WEYERHAEUSER RESEARCH SKILL REQUIREMENTS AND IMPLIED EDUCATIONAL NEEDS

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Considering the past history of the Wood Products Industry, you note that it is rather like Topsy; when the rest of us got here, it was already here. It didn't grow out of research the way many other industries have, such as chemicals, pharmaceuticals, and the great oil-based industries. Many of the people in wood industry manufacturing still look at R&D as something that really isn't needed, and "if you'd have just gotten out of our way, we'd be about the same place we are now, without you." Have you ever run into that? So, in the formative years, I think, not just in Weyerhaeuser but in other companies in the field in general, we were very much isolated from operations. Therefore, we were not too certain what our objectives were, and they kind of came and went; they would rise and fall with the tides and we are in a business that has lots of tides. Profit orientation was cloudy because we really didn't get good feedback; we had no clear view of the results; and we really for a long time weren't allowed to look at the profit results, possibly because the sophistication to account for incremental improvements was missing.

Consequently we lacked a sense of urgency that people in operations feel one must have in order to communicate with them, so we got into a vicious circle. There was some extremely innovative work done at the universities, institutions, and our research group as well; but without a tie to operations it tended to be on products, and, in many cases, without a good tie to the market itself, they were kind of "cute" products. So things went along slowly and even the good ideas had rocky paths to implementation. Incidentally, Weyerhaeuser tries to remind itself that we wish to be leaders in the implementation of technology, not necessarily in its research and development. So when I say R&D, I mean implementation and whatever has to be done in order to get to that point.

The profit results, as you can see from my discussion, would also be very mixed, but the best results were evolutionary in nature in both product and process. True, there were some significant breakthroughs, but I'm not really concerned about those; every now and then one can be lucky. Our mixed results are readily understandable when you consider that we really weren't tied to the business; we didn't talk back and forth very well, and in fact there were some deliberate barriers to that. Weyerhaeuser itself being large, we try to remember we just aren't entrepreneurially-minded, we're commodity-oriented if you come up with a real good one; but if it's cute and one man in one day in one closet can manufacture the world's supply, if it's a 7,000 percent return on his investment, we can't afford it because we'll drown it.

Some of the work in the past was nonscientific. We have dealt in a kind of "black art" in many of our businesses—saw filing for example. Dan Mote and such people are trying to make some changes there, but still we beat on saws

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behind a curtain. There are a lot of examples like that in our industry. Some of that is because we haven't been able to put numbers on things and measure things. There have been some wise men back in history who said, "If you can't do that, don't bother with me, I don't want to talk to you about it." The problem is because we have such a heterogeneous raw material, e.g., where the variation within a tree in many cases is worse than the variation between two randomly selected species. Our industry is scattered. We run from very large corporations, 25,000–50,000 employees, down to a "Ma and Pa" operation that can compete very well in certain product lines and return a better ROI. So we're a rather weird bunch and we tend to go our separate ways. In the case of Weyerhaeuser operations, we've made some significant changes slowly over the last ten years, and we think we're at a place where we want to hang in there for a while and see what we can do with some of the promising new technologies available and emerging. We are very closely tied to our business goals; in dealing with the operations, we try to understand exactly where their needs are and try to get a "technology pull" developed and get away from old "wet noodle-pushing," the technology push from the "ivory tower."

The business today has the opportunity of approving or disapproving a large percentage of our research and development budget. Taken out of context, it's frightening. The R&D department managers have a dotted-line relationship with a business vice-president, a parallel opportunity to fight with the manufacturing vice-presidents and marketing vice-presidents or managers. We try to offset the natural tendency to look short-term by insisting that each business have at least a five-year technology implementation plan and that is a primary tool. R&D within, and working with its clients, maintains "conceptual mills of the future" so that we understand where we're trying to go. Then we hold back 15–20% of our total research and development budget so that only senior management says yea or nay. If the business doesn't think a given project has reasonable application to current goals or its application isn't clear enough, we'll pull back and work on it a little while. We recognize that one day it's going to have to surface for business approval, so even that gives us some direction. The result is that we are very goal-oriented, primarily in terms of "what the implementation is going to be, where it will be by mill, by technology, by quarter."

