

RESEARCH AND DEVELOPMENT IN THE PULP AND PAPER INDUSTRY: YEAR 2000 AND BEYOND

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RESEARCH SPENDING: YOU GET WHAT YOU PAY FOR

RESearch and development spending in the pulp and paper industry is at its lowest point in 30 years—and perhaps the lowest point ever. Unfortunately, the situation is likely to get worse before it gets better. But it will get better, and indeed R&D will become the competitive advantage that distinguishes the industry consolidators from those companies who will become acquired and merged.

CAPITAL VS. RESEARCH SPENDING

Some, if not most, of the management of the U.S. pulp and paper industry believes that research and development has been a failure. My analysis generally supports that view but concludes that the failure is one of improperly anticipating the future, not necessarily a failure to produce good research.

Suppliers to the pulp and paper industry have made more contributions to the industry than the paper companies have. Suppliers have spent more money on research and development and earn better financial returns. There may be some lessons to learn from this. And if we don't learn those lessons, then suppliers and institutes will become the *de facto* R&D organizations for developing the core processes for the industry. Indeed, one could argue that this concentration of strength in the supplier organizations is a major contributor to the accelerated development of the paper industry in the developing nations. Was this a strategic mistake?

For industrial research and development to survive in the U.S. industry, we must make a greater measurable contribution to corporate profitability by shifting our emphasis from new process development to new product research and development. Why are most U.S. paper companies abandoning research and development? To answer this, it is important to remember that all compa-

nies exist to return profits to their shareholders; the best companies manage their assets to do this in both the long and the short term. Without question, R&D is an investment in the future. Just as investment in a new paper machine requires 3–5 years to pay back, research and development is money spent now that has only future prospects for a payout.

In reviewing investment in new fixed capital as a percent of sales for a cross section of major U.S. paper companies, we appear to be quite willing to invest in hard assets such as paper machines, expecting to increase the return to our shareholders. The average rate of investment, as a percent of sales, is approximately 8%, almost twice the rate of the next most capital-intensive manufacturing industry. Now, when reviewing the investment in research and development that these same companies support, a completely different story emerges. Industrial Research Institute (IRI) figures show that the pulp and paper sector has the lowest R&D spending as a percent of sales of any U.S. industry.

Comparing these two investments (**Fig. 1**) demonstrates that corporate pulp and paper in the United States has voted with its investment dollar and voted in favor of fixed assets, not technology. One could look at the financial returns on the investments made in hard assets and argue that we could not possibly have done worse if we had put the same amount of money into research and development, but I believe there is an entirely different explanation: Despite the low levels of funding, more than US\$ 2 billion has been spent on research and development by U.S. paper companies in the past 10 years. One can only conclude that some of our management has looked at the results and considered that this investment has been a failure and is not worth continuing.

This point of view was recently expressed in very clear terms by the chief executive officer of one of the

largest U.S. companies. At the 1999 Annual TAPPI Meeting in Atlanta, GA, Pete Correll, the chairman and CEO of Georgia-Pacific, said, "... R&D in our industry has been a terrible failure." In a later speech to the graduating class at the Institute of Paper Science and Technology in Atlanta, Correll referred to the lack of significant change in the fundamental processes used in our industry.

