

Planning now for the next paper industry growth cycle

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As capital spending in the paper industry slows after record levels during the late 1980s, attention should turn to ensuring an adequate supply of engineers for the next up cycle.

The U.S. pulp and paper industry has been on a real tear since 1984. Capital spending has been at record levels every year since then, topping out at US\$17-18 billion in 1990.* Operating rates in some grades, as well as paper company profits, began declining slightly in 1990, but especially during the last two or three years of the six-year boom most mills ran flat out and generally got the price increases they demanded for their products, particularly market pulp. For most of this period, performance of the Canadian paper industry paralleled that in the United States. In fact, the paper industry worldwide has done quite well in recent years.

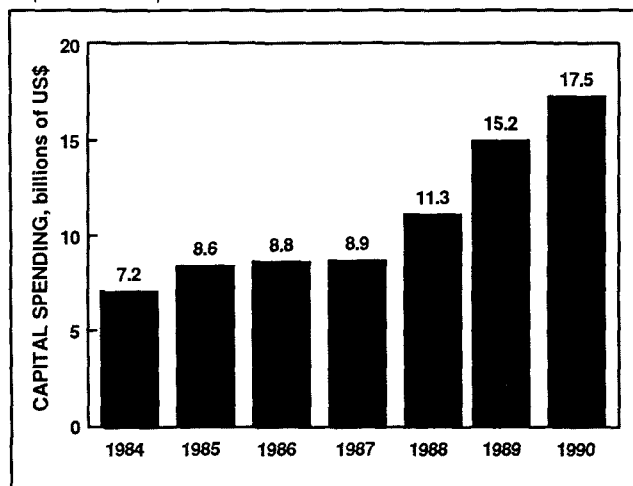
This presentation focuses only on the U.S. paper industry. It sketches briefly the industry's progress—at least as far as modernization and expansions are concerned—and tries to relate all the spending activity since 1984 to engineers or more specifically to the engineering manpower needs dictated by a virtual runaway growth boom (which has finally entered a long-predicted cyclic slowdown).

Growth boom: 1984-90

In 1989 everyone seemed to agree that growth was beginning to peak and that the year would likely be the last in six consecutive years of record capital spending. But although demand slowed and prices and production fell off in certain grades, the spending momentum carried through 1990, with a return to more "sane" spending expected beginning in 1991. Some industry analysts see an upturn in the capital spending curve beginning in 1992 or 1993.

Before we look more closely at the 1984-90 growth boom that had such a profound impact on engineering manpower needs, let's back up in time a little and look at where

1. Capital spending for U.S. paper industry, 1984-90 (published in September 1988)



we were just a few years ago. Many of you probably remember the back-to-back, doublebarreled recessions of 1982 and 1983. As reported at the time, industry analysts expected the 1982 recession to be short-lived. In retrospect, we now see that perhaps it was. In fact, what seemed at that time to be a continuation of the 1982 recession was actually the beginning of another short-lived recession in 1983. Whatever the case, the industry began a full recovery in 1984—an unprecedented recovery that was still in progress in 1990, even though a cooling off period had begun.

The paper industry came out of the 1982 and 1983 recessions crippled and pretty well banged up. It may be somewhat of an oversimplification, but mills were generally in very poor condition. They had been bled literally to death in many cases by their parent companies in the highly competitive and profit-driven period from the late 1970s through the early 1980s. Many mills were worn out, outdated, and very nonautomated by today's standards, as well as by the standards of some other industries at that time.

Just before the recessions, in late 1981, *Pulp & Paper* took a close look at the industry's need to modernize. We

*More recent figures have been substituted for some estimates and projections included in the presentation at the TAPPI 1990 Engineering Conference.

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I. Engineering manpower needs of U.S. paper industry, 1986-91

Year	Capital spending, billions of US \$	Engineering fees, millions of US \$	Engineers needed	Engineers available	Balance
1986	8.0	360	4500	4500	0
1987	8.5	380	4750	4500	-250
1988	11.3	510	6400	4750	-1650
1989	10.0	450	5600	5000	-600
1990	9.5	430	5000	5000	0
1991	9.5	430	4750	5000	+250

talked with some of the industry's top executives on both the manufacturing and the consulting sides. These experts generally agreed that some drastic modernization steps had to be taken if U.S. mills were to remain competitive both domestically and in the world marketplaces.