The foregoing points suggest some skill requirements that are different from the way it's been historically. Our goals are very heavily process, say 90%. The most important objectives in reaching our goals have to do with measurement, understanding what we're doing today, and controlling it so we actually do what we thought we were. Next in order, come improvement of the yield after we have control of the process today, productivity improvements, and value retention (that might be a backwards word to you, but it addresses the opportunity there originally—and how do we save what was there, how do we avoid downgrading the product?). And finally there's cost reduction. It's difficult to separate some of those; in many cases a given project or opportunity overlaps; I would say in most cases they respond to more than one of these objectives.

The strong scientific basis is clearly required. We insist on measurement, on a precise definition of what we're talking about and what we're going after—measuring it properly, relating it to fundamentals understood today, or going back and trying to dig out the fundamental understanding. The idea, remember, is to get to an implementation, whether it requires a new design or putting together bits and pieces already available. The best case would be to put together a combination of things already known, understood and tested, and somewhat comfortable to operators, and whatever will accomplish what we're trying to do without additional R&D effort.

If you step back about three steps from the trees and take a look at this forest of thought, it's kind of interesting, if not shocking. We are handling and processing geometric shapes more than any other thing, and that's materials handling. It's a shock to some of us who have a different background to recognize "materials handling"; we may look down our noses at such an unsophisticated field, but really that's what we're dealing with. Understanding the chemistry and morphology of the material we are handling is a requirement. But that in itself doesn't get us anywhere. A good strong understanding of why we screwed it up doesn't help much. We need to be able to translate that understanding into the mill—how to do it in real life, not in the lab, and that talks about designing something, building something, training absolutely anybody to run it and keep it in shape. I'm beginning to understand why the army addresses itself to fourth-grade education; it's amazing how many people with a college degree can uneducate themselves quickly when they try. That causes a training problem that we also have to address.

But this is where I'm getting to; engineering skills, which I have heard recently defined as "the art of applying a science," are conspicuously deficient in most current wood science and technology curricula. Worse, the engineering schools seem to be expanding to fill that role. If you take a look at the spectrum of science from the very basic, maybe Einsteinian theory, all the way through technical service, at one time engineering was hardly even there—it sprang up on the application end, building roads and such. I can understand the separation between wood science and wood technology as you have been defining it, but you seem to give little thought to application skills. Engineering is not only there today but it's moving down toward the more basic side of the spectrum and it's growing. I suggest to you that engineering schools are threatening your position, and they currently stand a very good chance to relegate your graduates to shrinking roles.

Because we need those engineering skills and we have relatively few of them, we are working on a team basis, perhaps more than we would like to. We'll put together a team that includes individuals with engineering, wood science, computer, and mill operations skills (we especially need the practical). Sometimes one person fits more than one of those, and sometimes you wind up with a team that's a lot larger, depending on what you're trying to accomplish or how well individuals fit the needed roles.

The result is that our hiring focus has changed a great deal. Except at the graduate level, I cannot recall hiring a person with a degree from a School of Forestry in the past few years. (If I did, it was because of "whom" he/she knew, not "what"!) The primary needs are in mechanical engineering, electrical engineering, and computer science. Remember I'm talking about research, I don't want you to be misled; later I'll specifically address our needs in areas other than wood products research. Physics and applied math are next and then IE's, ag engineers and chem engineers are somewhere in the group. We used to have something like 15–20% of our total professional staff who were engineers, depending on what year you look at. Currently that collection of engineers is just touching 50% and that does not include math, physics, and computer science! The trend, I think, will continue until our R&D goals change—and I wouldn't expect that to be a significant change, if any.

If you look at national pay scales (we use a composite based on several national annual surveys), the spread of 8–15% between science and engineering reflects the difference in demand throughout a career, and over time the gap may be widening. Our term "science" here includes chemistry, wood science, wood technology, and a few other incidental categories. Engineering includes physics and math and computer science because we've noted looking at the individual curves that you can collapse those groups into these two for simplicity. If you've got somebody that comes to you and says, "I want to go into the research business—how can I get the best income from it?" these relative pay scales certainly suggest an answer, and it holds into the graduate level.

