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Factors Influencing the Market for Tires and Tire Fibers

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Synopsis

Not only technology, but domestic and international economic considerations, social developments, consumer lifestyles, and political pressures are the determinants of tomorrow's tire market. Tires for global markets are subject to international competition and world tire standards. Over-the-road highway tires—auto and truck—need improved technology to meet government safety regulations at affordable user costs. Grading and labeling implies substantial pressure on constructions and fibers. Vehicle design changes to meet demands of changing lifestyles bring other implications for tire and fiber markets. Cost per ton of freight hauled is becoming increasingly important. Earthmover tires of the future will be required to haul greater loads at higher speeds, meaning much larger vehicles, bigger tires, and higher ton miles per hour of payload.

FACTORS AFFECTING THE USE OF FIBERS IN TIRES

Expenditures for fibers by the tire industry are almost equal to the expenditures for rubber. Total expenditures for tire fibers this year, 1972, will approximate a half-billion dollars. This is about 25% of the industry's total purchases of raw materials. It is almost 15% of the man-made fiber industry's sales.

So, both the tire industry and the fiber industry should have a reasonable curiosity about the factors influencing the market for tires and tire fibers. In point of fact, I can recall no other time in the history of the tire industry when more questions were being asked about the factors that determine the use of fibers in tires.

In the post-World War II era, the tire industry has spent $300 million for cotton fibers, $3.5 billion for rayon fibers, $3.1 billion for nylon fibers, $555 million for polyester fibers, $100 million for glass fibers, and $20 million for steel fibers. In 1972 alone, we estimate that the industry will spend $40 million for rayon, $235 million for nylon, $165 million for polyester, $31 million for glass, and $21 million for steel. How much is the industry likely to spend for each of these fibers in 1975 and 1980?

Two places to look for the answer are: (1) the history of fiber adoption in the U.S.A., and (2) the contrast between fiber usage in the U.S.A. and the rest of the world, particularly Europe. Tire fiber adoption conforms to the general pattern of technological innovation: the frequency and rate of

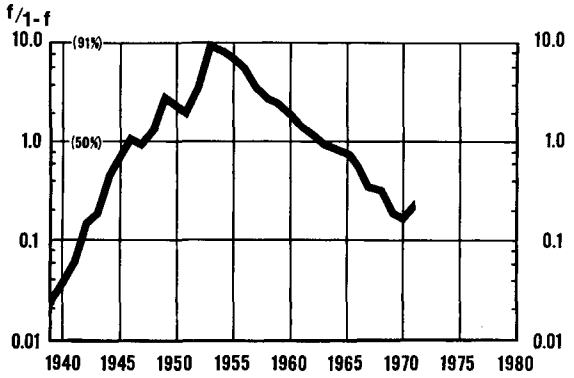

Fig. 1. Rayon tire fiber substitution rate.

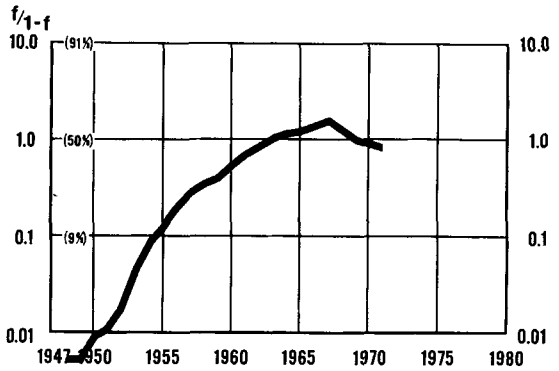

Fig. 2. Nylon tire fiber substitution rate.

adoption of successive new products is faster and faster. Cotton was the sole tire fiber for 40 years. Rayon and nylon went from introduction to their peak per cent in 16 years. Polyester has gone from introduction to its present popularity in 10 years.

One can surmise that the adoption of steel may be more rapid than any of these earlier fibers. In fact, it is possible to formulate a series of ever faster growth rates, which could delineate the adoption of Fiber R, Fiber N, Fiber P, Fiber G, and Fiber S, and Fiber B.

According to Cetron and Ralph, it is not necessary to understand the factors which have given rise to these successive shifts to new fibers. Given an initial rate of adoption for a new fiber, one can plot the rate of substitution for existing fibers by a formula they have proposed, which is $f = {}^1/_2[1 - \tanh a(t - t_0)]$.