We also surveyed the mills directly and found that about half the paper machines then in operation were obsolete—that is, they were 15 years old or older and had not been upgraded at all since original startup. Many of these vintage machines were 30-50 years old, with little or no upgrading since startup. We also looked at the new tax laws that helped to get the paper industry, in particular, on the road to modernization in the 1980s. And, of course, we looked at the need for automation.

Spending binge causes problems

Apparently, most paper companies were very much aware of these problems, because as soon as the recessions ended, they began an extended spending spree. Capital spending went from about US\$ 6 billion in 1983 to some US\$ 7.2 billion in 1984. As Fig. 1 shows, spending hasn't slowed down since. By spending so much money, American paper companies have actually been playing a game of catchup. And, generally, they've been winning the game. Today's mills are much more modernized and more highly automated than their early 1980s counterparts. The turnaround in less than a decade has been dramatic and just short of phenomenal.

As is generally known, this growth and modernization binge caused some problems. Paradoxically, the industry actually exceeded its ability to grow. The resources to engineer, construct, and equip were heavily strained, and a dangerous shortage or undercapacity existed in all three areas.

Pulp & Paper took a close-up look at this problem in the September 1988 issue. At that time, the industry was just beginning to realize fully the implications of an imminent engineering shortage. A severe, growing shortage of engineering manpower threatened to stop the growth boom dead in its tracks, unless overanxious, overly ambitious paper companies were willing to tread a little

II. Undergraduate enrollment by class for Western Michigan University's Department of Paper and Printing Science and Engineering

	1982	1983	1984	1985	1986
Freshmen	52	52	47	29	18
Sophomores	46	36	39	20	29
Juniors	39	22	41	22	35
Seniors	55	55	42	44	36
Others	5	2	3	1	0
Total	197	167	172	116	109

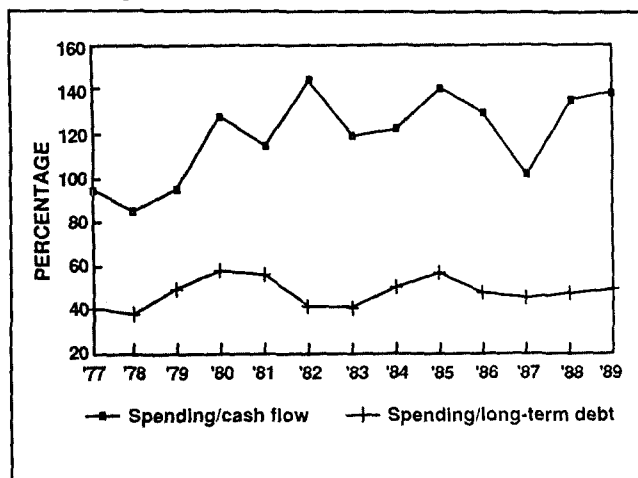
III. Salaries of pulp and paper industry engineers, 1988-89

	Salary, thousands of US\$		Change, %
	1988	1989	
Lower decile	35	33	-6
Lower quartile	42	41	-2
Median	53	52	-2
Upper quartile	66	65	-2
Upper decile	85	79	-8

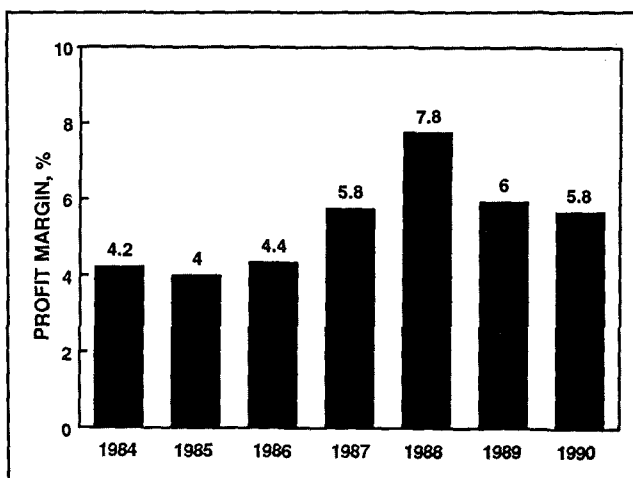
more carefully or move a little more slowly. The expansion rampage brought on new affiliations, as lines lengthened at engineering and construction companies. Consulting engineering firms began desperate efforts to staff up as demands increased, while at the same time trying to keep the quality of their work at a high level.