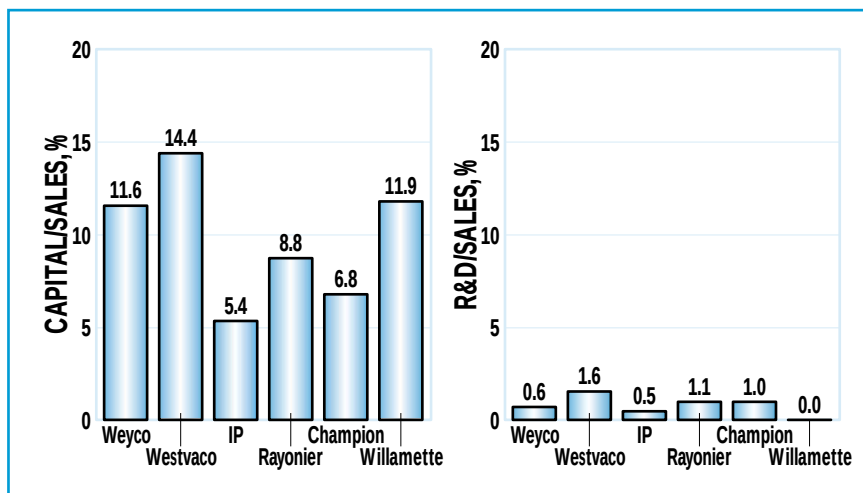
To consider Mr. Correll's comment—as painful as it is to hear—go back and look at where the research and development dollars were being spent 30 years ago when I first joined the industry, and then contrast that investment portfolio with what we believe the major issues are today, which we should have been working on 30 years earlier. I take this approach because, first and foremost, it is essential that research and development anticipate future needs. We must not only anticipate the future, but, as the Second Commandment, we must have the technological solutions ready before they are required. Our value today reflects in large measure on how good we were 20–30 years ago in anticipating the future.

It has often been said that pulp and paper companies have no proprietary technology but, rather, the industry obtains its technology from its suppliers and shares it widely. This statement can be supported with analysis that demonstrates that major pulp and paper industry suppliers not only invest more in research and development, but have earned better financial returns than have their customers. I say this not to be critical of our suppliers, but to admire them for their success, and to learn some lessons for the paper companies from their behavior.

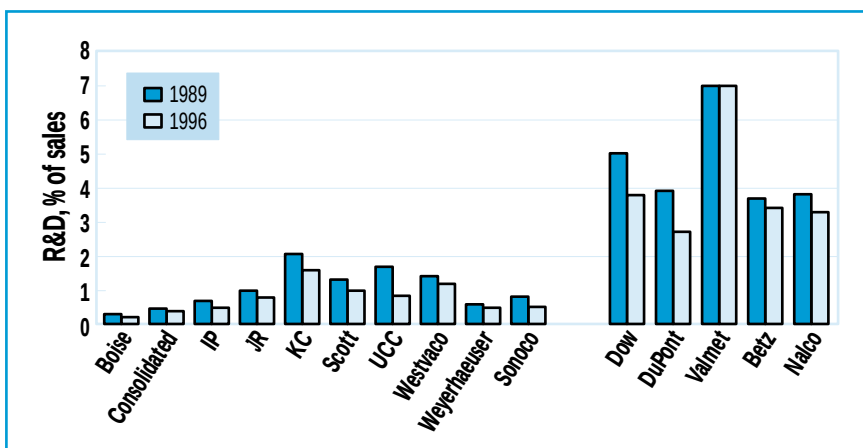
Finally, I believe that there is indeed a future for R&D in this industry, but it will look very different from the past. For sure, those companies who are the consolidators have strong in-house R&D; those who are acquired do not.

1970s R&D AGENDA VS. CURRENT NEEDS

In October 1971, I joined the newly opened Corporate Research Center of International Paper. Contrast that 1970s agenda from 28 years ago with the needs our businesses are facing now:



1. Corporate priorities: capital spending vs. R&D



2. R&D investments are down in both paper companies and suppliers.

- Where should the next mill be built?
- What is the next radical departure from kraft pulping?
- What is the next breakthrough in chlorine gas mixing?
- How can I get a 5%-point-higher yield from kraft?
- How can I get my fine paper machine to 2500 ft/min?

Today, we aren't considering new mills in the United States; we're talking about closing existing mills. Pulping chemistry has almost come to a standstill or is revisiting decades-old subjects like polysulfide and borate. Today, we focus on mechanical changes to our digester systems to make them run better and produce better pulp. "What is chlorine?" is the question today, not "How do I mix it better?" Wood cost is still a big issue, but we aren't as excited about the opportunities to reduce wood cost in pulping as we are about doing it by growing better trees faster. Papermaking still has many opportunities, but most of them are in the machinery area and will be developed by the

Innovator	Mechanical	Chemical
Supplier	Extended nip press	Synthetic binders
	Dilution headbox	Retention aids
	Single-tier drying	Neutral sizing
	Metering size press	
	Top wire forming	
Paper company	Short-dwell coater	Whitetop liner
	Film press coated	Clay-coated kraft
		Ink-jet paper

I. Innovations in paper technology

machinery suppliers. The paper companies will concentrate on reducing the art to science and engaging and teaching the hourly operators how to do it better.