One can plot the substitution rate as a straight line on a logarithmic scale, by using the value of the substitution rate divided by 1 less the substitution rate $[f/(1 - f)]$. If one does this for tire cord, the graphs shown in Figures 1 through 5 result. Note that on the scale used for plotting $f/(1 - f)$, the figure 1.0 represents a 50% substitution rate, and 0.1 and 10.0 represent 9% and 91%, respectively.

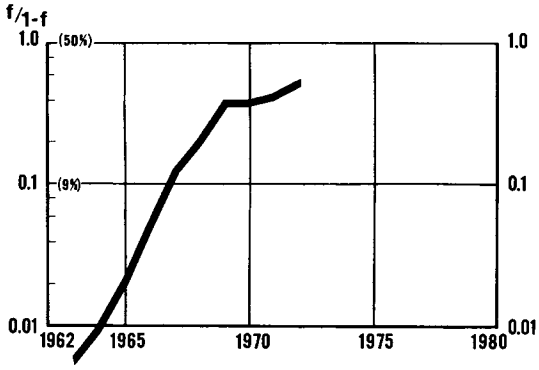

Fig. 3. Polyester tire fiber substitution rate.

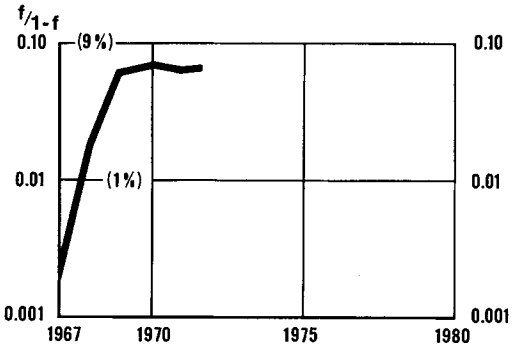

Fig. 4. Fiberglass tire fiber substitution rate.

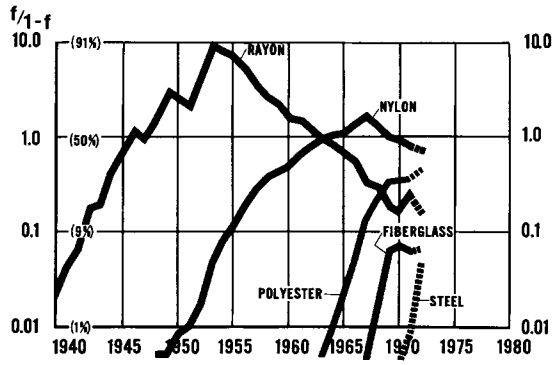

Fig. 5. Tire fiber substitution rates.

Using the horizontal time scale at the bottom one can estimate how long it will take for the new fiber to capture a specified share of the market (Figs. 1–4). Putting all the lines plus one for steel on a single chart (Fig. 5), it is evident that the time required for each subsequent fiber to achieve a 50% penetration of the market is shorter than for the fiber that preceded it.

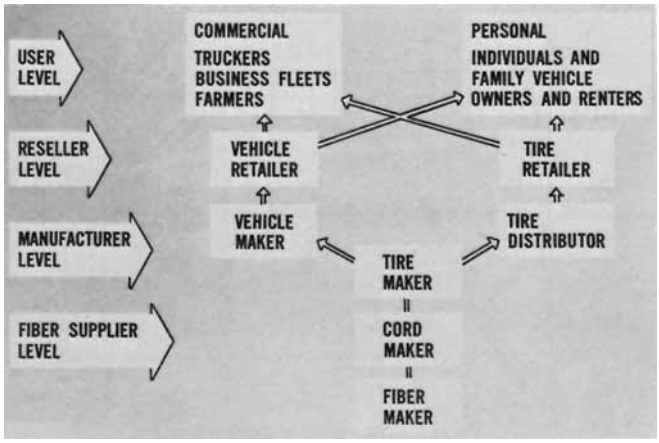

Fig. 6. Sources of tire fiber determination.

	RAYON	NYLON	POLYESTER	GLASS	STEEL
AUTO TIRES					
OE	19 %	2 %	67 %	11 %	1 %
REPL	20	34	36	7	3
TRUCK TIRES					
OE	1 %	99 %	-	-	2 %
REPL	1	97	-	-	2
GRAND TOTAL	15 %	45 %	32 %	6 %	2 %

Fig. 7. Tire cord usage by product and market segment.

