Established in 1992. Authorized as a New Zealand Crown Research Institute by the Crown Research Institutes Act of 1992 ((other institutes include AgResearch, Industrial Research Ltd., Institute for Crop and Food Research Ltd., Institute of Water and Atmospheric Research Ltd., Institute of Geological and Nuclear Research Ltd. Institute of Environmental Science and Research Ltd.). Part of a three segment New Zealand Science and technology System, namely Ministry of Research, Science and Technology (MoRST) (provides science policy advice), Foundation for Research, Science and Technology (FRST) (responsible for funding science outputs), and Crown Research Institutes (CRIs) (perform actual scientific research).

Public-Private Sector: Private independent organization authorized by national statute.

Mission: Innovation-focused businesses based on world-class science from which can be created globally competitive, market viable technologies. As a unit within Industrial Research Limited (IRL), Wood Technologies Research focuses on inventing new technologies and adapting existing technologies so clients or partners can gain a competitive advantage.

Primary Research Focus: Eight industry sectors, including forest products (Wood Technologies Research Unit), energy, marine, health and communications. Technology areas applied to these sectors are materials and materials performance, sensing and detecting, biochemical technologies, energy technologies, and measurement and analysis.

Governance and Organization: Board of directors (six persons) and an executive management team (nine persons, including chief executive officer) of parent organization Industrial Research Limited. Wood Technologies Research Sector is one of nine research and development sectors (other sectors are health sector, food sector, marine sector, technologies sector, energy sector, assets and infrastructure sector, manufacturing and processing sector, information and communications sector). Organization wide offices in New Zealand (Auckland, Christchurch and Wellington).

Strategic Program Directions: Wood technology research applied in the wood industry sector draws from various scientific disciplines (biochemistry, physics, mathematics, mechanical engineering, chemical and

biological engineering, organic and inorganic chemistry, electrical engineering, metrology and information technology) and areas of expertise (materials performance, intelligent systems, communication, biochemical technologies, energy technologies, measurement and analysis). The disciples and expertise are then applied within the various research and development sectors.

Client Groups: Public and private.

Services Provided: Information (literature searches), research, consultation, pilot scale production (electro-mechanical devices), and training (conferences and workshops).

Budget and Funding Sources: Funding level and source for IRL's Wood Technologies Research Unit is not available (proprietary). IRL budget in total (2002) is $61,512,000 (NZD) (US$ 42.5 million), a sum originating from government (competitive bidding) – 54 percent, customers – 46 percent, and interest income – less than 1 percent.

Scientists and Supporting Staff: Number of staff assigned to IRL's Wood Technologies Research Unit is not available (proprietary). IRL has a total staff of 400 (320 researchers) which forest products staff is publically unknown (probably 10 to 15). IRL's stated expertise in wood technology includes materials properties and materials performance, acoustic responses, biochemical technologies, and measurement and analysis. Specific past research in wood technologies has included: sawblade design, measurement of wood fiber properties, kiln moisture sensors, and tree and log stiffness sensing devices.

Measures of Performance: Science (papers, monographs, books, technical reports), technology (workshops, joint ventures established, licenses granted), human resources (staff turnover, professional development, avoidance of accidents), staff composition (teams, support), financial (gross revenue, earnings performance, return on asets, return on equity, debt, capital expenditure, revenue per FTE).Yearly performance targets are established and compared with actual accomplishments.

Norway

■ ***Norwegian Forest Research Institute (SKOGFORSK)****

Date Established: Established in 1917.

Public-Private Sector: Public government organization operating autonomously, although organizationally located in the Ministry of Agriculture. In 2006, to be merged with Norwegian Institute for Land Inventory.

Mission: Strengthen the scientific basis for the management of forest resources, creation wealth and economic well-being from forests, and develop countermeasures against environmental problems involving forests.

Primary Research Focus: Forestry and forest products.

Governance and Organization: Research organization operating with special independent credentials, although administratively located in the Ministry of Agriculture. The institute is guided by a seven-member board of directors and is administered by an institute director. The institute is organized in five departments, namely the Departments of (a) Forest Ecology and Environment, (b) Forest Operations and Processing, (c) Economy and Internal Services, (d) Forest Production, (d) Marketing Contact and Research Support. Research facilities are located at As (headquarters) and Bergen Norway.

Strategic Program Directions: Research is focused on problem areas involving establishment of forests, growth conditions for existing forests, forest ecology and silviculture, and the economy and utilization of wood.

Client Groups: Public and private.

Services Provided: Information, research (direct delivery of information), consultation (advice and counsel), and education (conferences and workshops).

Budget and Funding Sources:

A. Income (2003) (Norwegian kroner)

76 million – Total (US$ 11.4 million)

B. Source of Income (2002) (Norwegian kroner) (estimated):

Commissioned Research (such as Ministry of Agriculture, Research Council of Norway) – 41 percent (31.2 million)
Basic Grants (Research Council of Norway) – 25 percent (19.0 million)
Strategic Institute Programs (NFR) – 15 percent (11.4 million)
National responsibilities, administrative support)Ministry of Agriculture) – 12 percent (9.1 millions)
Fund for Forestry Development – 5 percent (3.8 million)
Other revenues (such as teaching assignments) – 2 percent (1.5 million)

Total expenditures and program focus of expenditures are not available.

Scientists and Supporting Staff: Staff in 2003 was 107, with full-time research staff estimated to be 75 (40 PhD's, 35 Masters degrees).

Measures of Performance: Research highlights, sponsored conferences, and detailed listing of publications (such as articles, client reports, book chapters).

▪ ***Norwegian Institute of Wood Technology (NTI)****

Date Established: Established in 1949.

Public-Private Sector: Private independent organization (association).

Mission: Promote member companies' profitability by using updated knowledge about the properties, use, and processing of wood. Such is to be accomplished by research, diffusion of knowledge, counseling, and quality documentation.

Primary Research Focus: Forest products (and production processes)

Governance and Organization: Managing director responsible for administering four major institute sections, namely information resources, financing and personnel, utilization and durability, and quality and processing technology. Headquartered in Oslo, Norway, the organization has 152 company members representing general sawmilling, wood-working, glulam and timber frame industry.

Strategic Program Directions: Research and development activities focused on two major topical areas, namely utilization and durability of wood (for example, roof trusses, wood-based panels, glulam, timber bridges, wood preservation, multi-story timber buildings) and wood production technology (machine grading, flooring and paneling, wood drying, sawmilling, and wood working machinery).

Client Groups: Private, owner-member emphasis (companies and trade organizations, especially information needs of member companies).

Services Provided: Information (library access), research and development projects (direct delivery of information), individual company consultations (for example, quality control schemes), testing service (for

example, mechanical testing, glue testing, chemical analysis, microscopi, testing of preservatives), and training. In detail, the organization provides the following services: management and execution of research and development projects, establishment of quality control schemes, marking and certification of wood-based products, educational courses, standardization work, library literature searches, export-oriented assistance, laboratory materials testing, and general consultancy services. The Institute serves as the inspection agency for various quality control schemes in Norway and elsewhere (for example, strength grading, wood preservation treatments, glulam, dry kiln operations, and Europallet control system). The organization is approved for testing, inspection and certification as a basis for CE-marking of wood panels and timber construction products. It is also the only registered organization in Europe for JAS-certification (Japan) of glulam and load-bearing constructions.

Budget and Funding Sources:

A. Income (2004) (Norwegian kroner):

30.8 million – Total (US$ 4.6 million)

B. Source of Income (2003) (Norwegian kroner):

Services-project provided fees – 89 percent (27.4 million).
Member fees – 11 percent (3.4 million)

Approximately 25 percent (5.9 million Norwegian kroner) of revenue from contracts and projects comes from services performed for foreign clients.

Total expenditures and program focus of expenditures are not available.

Scientists and Supporting Staff: Total staff of 36, of which an estimated 9 are support or managerial staff. Project staff are distributed by subject area as follows: 17 staffs – utilization and durability, and 10 – production technology and quality. Staff competency is asserted in the following areas: quality control management, material and production management, timber and wood drying, biomass energy sources, timber processing and cutting tools, technology for timber grading, gluing and adhesive technology, wood preservation, structural timber and timber framing, and mechanical wood fasteners.

Measures of Performance: Number and quality of services delivered.

▪ ***Paper and Fiber Research Institute (PFI)****

Date Established: Established in 1923 as a private foundation. In 2004, the organization became a shareholding company.

Public-Private Sector: Private independent organization. The institute is a shareholding company (jointly owned by STFI-Packforsk AB [95 percent], Norske Skogindustrier ASA [1 percent], Borregaard Industries Ltd. [one], M. Peterson & Søn [1 percent], Södra Cell Tofte AS [1 percent] and the PFI foundation [1 percent]).

Mission: To enhance the competitiveness of clients, doing so by being known worldwide (world brand) in pulp and paper research. Such is to be accomplished by being a technological and scientific center of expertise, an innovator in the development of new and improved processes and products, by assisting the industry in international research cooperation and standardization work, and by utilizing the resources of cooperating partners to deliver the best technologies available.

Primary Research Focus: Forest products, especially pulp and paper technologies and novel materials based on wood fibers.

Governance and Organization: The institute is governed by a six person board of directors (three represent STFI-Packforsk, one represents the PFI foundation, one represents the four largest industry owners, and one represents PFI employees). It is administered by a director and os organized into three departments, namely pulp and novel materials, fiber and pulp, and financial and administration. PFI is located at the campus of the Norwegian University of Science and Technology (NTNU) in Trondheim, Norway. The institute cooperates worldwide with a number of organizations, including main cooperators such as STFI-Packforsk AB, NTNU, and SINTEF(Foundation for Scientific and Industrial Research), and other cooperators including various universities.

Strategic Program Directions: Institute research is focused on two major research groups and four core activities, namely fiber and pulp (mechanical pulping and fiber characterization, and adsorption and hygiene), and paper and novel materials (paper, novel materials). The institute also engages in various contractual work and supports the education of students in the fields of pulp and paper.

Client Groups: Public and private, owner-member emphasis. Nordic mills constitute a main customer group, although clients do exist throughout the world (customers on all five continents).

Services Provided: Information (library resources), research (direct delivery of products), consultation and advice (quality control assessment), and training and education (cooperation with Norwegian University of Science and Technology). Examples of contractual work include characterization of pulp and paper processes, new product evaluation, pilot trials, image analyses, and literature studies.

Budget and Funding Sources:

A. Income (2004) (Norwegian kroner):

27.1 million – Total (US$ 4.1 million)

B. Source of Income (2004) (Norwegian kroner):

Private industrial sources. 72 percent (19.4 million)
Government sources – 28 percent (7.6 million)

Total expenditures and program focus of expenditures are not available. However, the institute's research program accounts for 75 percent of its activities, with the remaining 25 percent provided by contract and consulting services.

Scientists and Supporting Staff: Total staff of 25 distributed as follows: research scientists–12 persons, engineers and technicians–nine persons, and administrative personnel–four persons. By topical areas, research scientists and research engineers are distributed 50 percent to paper and novel materials and 50 percent to fiber and pulp. The institute has the capacity to supervise 8 to 10 diploma students.

Measures of Performance: Not available.

Philippines

▪ ***Forest Products Research and Development Institute (FPRDI)****

Date Established: **:** Originally established in 1954 as the Forest Products Laboratory, a Division of the Bureau of Forestry under the Department of Agriculture and Natural Resources. However, 1957 is considered as the organization's founding year when it was reorganized into the Forest Products Research Institute (FPRI), a semi-autonomous unit located at the University of the Philippines (UP).

Public-Private Sector: Public government organization. The institute is the research and development arm for forest products utilization of the Department of Science and Technology (DOST). The latter is responsible for coordinating and managing the Philippine national science and technology system. The institute is one of seven research and technology units within the DOST system.

Mission: To generate, improve and transfer appropriate technologies and information on efficient utilization of forest-based products to make local industries more competitive in the domestic and global markets and to benefit the general public. This mission is grounded in the belief that a sustainable forest-based industry that is able to produce economically competitive and environment-friendly commodities can contribute to socio economic development and can support the disadvantaged sectors of Philippine society. The mission is accomplished by (a) conducting basic and applied research required to improve the utility and value of wood and non-wood products, (b) transferring research generated and technologies, and (c) providing services and training in various technical field. Specific objectives are:

- •Generate scientific knowledge on forest-based materials critical to the development of production technologies.
- •Ensure the global competitiveness of ecologically friendly forest-based products.
- •Enhance efficiency and effectiveness of existing forest-based industries and assist in the establishment of new enterprises.

Primary Research Focus: Forest Products (wood and nonwood)

Governance and Organization: The institute consists of the office of the director, supported by a planning staff, technical services staff, and an information and communications staff. Three divisions are responsible for research and development, namely: materials properties evaluation division (three section), mechanical processing and product development division (four sections), and chemical processing and product development division (three sections). In addition, there is a division for finance and administration (three sections). The technical services staff serves as the technology transfer arm of the institute. The institute is located at the University of the Philippines Los Banos Campus in College, Laguna, Philippines.

Strategic Program Directions: Research is conducted in five major areas, namely furniture and handicrafts (for example, product development, codes and standards), construction materials and utility structures (for example, design and development, fire resistance), material science (for example, chemical properties of wood), handmade paper (for example, alternative fiber material for paper), and chemical products and biomass energy (for example, utilization of resins and oils). The organization's medium term plan 2005-2010 gives emphasis to the forest two major areas.

Client Groups: Public and private.

Services Provided: Information (library resources, software), research (direct delivery of products), consultation (waste reduction methods, structural design), testing and calibration of materials, training (wood identification, bamboo preservation, production planning and control). Specific reference is to technology transfer in the following areas: promotion and public assistance regarding new technologies, technology assessment and piloting of new products and processes, development of manpower around new technologies, approaches to assessing economic and marketing issues.

Budget and Funding Sources: Specific amounts of funding are not available. However, funding sources are as follows: Government of the Philippines (GOP), International Organizations [International Tropical Timber Organization (ITTO); Australian Center International Agricultural Research (ACIAR); Agri-Technological Institute (ATO)], local funding agencies, Philippine Council for Industry and Energy Research and Development (PCIERD), and DOST-Grants-in-Aid (DOST-GIA).

Scientists and Supporting Staff: The Institute has a total staff of 238 (2005) distributed as follows: managerial – five staffs (2 percent), administrative – 72 staffs (30 percent), and 161 technical research staffs (68 percent).

Academic degrees of staff are: PhD – 13, master of science – 41, and bachelor of science – 113. The project allocation of staff leaders to major research areas is estimated to be:

- •Furniture and handicrafts – 28 percent (19 project leader staffs)
- •Housing materials and construction technologies – 24 percent (16 project leader staffs)
- •Material science – 22 percent (15 project leader staffs)
- •Handmade paper – 13 percent (nine project leader staffs)
- •Chemical products and biomass energy –13 percent (nine project leader staffs)

Measures of Performance: Research highlights, sponsored conferences, listing of publications, number of services provided (tests and calibrations, training sessions conducted), and scholars supported.

Poland

▪ ***Research and Development Center for Wood-Based Panels****

Date Established: 1974

Public-Private Sector: Public government organization

Mission: Provide research and development services for the wood industry.

Primary Research Focus: Forest products, especially panel and composite products.

Governance and Organization: Organizationally located within the federal Ministry of the Economy, the center is governed by a director and organized into four major units (each lead by a manager), namely:

- •Technical and Technological Laboratory
- •Research Laboratory (including laboratories for product testing and industrial harmfulness) (research laboratory is accredited by the Polish Center for Accreditation)
- •Designing and Prototypical Laboratory
- •Scientific-Technical Information Center (and foreign cooperation)

The center's headquarters is located in Czarna Woda, Poland.

Strategic Program Directions: The center's research and related initiatives are strategically grouped within its major administrative units:

- •Usefulness of lignocellulose raw products (wood waste, annual plants) to produce wood-based panels (for example, energy requirements, waste disposal, cost reduction).
- •Restriction of factors harmful to manufacturing personnel (for example, noise absorption, ventilating systems, toxic substances, and vibration).
- •Design and implementation of measurement systems (for example, strength testing apparatus, formaldehyde emissions detection).
- •Collecting and distributing information related to wood-based panels (including patent information, assessment of product market demand).

Client Groups: Public and private.

Services Provided: Information, research (direct delivery of products), testing, and consultation (advice).

Budget and Funding Sources: Not available.

Scientists and Supporting Staff: Total staff of 30, 16 with university degrees (including three PhD, 12 masters). The center's managerial staff are distributed as follows: Administration -- one staff (center director), Technical and Technological Laboratory – two staff, Research Laboratory – two staff, Center for Scientific and Technical Information – one staff, and Designing and Prototypical Laboratory – one staff. In addition, the center has 13 staff classified as workers.

Measures of Performance: Not available.

Slovak Republic

▪ ***Forest Research Institute (FRIS)***

Date Established: Established in 1948 after a reorganization. Research by predecessors of the Institute is documented as having occurred since the late 1890s.

Public-Private Sector: Public government organization.

Mission: Obtain new scientific knowledge on forest ecosystems and their management, doing so by undertaking research activities in the fields of biology, forest management, forest technology, and economics. Also, serves a coordinating function for forestry research occurring in the Slovak Republic.

Primary Research Focus: Forestry, with modest forest products emphasis

Governance and Organization: Responsible to the Ministry of Agriculture. Lead by an institute director that is advised by three boards (scientific, operational, and overall planning). Institute is organized into a research section and a special activities and services section (extension, administration, information, transportation, standards). Research programs are administered by seven departments, namely departments of forest genetics and tree breeding, silviculture, forest protection and game management, forest environment, economics and policy, management and monitoring, and forest technology and engineering. Research is conducted at four research stations and the Institute's national headquarters in Zvolen, Slovak Republic.

Strategic Program Directions: Research focuses on topics that are consistent with the Institute's departmental structure, namely: forest genetics and tree breeding, silviculture, forest protection and game management, forest environment, economics and policy, management and monitoring, and forest technology and engineering.

Client Groups: Public and private, government emphasis.

Services Provided: Information, research (direct delivery of products), consultation (advice), testing, and training and education (workshops and conferences).

Budget and Funding Sources:

A. Income (2001) (Slovak koruna):

56.2 million – Total (US$ 1.8 million)

B. Source of Income (2001) (Slovak koruna):

Contract for work (not all for research) – 14 percent (7.9 million)
Government (an assumed source) – 86 percent (48.3 million)

C. Focus of Expenditures:

Scientific and technical projects accounted for 51.3 percent of expenditures. 126 projects were supported by funds provided as contract for work.

Total expenditures and program focus of expenditures are not available.

Scientists and Supporting Staff: Institute staff of 170, of whom 78 are researchers (51 PhD's) and 92 are supporting staff (assistants, administrators, overhead staff).

Measures of Performance: Research highlights, sponsored conferences, and listing of publications.

South Africa

▪ ***Forestry and Forest Products Research Center (FFP)****

Date Established: Not available.

Public-Private Sector: Public-private combination. A joint venture between the University of KwaZulu-Natal and the Division of Water, Environment and Forestry Technology of the Council of Scientific and Industrial Research (CSIR) (CSIR established as a science council in 1988 by an act of the South Africa Parliament).

Mission: Bring academia and industrial research together with a focus on maximizing value extraction for plantation-grown timber required by the pulp and paper processing industry. Achieve mission by aligning research activities with market needs for research; improving knowledge base (forest resource and processing industries) through excellent scientific research and development; and advancing transfer of knowledge to client groups. Mission also includes establishment and promotion of a thriving postgraduate research facility that works in close collaboration with established research teams from the Center and CSIR.

Primary Research Focus: Forestry and forest products.

Governance and Organization: Center director and staffs from the University of KwaZulu-Natal and CISR's Division of Water, Environment and Forestry Technology. Governing boards and advisory committees unknown. Administratively organized in a manner consistent with center's six research programs, namely chemical wood properties, physical wood properties, pulp and paper properties, forestry and tree physiology, remote sensing, and IT and solid wood. The center also participates in two cooperatives, namely eucalypt research cooperative and fiber research processing cooperative. Center administrative offices (CSIR) located in Durban, South Africa. Also sponsors two cooperatives (Eucalypt Research Cooperative and Fiber Research Processing Cooperative).

Strategic Program Directions: Research focuses on the following major categories: site and terrain classification, site species matching, remote sensing, geographic information systems, resource evaluation, wood properties, pulp and paper analysis, and software and database development.

Client Groups: Public and private.

Services Provided: Information, research, consultation (advice), and training and education. Special consultations focus on site and terrain classification (species recommendations, fertilizer applications), site species matching (spacial limitations technology), remote sensing (tree biomass estimations), geographic information systems (spacial data integration), resource evaluation (resource characteristics, processing requirements, market demand), wood properties (wood image analysis), pulp and paper analysis (pulp analysis, strength testing), and software and database development (decision-guiding software). Center supports a thriving post graduate research faculty (more than 10 faculty members) and provides various short courses (example topics are wood quality for pulp and paper, and production planning and sawmill simulation).

Budget and Funding Sources: Not available.

Scientists and Supporting Staff: Information describing total staff and its responsibilities are not available. The 11 contact staffs listed in public documents are as follows: director and support staff (two staffs), chemical wood properties (two staffs), physical wood properties (two staffs), pulp and paper properties (two staffs), forestry and tree physiology (one staff), remote sensing (one staff), and operations research (one staff).

Measures of Performance: Limited listing of research publications.