Fluor Daniel, for example, reported that clients were having a hard time getting quotes on vendor-led turnkey projects. Sirrine reported a continuing shortage of electrical and process control engineers, and Rust was being very cautious about work it was taking on. Williamson at BE&K said he had not seen so much activity since the early 1960s. Zareh at Sandwell said there were

2. Capital spending for U.S. paper industry as a percentage of cash flow and long-term debt



3. Profit margins for the U.S. paper industry, 1984-90



currently no bargains at engineering companies and that escalating costs could end the expansion. Thompson emphasized that Jaakko Poyry was taking its time and being picky about projects.

Although the engineering crunch did not deter new expansion announcements, it certainly made things difficult for companies trying to build those expansions in the most cost-effective and expedient manner. Weyerhaeuser, for example, reportedly had to hire two different engineering firms to design its Columbus, Miss., pulp mill, and Boise Cascade had to go to three firms to find engineering for its International Falls, Minn., fine paper project.

A few months after the September 1988 report, we looked a little closer at the construction side and found an even more severe crunch developing in the wake of new projects coming off the drawing boards. We discovered that some 263,000 construction workers per year would be needed for the next five to ten years, and that only some 227,000 were being trained to fill the needs during that period. That was in February 1989; increased capital project announcements in the paper industry alone have since increased those projected needs by at least 10%.

On the paper machine side, deliveries were running about 15 months when we did the September 1988 report. By April 1989 delivery dates were running 18-20 months. In late 1990, deliveries had stabilized at around two years. How can paper companies develop effective marketing strategies when they know it is going to take two years to get a machine installed? And, of course, it takes many many months from project feasibility studies to even get to the stage of ordering a new paper machine.

Engineering manpower shortage

The September 1988 report included Table I, which shows engineering manpower needs in the paper industry from 1986 through 1991, based on capital spending projections at that time. A comparison of the number of engineers needed versus those who would be available during the next three years showed a deficit of some 1600 beginning in 1988, 600 beginning in 1989, and break-even in about

1990. The engineering company that made these estimates saw a surplus of engineers beginning in 1991. Again, these projections were based on capital spending as foreseen then—and remember that capital spending continued to climb through 1990.

We know now that capital spending in 1989, for example, was much higher than the US\$ 10 billion shown in Table I—in fact, more than US\$ 5 billion higher. Obviously, that changed the projections for engineers needed, extending them out at least several more years. The continued increase in spending for 1990 will extend the projection even further.

Now that the industry has clearly entered a cyclic slowdown and paper companies are beginning to back down on capital spending, there should be break-even and even a surplus somewhere in the not too distant future.

Table I shows a peaking of engineers available at about 5000. The reasons why more engineers won't be available in the near future are not clear, but possibly contributing to the problem is the fact that the number of engineers graduating from pulp and paper schools has been declining in recent years.

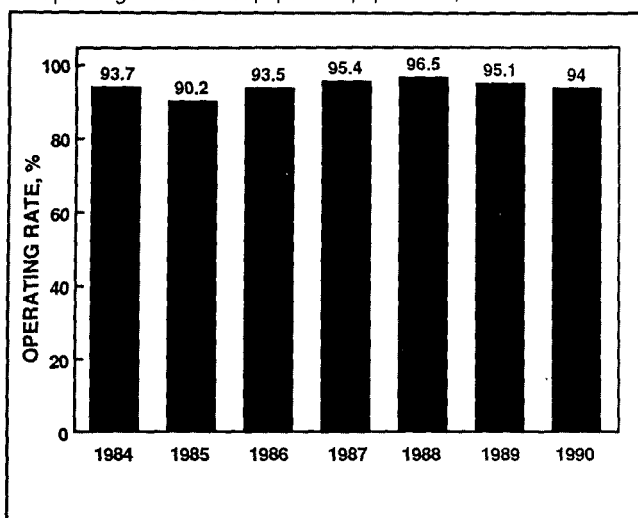
For the September 1988 issue, we also surveyed paper schools to find out the severity of this problem and to get their ideas on what could be done to rectify it. The schools generally reported a declining enrollment due to several factors, including changing demographics and, possibly more important, a growing image problem with the pulp and paper industry.

Table II, taken from that study, shows enrollment trends at Western Michigan University's Department of Paper and Printing Science and Engineering from 1982 through 1986. The total number of students in Western Michigan's paper school declined from 180 in 1982 to 109 in 1986. Probably, the number has fallen below 100 for 1990.