However accurate this formula may be for predicting the rate at which new fibers become acceptable it tells us nothing about the reasons. Some kind of a cost–benefit ratio is clearly involved in the acceptability of a new fiber. Cost figures can be quite explicit. They will be examined in a moment.

The benefits attributable to each fiber are far more complex. Physical characteristics of various cords are determinable in the laboratory and in use on tires. But their actual importance to the tire buyer is an equally complex question.

One complication is that the tire market is segmented: segmented by product, segmented by distribution channels, and segmented by end-user. Desired cord characteristics may be different for auto tires, for truck tires and for farm tires. The tire manufacturer may have certain needs in mind such as processability when he buys a cord. At the next level—the vehicle manufacturer or replacement tire dealer may demand still other characteristics. And the final user may have completely separate thoughts (Fig. 6). Analysis of cord usage by product segment and by market segment reveals dramatic differences in penetration by each type of fiber (Fig. 7).

What accounts for the continuing and persistent difference in tire and fiber choice between different purchasers in the same product segment—such as auto tires? Why for example, does the individual or family user of

tires buy nearly 85% of his cars equipped with fiber glass belted tires and yet only 35% of this longer-wearing type when selecting replacement tires?

In 1966, when most OE auto tires were rayon, only 20% of the replacement tires were rayon. Again, why? Likewise, when for several years nearly 100% of OE auto tires were of two-ply design, this construction never exceeded 20% in the replacement market. Why? Clearly, a tire is not a tire and a fiber is not a fiber.

Sweeping generalities such as "as OE goes so goes the replacement tire market" are certainly not justified by the record. Rayon tires, two-ply tires, and bias-belted tires each at one time captured almost all of the OE market, but the replacement buyer had completely different preferences and made other choices. One lesson of this experience is, "Don't confuse the customer with the consumer." Vehicle manufacturers are customers, not consumers. Tire dealers and distributors are customers, but not consumers.

Customers needs and wants play an important role in tire design and fiber selection, especially in the *short run*. In the long run, however, the consumers' wishes usually prevail. The consumer is the user of the vehicle and its tires. If a tire design or fiber does not satisfy him, all the sales efforts of fiber makers, tire makers, vehicle makers, dealers, and distributors will ultimately fail.

But again, the consumers themselves are not a single, monolithic market. The identical individual may buy a tire of different materials in a different buying situation. In the context of a $5000 vehicle purchase, financed at $150 a month, this consumer may be willing to pay hundreds of dollars extra for deluxe tires, fabulous fiber tires, FM radio, air conditioning, or the like, going whole hog, so to speak. But when faced with these products individually in the aftermarket, a far lower percentage of these same people will spend their money for these items.

But most replacement tire buyers never buy OE tires because they never buy new cars. The typical tire buyer in the U.S.A. is a used car buyer. What this means then is that the buyers and users of replacement tires tend to be different people, literally, than the users of OE tires. They are different in the same way that used car buyers are different from new car buyers—in age, income, education, occupation—which may affect their choice of tire construction and fibers, for economic as well as other reasons.

The selection criteria at each level of the replacement market are quite different from the criteria for OE. And since nearly three replacement tires are sold for each OE tire their impact on the fiber market is most significant. Let's take a look at the user level of the tire market (Fig. 8a). Consumer purchasers of replacement tires have high tire awareness compared to new car buyers. They also have high price awareness, high functional awareness, but relatively low appearance and ride orientation, important to the new car buyer.

Now let's take a look at the dealer level (Fig. 8b). At the dealer level one again finds differences in tire preferences and hence fiber differences

CONSUMER

OE TIRES	REPLACEMENT TIRES
LOW TIRE AWARENESS	HIGH TIRE AWARENESS
LOW PRICE AWARENESS	HIGH PRICE AWARENESS
LOW FUNCTIONAL AWARENESS	HIGH FUNCTIONAL AWARENESS
HIGH APPEARANCE ORIENTATION	LOW APPEARANCE ORIENTATION
HIGH RIDE ORIENTATION	LOW RIDE ORIENTATION

(a)

VEHICLE DEALER

OE TIRES	REPLACEMENT TIRES
OPTION PROFIT	HIGH UNIT & DOLLAR SALES

TIRE DEALER (REPL)

NO CAR BUYER COMPLAINTS	PREFERENCE BRANDS
	COMPETITIVE TIRES
	VARIETY OF GOOD AVERAGE-PRICE TIRES
	LOW ADJUSTMENTS
	RETREADABILITY