▪ ***Institute for Commercial Forestry Research (ICFR)****

Date Established: Formally established in 1984. Evolved from the Wattle Research Institute (WRI) which was established in 1947.

Public-Private Sector: Private independent organization. Sponsored by 14 member companies and cooperatives (primarily owners of small woodlots).

Mission: Contribute to the global competitiveness of Institute sponsors through excellence in technical innovation in sustainable plantation silviculture. Accomplishes mission by maintaining a forestry research infrastructure that is available to member companies and by conducting industry-directed forestry research.

Primary Research Focus: Forestry.

Governance and Organization: Institute director (administrator) responsible to a board of control (11 person), plus three steering committees and a management committee. Research administratively organized into four units complementing the organization's research programs (acacia bark research, tree improvement, applied silviculture, forest productivity). Although located on the Pietermaritzburg campus of the University of KwaZulu-Natal, the Institute is fully autonomous from the University. Two regional centers are also engaged in research (Sabie and Kwambonambi).

Strategic Program Directions: Research priorities are established in response to recommendations from the Board of Control, Management Committee, and three Steering Committees. Research focuses on tree improvement (genetic improvement of pines, eucalyptus, and wattle), acacia bark utilization, applied silviculture (nutrition and vegetation management), and forest productivity (harvest impacts, site classification, soil-water relations). Research is conducted in close collaboration with timber growers. Strong emphasis on the application of scientific findings, hence a focus on developing technologies to grow trees in a profitable, sustainable and responsible way.

Client Groups: Private, owner-member emphasis.

Services Provided: Information, research, consultation (advice), educatiob, and training. Sponsors have free access to services such as: literature and reference searches, content pages of current journals, access to data bases, books and journals, and access to ICFR papers and publications.

Budget and Funding Sources: ICFR is funded by direct contributions from sponsoring (member) companies and a nationwide forest industry organization (ICFR is the only privately funded forestry research institute in South Africa).

A. Income (2005) (South Africa rand)

12.5 million – Total (US$ 2.0 million)

B. Source of Income (2005)(South Africa rand)

Nationwide industry organization[#] – 50 percent (6.25 million)
Member direct funding – 50 percent (6.25 million)

[#] Forestry South Africa, a national consortium of industrial forestry companies.

Total expenditures and program focus of expenditures are not available.

Scientists and Supporting Staff: As of 2004, total staff of 59 distributed as follows:

- •Administration (director, financial, personnel)– 27 percent (16 staff)
- •Functional support (publications, computers, library)– 17 percent (10 staff)
- •Forest nutrition research – 12 percent (seven staff)
- •Eucalypt tree improvement research – 10 percent (six staff)
- •Forest productivity research – 17 percent (10 staff)
- •Plantation re-establishment research – 10 percent (six staff)
- •Acacia tree utilization research – 7 percent (four staff)

Measures of Performance: Success is measured in terms of organization's ability to provide applicable technical solutions to operational problems. Performance measures include list of publications, projects in process, conference proceedings, and workshops and presentations.

Sweden

■ ***Forestry Research Institute of Sweden (SKOGFORSK)****

Date Established: Formally established in 1992 by forest landowner associations and industrial forestry companies. Research programs historically go back to 1936 (sponsored by Tree Breeding Association).

Public-Private Sector: Combination public and private organization. May be viewed as a private foundation that is defined by various Swedish federal laws that govern private companies (laws prescribing legal responsibilities, prerequisites for membership, financing and accounting, governing board representation).

Mission: Provide forestry in Sweden with knowledge that contributes to forestry's international competitiveness and the ecological sustainability of Swedish forests. Pursue research results that are demand-driven and capable of being readily applied by forest industry and forest landowners.

Primary Research Focus: Forestry

Governance and Organization: Governing board of directors and a managing director. Also, various advisory committees engaged in setting research directions and priorities. Two directors are responsible for research organized into two units, namely wood supply research program and forest production research program. Extension is also formalized as a unit within the organization. Organization headquartered in Uppsala, Sweden with offices in Ekebo and Savar, Sweden.

Strategic Program Directions: Research program (2005-2008) focuses on two principal areas, namely forest production (tree improvement, silviculture, conservation management, seedling production), forest management (silviculture, planning, and conservation management), and wood supply (logistics, raw material utilization, and forest operations technologies). A three-tiered planning process (influenced by research advisory committees) is used to establish priority research areas. The institute serves various coordinating functions, including actions to transform results of basic research done in universities into practical uses to be applied by landowners and forest industry.

Client Groups: Public and private.

Services Provided: Information (manuals, videos), research (reports, software), consultation and training (conferences, seminars, excursions). Special emphasis placed on disseminating results of research (estimated 15-20 percent of budget).

Budget and Funding Sources:

A. Income (2004) (Swedish krona):

Approximately 110 million – Total (US$ 14.0 million)

B. Source of Income (2004) (Swedish krona):

- Services and commissioned work – 50 percent (55 million)
- Government and forest industry* – 50 percent (55 million)
  - federal government grants – 50 percent (27.5 million)
  - forestry and forest industry sector – 50 percent (27.5 million)
    - fixed member fees – 25 percent (6.9 million)
    - research grants – 75 percent (20.6 million)

A "framework" agreement (for four-year period) guides the development of 50 percent of the Institute's budget. The agreement is the result of negotiations between the federal government and the private forestry sector, with each contributing 50 percent of the funding necessary to cover the research activities agreed to by the two sectors (however, there is no upper limit on contributions of the private forestry sector). The portion (50 percent) contributed by the forestry and forest industry sectors are derived from (a) fee assessed member companies and organizations (25 percent of sector's contribution; fee is based on ownership of productive forest area and site productivity) and (b) variable research grants (75 percent of sector's contribution; levy of 0.60 SEK per cubic meter of harvested timber and pulpwood).

Total expenditures and program focus of expenditures are not available.

Scientists and Supporting Staff: Institute staff of 100, of which approximately 60 are researchers. Approximate staff is distributed (2005) among principle research areas is as follows: forest productions – 55 percent of staff, and wood supply – 45 percent of staff. Importance of transferring results of research into practical use is reflected by the reality that communication skills are an integral part of processes used to recruit researchers.

Measures of Performance: Research highlights and listing of publications.

▪ ***Swedish Institute for Wood Technology (SP-TRATEK)****

Date Established: Established in October 2004, when TRATEK (Swedish Institute for Wood Technology Research) became part of the Swedish National Testing and Research Institute (SP). As an organization, TRATEK's roots can be traced to the mid-1800s.

Public-Private Sector: Private independent ("limited company"), government authorized. However, all of the company's shares are owned by the government.

Mission: Strengthen the competitiveness of wood as a material and to enhance the long-term profitability of various sectors of the Swedish wood-based industry. Research and development programs are to benefit the wood working industry through their application either in-house or in the marketplace.

Primary Research Focus: Forest products, especially sawmilling, joinery, housing, furniture, and board products.

Governance and Organization: SP-TRATEK is one of three subsidiaries and one cooperative of the Swedish National Testing and Research Institute (SP) (others subsidiaries are SITAC [Swedish Board of Housing, Building and Planning, and Swedish Board of Physical Planning and Building][products and person certification in the construction sector], and SMP [Swedish Machinery Testing Institute] [machinery testing, inspection and certification]) and one cooperative (EUROMET [coordination of metrological programs]. The cooperative is the European Collaboration in Measurement Standards [EUROMET]). SP-TRATEK is organized into four different development areas, namely processing and processes research, materials and products research, building and housing research, and quality and testing research. Advisory committees provide counsel for each of these development areas. SP-TRATEK is headquartered in Stockholm, Sweden, with operations in Skelleftea, Boras and Vaxjo, Sweden.

Strategic Program Directions: The organization's programs embrace fundamental research, applied research, development work, investigations, production of information (reports), consulting services, testing and monitoring, and various forms of training and education. Activities in these areas span a range of activities, from felling and handling timber in a forest setting through to the processing and distribution of finished wood products to consumers. The work of SP-TRATEK is carried out in four major areas of research and development, namely:

- Processing and processes – Develop methods of more cost-effectively producing and processing timber products. Activities occur in the following key areas: sorting, drying, production, and logistics.
- Materials and products – Develop ways of improving the durability, lifetime, and reliability of wood. Activities occur in the following key areas: environmental durability, and computer-supported product development.
- Building and housing – Develop products, processes and methods that enhance the advantage of wood used in buildings. Activities occur in the following key areas: fire safety, moisture resistance, building products, and international standardization.
- Quality and testing – Develop improved approaches to product testing, production management, and the certification of processes and products. Activities occur in the following key areas: stress grading and quality sorting of lumber, laboratory testing of furniture, and national and international standardization procedures.

SP-TRATEK carries out its activities in close collaboration with companies, universities, and colleges, as well as industrial and scientific organizations both in Sweden and abroad.

Client Groups: Public and private. SP-TRATEK's customers include sawmills, joinery companies, furniture manufacturers, producers of various board products, equipment manufacturers, and builders of homes and commercial buildings.

Services Provided: Information (library, software), research (direct delivery of products, joint research activities), consultation (advice), testing, and training and education.

Budget and Funding Sources:

A. Income (2004) (Swedish krona):

65 million – Total (US$ 8.3 million)

B. Source of Income (2004) (Swedish krona):

Federal funds – 14 percent (9.2 million)
Third-party funds* – 35 percent (22.5 million)
Services provided – 51 percent (33.3million)

* for example, European Union, national research funds.

C. Expenditures (2005)(Swedish krona):

54.6 million -- Total budgeted

Personnel – 66 percent (36.0 million)
External costs – 24 percent (13.0 million)
Property costs (laboratories) – 4 percent (2.3 million)
Depreciation and interest – 4 percent (2.4 million)
Internal costs – 2 percent (0.9 million)

D. Expenditure by program area (2005) (Swedish krona)

62.6 million -- Total budgeted

Processing and processes – 18 percent (11.0 million)
Materials and products – 23 percent (14.4 million)
Building and housing – 28 percent (17.5 million)
Quality testing – 31 percent (19.7 million)

The organization's fiscal philosophy is not to generate profits for distribution to SP-TRATEK owners, but rather to invest any financial surpluses back into the organization's programs. A substantial part of SP-TRATEK's work consists purely of assignments commissioned and paid for entirely by industrial clients. Among the funding sources for the organization's programs are the Swedish Wood (Swedish Wood Exporters' Association, Swedish Timber Council and Association for Swedish Wood Products Research), VINNOVA (The Swedish Agency for Innovation Systems), KK-STIFTELSEN (Knowledge Foundation), the Nordic Industrial Fund, SJFR (Swedish Council for Forestry and Agricultural Research), Brandforsk (Fire Research Council), and various European Union programs.

Scientists and Supporting Staff: In 2004, SP-TRATEK reported the employment of 56 persons, allocated among program areas as follows:

- •Processing and processes – 10 staffs (six scientists, four support (18 percent)
- •Materials and products – 11 staffs (10 scientists, one support) (20 percent)
- •Building and housing – 15 staffs (15 scientists, zero support)(27 percent)
- •Quality testing – 18 staffs (five scientists, 13 support) (32 percent)
- •General organization management – 2 staffs (director, deputy director) (3 percent)

Measures of Performance: Listing of publications.

▪ ***Swedish Pulp and Paper Research Institute/Institute for Packaging and Logistics (STFI-PACKFORSK)***

Date Established: Established in 2003 after merger of merger of the Swedish Pulp and Paper Research Institute and the Institute for Packaging and Logistics. The organization will eventually become one of four super institutes through which the Swedish government promotes industrial research.

Public-Private Sector: Private independent research organization. The ownership of STFI-PACKFORSK is as follows (2004): industry companies – 51 percent (six companies), government (IRECO, a government holding company) – 29 percent, STFI Association of Interested Parties – 10 percent (10 companies), and Private Owners Association Packforsk – 10 percent. STFI-PACKFORSK has extensive formal and informal cooperative relations with various universities and industrial research institutes, both within Sweden and internationally. In 2004, STFI-PACKFORSK became the dominate shareholder (95 percent ownership) of the Paper and Fiber Research Institute of Norway (PFI).

Mission: Provide outstanding knowledge, solutions and expertise that will give partners and clients a competitive advantage. Furthermore, contribute to the productivity and profitability of clients by (a) carrying out research at the highest international level, (b) implementing research results in contract assignments, consultations, and educational services, and (c) providing services utilizing efficient pilot plant and laboratory equipment. Research program is asserted to be characterized by high competency, significant commitment, and high ethical standards.

Primary Research Focus: Forest products, special emphasis on packaging and on pulp and paper.

Governance and Organization: Governed (in 2005) by a 15-person board of directors (chair, 10 members and four deputy members), and administered by two officers and eight directors (president, executive vice president and six directors, one from each of STFI-PACKFORSK's divisions). Executive management staff also includes a market coordinator and a chief financial officer (finances and human resources). STFI-PACKFORSK is advised by a research council (eight persons) that advises on research program directions and performance, and by a committee of scientific advisors (eight persons) that work directly with the organization's scientific staff. STFI-PACKFORSK is headquartered in Stockholm, Sweden, with the organization's Division of Packaging Logistics located in Kista, Sweden.

The organization's structure is arranged into six divisions (plus a market coordination and a finance unit and human resources unit), namely:

- Fiber, Pulp and Energy (chemical analysis, chemical and mechanical pulp, mill systems and energy, and wood, fiber and mechanical pulp)
- Papermaking (measurement, paper chemistry and microbiology, paper physics, processing technology)
- Paper as an Information Medium (appearance and imaging, printability, printing processes, and surface treatment)
- Packaging and Logistics (new materials and composites, packaging development and testing, packaging materials, and packaging systems)
- Eurofex (general services, IT services, operation and maintenance, physical testing, research and project management, sales and workshops)
- Strategic Information (ChemSource, information and training, information center, standardization and quality control, sustainability and foresight studies)

Strategic Program Directions: STFI-PACKFORSK's activities are carried out in interdisciplinary projects under four headings: (a) research, contract work and consulting (focused on wood and fiber, pulp, papermaking, paper, converting, and testing), (b) specialized services (use of special equipment and instruments), and (c) training and education (workshops, conferences and graduate education). The organization's research activities are grouped into 19 different research clusters, each bringing together projects that have a common theme or direction (clusters are selected by matching what is scientifically and technically promising against the product and marketing interests of STFI-PACKFORSKS customers). In 2003-2005, the research clusters were as follows:

- *Tools for wood and fiber streaming* (develop tools for optimal allocation of wood and fibers).
- *Biorefinery* (novel technologies for valorization of pulp mill residues).
- *Extended use of mechanical pulps* (increase the use of mechanical pulps by lowering energy demand and improving finished properties).
- *Chemical pulp research* (develop economically viable, technically feasible and environmentally sound processes that fully utilizes the potential of Nordic wood species).
- *Funcpack* (visual and interactive functionality of packaging).
- *New fibers for new materials* (widen the application span of cellulose fibers and to achieve fiber qualities with a higher added value).
- *Advanced fiber management in papermaking* (improve paper quality and improve utilization of natural resources).

•*Control of detrimental substances in papermaking* (enhance papermaking process by reduction in the amount of damaging material in the papermaking system).
•*Microbiology* (control of the microflora responsible for slime deposits and toxin producing bacteria).
•*Paper chemistry* (enable the manufacture of paper/board materials with superior optical and mechanical properties).
•*Mechanical dewatering* (improve the efficiency of mechanical dewatering processes).
•*Improved formation* (better formation for coating and printing).
•*Engineered sheet structure* (make stratified forming a viable technique for improving product properties).
•*Engineered board* (strengthen markets packaging paperboard).
•*Paper mechanics* (increase paper fracture toughness, stiffness and creep resistance).
•*New Surfaces* (understand application of new coating strategies and related analytical methods).
•*Newsprint* (strengthen multicolor print capacity and better runnability).
•*Printability* (develop high quality print surfaces for graphical papers and packaging boards).
•*Sensory analysis* (devise methods to evaluate importance of quality perception of paper and board).

STFI-PACKFORSK partner members (committed to long term research agreement with the institute) can choose cluster involvement; nonpartner members require leadership approval to participate in a cluster. STFI-PACKFORSK engages in extensive cooperation with public and private research organizations in Sweden and internationally.

Client Groups: Public and private, owner-member emphasis.

Services Provided: information (SFI Information Center – searches, data bases, library collection), research, consultation (advice and counsel), testing (pulp testing, paper structure measurement, chemical analysis, process simulation) and education and training.

Budget and Funding Sources:

A. Operating Income (2004) (Swedish krona):

274 million – Total (US$ 31.3 million)

B. Source of Income (2003) (Swedish krona):

The exact portion of operating income provided by various sources is not publically available, although in 2003 such is estimated to be distributed as follows:

industry funding – 50 percent (117 million)
public agency funding – 20 percent (47 million)
contract work and services – 30 percent (70 million)

The major part of STFI-PACKFORSK's research program is funded jointly by partner companies and by the government. Example public funding sources are European Commission, Nordic Industrial Fund, Swedish Environmental Protection Agency, Swedish Waste Research Council, and the Foundation for Strategic Environmental Research. Primary public funding sources are the Swedish Energy Agency [STEM], and the Swedish Agency for Innovation Systems [VINNOVA]). Private non-company research funding originates from sources such as the Swedish Pulp and Paper Research Foundation and the Forest Industry's Water and Air Pollution Research Foundation. STFI-PACKFORSK also receives service and contract revenue from a large customer base outside the partner companies.

C. Expenditures (2004) (Swedish krona):

259 million – Total Operating Expenses[#]

[#]Net profit of seven million SEK in 2004

D. Focus of Expenditures (2003 and 2004):

In 2004, the organization's expenditures (turnover) was divided into three business areas as follows: exploratory research – 28 percent, industrial research – 46 percent, and consulting – 26 percent.

The portion (percent) of funding from various sources for each division is estimated (based on 2003 Annual Review) to be as follows (NA = not available):

Division	Industry-Funded Research	Publicly-Funded Research	Contract Work and Services
Fiber, Pulp and Energy	33	33	33
Papermaking	65	20	15
EuroFEX	50	15	35
Paper as Information Medium	50	15	35
Packaging and Logistics	45	10	45
Strategic Information	NA	NA	NA

Scientists and Supporting Staff: STFI-PACKFORSK employs about 250 persons (130 with university degrees), of which approximately 30 are PhD students and 20 are professors (full and associate). Approximately 80 percent of the organization's employees work with research. The distribution of employees among STFI-PACKFORSK's eight divisions and by employee type of expertise (researchers and support staff) is not available.

Measures of Performance: Profit and loss statements specify operating income (for example, sales, contract income), operating expenses (for example, personnel, depreciation), and net revenue. Also, STFI-PACKFORSK provides a detailed statement of assets (fixed and current) and liabilities, in addition to a listing of the number and quality of services delivered (for example, publications, tests conducted).

▪ ***Swedish Wood Ultrastructure Research Center (WURC)****

Date Established: Established in 1996 by the Swedish Agency for Innovative Systems (VINNOVA; previously known as the Swedish National Board for Industrial Technology and Development).

Public-Private Sector: Private independent, affiliated with a university.

Mission: The mission is to promote industrial utilization of wood fibers by significantly increasing the basic knowledge of wood and wood fibers, especially regarding their chemical structure, physical properties, and morphological ultrastructure. WURC's undertakes research of the type that its industrial partners are unable conduct themselves(for such reasons as high up-front costs, inordinate uncertainty of success, very distant future payout). The results of the Center's research are to be used in further research and development activities. The Center seeks to accomplish its mission by focusing on two major sets of objectives, namely:

•*Organizational Objectives*: (a) Provide an inventive and stimulating environment for high quality research and postgraduate education, (b) create a research environment where companies within the forest industry actively participate, (c) furnish industry with competent researchers, (d) become an internationally recognized research unit which attracts foreign researchers, and (e) promote interdisciplinary research.

•*Research Objectives*: (a) Significantly increase the basic knowledge of wood and wood fibers as regards their chemistry and morphology, (b) determine the effects of chemical, mechanical and enzymatic treatments on the ultrastructure of wood and the influence of such effects on wood fiber properties, (c) be based on cooperation between universities, industrial research institutes and forest industry companies, (d) build up and maintain a source of knowledge to support further research and development in the Swedish forest industry, and (e) contribute to the development of new industrial processes, new fiber-based materials and new consumer products.

Primary Research Focus: Forest products, especially the morphological structure and chemical characteristics of wood.

Governance and Organization: Governed by a 11-member board of directors (including three deputy directors), and administered by a center director (assisted by a managing group of three additional persons). Program direction and research design advice is provided by an international advisory group (three persons), an industrial advisory group (10 persons), and a well identified list of contact persons (11 persons). Organization is administratively divided into six research projects.

The Wood Untrastructure Research Center is owned by a federation organizations composed of the (a) Swedish Agency for Innovative Systems (VINNOVA), (b) five research organizations (Swedish University of Agricultural Sciences [SLU], Swedish Pulp and Paper Research Institute-Institute for Packaging and Logistics [STFI-PACKFORSK], Royal Institute of Technology [KTH], Chalmers University of Technology [CTH], and Uppsala University [UU], and (c) nine member companies [SCA, Stora Enso, Sveaskog, Eka Chemicals, Södra Cell, Korsnäs, Holmen, Kappa Kraftliner, and M-Real]. The WURC is headquartered at the Swedish University of Agricultural Sciences in Uppsala, Sweden.

