Professional Affairs

WOOD SCIENCE AND TECHNOLOGY IN A UNIVERSITY SETTING[1]

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The renewable resource of the university is the human mind. It is capable of absorbing, understanding, and integrating facts and then applying them to improve the well-being of individuals and societies. And it is education which passes on that knowledge from one generation to the next.

UNIVERSITY GOALS

The educational goal of the ancient Greeks and Romans—"Mens sana in corpore sano—A healthy mind in a healthy body"—helped an originally agrarian people become not only efficient farmers but also leaders in commerce, the arts, architecture, and military strategy. American universities have come much closer to this ancient ideal than their European counterparts, which, in the past, mainly instructed social and intellectual elites.

The difference can be understood from history. After President Lincoln signed the Morrill Land Grant Act in 1862, offering land to states founding colleges of agriculture and mechanical arts, many states seized the opportunity to develop systems for the promotion and diffusion of knowledge. About 100 years later, Clark Kerr, then President of the University of California, wrote in his book *The Uses of the University*:

> We are just now perceiving that the university's invisible product, knowledge, may be the most powerful single element in our culture, effecting the rise and fall of professions, and even of social classes, of regions and even of nations. Knowledge is now central to society. It is wanted, even demanded, by more people and institutions than ever before. Knowledge today is for everybody's sake.

Since 1862, our population and its complex needs have grown beyond all expectations. However, the basic goals of the land grant university—teaching and learning, research and creative activity, and extension education and service—have remained unchanged. To realize these goals, the university must establish an adequate academic community for the total human, and specifically intellectual, development of its members, then effectively bridge the gap between them and society at large.

ESTABLISHING A PROFESSION

In this country, forestry as a profession became solidly based when the National Forest system was created, largely through the efforts of Gifford Pinchot

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and various influential citizens, who convinced Congress of a future "timber famine" resulting from both a crucial shortage of wood supply and growing demands for forest products. The need for better utilization of forest resources was soon recognized. Early work by the U.S. Forest Products Laboratory and by farsighted scientists like Tiemann, Trendelenburg, Stamm, and Kollmann laid the foundation for education and research today. Yet even today, the Forest Service is projecting continued, increasing demand for forest products by the year 2020 at about 100 to 400 percent above the 1970 level.

Only during the last several decades has Wood Science and Technology begun to be recognized as an interdisciplinary segment of forestry or engineering schools. Wood Science, the body of knowledge unique to wood as a material, is founded on botany, chemistry, physics, and engineering; Wood Technology, in turn, applies science and knowledge to convert wood into useful products.

The Society of Wood Science and Technology was founded 21 years ago, serving the following objectives:

1. Developing and maintaining the unique body of knowledge distinctive to Wood Science and Technology.
2. Encouraging the communication and use of this knowledge.
3. Encouraging policies and procedures that assure the wise use of wood and wood-based products.
4. Encouraging high standards for professional performance of Wood Scientists and Technologists and acting as the professional organization for individuals who meet these standards.
5. Fostering education programs at all levels of Wood Science and Technology and furthering the quality of such programs.

TEACHING AND LEARNING

Today, this field is taught in professional schools, one of whose most essential roles is to provide and maintain channels of communication between the more sheltered university core and the applied field, whose professionals face industrial and commerical problems. In the U.S., there are currently 24 institutions offering a B.S. degree in Wood Science and Technology, enrolling 1,254 students, 27 institutions offering an M.S. Degree, enrolling 162 students, and 24 institutions offering a Ph.D., enrolling 72 students.[2]

Similarly, the management of forest resources and the forest products industries deals not only with biological and physical realities, but also with the technical and social relationships linking forest land, trees, and resulting products to the people who benefit from them. In employing graduates, the forest products industries must consider the impact of future managers. Economists have traditionally emphasized "land, labor, and capital," not always fully valuing the impact of management. The forest products industries must consider substituting better organization, incentives, and new technologies and skills for more energy, manpower, and serendipity. We need a new, well-educated generation of foresters and forest products technologists—and it is our universities that will aid in achieving this goal.

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[2] H. M. Barnes, 1979, personal communication.

