

EDUCATIONAL NEEDS OF THE CANADIAN SOLID WOOD PRODUCTS INDUSTRY

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ABSTRACT

To address problems in wood science educational programs, the Department of Wood Science at the University of British Columbia initiated a needs analysis of the Canadian wood industry. This analysis was conducted using a national mail survey as well as more qualitative focus groups. Results indicate that the current content of a university-based wood products educational program requires a shift in emphasis. A need for analytical and managerial skills was indicated as well as additional emphasis on mechanical processing. While basic wood science should remain strong, a deemphasis was needed to provide the time required for program content expansion. The length of an undergraduate program should be expanded to incorporate an additional year of industry placement as part of the educational process. In addition, a professional master's program should be available to train graduates with non-wood science degrees to bridge into wood product careers. By starting with a blank piece of paper and addressing one (out of many) key groups who hire our graduates, a recognition of the changing needs of the wood products sector is emerging. This is the first step in a process to address many of the previously expressed critical concerns regarding declining enrollments and interest in wood science educational programs.

Keywords: Education, teaching, wood processing, training.

INTRODUCTION

In order to better understand the educational needs of the changing Canadian wood products industry, a survey was mailed in 1994 to industry executives with hiring and management responsibilities in the primary, secondary, and tertiary¹ segments of the wood products sector. The survey contained a number of questions concerning three key areas of un-

dergraduate education and curriculum development: 1) program content—the specific knowledge, skills, and abilities that are required in a wood science or wood and fiber products program to best meet the future needs of an industry currently undergoing structural change; 2) program delivery—how to offer this new type of program to students; 3) program size—how large a program is needed based on the number of graduates required on an ongoing basis. Information was collected using both mail and facsimile (fax) survey techniques followed by two focus group meetings, one with primary producers and another with

¹ The tertiary sector consisted of firms that service the primary and secondary sectors and included consultants, equipment manufacturers, research organizations, associations, and government agencies.

secondary producers and the tertiary sector. Results of this research are being used to provide information necessary to reengineer the undergraduate wood science and technology program at the University of British Columbia and to address many of the concerns expressed in Bowyer (1991) and Lyon et al. (1992). Advice and assistance were provided by a senior management level, industry-based, ad hoc subcommittee.

Background

Enrollment in undergraduate Wood Science and Technology (WST) programs has decreased dramatically over the past 15 years (see Table 1). Bowyer (1991) reported that undergraduate enrollment averaged only 19 students in Wood Science and Technology programs in North America. In Canada average enrollment was only 16 students. He observed that while enrollments and numbers of graduates had declined, there were insufficient well-educated graduates for the forest products industry. In addition to increased demand by industry, there was increasing demand for graduate students to meet expanding research expenditures on forest products research at universities (Smulski et al. 1991). Fears have been expressed that as in-house industrial expertise is declining, public sector technical expertise is also declining due to reduction in enrollment in wood science and forest products (Lyon et al. 1992).

Bowyer's thoughts include the suggestion that we redefine the terms "wood technology" and "wood technologist" and reexamine our academic curricula. Bowyer suggests the following modifications (*italicized and bold*) of Ellis' definitions (1964):

Wood Technology—follows as the application of knowledge in the conversion, processing, **and use of wood**.

A *Wood Technologist*—applies wood science and related knowledge in making wood more useful to man, and . . . requires not only an expert knowledge of wood science, but, additionally, a sound

TABLE 1. Comparison of U.S. and Canadian forest products majors and graduates as reported by various surveys.

| Author, publication date: Year of enrollment: | Ellis 1964 early sixties | Barnes 1979 1977 | Bowyer 1991 1988 | Lyon 1992 1992 |
|--|--------------------------------|------------------------|------------------------|----------------------|
| Forest products majors | 400–450 | 1,065 | 480 | 324 |
| Forest products graduates | N.A. | 204 | 150 | N.A. |

Adapted from Bowyer 1991 and Lyon 1992.

understanding of industrial manufacturing equipment and methods **and/or an understanding of the process by which products are conceived, designed, distributed, and sold (i.e. marketing)**.