The paper industry record in achieving the priorities that were set forth in the 1970s is mediocre at best:

- There has been no progress in reducing investment costs.
- There has been modest progress by the supplier community in improving the basic kraft cooking process with modified cooking schemes.
- We have seen some progress by the machinery suppliers in developing larger-scale and more efficient mechanical pulping equipment, but only modest success for bisulfate chemithermomechanical pulp (BCTMP), despite great early promise.
- In bleaching, International Paper in particular became an industry leader in the mixing of chlorine and pulp and using hypochlorite in short sequence bleaching, none of which we use any longer.
- Oxygen delignification is an important technological milestone that was developed in the 1970s, but again, the suppliers are largely responsible.
- Polysulfide processes were developed to technical success, but commercially, they are a failure.
- Anthraquinone (AQ) is a modest success, but ironically, its success has been hindered because we as an industry are not sophisticated enough to measure the yield of our most important raw material.
- The paper machine equipment suppliers have generally done the best job of process development. The metering blade size press was followed by the rod and later the film press, both of which represent significant breakthroughs.

In summary, we have seen more technical success than commercial success, and more success by suppliers than by paper companies.

CONTRIBUTIONS OF PAPER COMPANIES VS. SUPPLIERS

To address the point about the relative contributions of suppliers and paper companies, I have collected some of

Innovator	Mechanical	Chemical
Supplier	MC-oxygen delignification	Anthraquinone
	High-shear mixers	
	Lo-solids cooking	
	High-solids firing	
	High-efficiency washing	
Paper company	HC-ozone bleaching	Polysulfide cooking

II. Innovations in pulp technology

the most significant advances in paper technology (**Table I**) and have sorted them as either mechanical or chemical, and either supplier-developed or paper company-developed. Clearly, the most important process advances have been made by suppliers. However, the paper companies have largely led the way in using chemistry to make new products, but in most cases while partnered with a major supplier of the chemical or equipment.

In examining pulp technology (**Table II**) in the same fashion, the tentative conclusion is even more clear. Suppliers have largely prevailed in this area, where the process output is an intermediate product. My single reference to a paper company succeeding in the mechanical area is the Union Camp ozone bleaching technology, where, in the end, the technology was licensed to a supplier.

The foregoing analysis of industry R&D performance suggests that the industry largely failed. I would suggest the following gaps:

- We failed to recognize the emergence of the southern-hemisphere competitors as the low-cost producers.
- We failed to recognize that environmental concerns about the biological impacts of our pulp mill effluents would escalate to the degree that we have experienced.
- We failed to recognize the advantages of eucalyptus and radiata pine plantations in fast-growing southern locations.
- Worst of all, we in the United States assumed that the demand for paper would grow forever, and we continued to build new mills and paper machines.

FAILURE TO ANTICIPATE THE FUTURE

These failures are not necessarily technical failures; most projects delivered some level of the intended benefits. I believe that the issue is one of failing to anticipate the future. In selecting the wrong projects, to a large extent, we addressed the wrong future.

Our management rewarded our failure by reducing or eliminating R&D while continuing to invest new fixed capital in the business. The beneficiary of closing

in-house R&D has been an increase in the amount of cooperative research and development—at the Institute of Paper Science and Technology (IPST) in Atlanta and through an industry–government sponsored program called Agenda 2020. Neither the Institute nor Agenda 2020 pursues product research, so moving toward cooperative research is a recognition that there is little proprietary advantage to be gained through process R&D. Cooperative R&D, through institutes or government-sponsored work, is little more exclusive than relying on suppliers for research.