The curricula of forest products departments stress the efficient use of materials derived from forest trees. Courses of study combine a background in science and general education, including communications, social sciences, and humanities, with knowledge of technologies and business practices. Various options are offered to prepare individuals for diversified careers in forest products and allied industries, as well as in public agencies. The wood industry management option emphasizes production skills and technical services associated with solid wood products like lumber, plywood, and composition boards; the pulp and paper option combines chemical engineering principles and fiber technology for producing paper products; and the wood science option allows the student to emphasize selected sciences and technology, including enough flexibility to develop a base for those interested in research, product development, and academic careers.

RESEARCH

Forestry and forest products research at the university level received a real boost through support given in accordance with the Cooperative Forestry Research Act of 1962 (McIntire-Stennis Act). Depending on the importance of forestry, individual states have aided research with additional funds.

Then, just a few years ago, the U.S. Department of Agriculture and the Association of State College and University Forestry Research Organizations held a series of research planning conferences to define problems and set priorities, an ambitious effort involving many of the best forestry research and management people. The resulting goals, rather broadly stated, cover existing programs in the major forest products departments in the country. "User" groups were invited to provide specific direction for future research in public agencies. Only a small number of representatives of forest products manufacturing participated; this is unfortunate because future funding could be based on priorities set at the national conference. Duncan (1979) focused on such potential financing problems facing university research in forestry and forest products; he also pointed to an apparent shift in priorities from products and utilization to timber production and forestry-related management, of public research expenditures at forestry schools and other nonfederal agencies.[3]

On the other hand, a very positive development over past years has been the increase in cooperative research efforts between universities, federal agencies, and industry. A real synergism appears to be developing, especially through the expanding program scope of the U.S. Forest Products Laboratory.

Most academic forest products groups strive for the following goals:

1. Advancing scientific and technological knowledge in our field;
2. Performing research directed toward solving immediate problems;
3. Performing the fundamental, unbiased studies that establish or verify basic property values, outline limitations of products and properties, and assure safety and performance.

Discussions about applied versus fundamental research will always continue. But the real question is: What is the optimum combination? Whatever the com-

[3] Duncan, Donald P. 1979. Potential problems facing university research in forestry and forest products. Forest Prod. J. 29(4):14–17.

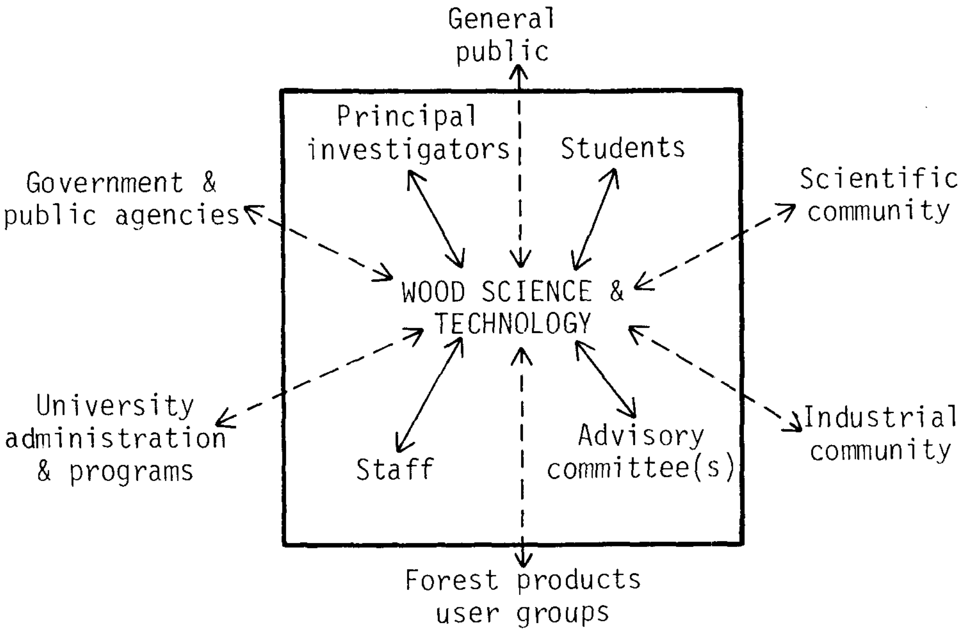

FIG. 1. Interfaces of Wood Science and Technology Departments.

bination, in these days of advocacy and controversy, stronger university research is needed to provide new knowledge so that the public can critically examine their own ideas and opinions, debate the issues, and make better decisions (Fig. 1).