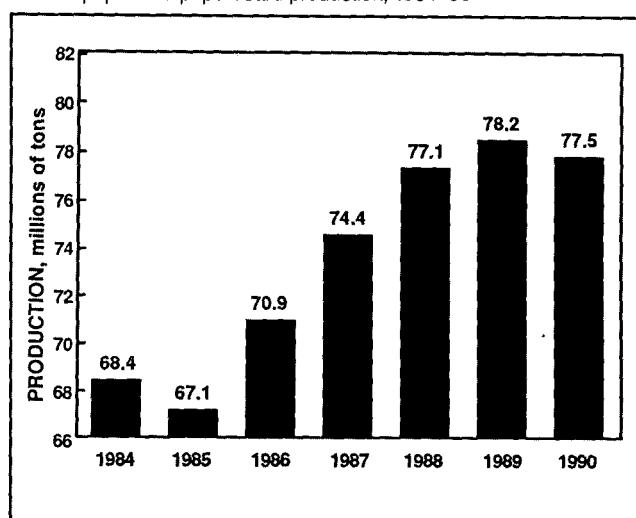
Generally, the trend is the same at other paper schools. The total at Miami of Ohio, for example, dropped from 200 in 1978 to 129 in 1989. The number of annual paper science and engineering degrees at North Carolina State has decreased from 26 in 1978 to only 17 in 1989.

Most of these schools have intensified their efforts to

4. Operating rates for U.S. paper and paperboard, 1984-90



5. U.S. paper and paperboard production, 1984-90



attract students, including seminars at high schools and mill sites where paper companies themselves bring in potential students. Also, paper schools are "buying" more students. Recruiters are doing little more than window shopping unless they can offer financial incentives—namely scholarships. N.C. State, for example, is attracting more scholastic talent than ever before, even though overall enrollment in the paper school is down. At N.C. State, a student can earn a pulp and paper degree in eight semesters, and by staying another semester, can earn a degree in chemical engineering as well. So the school is often able to attract chemical engineers along with paper science and technology engineers, making the recruiting investment more feasible.

Obviously, not all engineers serving the paper industry come from pulp and paper schools. Consulting firms serving our industry employ a broad spectrum of engineers from many schools, as well as from other industries. Also, paper equipment vendors employ various types of engineers, and relatively few of these come from paper schools.

Image problem

The declining availability of paper school engineers does indicate a serious image problem in our industry. This problem is not necessarily due to a negative image, but rather to the lack of any image at all. Some analysts describe pulp and paper as the "invisible industry" when trying to explain why it has such a difficult time attracting qualified engineering talent.

In reality, most people know little or nothing about the paper industry. Unlike the petroleum industry, for example, it has no glamorized tycoons, real or imaginary—no J.R. Ewings, no Gettys, no Pickens, no Iacoccas. There are no paper magnates, no pulp sheiks, no paper cartels to grab the attention of the international media. There are no television shows involving the paper industry. There is no *L.A. Pulp*, and no *Moss Point, Miss., Vice*. Movies and television shows glamorize lawyers, doctors, police, fire fighters, stockbrokers, and even teachers—but not engineers, and particularly not pulp or paper mill

engineers. I know of one novel written about the paper industry—titled *Prophecy*. And it is a story about a mutated monster that lived on paper mill effluent and occasionally ate people.

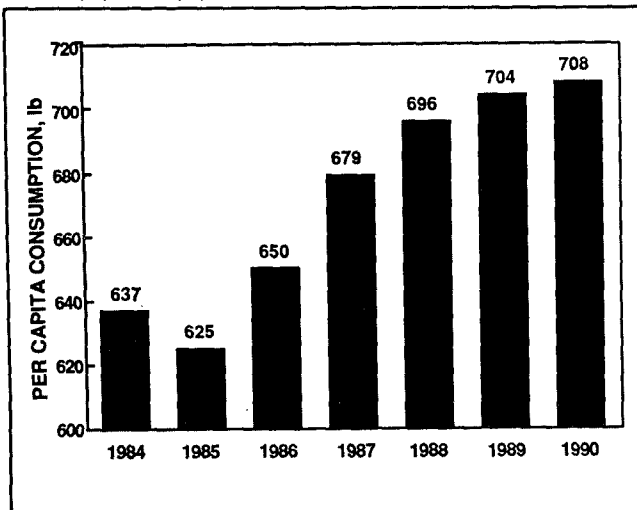
The public as a whole associates the paper industry with small towns, bad odors, and lingering labor problems. It's certainly not seen as a trendy business with many glamour trappings to attract today's image-conscious students.