These new definitions expand the skills and abilities of a wood technologist to incorporate more applied technology. This modification fits well with industry initiatives in Canada to develop a new type of education for the secondary wood sector (Holtham 1994). The crisis in education for Wood Science and Technology programs (as well as other forestry programs) is well recognized in the literature (Duncan et al. 1989; Kennedy 1990; Bowyer 1991). Reengineering education for wood technologists requires the first step, assessing the needs of future employers of graduates of any newly redesigned educational program. The needs assessment survey was developed to complete this task.

METHODOLOGY

Sample frame and sample size

A very large sample frame was developed using the membership, mailing lists, and assistance of the Council of Forest Industries of British Columbia (COFI), the British Columbia Wood Specialties Group (BCWSG), Industry Canada (IC), the Western Canadian Wood Machinery and Services Export Association, Forintek Canada Corp., and faculty members in the Department of Wood Science in the Faculty of Forestry at the University of British Columbia (UBC). A judgmental sample of 502 individuals was chosen to provide a cross section of potential employers of grad-

TABLE 2. *Responses by industry sector.*

| Sector | Number of respondents |
|--|-----------------------|
| Primary manufacturing (e.g., sawmills, plywood plants, OSB mills, pulp and paper plants) | 47 |
| Secondary manufacturing (e.g., engineered building components, custom-cut plants) | 27 |
| Consultants (e.g., process, quality control, financial, or managerial) | 9 |
| Equipment manufacturing | 4 |
| Research (private, semi-private, public) | 3 |
| Associations | 4 |
| Government (federal, provincial, municipal) | 4 |
| Undefined | 4 |
| Total | 102 |

uates of a relevant program in WST. Judgment was based on choosing personnel who set hiring guidelines without over-representation from any individual company. Emphasis was on industry representatives (compared to government or association) from a broad range of primary, secondary, and tertiary wood products companies. Suggestions from the ad hoc committee were incorporated into the final sample.

Of the 502 surveys mailed out, 453 were in English and were mailed to firms that operate predominantly in the solid wood sector throughout Canada, except for Quebec. An additional 49 surveys, translated into French, were mailed to key personnel in the wood products industry in Quebec. To ensure a broad cross section of potential employers, surveys were mailed to members representing each of the following three sectors: primary manufacturing, secondary manufacturing, and the tertiary support sector (see Table 2).

Survey design

A limited time horizon and the direction of the industry ad hoc committee expedited the survey development, design, and implementation. The survey was designed during January 1994. The ad hoc committee and other industry representatives, the Faculty in the Department of Wood Science, and the Dean of the Faculty pretested and pilot-tested the

TABLE 3. *Responses by position.*

| Position | Number of respondents |
|------------------------|-----------------------|
| Production management | 15 |
| Sales/marketing | 10 |
| Technical support | 10 |
| Senior management | 6 |
| Research/science | 4 |
| Engineering and design | 4 |
| Other | 37 |
| Undefined | 16 |

survey². Once completed, the survey, covering letter, and attachments were translated into French in order to cover the entire Canadian sample frame. Packages were mailed the first week of February, and respondents were asked to fax back the two-page survey. The official cutoff date for responses was February 28, 1994.

RESULTS

Responses

Of the 502 surveys mailed, 102 were returned by the cutoff date. This response rate of 20.3% is well within the acceptable limits given that there were no prenotification letters, no follow-up letters or surveys, no prepaid response method, and no telephone contact (Adams 1986; Bruvold and Comer 1988; Kanuk and Berenson 1975). Responses were received from all sectors, with the majority from primary (47 responses) and secondary manufacturers (27 responses). All other sectors were grouped as "other" or "tertiary" for the purposes of reporting (28 responses). Complete respondent profiles are summarized in Tables 2 and 3.

Program content

There was general agreement among all three groups (primary, secondary, and tertiary) that

² A pretest asks respondents to comment on each question, while a pilot test requires selected individuals to actually complete the survey and provide an overview and evaluation of a more finished survey instrument.

the best program would have about 55% fundamental traditional content and 45% applied and technical skills education. Fundamental content was defined as education in wood science, mechanical wood processing, pulp and paper technology, and business logistics. Skill content was defined as computer proficiency, production and management skills, communication competence, and laboratory skills. The nearly even split between fundamental knowledge in the program sector and the more applied support knowledge in skills indicated that any new program must ensure adequate attention to non-wood technology instruction while maintaining the basic program strength in wood science.