A good case can be made for interdisciplinary problem-oriented research based at universities because they are the repositories of brainpower and accumulated literature. Most importantly, university students must learn to understand the technical and sociological problems of today's world and seek avenues for solving them. Because most solutions require an interdisciplinary approach, only professors committed to interdisciplinary research will be able to adequately instruct their undergraduate and (especially) graduate students. This does not mean, however, that fundamental research should be neglected. Indeed, tomorrow's technology rests on today's foundation.

Broad research goals and policies are important. In screening potential areas of activity, the following criteria may help assess research value:

1. Does it contribute to knowledge or productivity?
   a. Will it affect many producers of forest products?
   b. Will it help the user or consumer?
   c. Will it contribute to product value?
   d. Is it innovative, with potential for further change?
2. Is it feasible?
3. Can it be accomplished within given cost and time constraints?
4. Is it related to existing research or extension programs?
5. Does it contribute to personal recognition?

6. Does the researcher *really* want to do it?
7. Does the researcher wish to involve others?

EXTENSION AND CONTINUING EDUCATION

In 1914, the Smith-Lever Act laid the foundation for the Cooperative Extension Service, which became the largest problem-solving educational system in the world. Linked to land grant colleges and agricultural experiment stations, this system provided for the evolution and use of practical knowledge to advance agriculture. The Cooperative Extension Service exists today to help people identify and solve their problems and take advantage of their opportunities by using practical research-based information. Credibility in disseminating information was and is essential for maintaining the continuing effectiveness of programs.

There is now growing recognition at state and federal levels that liaison with user groups through specialists and continuing education programs can be extremely useful in advancing forestry and forest utilization. Although the number of extension specialists directly involved with manfacturers and forest products users has grown slowly, their efforts are now combined with those of researchers, who themselves have extended research results of their own and of others. For example, in the area of sawmilling, the program of State and Private Forestry, U.S. Forest Service, has had a significant impact. It seems logical to link this service function with the educational function of universities in the future.

NEED FOR TRANSFER OF TECHNOLOGY

In the face of change, the need for private enterprise to remain profitably competitive must lead to the development of new or improved processes and products. Though it may sound ironic, to the user it seldom matters how knowledge and ideas become technology, or how technology becomes production. To researchers, however, this transfer is of vital importance. But how are innovation and improvement achieved? Certainly, some process- or product-related research is goal-oriented from the start, but other valuable information may evolve simply from the compelling curiosity of a researcher to probe deeper into the unknown.

Although scientists, technologists, and businessmen can become directly or indirectly tied to each other through an idea, whether for improvement or innovation, businessmen and scientists are often uneasy companions. In today's economy, they find symbiosis advantageous but view each other with much misunderstanding. Businessmen may not share the belief of sociologists, who feel that researchers' need to communicate is partly an expression of stimulus hunger and partly the need for social recognition. Instead, they may view scientists' desires to publish their findings as an invasion of proprietary business rights. Conversely, whereas some scientists have persuaded enlightened managers that science itself springs from a shared knowledge, others have embraced the business point of view realizing short-term advantages. These differences of opinion can hardly be resolved because no exact and objective measures exist to show the value of open communication of scientific and technological research.

Past performance in high-technology industry apparently suggests that:

1. Basic research stimulates innovation in industrial technology, without which the economy would stagnate;

2. Restrictions on scientific communications are harmful to industry in the long run;
3. Institutions conducting basic research must encourage open publication and transfer of knowledge through technology into practice.

But there are two important additional factors to consider:

1. Many persons have the need to satisfy their curiosity;
2. Many researchers derive some of their greatest satisfaction from seeing the product of their work implemented.

These human needs have practical consequences for industry because many manufacturers, as well as users, cannot foresee future consumer needs. Just remember the economic surpluses during the 1950s and compare them with today's shortages. Raw materials were relatively inexpensive then; yet today, wood costs have increased to around 60 to 70 percent of total production costs. Therefore, industries must continually seek improvements and promote technological change, especially in the areas of material and energy conservation.