Recruiting bright, high-performance high school graduates for careers in papermaking is not an easy task today, considering the allure of other, more glamorous professions. Not many paper mill engineers wear expensive suits and drive trendy automobiles. To attain the position and trappings they've learned to desire from a highly materialistic mass media, many of today's brightest young people are seeking careers in the business world, investment banking, high technology computers, etc. The competition for talented students is obviously stiff.

One thing the paper industry does have going for it, at least for the time being, is fairly attractive salaries for engineers—and job security. The *Pulp & Paper* salary survey for 1988-89, summarized in Table III, showed that the median annual income of engineers was about US\$ 52,000, which is somewhat above that of most other manufacturing industries in the United States. Engineers' salaries varied from around US\$ 33,000 at the lower decile to US\$ 79,000 at the upper decile. An increase of about 7% was forecast for 1990. These fairly attractive salaries should and are being advertised extensively by recruiters.

The paper industry is paying professional employees more in recent years because profits have been extremely high—almost sinful profits by some companies. And as indicated earlier, the paper industry is spending for more than just salaries. The 1989 capital spending increase to near US\$ 15.5 billion represented an increase of about 35% over the previous year, compared with an average of only 8.2% by other manufacturing industries in 1989. Considering that manufacturing industries account for nearly 40% of all capital spending in the United States, the fact that paper companies outspent their other industrial counterparts by four to one last year is very significant. In 1990, the paper industry was on a spending track that

6. U.S. paper and paperboard consumption, 1984-90



should show about a 15% increase over 1989. Figures for other manufacturing industries are not available yet, but certainly they will average much less than 15%.

High profits fuel big spending

What fuels this kind of spending? **Figure 2** may seem a little confusing, but it simply shows capital spending as a percentage of cash flow and long-term debt. As cash flow, which is basically profits plus depreciation, has increased over the years, so has capital spending. In fact, capital spending has tended to exceed cash flow in recent years, ranging from about 90% of cash flow in 1977 to some 135% of cash flow in 1989. So all this graph really is showing is that profits have been used to help finance expansions and modernizations in recent years—the higher the profits, the more money available for that purpose. Since the industry's profits soared between 1984 and 1989 (and particularly in 1988 and 1989), capital spending has been extremely high during that period.

Of course, capital spending is financed not only by profits or cash flow. In fact, most of it comes through borrowing. As shown by the bottom line in **Fig. 2**, capital spending has averaged about 50% of the industry's long-term debt since 1977, ranging between 40% and 60%. Obviously, this means that as capital spending has increased, so has the long-term debt. If capital spending, at about US\$ 3.5 billion in 1977, was some 40% of the long-term debt, then the long-term debt at that time was approximately US\$ 8.75 billion. In 1988, capital spending was some US\$ 11.3 billion (as shown in **Fig. 1**), which means that the long-term debt, shown by the bottom line of **Fig. 2** at about 45%, was around US\$ 25 billion. The rapid increase in long-term debt from about US\$ 8.75 billion in 1977 to US\$ 25 billion in 1988 means that a high percentage of the recent growth boom was financed by borrowing.

On the subject of profits, **Fig. 3** shows how the industry has fared since 1984. In 1988, profits were extremely high at about 8% of sales. In dollar figures, the paper industry's profits in 1989 were about US\$ 7 billion on some US\$ 80 billion in total sales. The figure for 1990 was only a rough approximation, based on first quarter results. This figure

may go up or down, depending on many factors, including product pricing, which has softened in certain grades.

Operating rates

During the past six or seven years, the industry has been selling at high prices and making extremely high profits, so mills must have been running almost full out, which **Fig. 4** shows. Again, except for a slight dip in 1985, mills have been running a steady 94-95% since 1984, with a flattening out shaping up for 1990. Because **Fig. 4** combines paper and paperboard, the rates would be somewhat lower for paper and considerably higher for board. Operating rates for some board grades, such as linerboard, exceeded 100% during the late 1980s, heavily assisted by the low value of the dollar against most European currencies.

With many new paper and board machines on-line in recent years and with many existing machines being rebuilt for higher capacity and productivity, operating rates of 95-100% obviously have boosted production considerably. The 1989 record for combined production of both paper and board of some 80 million tons (**Fig. 5**) was not expected to be topped in 1990. The rate of growth began slowing somewhat in late 1989.

Demand continues to increase

Obviously growth has to be fueled by demand. There are many ways of gauging demand for paper products, the two most popular being the number of pounds consumed per capita, which is shown for the United States in **Fig. 6**, and the ratio of tons consumed versus real gross national product (GNP). As illustrated in **Fig. 6**, per capita consumption of paper products continued increasing through 1989 and into 1990, but at a slightly slower pace. In 1990, each American was expected to consume a little more than 700 lb of paper and board, from tissue grades to cosmetic cartons.