Strategic Program Directions: The Center's research program is focused on the basic elements of wood fiber and how they are influenced by external factors such as chemicals, enzymes, and mechanical actions. Specifically, the research at WURC is concentrated on the morphological structure of wood and wood fiber in the range of 500 nm to less than one nm (close to atomic and molecular bonding distance). Among the areas currently being researched are: wood and pulp fiber models, cell wall ultrastructure, fiber chemistry of wood polymers (molecular level), physical properties of fiber materials, fiber defects and structural changes, and ultrastructural modeling of wood (with respect to metal ions).

Client Groups: Public and private, owner-member emphasis.

Services Provided: Research (direct delivery of products), consultations, and sponsorship of seminars and conferences.

Budget and Funding Sources:

A. Income (2004) (Swedish krona):

Cash – 9.90 million
In-kind – 8.20 million
Total – 18.10 million (US$ 2.3 million)

B. Source of Income (budget 2004) (Swedish krona):

Industry – 34 percent (6.1 million)
Cash – 3.9 million
In-kind – 2.2 million

Universities – 33 percent (6.0 million
Cash – 0.00 million
In-kind – 6.00 million
VINNOVA – 33 percent (6.00 million)
Cash – 6.00 million
In-kind – 0.00 million

C. Focus of Expenditures (2004) (cash and in-kind):

Mechanical and physical properties of fiber materials – 31.9 percent
Cell wall ultrastructure – 27.5 percent
Fiber chemistry at molecular level – 15.1 percent
Wood and pulp fiber models – 11.0 percent
Managerial expenses – 8.2 percent
WURC joint expenditures – 6.3 percent

Scientists and Supporting Staff: During the period 2002-2004, approximately 60 to 70 persons were involved wholly or part-time in WURC activities. the center's staff was approximately as follows:

- •Senior scientist staff (professors and associate professors): 14 persons
- •Technical staff (post doctoral, technician): eight persons
- •Administrative staff (secretary, accounting): six persons
- •Students (Ph.D, Licentiate): 18 persons
- •Industry staff and scientists: 20 -25 scientists in active or advisory capacity

Measures of Performance: Listing of publications, conferences sponsored, educational products (degrees granted), management and administrative consequences (more cooperation, expanded industry capacity, improved research focus, improved research networks).

Switzerland

▪ ***Swiss Federal Laboratories for Material Science and Testing (EMPA)****

Date Established: Established in 1938 as the Swiss Federal Laboratories for Materials Testing and Research for Industry (known for some time prior to 1938 by the acronym EMPA). EMPA as an organization can be historically traced to 1880 (ETH Zurich Institute for Construction Materials Testing) when focus was on quality testing of building and structural materials, subsequently evolving into a general purpose testing institute for the construction and mechanical engineering fields.

Public-Private Sector: Chartered by the Swiss federal government, EMPA is a quasi-private independent organization within the Swiss ETH Domain (Swiss Federal Institutes of Technology). The latter is composed of two Federal Institutes of Technology (ETH Zurich and EPF Lausanne) and four independent federal research institutions, one of which is EMPA.

Mission: The legally established purpose of the Swiss ETH Domain is to educate students in science, expand scientific findings through research, cultivate scientific junior staff, render scientific and technical services, perform public relations, and facilitate the exploitation of research findings. Within the ETH Domain, the following missions have been established: (a) EMPA is to serve society by improving the quality of life and the environment. Such is to be accomplished by promoting the environmental, economic, social and economic aspects of sustainability and their optimization relative to materials and system engineering, (b) EMPA Wood Laboratory is to promote the use of wood and its application through applied research and development, ambitious provision of services, and the transfer of high quality knowledge. The mission of the Laboratory, and of EMPA generally, is facilitated by its status as an independent, neutral research institution.

Primary Research Focus: EMPA Wood Laboratory: forest products, especially wood structure, wood properties, wood protection, and timber engineering.
Governance and Organization: The ETH Council (board) (nine members, including a chair and vice-chair) is responsible for overall management of the Swiss ETH Domain and has semi-autonomous status from the Swiss Federal Department of Home Affairs. EMPA is one of ETH Domain's four independent research institutions.

Overall governance of EMPA is the responsibility of a director general and a deputy director. An consultative commission (eight persons) provides counsel on general EMPA management activities and a research commission (10 persons) advises on research priorities, procedures and program evaluation. In addition to selected EMPA senior staff, the research commission consists of researchers and heads of research organization from around the world. The EMPA Academy is responsible for most of the organization's technology transfer activities.

EMPA is organized into six departments, five of which are engaged in research, development and testing work (the sixth department is responsible for communication, personnel, and financial management), namely:

- Advanced materials and surfaces
- Materials and systems for civil engineering
- Materials for protection and well-being of human body
- Information, reliability and simulation technology
- Mobility, energy and environment

Departments with special relevance to forest products research are the Department Advanced Materials and Surfaces and the Department of Materials and Systems for Civil Engineering. Within the latter is situated the EMPA Wood Laboratory (located in Dubendorf, Switzerland). The Laboratory is organized into four basic groups: wood basic science, wood technology, wood protection-microbiology, and timber engineering. Other laboratories within the Department that conduct research relevant to forest products are structural engineering, polymers and composites, and building technologies.

Strategic Program Directions: EMPA's overall strategy focuses on three core areas namely, (a) research and development into innovative, structural and functional materials, composites and systems; (b) integrated development and evaluation of products, processes and systems for the capital and consumers' goods markets, with particular reference to sustainability; and (c) measurement and analytical methods, simulation and modeling with computational and experimental verification. Within EMPA's overall strategic directions, the EMPA Wood Laboratory seeks to:

- Extend the knowledge on material properties (micrometer and nanometer scale) to foster added-value utilization of wooden resources and to enable possible transfer of adapted biological structures and functions into the technosphere.
- Improve the technical, economical and environmental quality of wood, wood composites, and combinations of wood and other materials including renewables, with special emphasis on the principle of sustainability.
- Ensure the safety, fitness for use, and durability of timber applications with regard to the expected requirements and impacts.
- Present parameter, criteria, and strategies to highlight the potentials of the forestry-timber sector for a future sustainable development.
- Analyze microbiological and hygienically problems related to all materials used in civil engineering.

Client Groups: Public and private. EMPA's most important stakeholders are considered to be business and society, institutes of higher education and universities and public authorities. The EMPA Wood Laboratory focuses specifically on services to industry, associations, federal agencies, nongovernment organizations, and various private customers. EMPA strives to combine targeted applied research and development with high quality services, and to exploit its interdisciplinary skills to ensure integrated approaches to problem solving.

Services Provided: Information (library, software), research (direct delivery of products, joint research activities), consultation (advice), and teaching and training. Specifically, the EMPA Wood Laboratory provides the following services (clients are charged according to EMPA's current hourly rates):

- •Characterize the behavior of wood and wood composites in single use or in combination with other materials, particularly in building applications with load-bearing, separating and/or aesthetically function.
- •Evaluate the effect and effectiveness of products and methods to protect, refine or combine timber.
- •Make use of a modern and efficient testing and analytic equipment and include the extensive know-how and state-of-the-art infrastructure of other EMPA Laboratories.

As part of the EMPA Wood Laboratory's interest in technology transfer, the following example activities are carried out: workshops, lectures and symposiums; publication of scientific and technical results of research; research program coordination and research procedure standardization; and consulting and conferring with individual clients. The Wood Laboratory also hosts the offices of the Swiss Association of Wood Research and the Center of Excellence for Wood.

Budget and Funding Sources.

ETH Domain total income in 2003 was 2,203 million (Swiss francs), with expenditures totaling 1,900 million (75 percent personnel). In 2003, the financial condition of EMPA Department of Materials Research and Technology was as follows: Expenditures totaled 115.7 million (Swiss francs) (personnel – 75 percent [87.0 million], materials – 4 percent [4.4 million], 21percent [24.3 million]). The department's funding (117.2 million) originated from federal government – 69 percent (80.8 million), third-party funds – 17 percent (19.5 million), services rendered – 12 percent (14.0 million), and other income – 2 percent (2.9 percent). Financial information for is not available for the EMPA Department of Advanced Materials Surfaces.

In 2003, the EMPA Wood Laboratory's income and expenditures were as follows:

A. Income (2003) (Swiss franc):

2.6 million – Total (US$ 2.0 million)

B. Source of Income (2003) (Swiss francs):

Government – 58 percent (1.5 million)
Services provided – 15 percent (0.4 million)
Third-party sources* – 27 percent (0.7 million)

*Special, nonrecurring income from industry and government.

C. Expenditures (2003) (Swiss franc):

Personnel – 92 percent (2.4 million)
Operating expenses and infrastructure – 8 percent (0.2 million)

D. Focus of Expenditures (2003) (Swiss franc):

Basic wood sciences – 19 percent (0.5 million)
Wood protection – 31 percent (0.8 million)
Wood technology – 31 percent (0.8 million)
Timber engineering – 19 percent (0.5 million)

Scientists and Supporting Staff: In 2003, the Swiss ETH Domain engaged 18,694 students, 2,780 staff with diplomas, and 11,765 personnel classified as professors, non-professional academic, or administrative-technical staff. EMPA total staff in 2003 was 824 persons or 719 full-time equivalent positions. These 824 staffs were as follows: five professors, 367 research personnel, 462 administrative and technical personnel. EMPA was also responsible for 67 doctoral candidates, 50 diploma students, 657 trainees, and 33 apprentices. Twenty-one staffs were assigned to EMPA's Wood Laboratory, distributed as follows: wood basic science — four staffs, wood technology — six staffs, wood protection-microbiology — six staff, and timber engineering — four staffs.

Measures of Performance: General description of research results (reported in EMPA annual report and in EMPA annual report of activities). For 2003, the following were cited as accomplishments: 425 publications, 21 patents granted or applied for, six licensing agreements, and two spinoffs or start-ups. In addition the EMPA Academy sponsored 199 events (seminars, courses, lectures) that involved 6,000 persons. For the Swiss ETH Domain in general, the following performance goals are to guide the domain's two institutes and four independent research organizations (including EMPA): excellent and attractive teaching and research by international standards, pole position in international research, attractive working conditions and equal opportunities for women and men, creation of innovative teaching programs, increased cooperation with the other Swiss universities of applied sciences, and technological and economical implementation of new knowledge and techniques.

Taiwan (Republic of China)

▪ ***Taiwan Forestry Research Institute (TFRI)***

Date Established: Established in 1945, although origin can be traced to the late 1890s.

Public-Private Sector: Public government organization

Mission: Conduct research focused on forests, forestry and forest uses.

Primary Research Focus: Forestry and forest products.

Governance and Organization: Director (supported by a deputy and a secretary general) reporting to the Council on Agriculture. The Institute is organized into three administrative support offices (accounting, personnel, ethics), six regional centers, and 10 divisions (27 laboratories), namely divisions of forest biology, silviculture, forestry economics, forest management, watershed management, forest protection, forest utilization, forestry chemistry, wood cellulose, and forestry extension. The Institute is headquartered in Taipei, Taiwan.

Strategic Program Directions: The Institute's programs are aligned with its divisional structure, namely:

- •Forest biology (laboratories on forest resources conservation, forest ecology, forest plant systemics).
- •Silviculture (laboratories on tree genetics, silviculture, forest soil).
- •Forestry Economics (laboratory on forest economics).
- •Forest Management (laboratory on forest planning, recreation, stand management,
- •Watershed management (laboratories on forest hydrology, water chemistry, erosion and sediment control).
- •Forest protection (laboratories on forest pathology, forest fire, entomology, wildlife).
- •Forest utilization (laboratories on wood material, wood processing, wood composites, timber engineering).
- •Forest chemistry (laboratories on chemistry, polymeric resins, wood preservation).
- •Wood cellulose (laboratories on papermaking, pollution abatement, pulping and bleaching).
- •Forestry Extension (extension of research findings, information management, experimental forests)

The major research activities of the divisions engaged in forest and wood products research are as follows:

• Division of Forest Utilization: *Wood Material Laboratory* (investigation of anatomic, physical, and mechanical properties of wood, bamboo and rattan; evaluation of material strength by nondestructive tests; wood identification and material properties analysis services); *Wood Processing Laboratory* (development of kiln schedules for drying wood and bamboo; improvement and development of machining technology; manufacture of lam-boo and press-lam products; utilization of small-diameter logs); *Wood Composite Laboratory* (manufacture and processing of particleboard, fiberboard, and oriented-strand board; identification and reduction of volatile organic compound emission during adhesion; evaluation of adhesives and adhesion technology); *Timber Engineering Laboratory* (evaluation of static and dynamic strength of wooden structure; investigation of fatigue strength of furniture; examination of the structure performance in wood construction, furniture, and interior decoration)

• Division of Forest Chemistry: *Forest By-products Laboratory* (extraction, analysis, processing and utilization of essential oils; analysis and chemical processing of forest by-products; media development for mushroom cultivation and their chemical analyses); *Polymeric Resin Laboratory* (synthesis and analysis of coatings and adhesives; durability evaluation and property improvement of coating and adhesives); *Wood Material Preservation Laboratory* (chemical modification and flame-resistance improvement of wood material; development of low-polluting preservatives; natural durability and utilization study of plantation wood).

• Division of Wood Cellulose: *Pulping Laboratory* (wood fiber morphology and chemical analysis; raw material and pulping studies; pulping technology); *Papermaking Laboratory* (papermaking technology; paper characterization and evaluation; handmade and specialty papers; paper converting).

The six regional centers place emphasis on subjects that benefit from a center's particular geographic location, for example watershed management, urban forestry, silviculture, biological diversity, and natural forests.

The Institute also engages in extension activities (through the Division of Forestry Extension) that include distribution of forestry research results, training and education programs, conference sponsorship and organization, management of information data bases, and preparation and distribution of publications.

Client Groups: Public and private.

Services Provided: Information, research (direct delivery of products), consultation (advice), and training (workshops).

Budget and Funding Sources: Not available.

Scientists and Supporting Staff: In 2003, staff totaled an estimated 168 of which 137 were considered scientists or technical staff. The Institute also employees and additional 201 support staff (technicians, helpers, drivers) that are assigned to various units of the Institute (headquarters, division, branch centers). Excluding the 201 support staffs, the Institute's administrative and scientist staff was distributed as follows:

Office of Director and Administration – 31 (18 percent)
Division of Forest biology – 12 (7 percent)
Division of Silviculture – 16 (10 percent)
Division of Forest Management – 21 (12 percent)
Division of Forest Economics – 6 (4 percent)
Division of Forest Protection – 8 (5 percent)
Division of Forest Utilization – 12 (7 percent)
Division of Forest Chemistry – 8 (5 percent)

Division of Wood Cellulose – 7 (4 percent)
Division of Forestry Extension – 7 (4 percent)
Research Centers (five) – 40 (24 percent)

Measures of Performance: listing of publications and a general description of the results of research carried out by each division in the Institute.

United Kingdom

▪ ***Timber Research and Development Association (TRADA)****

Date Established: Established as TRADA in 1962. Origin can be traced to 1934 as the Timber Development Association.

Public-Private Sector: Private independent organization. In 1994, TRADA's two TRADA subsidiaries (TRADA Quality Assurance Services and TRADA Technology) became TRADA Technology Limited and a member of the TTL Chiltern Group of Companies. Via a unique relationship, the services of TRADA Technology Limited are provided through a sole appointed service provider, namely TRADA Technology (Timber Research and Development Association).

In addition to TRADA Technology, the Chiltern Group of companies also provides specialized services via BM TRADA Certification (multi-sector certification body accredited by United Kingdom Accreditation Service), Chiltern International Fire (fire resistance testing, fire safety engineering), Chiltern Dynamics (testing of building materials for security, strength and durability), FIRA International (testing, research and consultancy for furniture and allied industries), and Chiltern Clarkebond (consultancy in prefabrication and modular design).

TRADA has a very diverse membership encompassing companies and individuals from around the world and across the entire wood supply chain, from producers, merchants and manufacturers, to architects, engineers and end users. Membership categories are corporate members (companies that produce, trade or manufacture wood products), professional members (organizations and individuals that design, specify or use timber), and student members (persons enrolled in recognized educational body).

Mission: Provide members with the highest quality information on timber and wood products to enable them to maximize the benefits that timber can provide. Mission is to be accomplished through active and ongoing programs of information and research. The former of which is made available through web sites, extensive collection of printed materials, and education and training courses, while the latter are driven by the desire to update and improve information so that it continues to meet members' needs in the future.

Primary Research Focus: Forest products, directed entirely at building markets and specifications for timber and other wood-based products. Complementing the organizations major program areas, the organization is administratively divided into four major units, namely timber frame housing constriction program, timber construction program, engineered timber and components program, and timber supply chain program.

Governance and Organization: Board of directors (11 persons elected) and chief executive officer.

TRADA does extensive partnering in the sponsorship of its research program. For example, a project involving the calibration, testing and evaluation of plywood glue bond performance is jointly sponsored by 12 organizations (European Commission, TRADA Technology Ltd., Danish Technological Institute, Wilhelm-Klauditz-Institut [Germany], Valtion teknillinen tutkimuskeskus [VTT] [Finland], Centre Technique du Bois et de l'Ameublement [CTBA] [France], Stichting Hout Research [SHR] [Netherlands], Statens Provningsanstalt [SP] [Sweden], Building Research Establishment [United Kingdom], Centro de Investigacin Technolgica [CIDEMCO] [Spain], Blomberger Holzindustrie [Germany], and Toro-Compensati Toro [Italy]).

Strategic Program Directions: TRADA research falls within four broad categories, namely:

- •Timber frame housing and construction (three projects 2004).
- •Engineered timber and components (structural use of timber)(nine projects 2004).
- •Timber in construction (nonstructural use of timber) (three projects 2004).
- •Timber supply chain (non-constructional uses, statistics, e-commerce)(nine projects 2004).

The TRADA Research Program is delivered exclusively under contract by TRADA Technology, an independent company. Most research projects are carried out in partnership with leading industry companies and most are partially funded with government support, both from the United Kingdom and the European Union.

Client Groups: Public and private, owner-member emphasis.

Services Provided: Information (especially, "askTRADA" website), research (direct delivery of products, joint research activities), consultation (advice), and training (workshops). The commercial service activities of TRADA and TTL Chiltern are extensive, falling primarily into the following areas: building surveys (on-site inspections), certification (chain of custody certification [FSC], quality management certification [ISO 9001]), engineering (construction support), business solutions (performance and management), testing (material and construction), and fire safety (engineering and testing).

Budget and Funding Sources:

A. Income (2003) (British pound):

628,000 – Total (US$ 1.1 million)

B. Source of Income (2003) (British pounds):

Member fees – 68 percent (424,000)
Investment Income – 6 percent (35,000)
Other Income – 26 percent (169,000)

C. Expenditures (2003) (British pounds):

Operations – 75 percent (727,000 GBP)
askTRADA Expenditure – 25 percent (248,000)

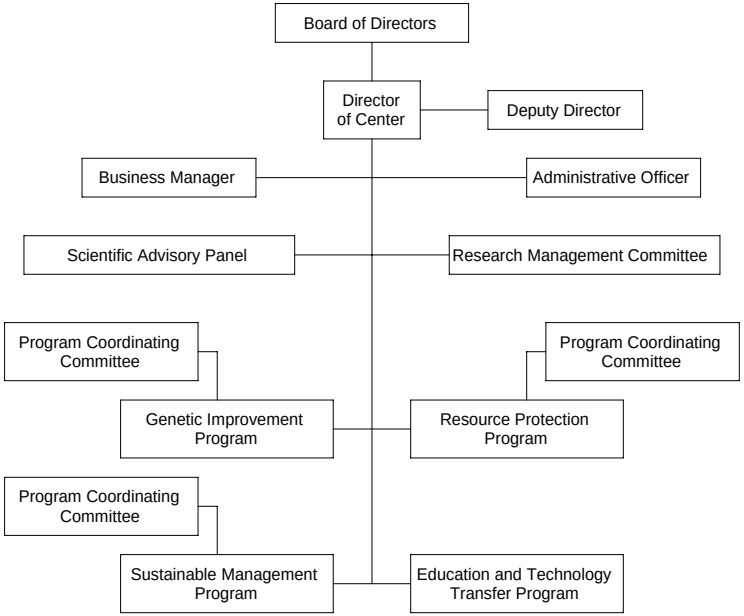
Program focus of expenditures is not available.

Scientists and Supporting Staff: Estimated 50 for TRADA Technology.

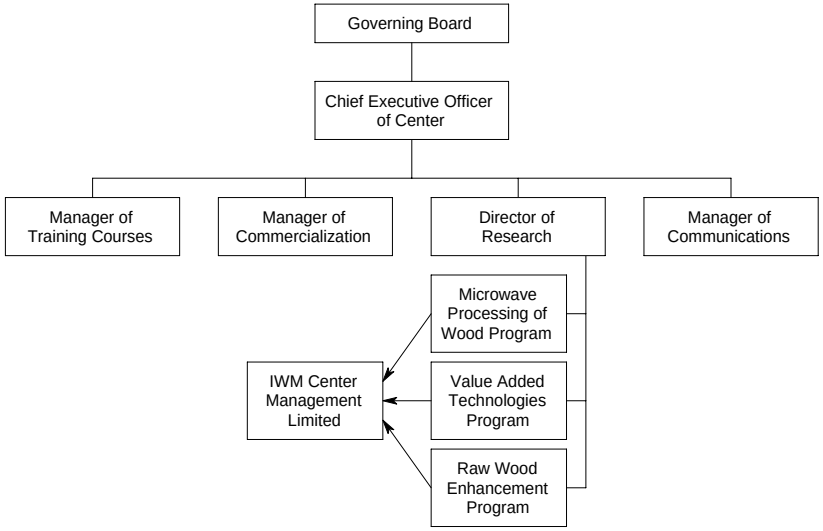
Measures of Performance: Income and expenditure statements, and statements of assets and liabilities.