SOURCES OF INFORMATION AND METHODS OF COMMUNICATION

For effective information transfer, there must be an audience, a vehicle for transfer of knowledge, and a source of information.

Sources include literature (books, journals, and so forth), society and association reports and meetings, laboratory and university reports and seminars, reports on commercial contracts, government information services, as well as personal observation and contacts. The results of research and development are being published in such volume that even the best information system may be outstripped. An estimated 60,000 scientific and technical journals are published every year, containing roughly one and a half million articles. Technical books produced annually may total 70,000. So, to stay as well informed as possible on all fronts, we must read enough of the right sources or risk becoming anachronisms.

To cope with this information explosion, computer technology has been applied to information retrieval. For instance, our Forest Products Research Society, aided by university personnel, has developed the Abstract Information Digest Service; numerous other computer-based retrieval systems are available through university libraries.

But without interpretation and communication, all this information is useless.

In general, to communicate, the sender passes information and understanding to the receiver, who, in turn, can acknowledge its receipt in the form of feedback. If the sender wants to change the receiver's behavior, his objectives must be clear and his actions precise. In most cases, feedback is essential for the sender to recognize the image created in the receiver's mind. Such feedback also provides information about the receiver's motives. Yet often, when researchers and users meet, some of the most basic aspects of communication are overlooked. And to make matters worse, researchers and their audience do not necessarily speak the same language.

Organizations valuing information transfer must be concerned not only with their communication *channels*, but also with their communication *network*, the

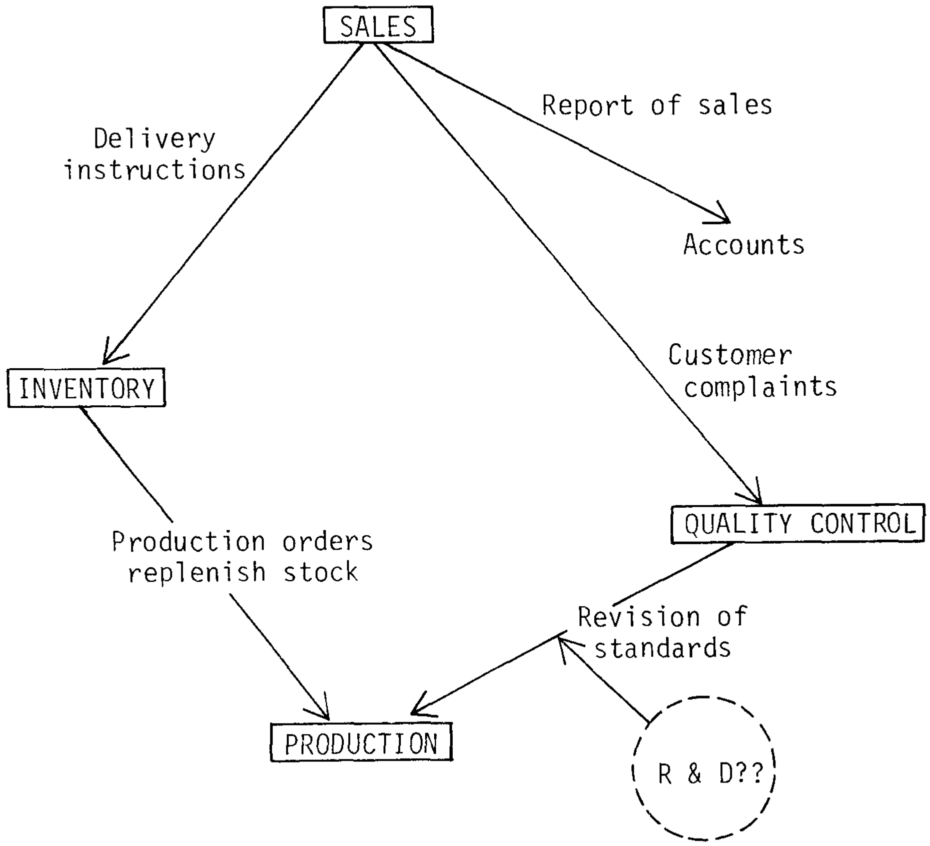

FIG. 2. Communication network in a manufacturing plant.

contact pattern among decision centers (Fig. 2). This network substantially affects success or failure of communication.