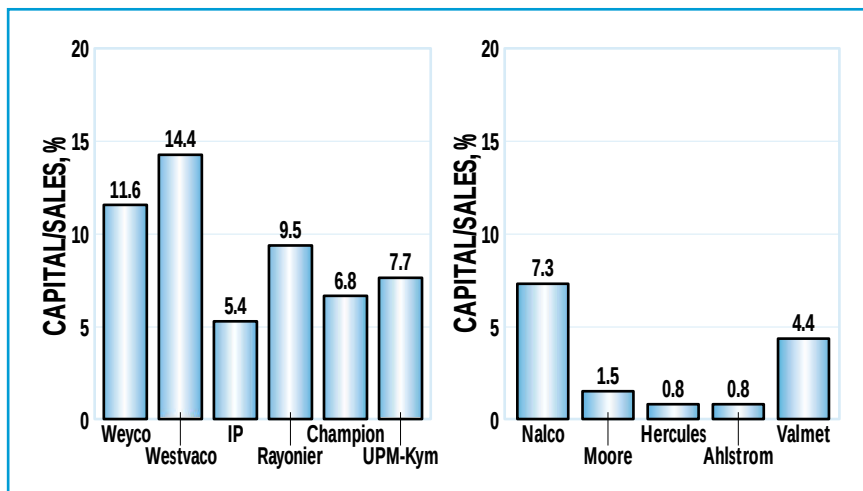
CHARACTERISTICS OF INDUSTRY PRODUCERS AND SUPPLIERS

If the suppliers are making the contributions, we can review the characteristics of selected paper companies and compare them to a collection of suppliers familiar to the paper industry. Even though the supplier group is far more diverse in the products they manufacture than is the paper industry, they nevertheless have far more in common financially than do the industrial companies they supply.

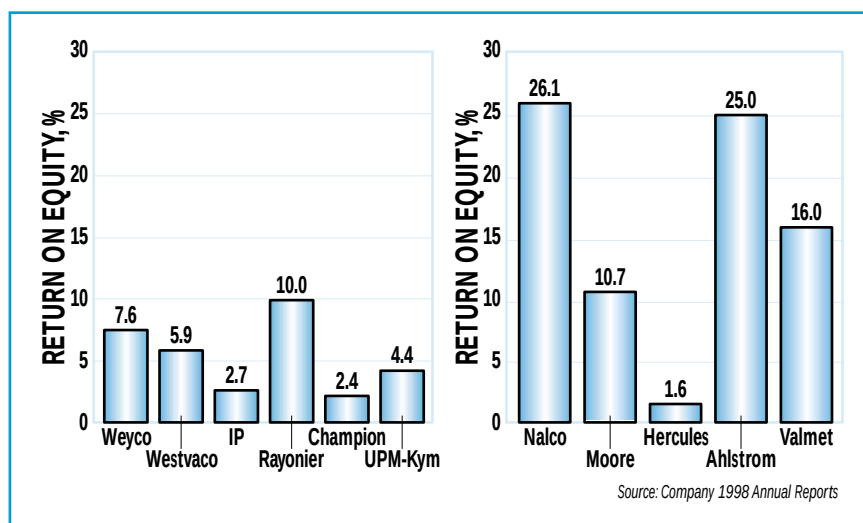
Considering relative levels of investment in research and development (Fig. 2), the available data show that suppliers are more R&D intensive, although from 1989 to 1996, all paper companies and most suppliers dropped their R&D investment as a percent of sales. Later, in 1998, Boise and Union Camp Corp. further reduced their investment to zero.

In reviewing actual investment dollars, the supplier group—some chemical, some machinery or controls—invests about ten times more in R&D compared to the industry they serve. For example, in 1996, Valmet spent the same number of R&D dollars that International Paper spent.

Our suppliers also invest in people—as measured by sales and administrative costs—at a rate of 2–5 times that of the paper companies. One can imagine that much of this investment is in new product development, marketing, and sales. Do these characteristics lead to better financial performance?



3. 1998 capital spending: paper group vs. supplier group



4. 1998 percent return on equity: paper group vs. supplier group

In general, paper companies enjoy a higher operating margin. The relatively high operating margin is a major reason why old mills stay running: they can enjoy cash-positive costs even on ancient assets. It is no coincidence that the older assets tend to supply products to niche markets. However, the operating margin for paper does not offset the high capital cost that we pay to achieve that margin.