APPENDIX B:

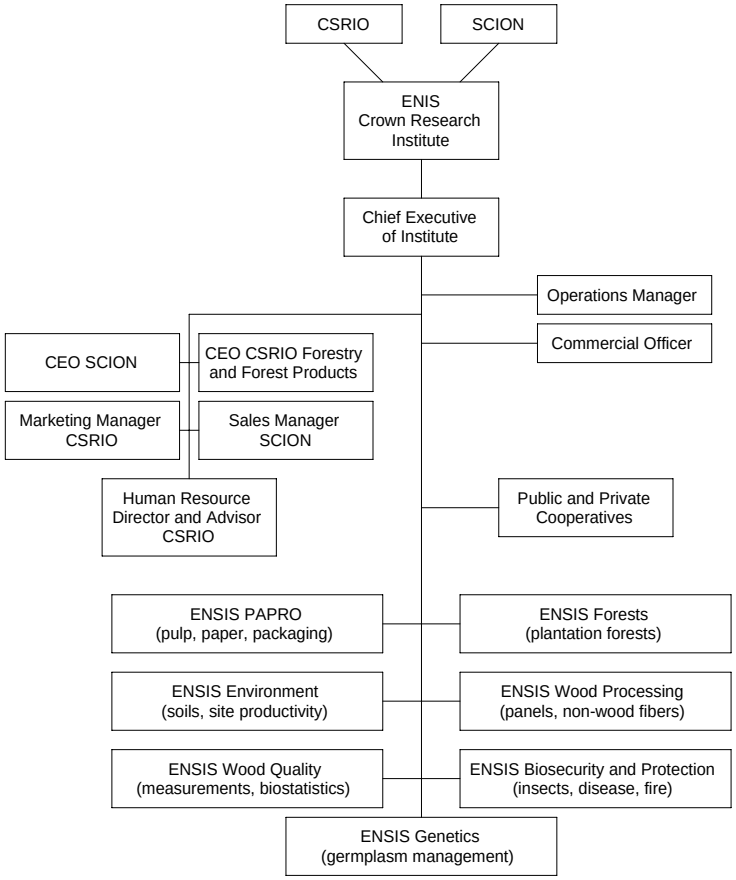
Organizational Charts of Case-Example Forest Products and Related Research and Development Organizations



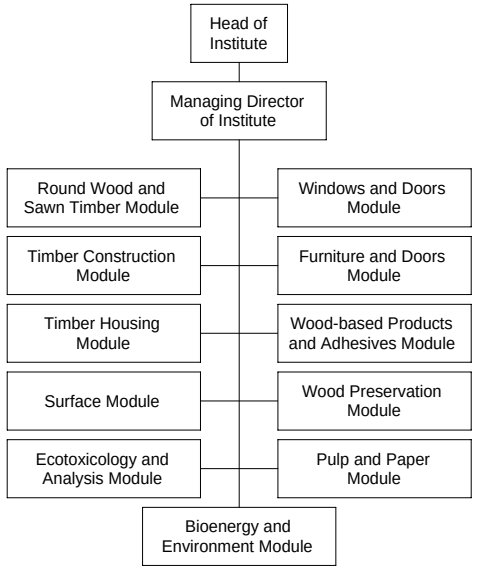
AUSTRALIA: COOPERATIVE RESEARCH CENTER FOR SUSTAINABLE PRODUCTION FORESTRY (CRC)



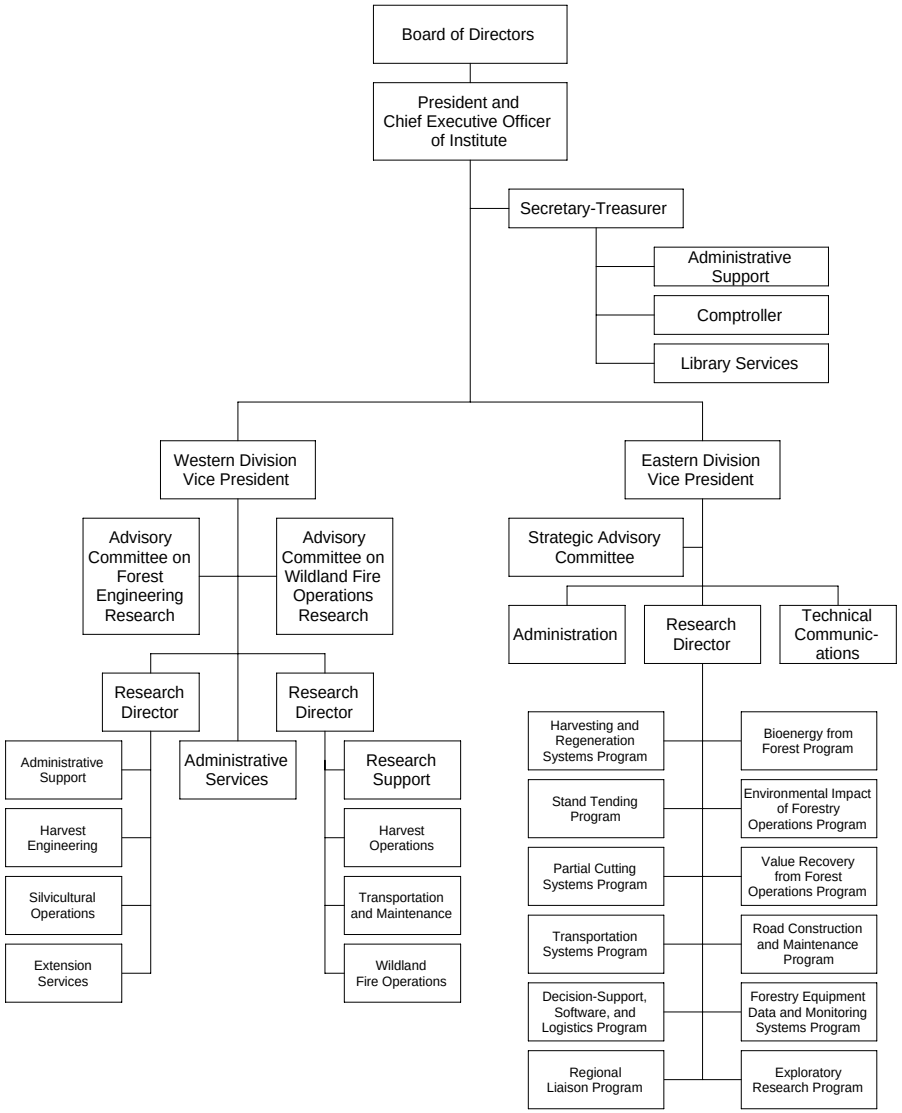
AUSTRALIA: COOPERATIVE RESEARCH CENTER FOR WOOD INNOVATIONS (CRC)



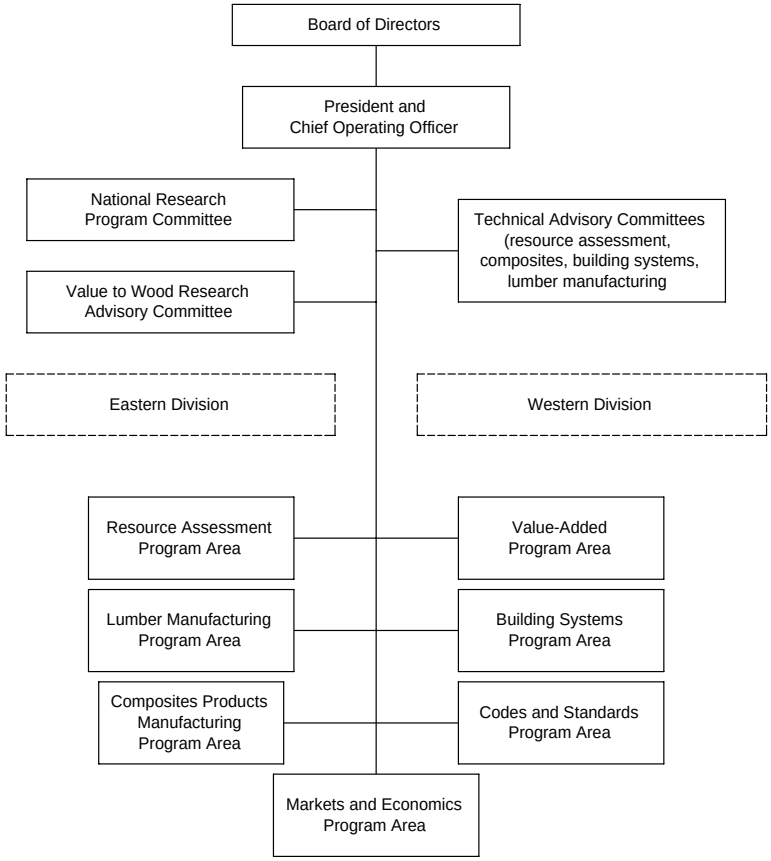
AUSTRALIA: ENIS



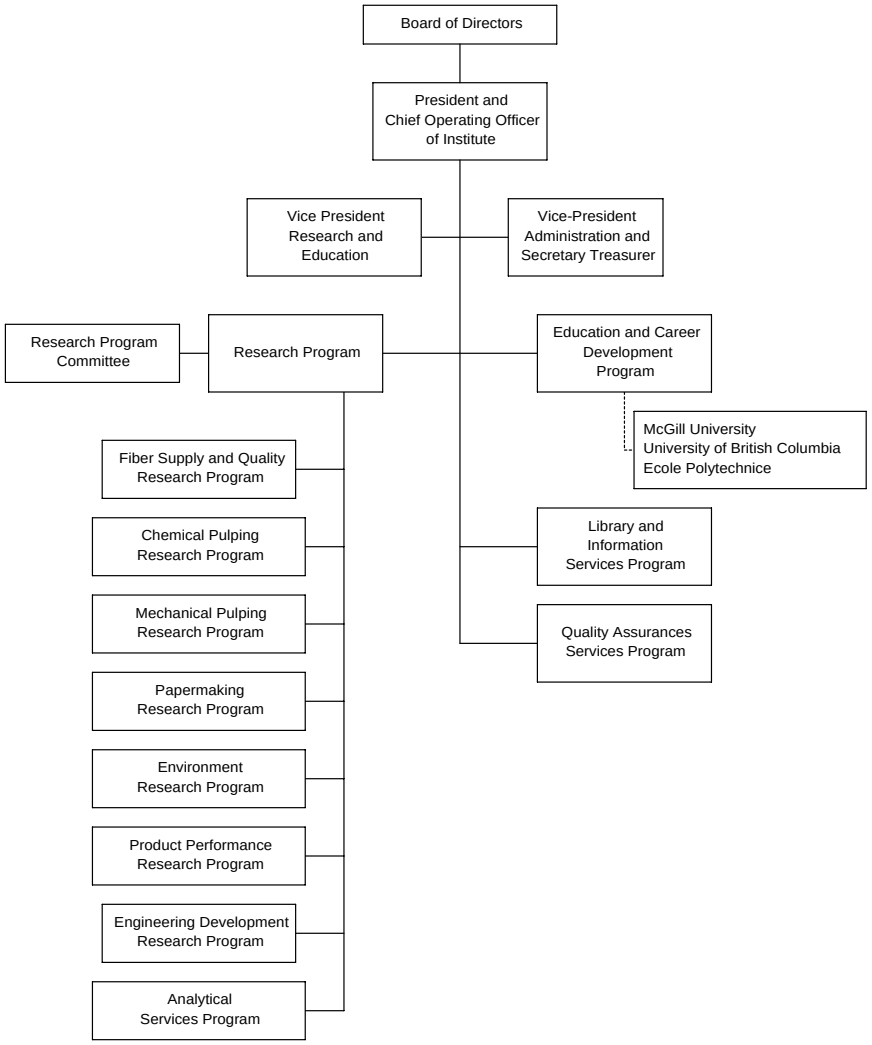
AUSTRIA: HOLZFORSCHUNG AUSTRIA (HFA)



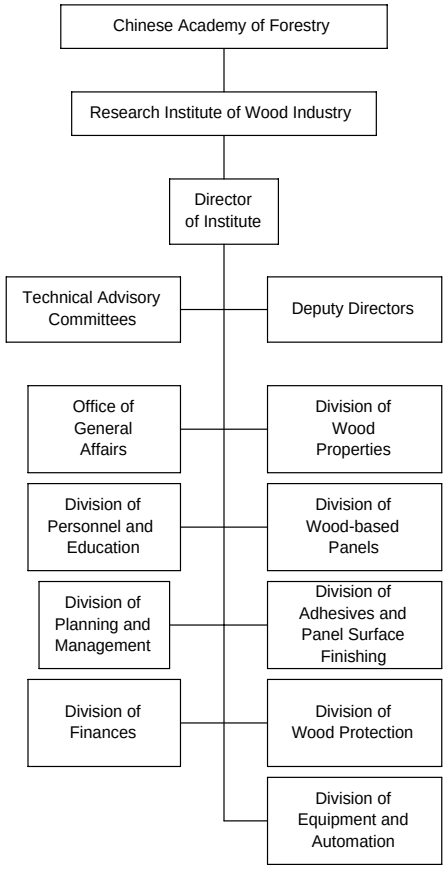
CANADA: FOREST ENGINEERING RESEARCH INSTITUTE (FERIC)



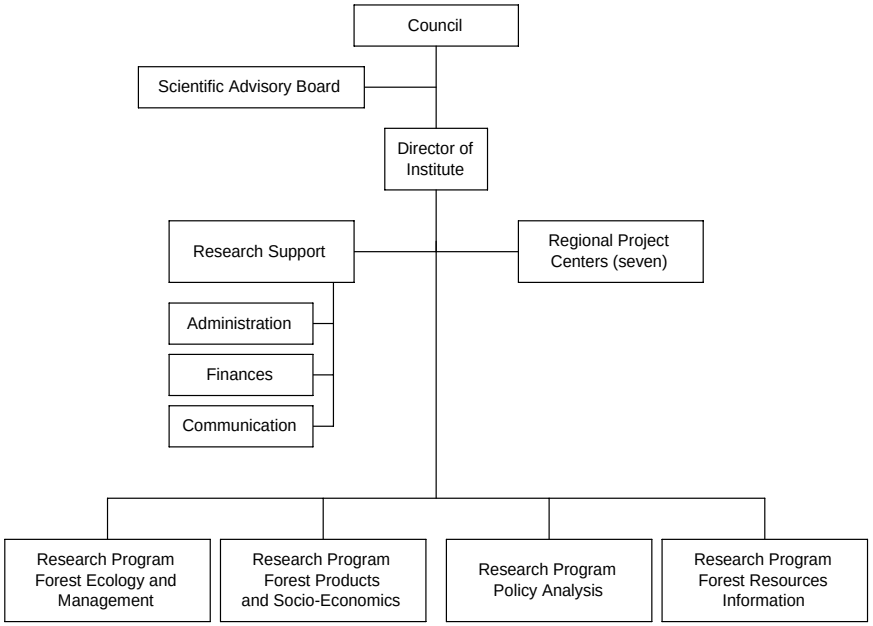
CANADA: FORINTEK CANADA CORPORATION (FORINTEK)



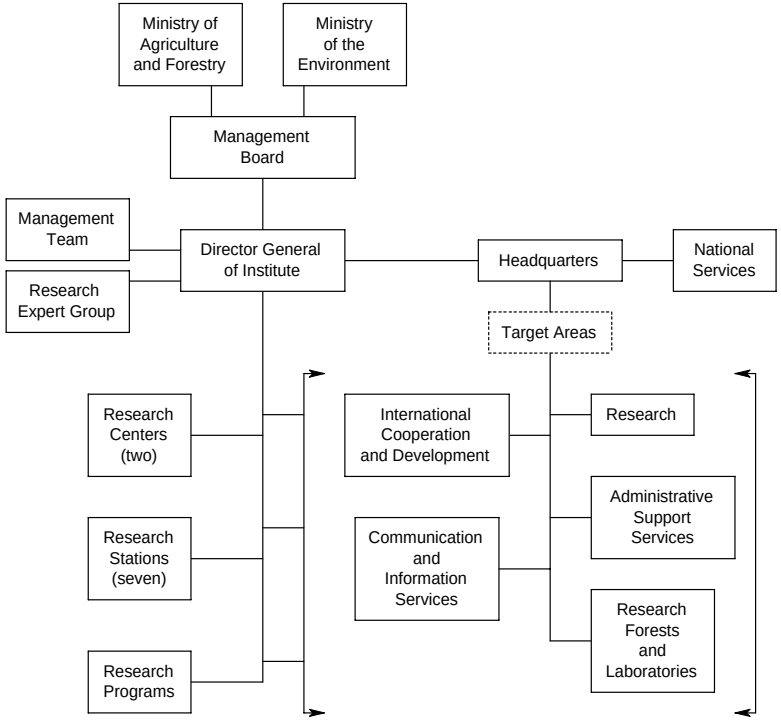
CANADA: PULP AND PAPER RESEARCH INSTITUTE OF CANADA (PAPRICAN)



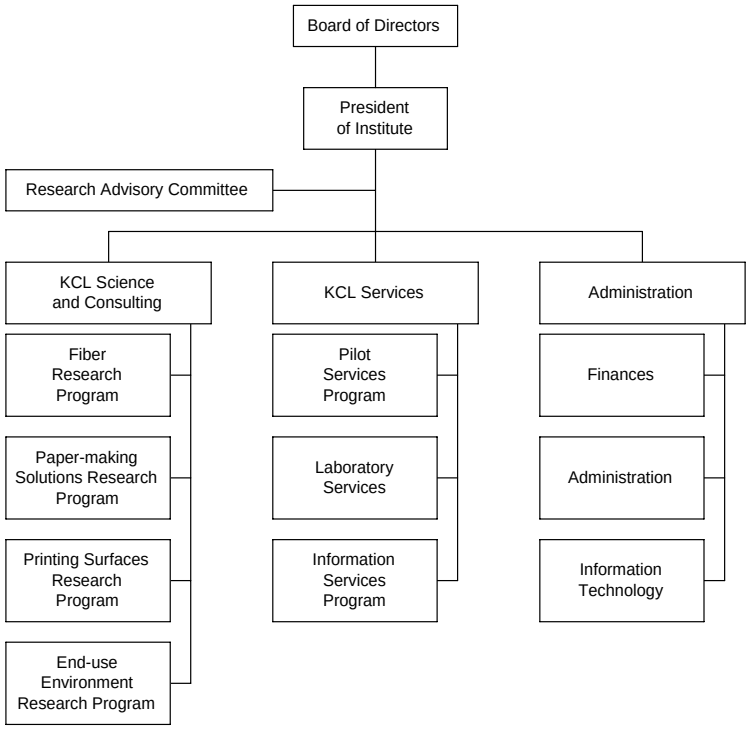
CHINA: RESEARCH INSTITUTE OF WOOD INDUSTRY (CRIWI)



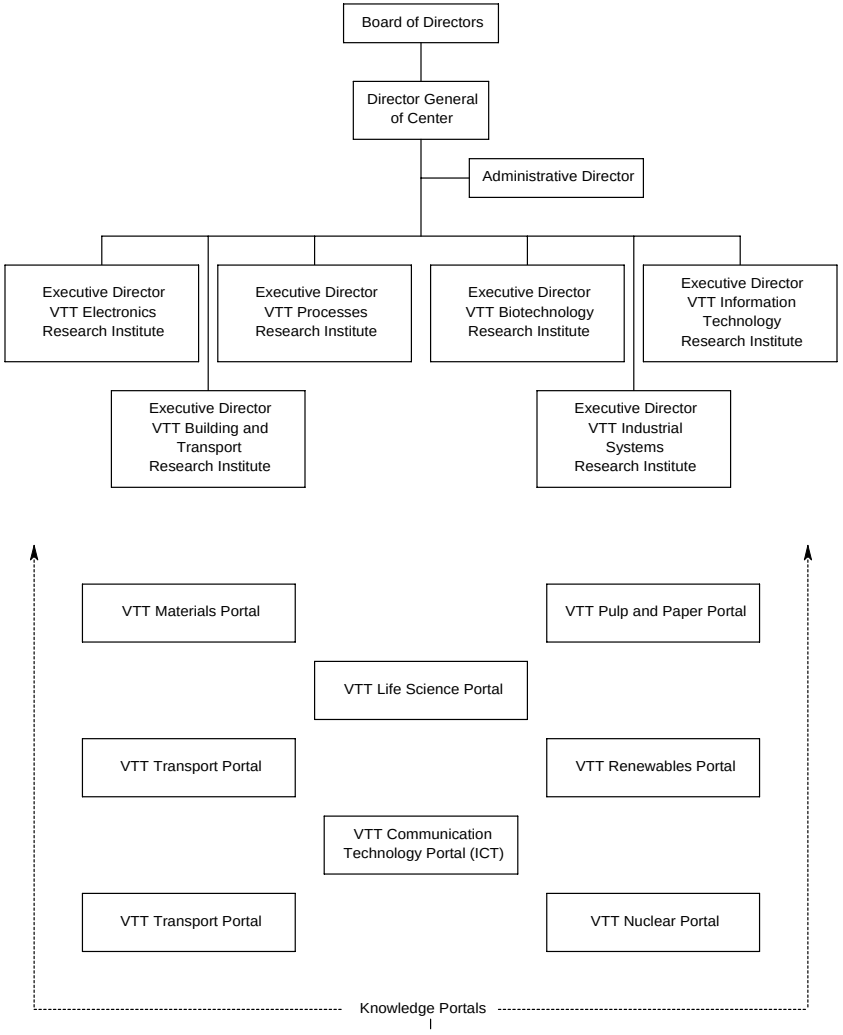
FINLAND: EUROPEAN FOREST INSTITUTE (EFI)