Engineering manpower projections

What does all of this growth and prosperity mean to engineers involved in various ways with the paper industry? **Table I** analyzed what the industry's increased spending meant in terms of consulting engineering fees and engineering manpower. The projections on capital spending for 1989 and 1990 were significantly lower than actual expenditures.

Shortage could continue

If we plug in the correct figures for 1989 and estimate a slow backing down in 1991 and 1992, we have a picture roughly like **Table IV**. Instead of a shortage of 600 engineers in 1989, we should have been looking at a shortage of perhaps more than 2000. Instead of catching up or breaking even in 1990, with a surplus of engineers beginning in 1991, we may be seeing a shortage of 1000 or more extending into 1991. A flattening out period is then expected.

Again, this is using the assumption that engineers available to consulting engineering firms for work on engineering projects will peak at around 5000. The figures

IV. Revised engineering manpower needs, 1986-91

Year	Capital spending, billions of US \$	Engineering fees, millions of US \$	Engineers needed	Engineers available	Balance
1986	8.0	360	4500	4500	0
1987	8.5	380	4750	4500	-250
1988	11.3	510	6400	4750	-1650
1989	15.2	685	7800	5000	-2800
1990	13.5	600	6500	5000	-1500
1991	12.5	560	6000	5000	-1000

here are just for consulting engineers. We estimate that there are perhaps another 5000 engineers employed directly in the industry at some 600-700 mills. There may also be another 2000 or more engineers involved with the industry through vendor companies or as individual consultants.

Growth, but slower growth, ahead means that the graphs should still continue to increase, but at a somewhat slower pace. Production, for example, is still expected to rise by 2% for paper and 1.3% for paperboard in 1990. Operating rates are expected to decline to about 93.5% (for paper and board combined) and perhaps drop to an average of 92-93% for 1991. As Fig. 1 indicated, capital spending was expected to peak in 1990 at about US\$ 17.5 billion and decline somewhat for the next couple of years.

All of this, of course, assumes continued slow growth in the general economy. Anything major, such as a rapid change in interest rates, inflation, or a significant change in the dollar versus foreign currencies, could easily upset the cart—or the chart in this case. The picture could change quickly and significantly.

Whatever the situation on the economic front, the paper industry has been riding a sustained crest for seven years now. Even with the return to more "sane" spending for a few years beginning in 1991, the industry is still expected to remain basically healthy and strong into the foreseeable future. However, eventually there could be a serious downturn. How far, for example, can the long-term debt be extended? Already it is at 60-70% of the industry's net worth, which means there is a ceiling not too far above current levels of spending.

Engineering exodus

If past practices are any indication, the effects of a serious down cycle on swollen engineering ranks could be disastrous. In the next real down cycle, based on what has happened in prior cycles, some 3000-4000 engineers could be lost to the industry—most of them permanently. They would be from all areas serving the industry, including consulting engineers, equipment manufacturers, pulp and paper mills, and corporate and divisional engineering operations at paper companies.

The term *permanently* is used because from what we can determine, once an engineer is released, laid off, fired, or whatever, from the paper industry—particularly an engineer with many years of dedicated service—he or she is not likely to return when things are better, no matter how enticing the call. To some degree, this has happened in the current growth boom. In prior down cycles, the

paper industry, and those vendor and consulting companies serving the industry, have lost literally tens of thousands of highly experienced engineers—never to return. This gruesome fact has now come back to haunt us.

As is generally known, the paper industry began a restructuring during the mid-1970s that more or less broke up its large central engineering groups. Since that time, paper companies have come to rely increasingly on consulting engineering firms and equipment manufacturers, not only for engineering design and turnkey project development but also for the development of technology itself. More and more paper companies are tending to become only machine operators and merchants, and to leave the engineering and technology in the hands of others more qualified and more efficient. This trend needs to be examined more closely. Surveys can give a more accurate picture of where the engineers are and what's happening to them.

Conclusion

The paper industry of the 1990s is still somewhat of an enigma. It has changed dramatically in recent years. It battened its hatches against recession and came out fighting when the storms were over. Today it is a relatively modern industry, but still with a long way to go and some catching up to do. It learned some important lessons in 1982 and 1983, at least from a business and operating viewpoint. Let's hope it also has become a little wiser in handling its most valuable resource—its employees, and particularly its engineers. □

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