Table 4 shows that there was surprising unanimity among all three segments (primary, secondary, and tertiary) concerning the relative importance of a variety of topics designated as fundamental, traditional content. As is obvious from Table 4, responses indicated that about 15% of educational time should be devoted to each of wood science, mechanical processing of wood, and business logistics. Pulp and paper and other miscellaneous topics should take up an additional 15% of educational time allotment.

Respondents indicated that the other approximately 40% of instructional time should be devoted to areas designated as applied, technical skills. Again there was surprising agreement among the different sectors regarding the relative importance of different skill components (see Table 4). Respondents designated that about 15% of all instructional time should be allocated for production and management skills. Each of communication and computer skills was to account for about 10% of total time allotment. Laboratory and other miscellaneous skills account for the remainder of instructional time. Table 4 summarizes the breakdown of time allotment for instructional time.

This table provides a guideline for allocation of time and resources to meet the needs of the 102 respondents to this survey. It is interesting to note the unanimity of relative importance

TABLE 4. Breakdown of fundamental and applied education in % of total time commitment.

| Category | Pri- mary | Sec- ondary | Other | Grand Total |
|---------------------------|--------------|----------------|-------|----------------|
| Fundamental | | | | |
| Wood science | 16 | 15 | 18 | 16 |
| Mechanical processing | 15 | 15 | 21 | 16 |
| Logistics | 12 | 16 | 14 | 14 |
| Pulp & paper | 10 | 6 | 8 | 8 |
| Other | 3 | 4 | 1 | 3 |
| Total fundamental | | | | 57% |
| Applied | | | | |
| Production and management | 16 | 17 | 14 | 16 |
| Communication | 12 | 13 | 10 | 11 |
| Computer skills | 10 | 9 | 9 | 10 |
| Laboratory skills | 6 | 4 | 4 | 5 |
| Other | 0 | 1 | 1 | 1 |
| Total applied | | | | 43% |

among the primary, secondary, and tertiary sectors. The three most critical areas of education include wood science, mechanical processing, and production and management skills. Almost as important are business logistics. While results indicate that these four areas should form the core of any future educational program, other programs and skills should not be ignored but deemphasized in terms of time commitment. Additional detail concerning content of the four educational areas respondents considered most critical follows.

Wood science.—Respondents considered the most essential field of study within wood science as wood physics and drying (Fig. 1). Adhesives and wood composites, wood anatomy, and deterioration and protection were also considered very important. Less important, but slightly higher than optional, were wood chemistry and biology and biotechnology.

There were distinct differences between some of the responses from the primary and secondary sectors. Primary producers indicated that physics and drying, anatomy, deterioration and protection, and chemistry were all very important, with scores over 3.9. Secondary producers agreed with primary producers but considered wood chemistry less important than primary producers.

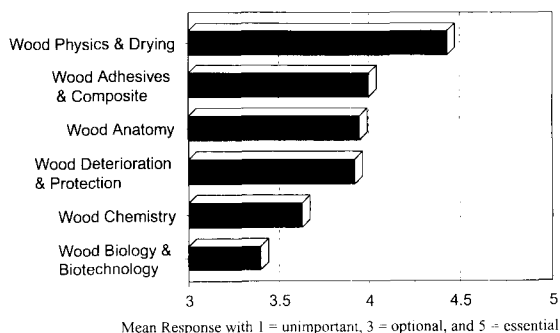


FIG. 1. Relative importance of content of wood science educational area.

Mechanical processing.—Lumber processing, quality control, process control, and lumber re-manufacturing were all considered very important aspects of education in mechanical processing, with ratings over 4.0 (Fig. 2). Both primary and secondary producers also rated computer-aided design and manufacturing (CAD/CAM) as important. Secondary manufacturers also considered door and window manufacturing as important. The “other” sector considered timber design and construction as important.

Production and management.—Respondents considered problem-solving, time management techniques, and cost accounting and budgeting as very important educational areas (Fig. 3). Also ranked as important were systems analysis and plant layout and design.