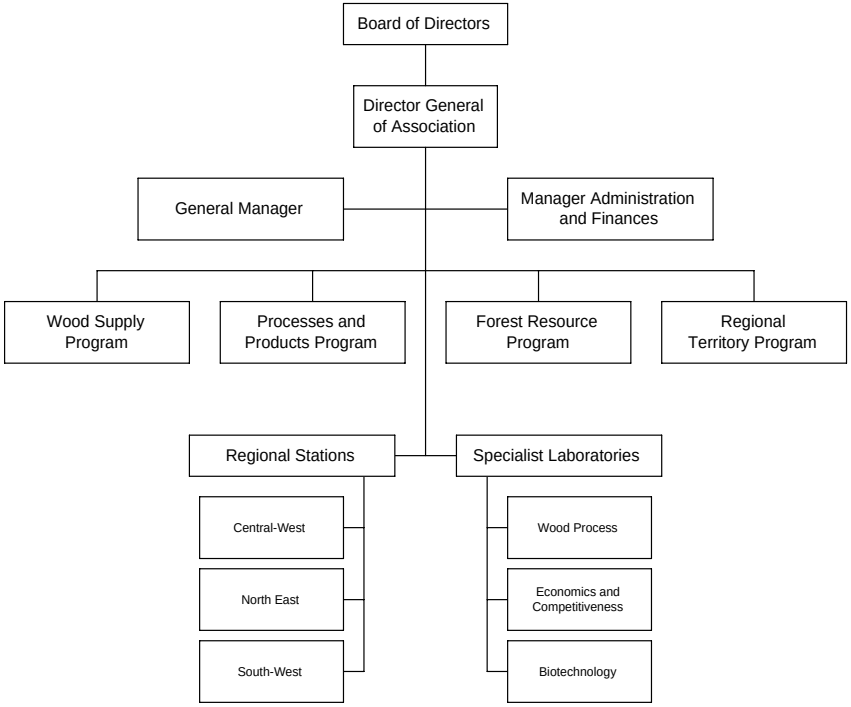
FINLAND: FORESTRY RESEARCH INSTITUTE (METLA)



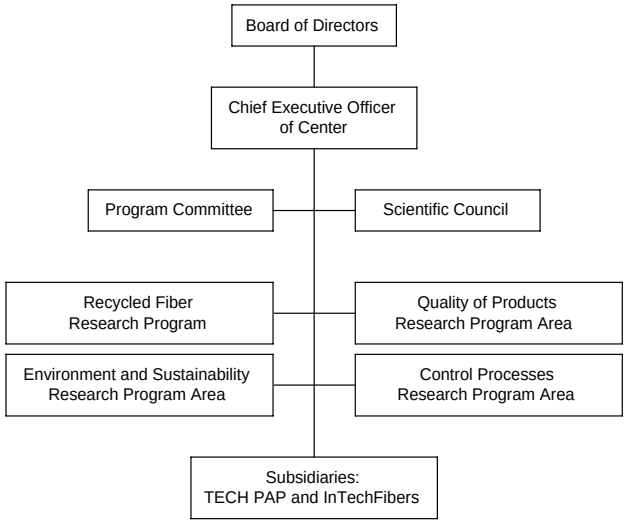
FINLAND: KCL (OY KESKUSLABORATORIUM-CENTRALBORATORIUM AB)



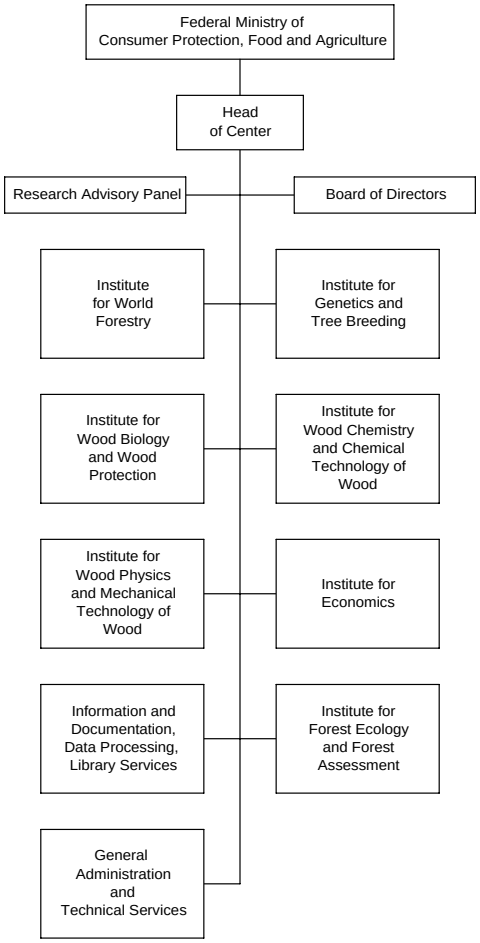
FINLAND: TECHNICAL RESEARCH CENTER OF FINLAND (VTT)



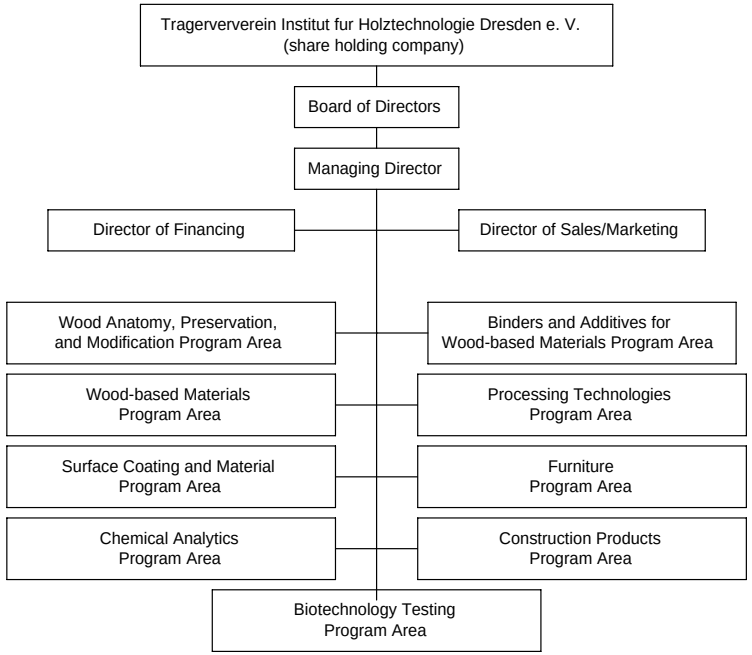
FRANCE: ASSOCIATION FOREST CELLULOSE (AFOCEL)



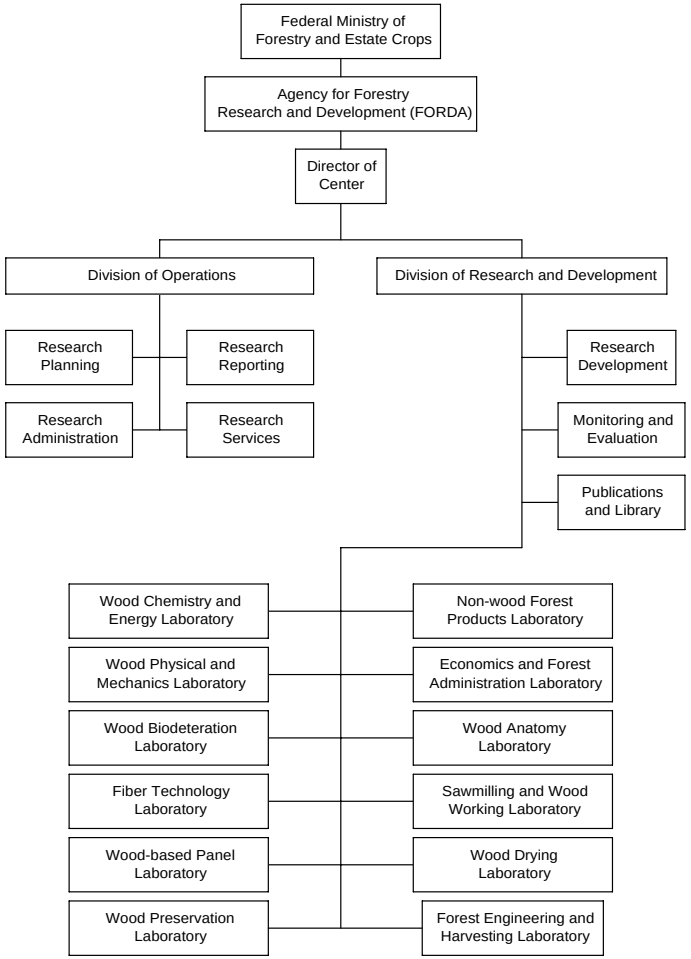
FRANCE: FRENCH PULP AND PAPER RESEARCH AND TECHNICAL CENTER (CTP)



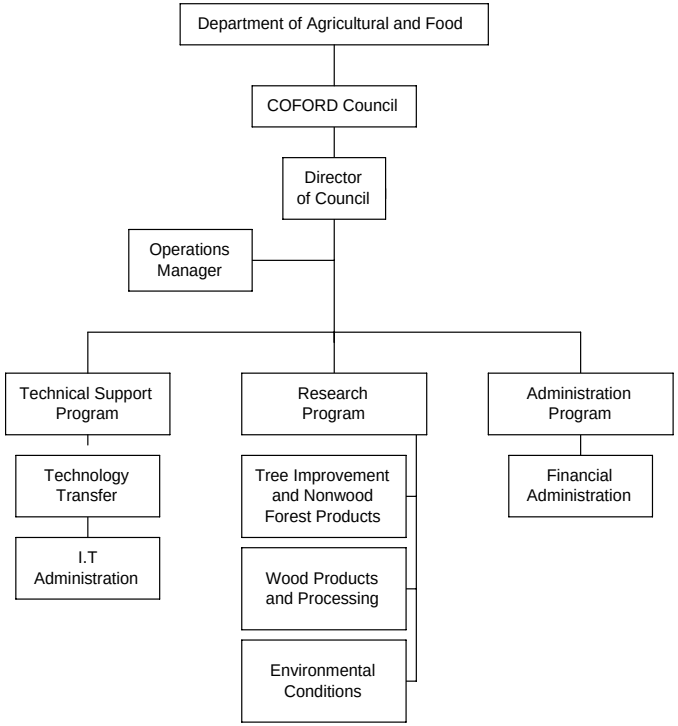
GERMANY: FEDERAL RESEARCH CENTER FOR FORESTRY AND FOREST PRODUCTS (BFH)



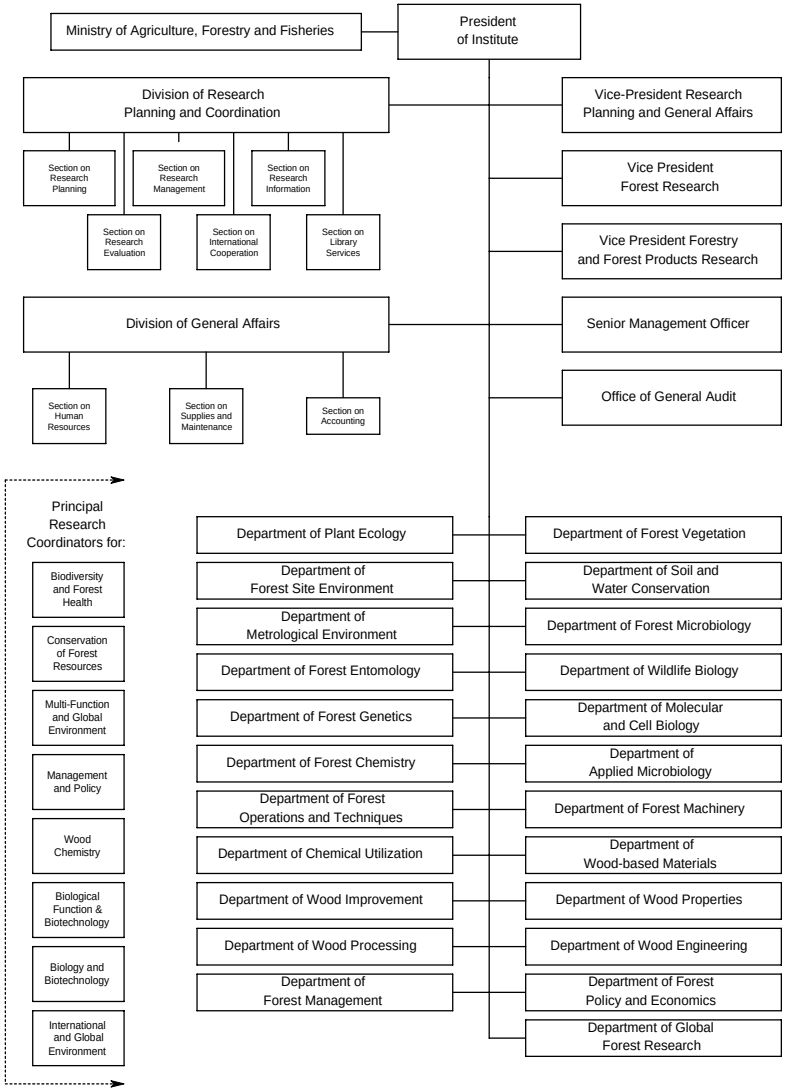
GERMANY: INSTITUTE OF WOOD TECHNOLOGY (IWT)



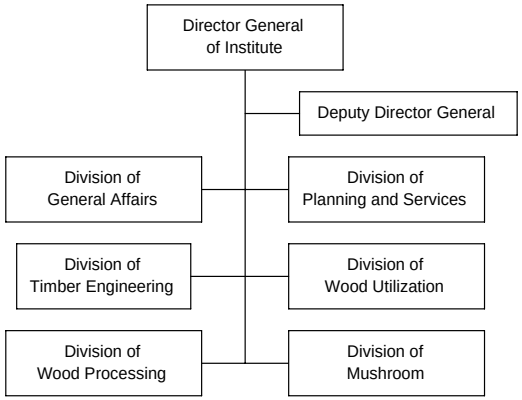
INDONESIA: FOREST PRODUCTS AND FORESTRY SOCIO-ECONOMIC RESEARCH AND DEVELOPMENT CENTER



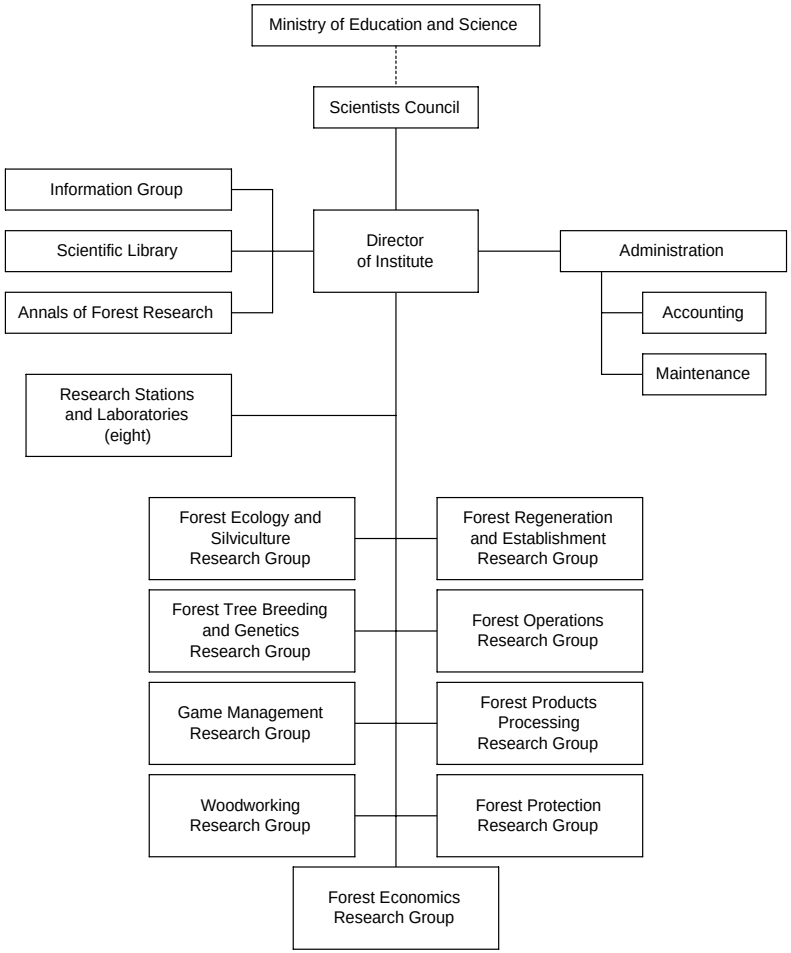
IRELAND: NATIONAL COUNCIL FOR FOREST RESEARCH AND DEVELOPMENT (COFORD)



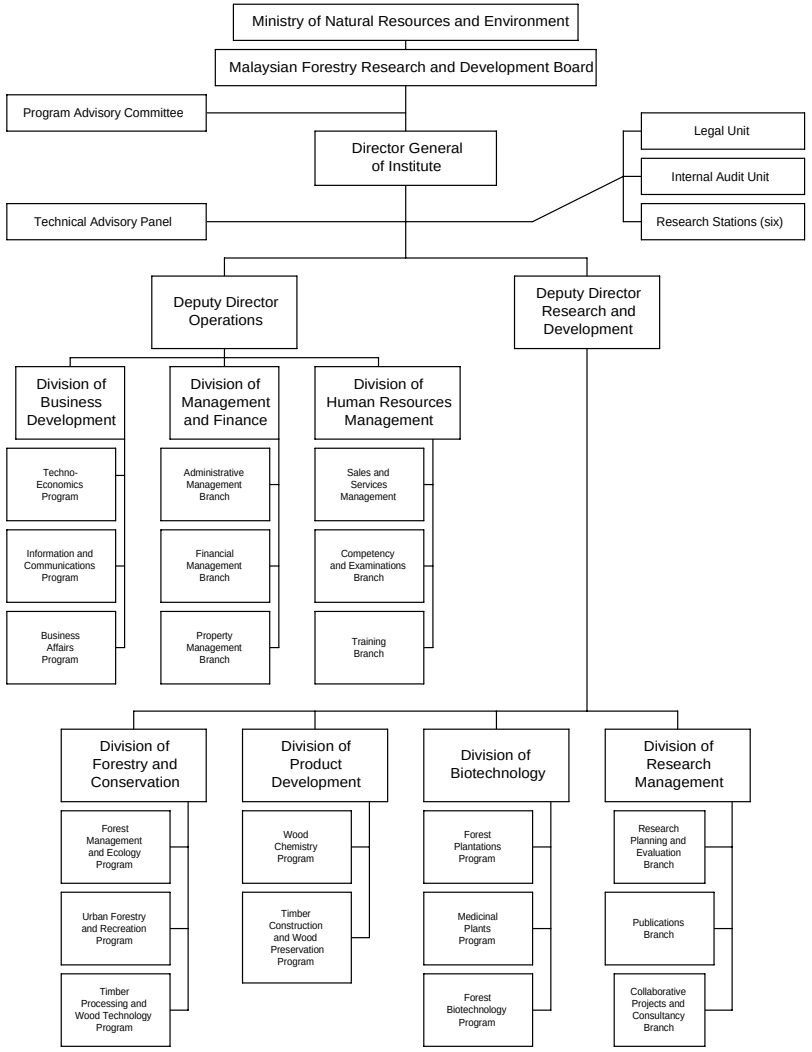
JAPAN: FOREST AND FOREST PRODUCTS RESEARCH INSTITUTE (FFPRI)