Universities are outstanding forums for making available academic expertise and for providing the right channels for the exchange of ideas, technical communication, and continuing education, whether to meet the requirements of industrial personnel or those of other scientists and technologists. The challenge, however, is recognizing and bridging the semantic and psychological barriers.

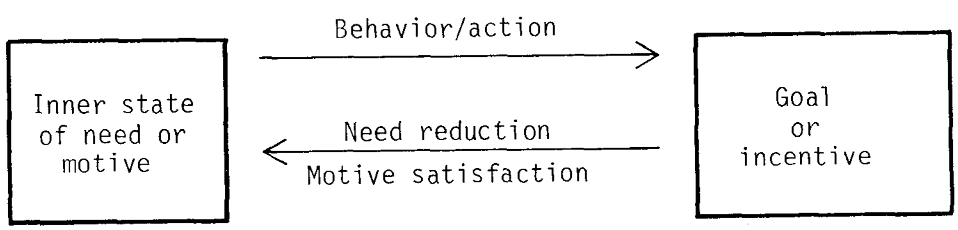

FIG. 3. Motivation.

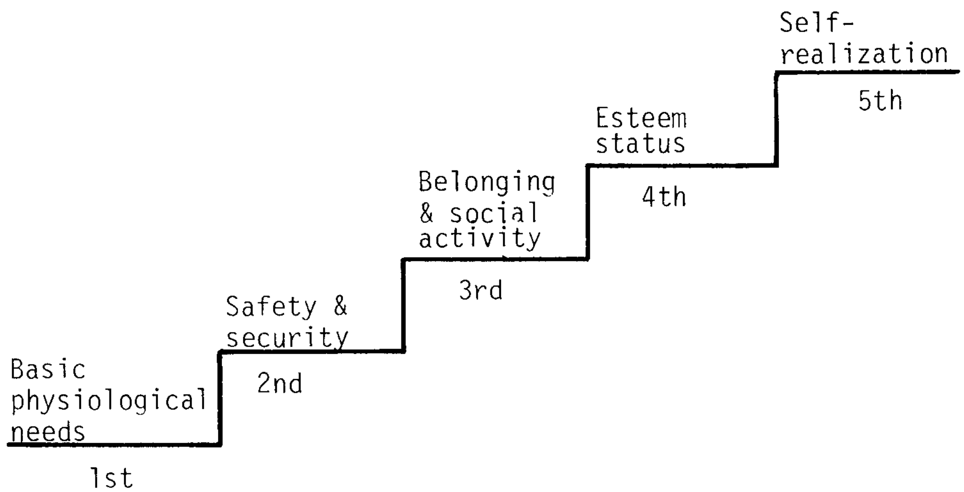

FIG. 4. Maslow's hierarchy of needs.

MOTIVATION

Human motivation is critical. Enthusiastic cooperation of workers stems from personal satisfaction associated with their endeavors. What kind of satisfaction do researchers seek? Do their personal motives support organizational goals?

Motives reside within individuals. However, the goals researchers strive for are often determined externally. Like others, researchers find goals attractive largely because of the needs they satisfy; thus, behavior is influenced by motives (Fig. 3). Managers of, or contractors for, research must consider both research goals and human motivations, especially when developing research plans.

How do we recognize motives if they cannot be observed directly? Psychologists and others working on motivation theories hold various, sometimes contrary, opinions. However, many agree on the three basic motivational categories: physical, social, and psychic. A. H. Maslow, for instance, ordered them in a "hierachy of needs" (Fig. 4). If his theory is correct, the development of the higher motive is dependent on the prior satisfaction of lesser needs. Belonging and contributing to an organization may be a strong motive once the family has been fed. Similarly, satisfying psychic motives may be expected to become important only after social needs have been reasonably fulfilled.

But what about the scholar not motivated to join the network of exchange of technological information? For outstanding individuals, there should be time and a setting removed from today's pressing problems in which to develop new ideas and approaches. To quote Henry David Thoreau: ". . . let him step to the music which he hears, however measured and far away."