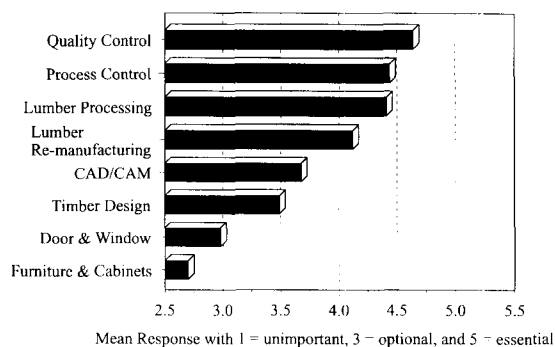


FIG. 2. Relative importance of content of mechanical processing educational area.

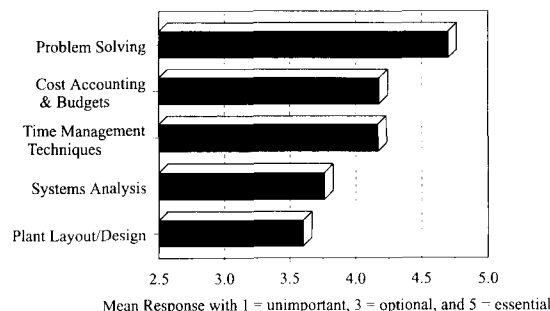


FIG. 3. Relative importance of content of production and management educational area.

There was little difference between primary and secondary producers.

Business logistics.—All sectors considered all four aspects of business logistics (international trade, management and finance, technology management, and human relations) as very important. There was little difference between sectors.

Other content.—Respondents indicated a few other areas of educational content that were considered important for an appropriate education (see Table 4). Two of the main topic areas were:

1. Computer Skills (word processing, data base, spreadsheets and statistical analysis) and
2. Communication Skills (report writing, oral reports, and interpersonal communications).

Written qualitative comments indicated a deep, but not a broad, need for a program devoted to secondary manufacturing with a focus on windows, doors, cabinets, plant design, and management. These qualitative comments indicated a need for “hands-on,” practical, technical knowledge at the university level. This need did not show up in the descriptive statistics but was clear from the comments, both written and during subsequent focus groups.

Program delivery

As part of survey design, pilot testing, and pretesting, the short list of options available

for offering an acceptable university-based program included:

- four-year undergraduate program similar to current one,
- five-year co-op undergraduate program incorporating approximately 12–18 months of related industry work experience,
- one-year wood science/forest products minor for undergraduate engineering students,
- one-year option for undergraduate forestry students, and
- one-year professional master's degree.

Survey respondents indicated the most preferred method of delivery was a four-year undergraduate program similar to the length and structure of the one currently offered. This assumes that the changes and restructuring presented in the content section are completed. The second most favored method of delivery was a five-year cooperative education program. It was surprising to note the lack of support for a one-year professional master's degree, although a few respondents did consider it essential (see Fig. 4).

Focus group discussion uncovered the fact that the majority of industry representatives did not understand that a one-year professional master's degree was intended to be a non-thesis degree that did not focus on research design and implementation. Support for a one-year master's program equaled that for a traditional four-year program if the one-year professional master's program had the following attributes:

- duration of 12 months or less,
- program designed for individuals with undergraduate science or engineering degrees but with little wood science training,
- course work focused on providing a basic wood science and processing background for individuals with analytical and scientific education,
- content focused on information, tools, and skills relevant to the emerging knowledge-based wood sector.

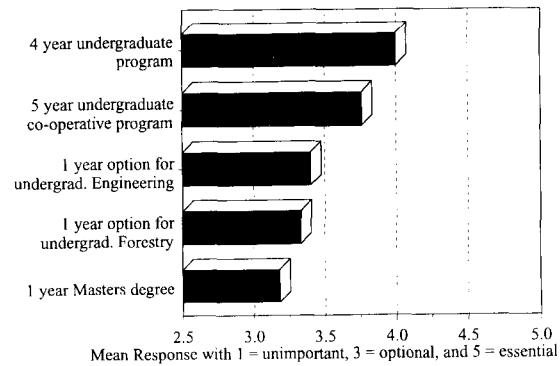


FIG. 4. Relative importance of delivery methods for revised educational program.