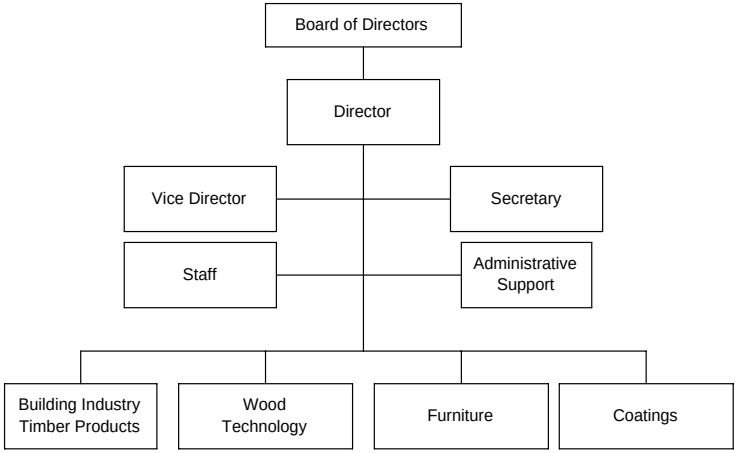
JAPAN: HOKKAIDO FOREST PRODUCTS RESEARCH INSTITUTE



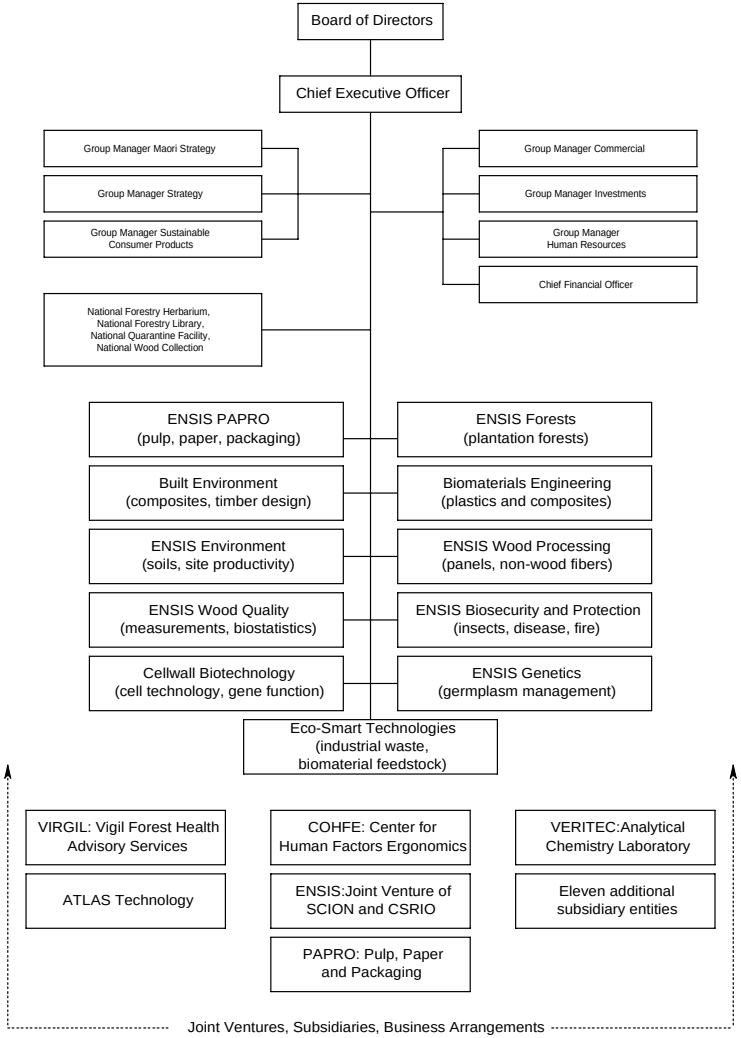
LATVIA: STATE FORESTRY RESEARCH INSTITUTE (SILAVA)



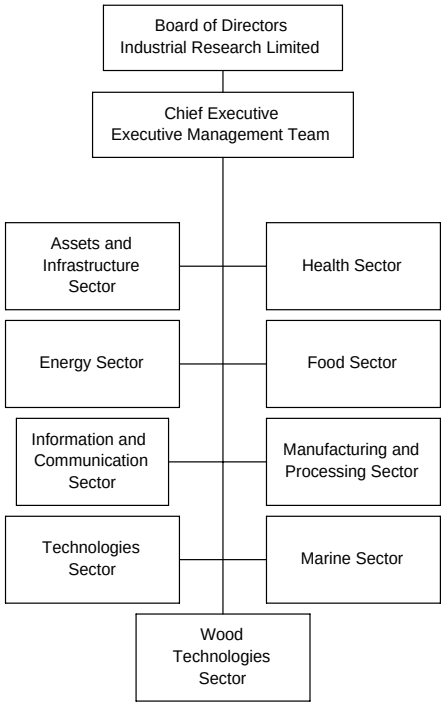
MALAYSIA: FOREST RESEARCH INSTITUTE (FRIM)



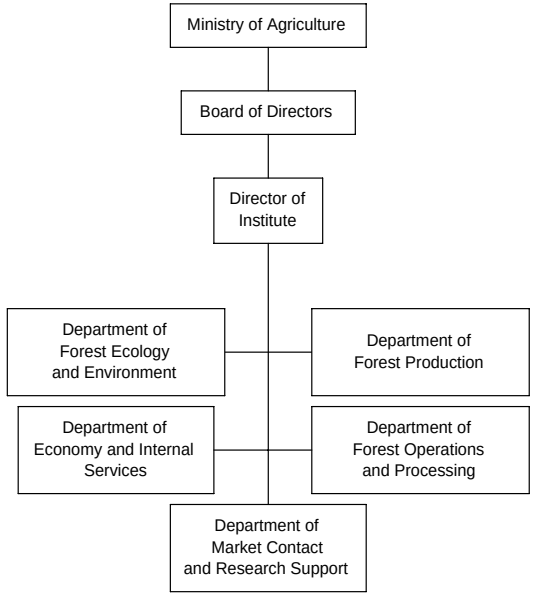
NETHERLANDS: SHR TIMBER RESEARCH



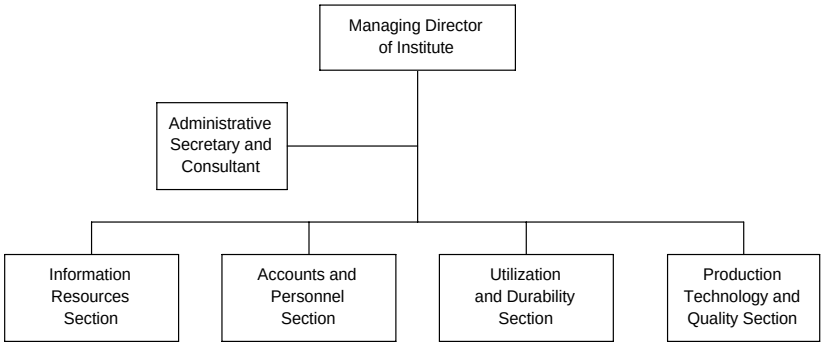
NEW ZEALAND: SCION



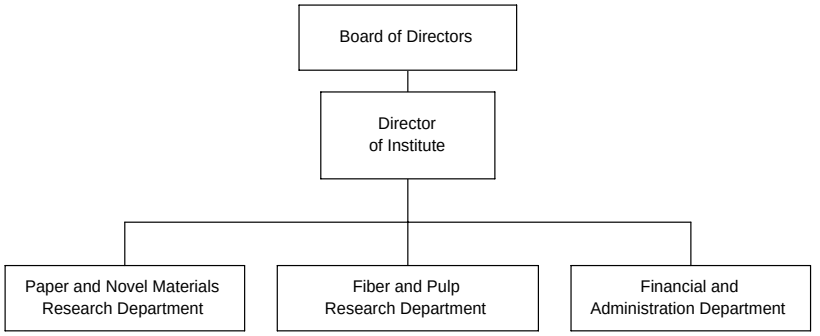
NEW ZEALAND: WOOD TECHNOLOGIES RESEARCH SECTOR, INDUSTRIAL RESEARCH LIMITED (IRL)



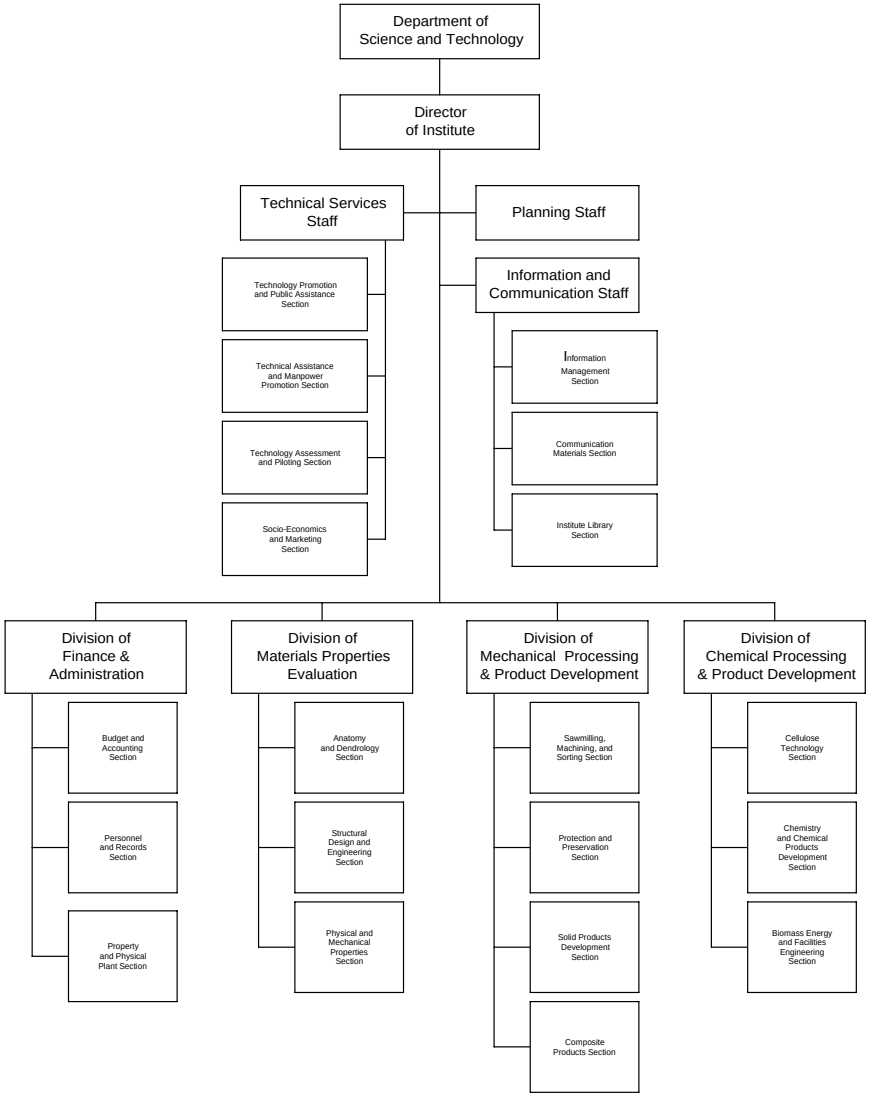
NORWAY: NORWEGIAN FOREST RESEARCH INSTITUTE (SKOGFORSK)



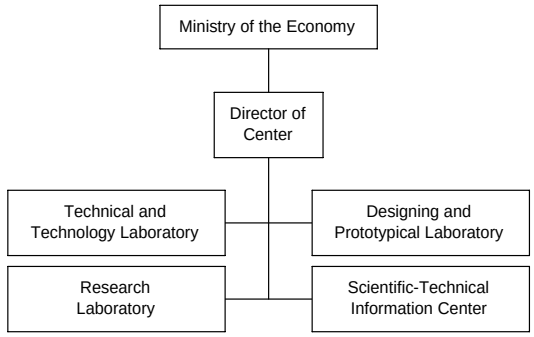
NORWAY: NORWEGIAN INSTITUTE OF WOOD TECHNOLOGY (NTI)



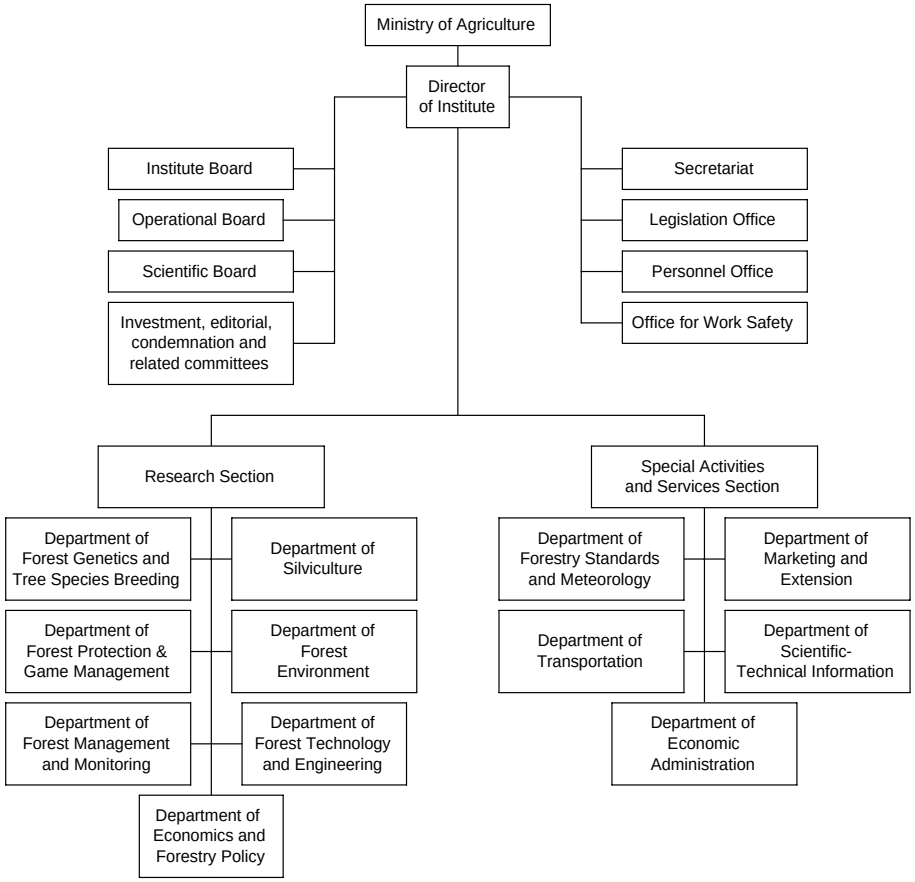
NORWAY: PAPER AND FIBER RESEARCH INSTITUTE (PFI)



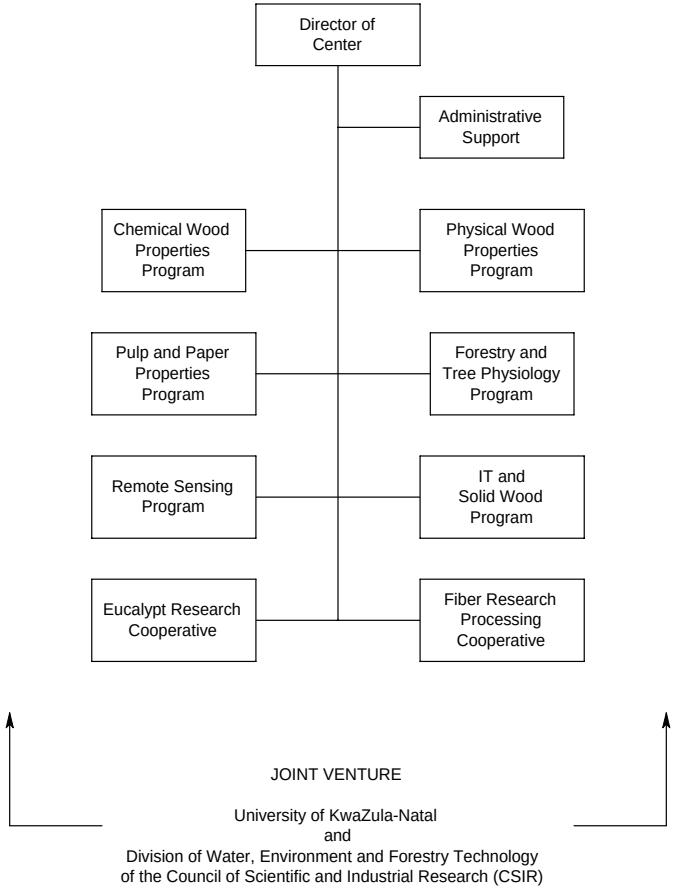
PHILIPPINES: FOREST PRODUCTS RESEARCH AND DEVELOPMENT INSTITUTE (FPRDI)



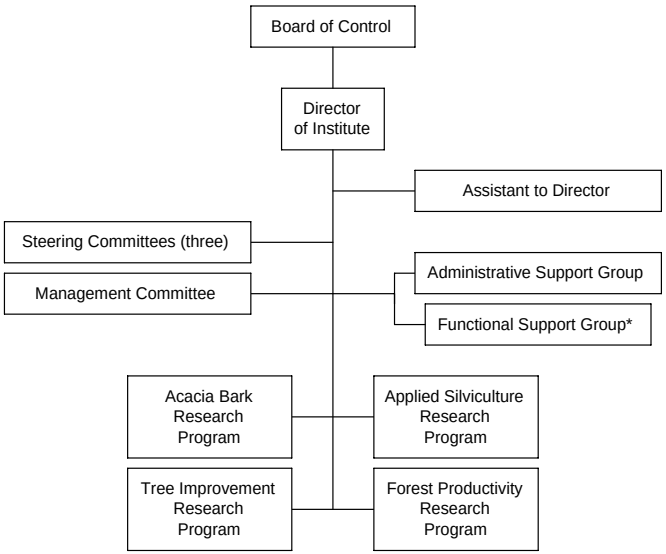
POLAND: RESEARCH AND DEVELOPMENT CENTER FOR WOOD-BASED PANELS



SLOVAK REPUBLIC: FOREST RESEARCH INSTITUTE (FRIS)

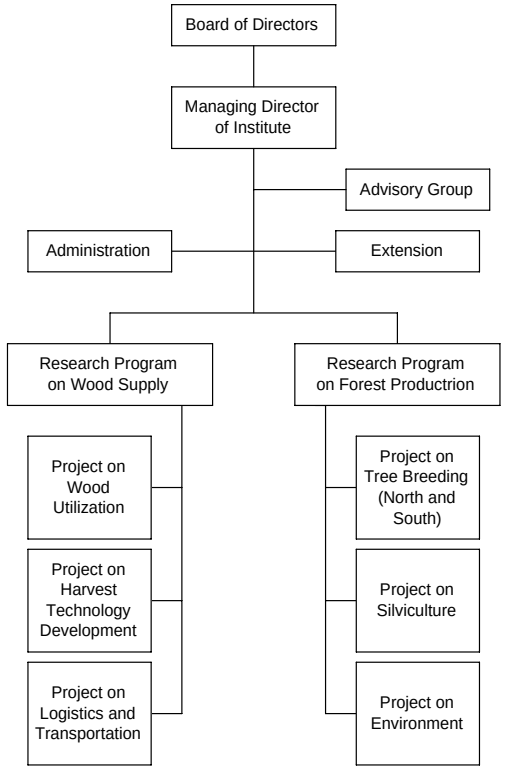


SOUTH AFRICA: FORESTRY AND FOREST PRODUCTS RESEARCH CENTER (FFP)

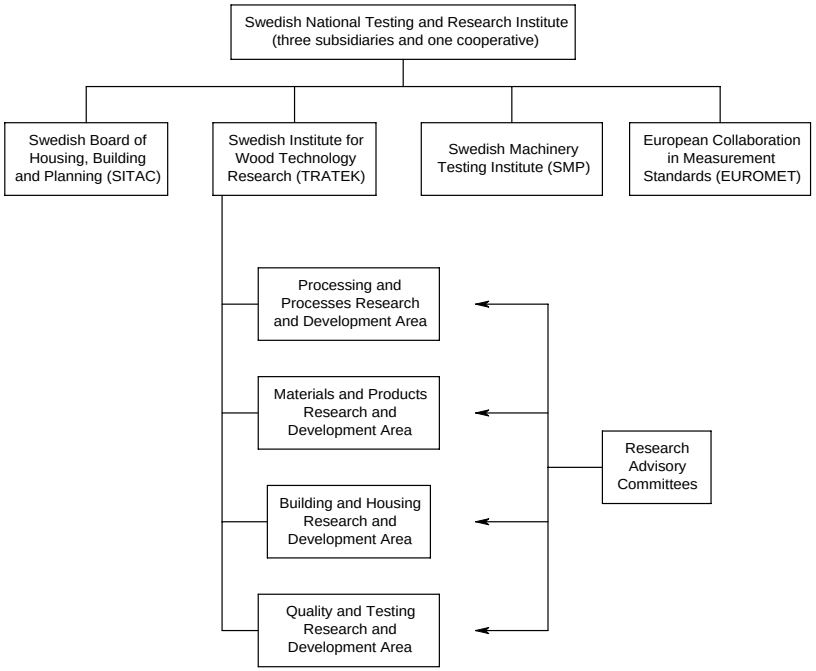


* Library, Laboratories, Editorial Publications, Information Mangement, Computer Network