It is no surprise to find that the paper company sample is more capital-intensive than is the supplier sample; the only exception is Nalco (see Fig. 3). Looking at the commonly reported return on equity (Fig. 4), which is the return to the shareholders on their share of the assets, the suppliers generally enjoy a higher percent return on equity than do their customers.

Since our suppliers have relatively low capital spending rates, one can deduce that their R&D more than likely does not go into their own internal manufacturing process development. They most likely have a very high emphasis on the downstream use of their specific products—digesters, chemicals, control systems, and paper machines—by their customers.

Some paper companies may match well in financial performance, but some rather large portions of the paper companies don't come close—and have not for years. It is worth considering the Rayonier example. Its forte is product development in the area of chemical cellulose; its rate of R&D investment was more than two times that of International Paper.

WHERE DID WE GO WRONG?

As an industry, we clearly went astray—but where did this happen? Do we have poor financial performance because we don't have enough R&D? Or, do we have little R&D because we are performing badly? My conclusion is this: We don't have much R&D because R&D has performed badly, and R&D has failed to make the contribution to the bottom line in paper companies that it clearly does in the suppliers.

Perhaps our clue to improvement can come from the word *supplier*. As paper companies, we tend to think of ourselves as *producers*, not suppliers. The supplier group mentioned here was successful because it created new products that made its customers more productive (though not necessarily more profitable). We tend to think that we produce commodities and that pricing for commodities is set by the low-cost producer. We reinforce that perception when we examine some of the niche-market players like Rayonier in our sample, as well as others like Wausau and Consolidated Papers, who earn good financial returns by playing in very-high-end product markets. In adopting a commodity mentality, we overlook the opportunities to gain a financial advantage through developing new products that enjoy higher margins than our existing products.

Consider the most exciting packaged product in the United States over the past several years—bottled water. By actual consumer taste tests, this product finished in second place to New York City tap water, yet U.S. sales of bottled water have grown by 28% in the past 3 years to over US\$ 4 billion.

Water, the ultimate commodity, recently sold at my local gasoline station at a price more than five times that of gasoline! If this can be done with water, why can't we do it with paper? Clearly, it is not the water that attracts the high price, it is the packaging of the water that represents an experience to the consumer. It is consumer marketing pull-through that accounts for success, and

this fact is well known to the paper industry participants in the tissue business. While this segment remains highly secretive, and noticing where university graduates are going to work these days, it is not hard to conclude that tissue companies continue to emphasize R&D at a high level as part of their competitive edge.

It is a challenge to make milk look appealing to the American consumer, but the stunning graphics that are possible with modern printing technology show some promise. To grow beyond the traditional 1–2% growth rate, packaging materials must become economically and functionally attractive to displace other materials. Can structures be developed that capture the markets currently held by other products? Can we regain some of the markets lost to plastics? Can milk be made to look as appealing as bottled water?

IMPLICATIONS FOR R&D

What are the implications for research and development? First, consider that our industry is all about upgrading trees to higher-value products. Traditionally, our research and development activities have focused heavily on the processing steps: growing trees, pulping wood and bleaching fiber, treating waste from the plant, burning black liquor, producing engineered wood products, and producing paper. We already see that those paper companies who have elected to continue to invest in research and development have moved a large part of their investment downstream toward developing new products with higher margins that satisfy the growth of their customers' markets.

In the future, we can expect that trend to accelerate, and we will see even more of an increase in efforts downstream of manufacturing. This does not mean that all traditional R&D will be abandoned, but it may change form. It does mean increased attention to the customers for our products and even more research on the customers of our customers.

CONCLUSION

The trend toward global consolidation will improve the prospects for R&D. In developed countries, printing and writing papers will continue to grow at the rate of GDP. For any one competitor to gain market share, that gain must come at the expense of another competitor. Therefore, there will be winners and losers. The winners will be those who invested their money—not just in new fixed assets but in the brainpower to develop new products that allow their customers to win. **TJ**

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