Synthesizing the quantitative results from the survey and the qualitative results from the focus groups and follow-up via unsolicited telephone calls showed that the three most favored methods of delivery were: 1) a five-year cooperative, undergraduate program with at least 12 months of work placement, 2) a traditional four-year undergraduate program, and 3) a one-year professional master's program designed for those successfully completing undergraduate engineering and other science programs.

Program size

Results were surprising in terms of the number of graduates of a redesigned and reengineered education program at UBC that would be hired by respondents. This question was answered by fewer than half of the 102 respondents who indicated that they would hire between 48 and 55 graduates per year. These results are not adjusted for: 1) the majority of respondents who did not answer this question, 2) those firms surveyed that did not respond, 3) those firms not surveyed. This represents an absolute minimum measurement of demand.

SUMMARY

A survey of a group of "customers" (i.e., primary, secondary, and tertiary wood sector firms) of one of the key "products" (students graduating from UBC wood products pro-

grams) has provided information needed to redesign undergraduate wood science programs. Three questions were answered in this report by a combination of a cross-Canada mail survey and two focus groups. The first concerned "What to Teach." Respondents indicated that a new core program should incorporate wood science, mechanical processing, production and management, and business logistics. Time committed to fundamental programs should equal approximately 55% of total education time, and core programs should focus on the mechanical or solid wood sector compared to the chemical or pulp and paper wood sector. Communication and computer skills should also be considered essential elements of any educational program. Other program areas should not necessarily be eliminated but deemphasized in depth and time commitments.

The second question concerned "How to Deliver the Program." A redesigned wood science/wood products program should be offered as both a traditional four-year undergraduate program, and a five-year cooperative program. In addition, a one-year professional master's degree should be considered to educate existing science and/or engineering graduates to upgrade their knowledge base in wood science.

The third question considered "How Many Graduates Will Be Needed Each Year." At least 48 graduates will be needed each year by the different sectors of the industry. This is a minimum baseline graduating class size.

DISCUSSION

To meet the needs of a changing society, a new type of wood science program needs to be developed to serve the primary, secondary, and tertiary wood products sectors. This paper reported on information from quantitative (survey) and qualitative (focus groups) sources. Results indicated that much of the traditional wood science program is still essential in a program reengineered to meet the needs of the Canadian wood industry. However, respondents also indicated the need for a new em-

phasis in two broad areas: 1) an area educators refer to as "process skills" (which includes communication, problem solving skills, etc.), and 2) an area categorized as applied technical experience that endows technology training and education with the same level of academic respect currently accorded to hands-on technical expertise in European education. In order to make room for these new areas of expertise, the core wood science curriculum must be reassessed in terms of content areas as well as content depth. In addition, nontraditional faculty educators may be needed to effectively teach students certain technical skills.

Not only does educational content need to change, but education delivery methods for the wood products sector need to expand beyond traditional undergraduate and research-oriented graduate programs currently offered at universities. New methods of delivery would include a co-op program that extends the length of undergraduate education to five years and incorporates one or more practical industry placements. This places some of the responsibility for education on the industry and organizations that require the trained graduates. An additional avenue of education delivery is the one-year professional master's. This degree would not be research-oriented but would act as a bridge to provide education and training for individuals with degrees in fields other than wood science. This degree would act as a conduit to stream a variety of disciplines and skills into the wood products sector. Other delivery methods currently being explored but not covered in this paper include ladder technical diplomas and university programs, high school preparatory programs, and outreach training programs that are linked with the graduate professional master's degree.

While this paper reports on the needs of one of society's sectors served by graduates of wood science programs, the needs of other sectors must continue to be considered. These other sectors include academic graduate schools, research technicians, government and institutional sectors, and the most important, society at large. Any new program developed to meet

the needs of the industry sector discussed in this paper must also consider how it must link with programs designed to serve the other sectors mentioned above.

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Erratum

Charles B. Vick et al., authors of "Hydroxymethylated resorcinol coupling agent for enhanced durability of bisphenol-A epoxy bonds to Sitka spruce," have discovered an error in their article, which was printed in Volume 27, No. 1. On page 4, paragraph 2, under Experimental Materials and Methods, the mole rate should be 1.5, NOT 1:5.