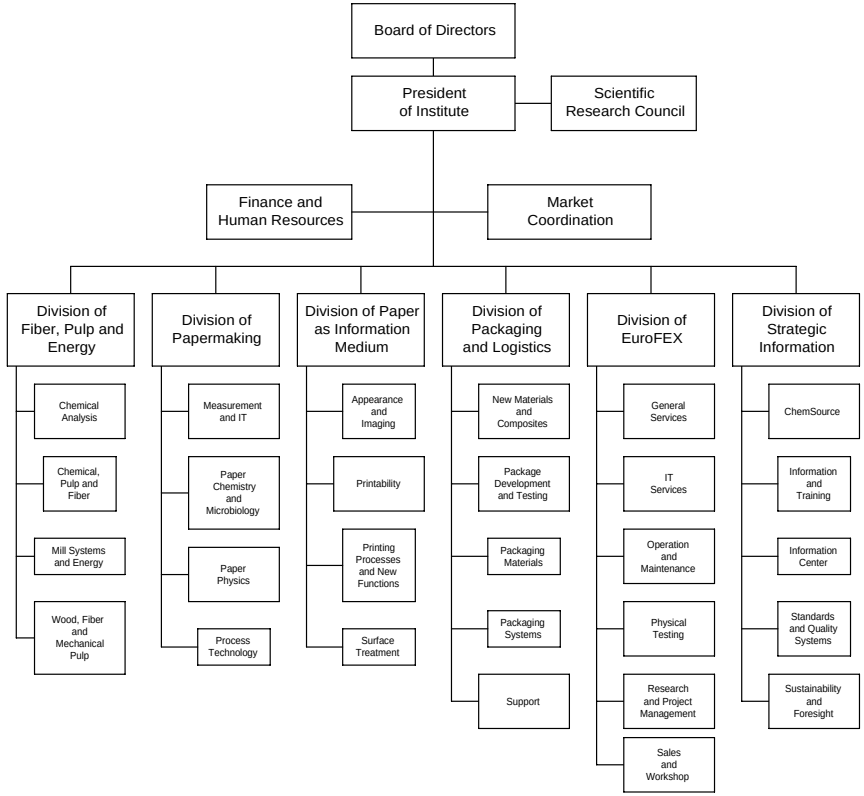
SOUTH AFRICA: INSTITUTE FOR COMMERCIAL FORESTRY RESEARCH



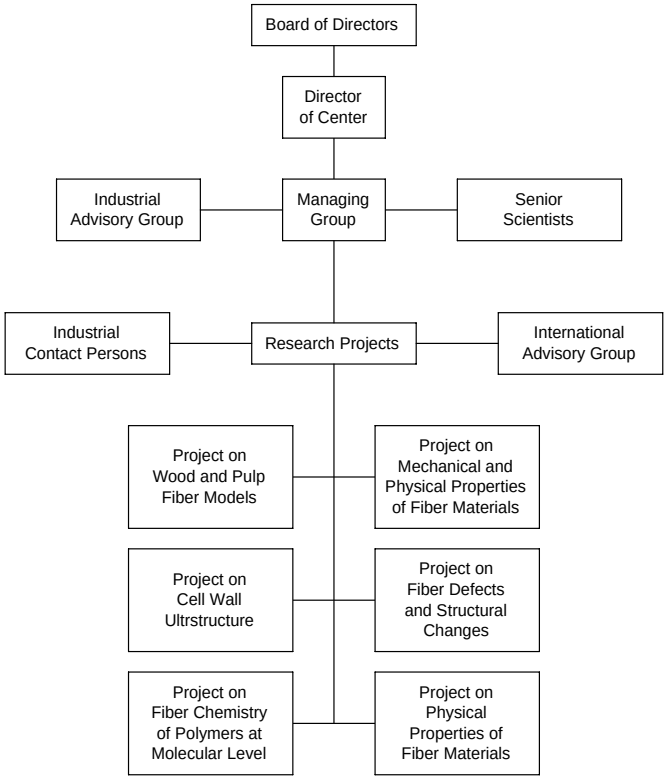
SWEDEN: FORESTRY RESEARCH INSTITUTE (SKOGFORSK)



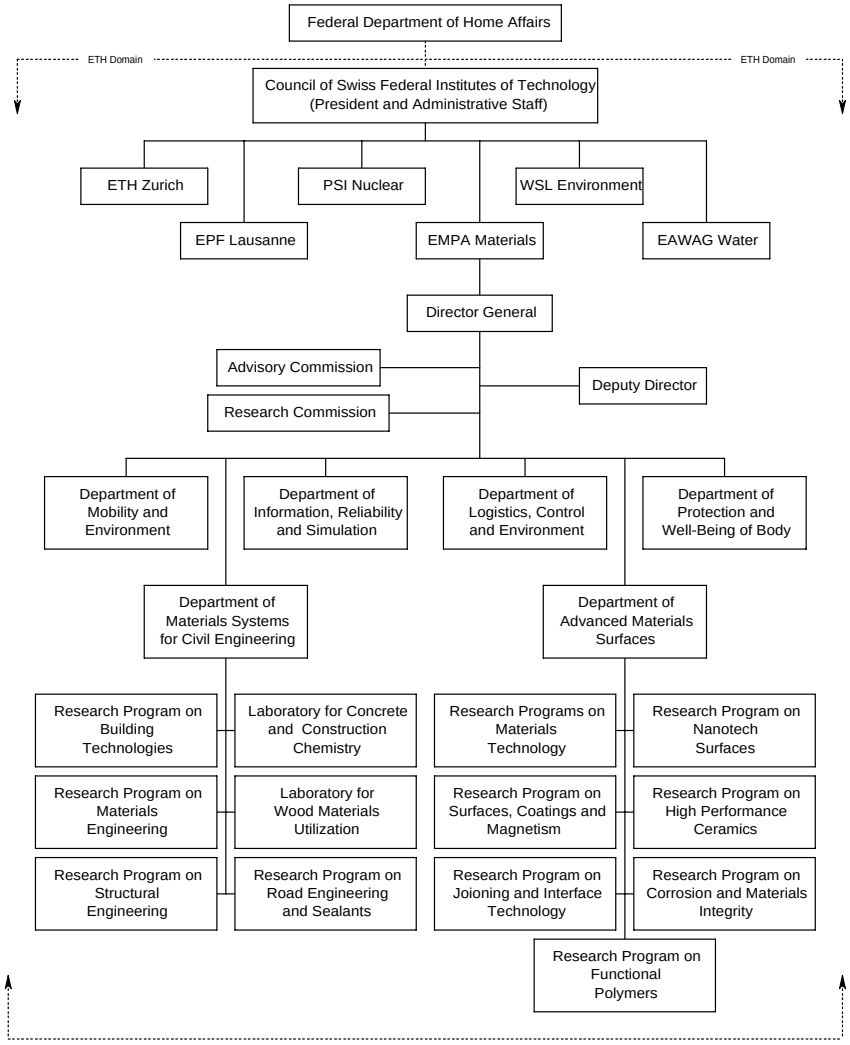
SWEDEN: SWEDISH INSTITUTE FOR WOOD TECHNOLOGY (SP-TRATEK)



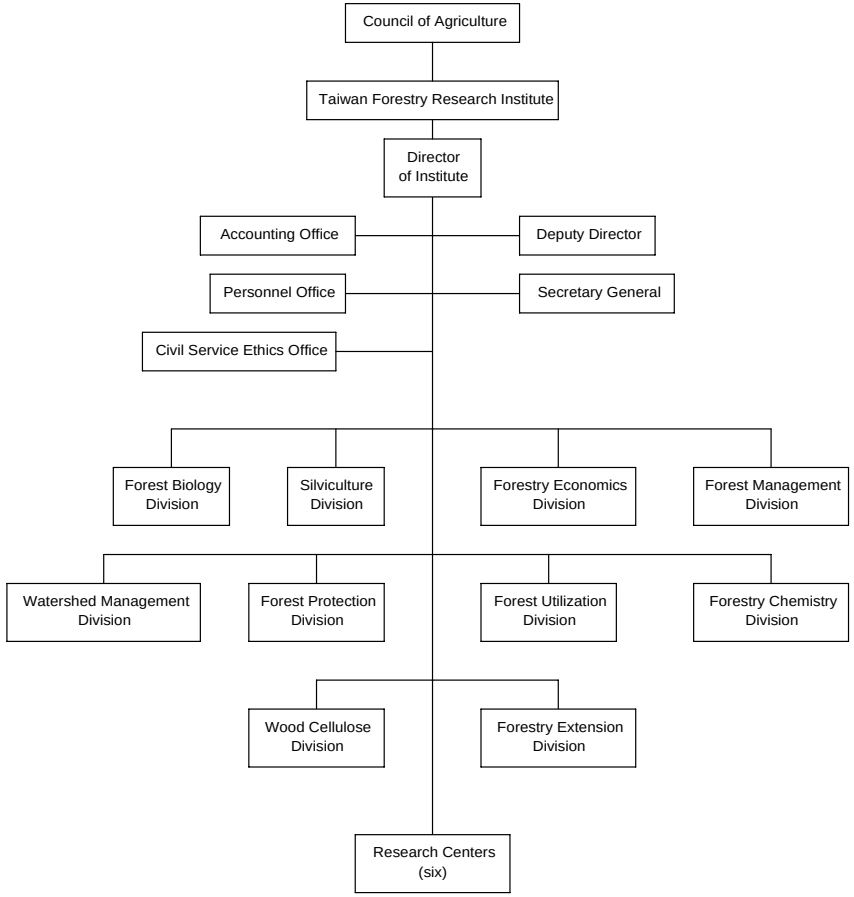
SWEDEN: SWEDISH PULP AND PAPER RESEARCH INSTITUTE/ INSTITUTE FOR PACKAGING AND LOGISTICS (STFI-PACKFORSK)



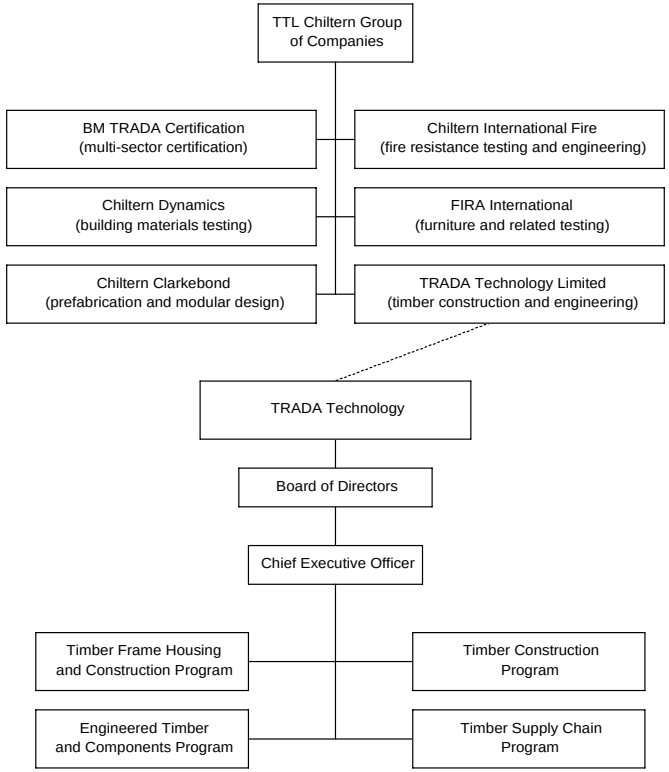
SWEDEN: WOOD ULTRSTRUCTURE RESEARCH CENTER (WUSR)



SWITZERLAND: SWISS FEDERAL LABORATORIES FOR MATERIAL SCIENCE AND TESTING (EMPA)



TAIWAN: FORESTRY RESEARCH INSTITUTE



UNITED KINGDOM: TIMBER RESEARCH AND DEVELOPMENT ASSOCIATION (TRADA)

APPENDIX C:

Abbreviated Description of the Organizational and Operational Characteristics of Selected Forest Products and Related Research and Development Organizations[3]

Federal Office and Research Center for Forests (FBVA) (Austria). Multidisciplinary Research and Training Center and a Public Authority of the Federal Government of Austria under the responsibility of the Federal Ministry for Agriculture, Forestry, Environment and Water Management. Organized into five departments, the center conducts forest and landscape research, prepares scientific guidelines, and disseminates knowledge. Its focus is on (a) sustainable use, multifunctional management and protection of forest ecosystems, (b) conservation and enhancement of biodiversity, (c) protection against natural hazards and georisk-management, and use, management and protection of water catchment areas. Information about the intensity of efforts devoted to various types of forest products research is not available.

Institute of Wood Research (Austria). Organizationally located within the University of Agricultural Sciences (established in 1873) which is within the federal Ministry for Science, the institute is one of seven institutes conducting research on forestry (for example, silviculture, economics) and forest products subject areas (especially Institute of Forest Engineering, staff of five). With a staff of seven (one PhD), the institute engages in educational activities and focuses on the following main areas of forest products research: wood technology, wood processing, and wood quality. Information about the intensity of efforts devoted to various types of forest products research is not available. The institute is located in Wien, Austria.

Queensland Forestry Research Institute (Australia). Institute (established in 1990) is a unit within the Department of Primary Industries of the Queensland Government. With a research staff 80 (15 PhD), the institute offers services involving pure and applied research, technical advice and management, development of decision support systems. Timber related legislation regulation, and tailored training programs. Its research focus is on silviculture, genetic resources, forest health, entomology, ecology, soils, wood chemistry, wood industry, wood quality, vegetative propagation. Research is undertaken for a fee for service or on a contract-funded basis. The institute has a budget of about $12 million (AU) that supports 165 projects. Information about the intensity of efforts devoted to forest products research is not available. The institute is located in Indooroopilly, Queensland.

National Forestry Research Center (Brazil). Organizationally the center (established in 1984) is located within the federal Ministry of Agriculture, and is one of 37 centers within the Brazilian EMBRAPA Organization (responsible for coordinating Brazil's National Agricultural Research System). The center is responsible for generating new technologies, services and products for reforestation activities, environmental conservation and the rational use of the Brazilian forests. It has a team of 59 researchers (28 PhD's) and modern facilities. Major research activities involve development of software for management decisions on pine forests, investigation biological control of forest pests, utilization of industrial wastes as fertilizers for arboreal species, and origin selection of eucalyptus, pinus and grevilea for reforestation. Information about the intensity

[3] Research organizations with potentially creative organizational and administrative settings. However, information about the organization was limited or the available information was in a language other than English.

of efforts devoted to various types of forest products research is not available. The center is located in Colombo, Brazil.

Forest Products Research Center (Brazil). Located within the Amazonia National Research Institute, the center (established in 1979) is part of the Ministry of Science and Technology. With a research staff of 24 (five PhD), the center's main areas of research are botany, entomology, forest products, natural forests, nonwood forest products, pathology, pulp and paper, wood chemistry, wood engineering, and wood processing. The center also provides education, extension and development services. Information about the intensity of efforts devoted to various types of forest products research is not available. Research is undertaken for a fee for service or on a contract-funded basis. The center is located in Manaus, Amazonas.

Forest Products Laboratory, Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) (Brazil). Located in the federal Ministerio do Meio Ambiente, the laboratory is part of the Institute of Environment and Renewable Natural Resources (IBAMA). The laboratory's main areas of research are eucalyptus, natural forests, nonwood forest products, forest products, product development, wood chemistry, wood industry, wood engineering, wood processing, and wood technology. The laboratory's staffing and degree of emphasis on forest products research is not available. The laboratory is located in Brasilia, DF.

Forest Research Institute (Bulgaria). The institute is a unit of the Bulgarian Academy of Sciences that focuses research on the forest resource aspects of silviculture, ecology, genetics, physiology, plantations, entomology, soil science and the ecology of wildlife. An estimated 100 staffs, 47 of which are scientists and researchers. Institute is located in Sofia, Bulgaria. Information about the intensity of efforts devoted to various types of forest products research is not available.

Canada Forest Research (Canada). A research unit of Canadian Forest Service (Natural Resources Canada) that focuses on emerging issues with the intent of advancing the quality and quantity of knowledge concerning Canada's forests. Research is focused on the following areas: biodiversity, biotechnology, climate change, ecology and ecosystems, entomology, forest conditions (monitoring and reporting), forest fires, forest and landscape management, pathology, silviculture and regeneration, and socioeconomics. Information about the intensity of efforts devoted to various types of forest products research is not available.

Forest Products Business Unit, Alberta Research Council (Canada). The forest products unit (one of 17 business units) is part of the Alberta Research Council which was established in 1921 by the provincial government of Alberta. The unit provides fee-for service research in the following areas: panel products, product development, pulp and paper, wood engineering, and wood processing. A staff of 90 persons (10 PhD's) are engaged in research and development activities (including a sustainable forestry program). Information about the intensity of efforts devoted to various types of forest products research is not available. However, the business unit can draw from research staff situated in 16 other business units (for example, bioproducts and advanced materials, environmental monitoring and technologies, carbon and energy management). The unit is located in Edmonton, Alberta.

Research Institute of Chemical Processing and Utilization of Forest Products, Chinese Academy of Forestry (CAF) (China). Organizationally located in the Chinese Academy of Forestry (CAF) within the Ministry of Forestry, the institute's (established in 1960) main areas of research are chemical

products, forest products, nonwood forest products, pulp and paper, charcoal, wood chemistry, engineering, product development, and marketing. Information about the intensity of efforts devoted to various types of forest products research is not available. The institute is also responsible for an extension program. A staff of 223 (7 PhD) are responsible for the institute's activities. The institute is located in Nanjingm, China.

Institute of Forest Ecosystem Research (Czech Republic). Institute focuses research on forest software applications, forest health monitoring, modeling of forest ecosystems, environmental impacts on forest conditions, ecology of animal breeding, and forest inventory. Estimated research staff of 10. Information about the intensity of efforts devoted to various types of forest products research is not available.

Institute of Wood Biology and Wood Technology (Germany). Part of the Georg-August University of Gottingen, the institute focuses on education and research in the areas of wood chemistry and technology, and wood biology and wood products. Estimated five to 10 professional staff and 25 to 30 supporting staff and graduate students. Current research involves wood protection, wood quality, and microorganism impacts on wood. Information about the intensity of efforts devoted to various types of forest products research is not available.

Forest Research Institute (Hungary). The institute is a unit of the Ministry of Agriculture and Rural Development that carries out applied research, professional consultations, and training activities involving forests. The institute is organized into seven departmental research units: forest ecology, forest tree breeding, silviculture and yield, plantation forestry, forest protection, and forest economics. The institute employs an estimated 20 persons, including the institute's director general. Information about the intensity of efforts devoted to various types of forest products research is not available. Institute is located in Budapest, Hungary

Institute of Wood Science and Technology (IWST) (Bangalore, India). Established in 1938, the Institute is a unit of the Indian Council of Forestry Research and Education (an autonomous society governed by a 21-member board of governors of which Minister of Environment and Forests is President). Research is focused on eight areas, including processing and utilization of lesser known timber of plantation species, development of indigenous substitutes for imported raw material in perfumery industries, and utilization of alternate timbers for catamarans, the traditional craft of poor coastal fishermen. Information about the intensity of efforts devoted to various types of forest products research is not available.

Forest and Range Management Research Institute (ISAFA) (Italy). A federal government-sponsored research organization, the institute's mission is to provide for study and research relating to the management and evolution of woods and mountain pastures. Such is accomplished by undertaking studies with high territorial importance, investing in research in concrete operational contexts, coming up to social programs that foster environmental protection, and by improving cooperation between Italian and foreign research organizations. Research and development priorities focus on woods and pastures and the complexity of their ecosystems, functions and values; innovative techniques for the gathering, treatment and representation of information relating to forest and pasture ecosystems; mathematical and statistical models for the dendrometrical estimation and description of the forest stands dynamics; typology, productivity and management of alpine pastures; and cultivation and genetic improvement of plants. Limited, if any, research appears to be focused on forest products or closely related topics. The institute is located in Villazzano, Italy.

Italy Center for Light Industry (CSIL) (Italy). Organizationally the center (established in 1980) is part of the privately owned Furniture Industry Research Institute. The center has a staff of six persons, whose research focus and intensity are not available (presumably furniture oriented). The center is located in Milano, Italy.

Wood Research Institute (Japan). The institute (established in 1944) is part of the Ministry of Education, Culture and Sports within Kyoto University. With a staff of 27 PhD's, the institute's main areas of research are wood chemistry, wood industry, wood engineering, wood processing, wood quality, wood technology, biology, pulp and paper, pests, and forest fires. Information about the intensity of efforts devoted to various types of forest products research is not available. The institute is also responsible for various educational programs. The institute is located in Uji Kyoto, Japan.

State Institute of Wood Chemistry (Latvia). The institute (established in 1946) is one of 25 institutes within the Latvian Academy of Sciences (presumably within the Ministry of Education and Science). The institute's main areas of research are protection and modification of wood materials, pulp production processes, cellulose derivatives, production of wood extractives, polymer chemistry, and influence of ecological factors of wood properties. In 1997, a staff of 111 (down from 344 in 1991) carried out the institute's activities of which 87 were involved in scientific investigations (46 PhD's). Information about the intensity of efforts devoted to various types of forest products research is not available. Located in Riga Latvia, the institute is also responsible for certain educational programs and related activities.

Forest Research Institute (Lithuania). Established by the Lithuanian government in 1950, the institute staff consisted of about 200 persons (in 2000). Research focus is on forest biodiversity, forest genetics, silviculture, forest soils and fores economics. Information about the intensity of efforts devoted to various types of forest products research is not available. Institute is located in Girionys, Lithuania.

Department of Forestry, Ministry of Industry and Primary Resources (Malaysia). Organizationally located within the Ministry of Industry and Primary Resources, the Department's (established 1933) main areas of forest products research involve wood technology and the wood industry generally, while forestry research focuses on afforestation, botany, forestry, natural forests, plantations, silviculture and management, social forestry, and wildlife. The department has a staff of 250 (two PhD's). Information about the intensity of efforts devoted to various types of forest products research is not available. The department is located in Negara, Malaysia.

Timber Research and Technical Training Center (Malaysia). Organizationally located within the Sarawak Department of Forestry, the center's (established in 1969) research focuses on wood technology, wood chemistry, wood quality, wood processing, wood engineering, and the wood industry. The center is also responsible for various educational programs. A staff of 10 (master and bachelor academic level) are responsible for carrying out the center's activities. Information about the intensity of efforts devoted to various types of forest products research is not available. The center is located in Kiching, Sarawak.