If the trend that I am talking about is universal at the research level, why shouldn't wood science take advantage of that trend? Why not get on the bandwagon before the engineering schools (represented by the engineering educators' group that met in Vancouver mid-June talking about how to expand to cover some of the wood science and wood engineering) put even more pressure on whether or not your graduates are in demand? What I advocate is this: Let's add more engineering basics. Remember that team I was talking about. I would just as soon not have to hire a specific engineer to fill out that team; I would really rather have the wood science person have strong enough engineering so that he can fill that role in many cases. In order to do that, something has to give. I am really not knowledgeable enough about curriculum to get very detailed, but in thumbing through the handbooks from three universities, there are very clearly to my mind a few things that can be cut out, things that have always been taught in the Schools of Forestry and I don't understand why. I want to see the value of the wood science degree improved so that I would be hiring that kind of person instead of having to go to the Mechanical Engineering School. The goal obviously is to bridge that gap between wood science (the understanding of what goes on, the chemistry and the morphology) and getting it in place so that I can show by the bottom line in a mill exactly what all this R&D effort has produced. That's when we get the budget approvals to continue to do our work; without the bottom line results, our resources dry up, and rightfully so.

I don't want to mislead you. I'm not trying to suggest that we don't want to have well-rounded people. As a matter of fact, my whole point here is to add the needed skill areas in replacement of unneeded subjects, but retain the arts and social sciences, give students the opportunity to broaden their education; we want them to be able to walk and chew gum at the same time. But for the time that you're going to set aside for scientific subjects, focus those very, very carefully so that they are addressing what the student truly needs for his selected future employment goals. Again, don't misunderstand; let's keep it pertinent, but don't go into great depth, and do without the information that you can learn better on your own or on the job, the "no-brainers."

How do these thoughts translate to specific action? For the research "generalist," i.e., the B.S. level graduate who wants to help turn ideas into reality and help the mills reap the benefits, coming from a curriculum perhaps called wood science: Get rid of "An Introduction to Forestry" or any other survey course of what other people are doing, or what he could transfer to. He doesn't really have to understand the logging practices and such. Look at courses like dendrology and mensuration and botany, and see that they don't get too deep. Perhaps ask to have them aim directly at your needs, not the needs of the school that provides that service for you. For crying out loud, don't put your students together with majors in that area, because they're just not getting the breadth that you're after. Help them focus on specifically what they're after; but be that as it may, what I want to leave with you today is: add some mechanical engineering, add some process sensing and process control. Just giving strength of materials is not adequate and just throwing them in with a bunch of mechanical engineering students is not adequate unless they're going to give up the time to go after a minor in that field (a very commendable thing to do, however).

If your students are interested in mill operations rather than research, then I'll back off a little bit and agree that the survey or generalized courses may be useful. In this case it does make some sense to send them over to the School of Business and let them learn a little bit of accounting, but still avoid putting them in with the accountants. Work with that school to get them something tailored to what you need—a little business law, such things that provide breadth, but don't dump them in with the rest of those people who don't have what it takes to come over and take the tough courses in your school or in engineering.

Again, implementation is the name of the game. You have to be able to talk to the engineers in the mill, and to the research implementers, so give your wood technology (mill-oriented) students a little engineering. They have to know what "millworthy" means, they have to know it when they see it—or don't see it. And they especially are going to be involved in computer-aided decisions and control. If your computer course now covers much in data crunching, you're wasting everybody's time. In this case, if the student goes beyond calculus, he'll never use it—never. That's an example of "avoid excessive depth."

On the end of this discussion, I'd like to outline briefly what I'd really like when we're talking about a specialist in the research field, the M.S. and Ph.D. graduate. Again looking at representative curricula and our experience, I would say the graduates in wood science don't have enough of the engineering skill; they have a hard time translating into hardware, so are usually restricted to basic research. The Ph.D.'s in engineering, for this kind of assignment, are too narrow, and are usually oriented to oil, energy, or space. What I'd really love to see is the wood science schools do a sales job on B.S. engineers-to-be, the ones that have those basics I'm advocating, show them the opportunities in our industry, and bring them into your graduate program. Until your undergraduates develop engineering skills, and perhaps even when they do, an engineer with advanced level knowledge of wood science would answer a lot of the needs we perceive, present and future. In the meantime, for the future success of your wood science and technology students at any level, I urge you to find ways to significantly strengthen their engineering and process control skills.