Center for Timber Research, Netherlands Organization for Applied Scientific Research (TNO) (Netherlands). The center is organizationally located within the Netherlands Organization for Applied Scientific research (TNO) which was established by federal law (1930) to support companies and governments with innovative and practical knowledge 94,400 (4,400 employees, revenue of 524 euros [36 percent

government, 64 percent contract]). TNO is an independent organization which allows it to provide objective and scientifically grounded judgements. With a staff of 16 (one PhD), the center's main research areas are wood chemistry, wood industry, wood engineering, wood processing, wood quality, and wood technology. Information about the intensity of efforts devoted to various types of forest products research is not available. The center also carries out educational and training activities. The center is located in Delft, Netherlands.

Forest Research Institute (Poland). A federal research institute established in 1945 (history back to 1930). Responsible to the Ministry of the Environment, the institute has 13 scientific departments and a staff of more than 225 persons (estimated 140 engaged in research). Forest products research is conducted within the Department of Forest Use, focusing on assessing and improving technological processes of wood harvesting (especially with account of economic and ecological aspects as well as ergonomic and labor safety requirements); properties of wood and elaboration of guidelines for its rational use, measuring, classification and recording; and assessing and estimating resources and elaboration of guidelines for harvest and collection of minor forest products. The Institute also sponsors economics research in the Department of Forest Policy and Economics. Information about the intensity of efforts devoted to various types of forest products research is not available. Institute is located in Warsaw, Poland.

Research Center for Forest Technology, Tropical Research Institute (Portugal). Organizationally located within Ministry of Research and Technology of the Department of Agricultural Sciences of the Tropical Research Institute, the center (established in 1997) has a staff of three (three PhD's) that focuses research on wood technology, wood chemistry, wood industry, wood quality, forest products, forestry, silviculture, and tree improvement. Although the center's total budget is estimated to be 215,000 euros, information about the intensity of efforts devoted to various types of forest products research is not available. The center is located in Lisbon, Portugal.

Forest Products Research Institute (Slovak Republic). Organizationally located in the federal Ministry of Economy, the institute has a staff of 30 (seven PhD). Although the institute has educational responsibilities, its research focus is the wood products, wood processing, wood quality, wood technology, wood engineering, and chemical products. Information about the intensity of efforts devoted to various types of forest products research is not available. The institute is located in Bratislava, Slovakia.

British Forest Research (United Kingdom). A research unit of the British Forestry Commission serving as the principal British organization engaged in forestry and tree related research, doing so by providing research, development, surveys and related services to forest industry and by providing authoritative advice in support of the UK government's forestry policies. The unit is organized into five divisions, namely divisions of biometrics, surveys and statistics, ecology, environmental and human sciences, forest management, technical services, and tree health. Research within these divisions focuses on the following areas: evaluating woodland resources and potentials; land reclamation and urban greening; people, trees and woodlands; protecting trees; sustainable forest management; tree improvement and forest genetics; woodland biodiversity, and woodlands and the environment. In addition, the unit provides a number of res-related services (library, training, consultancy). Information about the intensity of efforts devoted to various types of forest products research is not available. Organization is located in Farnham, England.

Center for Timber Engineering (CTE) (United Kingdom). Established in 2002, the center is part of Napier University where it seeks to provide the support base to establish timber as a preferred material for

construction, doing so by linking academic and research resources directly to the needs of forestry and forest industry. The center is administered by a management board composed of a director and seven additional board members, while a 17 person advisory board provides advice on research directions and priorities. Three programmatic areas are of interest to the center, namely undergraduate and graduate education (teaching and learning), knowledge transfer (on-line information sources, continuing professional development), and research (timber use in construction [six research staff], external timber cladding [seven research staff]). The center has 35 to 40 total staff (administrative, research, and support staff) that are grouped into three main areas, namely core staff, research staff, and knowledge transfer staff. Information about the intensity of efforts devoted to various types of forest products research is not available. The center is located in Edinburgh, Scotland

Forest Products Research Center (FPRC) (United Kingdom). Center is a department of Buckinghamshire Chilterns University College. Mission is to conduct wood-related research that is of international significance and quality. Research program focuses, three major areas, namely wood protection (understanding organism leading to wood deterioration and the means of protecting wood from such organisms), wood materials (physical and mechanical properties of wood, especially involving panel products), and forestry (woodland management, certification of timber resources). Center also engages in consultancies and in education at the undergraduate, graduate and postdoctoral levels. Staff of nine (four academic and five associate academic) plus six postgraduate students. Advisory committee of 23 persons from various academic, industry and trade organizations (four executive committee members, 19 full committee members). Measures of performance include publications, honors granted staff, international conferences attended, and engagement in research collaborations. Information about the intensity of efforts devoted to various types of forest products research is not available. The center is located in High Wycombe, England.

Paper and Fiber Research Institute (PIRA) (United Kingdom). A private independent organization specializing in consultancies to various industries engaged in packaging (for example, package design, recycling compliance), paper making (for example, market research, efficiency improvement), printing (for example, digital print technology, product testing), and publishing (web site production, database development). Established in the early 1930s, PIRA has a full-time staff of about 140 at its headquarters in England. In March 2004, PIRA was acquired by Swiss-owned Ciba Speciality Chemicals. Information about the intensity of efforts devoted to various types of forest products research is not available. The institute is located in Leatherhead, England.

Division of Forest Products Research, Ministry of Environment and Natural Resources (Zambia). The division (established in 1963) is organizationally located within the Ministry of Environment and Natural Resources. With a staff of seven (three master of science, four bachelor of science), the division focuses its research on forest products, wood industry, wood processing, wood engineering, wood technology, wood chemistry, nonwood forest products, pulp and paper, work safety, and charcoal. Information about the intensity of efforts devoted to various types of forest products research is not available. The division is located in Kitwe in the province of Copperbelt.

Other Organizations with Forest Products Research Responsibilities: Institute of Wood Science and Technology (Austria); Centro de Investigacion de Celulosa y Papel (CICELPA) (Argentina); Forest Research Institute (Bangladesh); Institute of Environment and Renewable Natural Resource (IBAMA) (Forest Products Laboratory) (Brazil); Institute of Wood Timber Structures (IBRANEM) (Brazil); Institute of Forestry

Research (IPEF) (Brazil); Center for International Forestry Research (CIFOR); Forestry Institute (Chile); Shanghai Research Institute of Wood Industry (China); National Corporation for Forestry Research and Development (Columbia); Forestry Research and Service Institute (Costa Rica); Forest and Landscape Research Institute (Denmark); Forest Research Institute (Estonian); Fraunhofer Institute for Wood Research (Germany); Forest Research Institute (Greece); National Forestry Institute (Guatemala); Institute for Wood Research (Italy); Wood Research Institute, San Michele all'Adige Istituto per la Tecnologia del Lego (Italy); State Institute of Wood Chemistry (Latvia); Institute for Forests and Forest Products (SBH) (Netherlands); Institute of Wood Technoloy (Scotland); CSIR Division of Water, Environment and Forestry Technology (ENVIRONMENTEK) (South Africa); and Forest Science Institute (Viet Nam).

APPENDIX D:

Comprehensive Description and Organizational Charts of Selected Forest Products Research and Development Organizations in the United States

▪ ***Forest Products Laboratory (FPL), Forest Service, U.S. Department of Agriculture***

Date Established: Established in 1910.

Public-Private Sector: Public.

Mission: Vision: To be the world leader in innovative wood utilization research that improves our quality of life while conserving wood and fiber. In reaching our vision, we will help create a future in which people throughout the world benefit from healthy forests and grasslands that provide round wood, solid sawn wood, composites, fibers, chemicals, energy, and other renewable materials in a sustainable manner. Mission: To identify and conduct innovative wood and fiber utilization research that contributes to conservation and productivity of the forest resource, thereby sustaining forests, the economy, and quality of life. The mission of the FPL is to be sought by advancing fundamental science; conserving the wood resource; promoting forest-related ecological; economic and social sustainability; providing information that supports natural resource policy development; ensuring safe, reliable, durable, and disaster-resistant, performance of wood structures; helping solve critical problems facing the U. S. Forest products sector related to wood-based environmental issues, and providing a high level of service to the public.

Primary Research Focus: Forest products.

Governance and Organization: Administered by a director that reports to the Chief, Forest Service, U.S. Department of Agriculture. Organized into three main units (each administered by an assistant director), namely Wood Products Research; Wood, Fiber and Composites Research; and Administration (human and financial resource management, communication, facilities, civil rights, library). Also a Technology Marketing Unit (TMU) (under the director's guidance) of State and Private Forestry, Forest Service, U. S. Department of Agriculture, and special staff of the Forest Service (Washington office), U. S. Department of Agriculture (focus on science policy, information management, customer services). Organization located at Madison, WI.

Strategic Program Directions (2006): Focus is on six strategic emphasis areas, namely conservation of resources, environmental research, sustaining ecosystems, social and economic vitality, basic wood science (foundation), and public service. These emphasis areas are expressed organizationally as: Wood Products Research, namely engineered properties and structures, durability and wood protection, engineering mechanics and remote sensing, and economics and statistics; and Wood, Fiber and Composites Research, namely composites sciences, forest materials modification, analytical chemistry and microscopy laboratory, microbial and biochemical technology, fiber and chemical sciences, and paper testing.

Client Groups: Public and private.

Services Provided: Information (library resources), research, publications, conferences and seminars.

Budget and Funding Sources (2006):

A. Income

US$ 33.1 million

B. Source of Income

Federal government appropriations – 100 percent

C. Expenditures

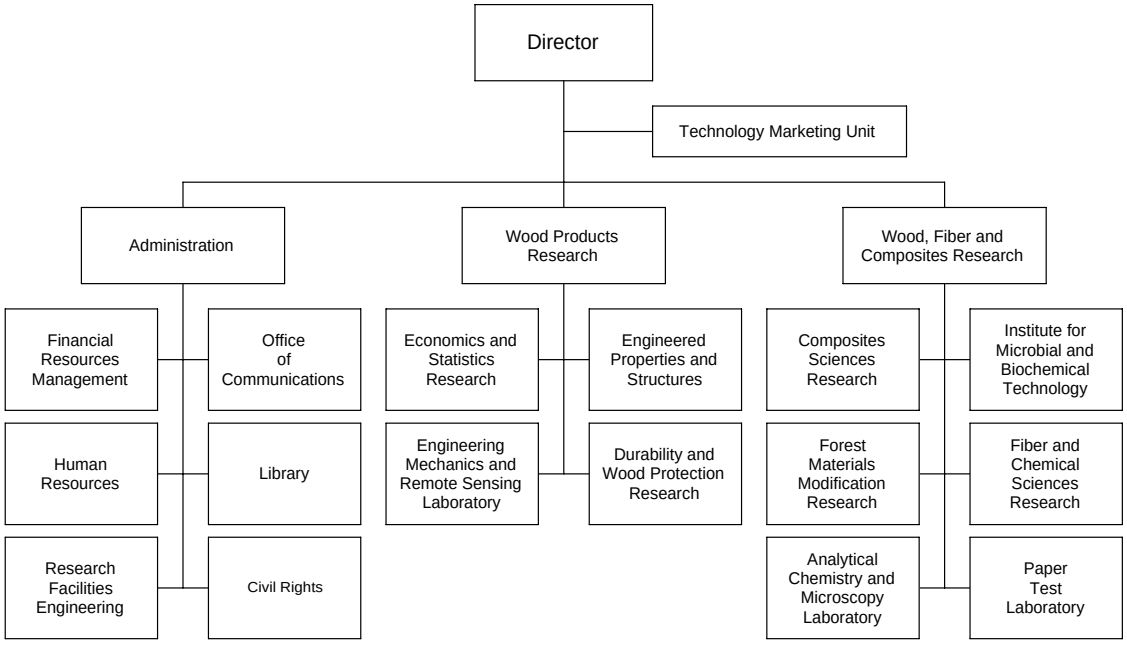
US$ 33.1 million

D. Focus of expenditures

Research generally – 66 percent
Hazardous fuels – 2 percent
Construction – 7 percent
Cooperative research -- 4 percent
Extra mural – 21 percent

Scientists and Supporting Staff: 204 permanent employees of which 61 are scientists and 143 are support staff. Distribution of total staff (estimated 2005): Office of Director (including TMU) – four percent, Office of Administration – 24percent, Wood Products Research – 42 percent, and Wood, Fiber and Composites Research – 30 percent.

Measures of Performance: Listing of publications.



UNITED STATES: FOREST PRODUCTS LABORATORY, FOREST SERVICE, U.S. DEPARTMENT OF AGRICULTURE

TAPPI, Technical Association for Pulp and Paper Industry

Date Established: Established in 1915.

Public-Private Sector: Private, member emphasis. In some cases, membership is open to individuals (member, associate member, student member), while in other cases membership is open to individual as well as organizations engaged in the manufacture of pulp, paper and related manufacturing (affiliate, sustaining, site member). Membership (2002) estimated to be 28,000 individuals in the worldwide pulp, paper and converting industry, and sustaining member companies desiring recognition as active supporters of the pulp and paper industry.

Mission: Vision: To make a significant positive difference in the professional lives of TAPPI members. Mission: To engage the people and resources of TAPPI in providing sound solutions to the workplace problems and opportunities that challenge our current and future members

Primary Research Focus: Forest products, especially pulp and paper.

Governance and Organization: Governing board (16 persons) including a president, vice-president and an executive officer (president). Organized into 11 technical divisions (industry segments) (composed of nearly 80 technical committees) namely coating and graphic arts; corrugated packaging; engineering; environmental; finishing and converting; nonwovens; paper and board; PLACE (polymers, laminations, adhesives, coatings and extrusions); process and product quality; process control; process control, electrical and information; and pulp manufacture. In additions, there are four independent committees as follows: Information Management (promotes the enhanced management, availability, utilization and quality of information and the development of new information resources and systems), Microbial and Microbiological Technology (evaluates microbiological control systems and studies microbiological processes), Paper Physics (promotes fundamental knowledge on the structure and properties of fibers and fibrous products), and Research Management (promotes enhancement of the management of research and development in the pulp and paper industry). Membership in the latter committee is by invitation only and is limited to corporate vice presidents, directors of research, or heads of organizations or academic departments devoted to research in the industry. Tappi Foundation supports public outreach activities. Organization headquarters in Norcross, GA.

Strategic Program Directions: Research directions are consistent with TAPPI's 11 technical divisions, namely coating and graphic arts, corrugated packaging, engineering, environmental, finishing and converting, nonwovens, paper and board, place (polymers, laminations, adhesives, coatings and extrusions), process and product quality, process control, electrical and information, and pulp manufacture.

Client Groups: Public and private, member emphasis.

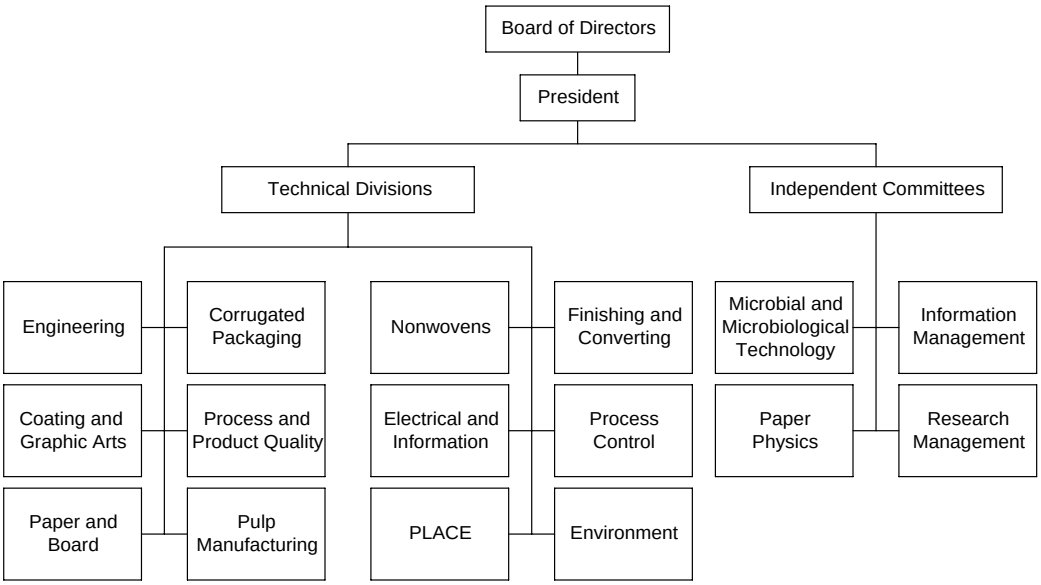
Services Provided: Information resources (library), publications, conferences and seminars, development of standards, material and process testing, on-line discussions. Reports ability to provide members with rapid access to: largest international group of technically experienced people in the industry, most comprehensive collection of reliable technical information and knowledge in the industry, and highest quality products and services created to meet the needs of people who solve technical problems in the industry.

Budget and Funding Sources (2005):

A. Income: $10.7 million
B. Source of Income: Not available.
C. Expenditures: $10.1 million
D. Focus of expenditures: Not available.

Scientists and Supporting Staff: 48 staff identified as contacts for information (95 total estimated staff).

Measures of Performance: Financial position statements, income-liability statements, publication lists, conferences sponsored, new members.



UNITED STATES: TAPPI
TECHNICAL ASSOCIATION FOR PULP AND PAPER INDUSTRY

Institute of Paper Science and Technology (IPST), Georgia Institute of Technology

Date Established: Established in 1929 as the Institute of Paper Chemistry (IPC) (affiliated with Lawrence College, Appleton, WI), and in 1989 was renamed the Institute of Paper Science and Technology (IPST).

Public-Private Sector: Private, member emphasis. Sixteen member companies (2005).

Mission: Vision: To be recognized as the worlds leading research and educational enterprise supporting the global pulp & paper and related industries; and to produce research output that has a significant beneficial impact on the manufacturing and use of pulp & paper and related products. Mission:Provide new knowledge and technology that contribute to the economic viability of the global pulp, paper, and related industries; prepare leaders for the pulp, paper, and related industries; and conduct research and transfer technology to support the technical needs and competitive position of member companies. Objectives: Integrate strengths of Georgia Tech & IPST, monitor and address needs of industry, perform research related to supply and utilization of forest products, anticipate-lead developments and create effective solutions supportive of the pulp and paper industry, produce graduates recognized for ability to lead industrial organizations in a global environment, and continually work to deliver value to IPST member companies.

Primary Research Focus: Forest products, especially pulp and paper.

Governance and Organization: Board of directors and a director. Integrated with Georgia Institute of Technology, a condition allowing intellectual property, licensing, contracts, and other issues to be handled by the Georgia Tech Research Corporation (GTRC). Affiliated with Center for Paper Business and Industry Studies (joint venture of Georgia Institute of Technology, Alfred P. Sloan Foundation, and industry).Organization located in Atlanta, GA. Responsible for Williams American Museum of Papermaking.

Strategic Program Directions: Research focus on five major topical areas, namely:

- •New product platforms – barrier coatings, intelligent packaging, fiber composites, and nano materials
- •Sustainable materials, chemicals and fuels – forest biology, new chemical products, biorenewable fuels and energy, and biocomposites
- •Recycling and environment – recycling, environmental; control, CO_2 reductions and credits, and environmentally sustainable process technology.
- •Business focused research – impacts of globalization, enterprise effectiveness, workplace transformation, commercialization, and technology adoption and implementation.
- •Process and product technology – pulping and bleaching, chemical recovery, forming, dewatering and drying, coating, corrugating and converting, paper chemistry and physics, corrosion, energy, sensors and controls, and separations.

Client Groups: Private, owner-member emphasis.

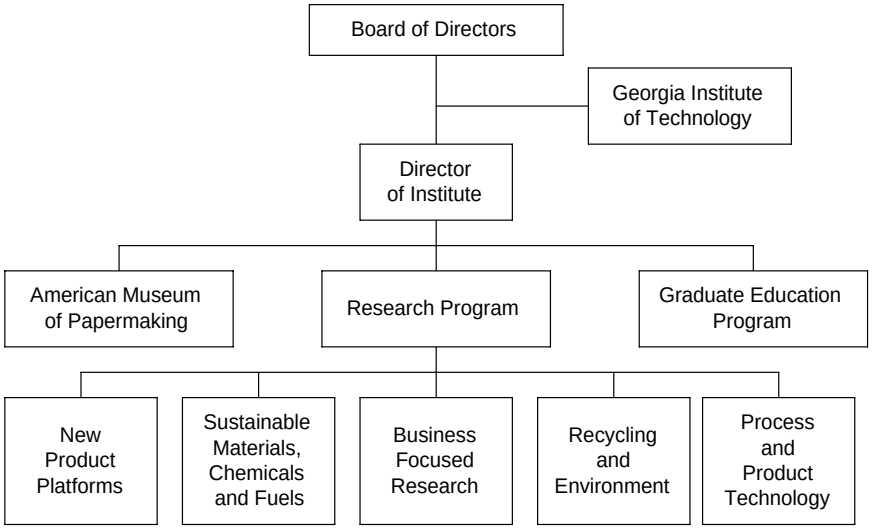
Services Provided: Research (direct delivery of products), testing, pilot experimentation, education (graduate education degrees).

Budget and Funding Sources:

A. Income: $23 million
B. Source of Income: Not available.
C. Expenditures: Not available.
D. Focus of expenditures: Not available.

Scientists and Supporting Staff: Academic staff of 12, research staff of 20, plus supporting staff.

Measures of Performance: Not available.



UNITED STATES: INSTITUTE OF PAPER SCIENCE AND TECHNOLOGY (IPST)
GEORGIA INSTITUTE OF TECHNOLOGY