(b)

VEHICLE MAKER

OE TIRES	REPLACEMENT TIRES
GOOD CAR PERFORMANCE	GOOD TIRE PERFORMANCE
LOW TIRE COST	UNIFORM TIRE PERFORMANCE

TIRE MAKER

OPTION PROFITS	EASY PROCESSIBILITY
COMPETITIVE ADVANTAGE	MINIMUN MANUFACTURING INVESTMENT
NO USER OR DEALER COMPLAINTS	LOW FIBER COST
NO SAFETY PROBLEM	

(c)

Fig. 8. Auto tire fiber selection criteria.

between car dealers and tire dealers. The number-one requirement of the car dealer is a tire and fiber that cause no complaints from the car buyer, and alternatively one that produces a good option profit, at a price that buyer will pay. Tire dealers are interested in tires that produce high unit and dollar sales. So they want popular types and brands, at competitive prices, yielding good margins in a variety of price lines. Low adjustments and good retreadability are important.

For the car manufacturer (Fig. 8c), the criteria are good car performance at the lowest possible tire cost. Complaints by car dealers and car buyers must be minimized. Some competitive product advantage or exclusivity would be desirable, if it did not cost too much. The tire manufacturer is looking for good tire performance, uniformity, easy processing, minimum plant investment, and low fiber cost.

Although the selection criteria at each level of the market are different for OE and replacement and between OE and replacement for the most part,

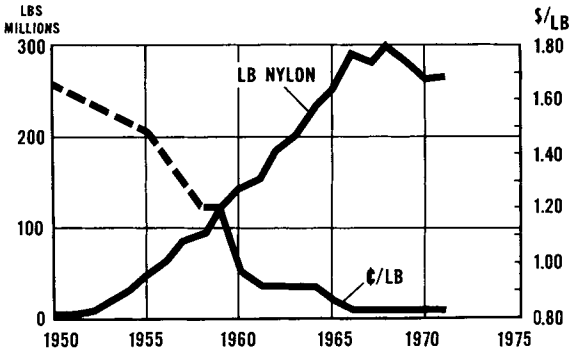

Fig. 9. Nylon tire body cord consumption vs. price.

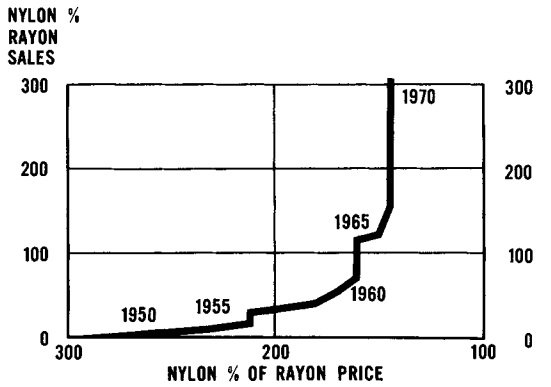

Fig. 10. Substitution rate of nylon for rayon related to relative price.

one criterion seems to cut across all segments and levels, namely, the right cost. As each new tire cord fiber is introduced, it establishes a cost–benefit ratio, in each product and market segment and level. As the price goes down from the usually high introductory levels for whatever reason (increased demand, improved supply, more economic processing, lower raw material costs, for examples), the cost–benefit ratios improve and usage mounts.

In Figure 9 you can graphically see that as the price of nylon fiber came down from the high levels of the early 1950's the use of nylon for tire cord went up in direct proportion, obviously a result of improved cost–benefit ratios.

When we look at a graph of the substitution rate of nylon tire fiber for rayon tire fiber related to the relative price of nylon to rayon tire fiber (Fig. 10), you can see that the cost–benefit ratios of nylon were such that at a 50% price premium nylon tire fiber sales were 300% of rayon sales.

While nylon, because of its cost–benefit ratios, was able to penetrate and substitute for rayon in virtually all product and market segments, it was unable to penetrate the OE auto tire product segment, despite its almost

complete takeover of other market segments prior to the introduction of polyester tire fiber.

At the consumer level, nylon did not meet the ride requirement. At the car dealer level, nylon's violation of the ride criterion caused new vehicle buyer complaints, which dealers dislike.

At the vehicle manufacturer level, the thump of a cold nylon tire reflected on the car's performance. The vehicle manufacturer had no cause to change from rayon to nylon tires even if they were better in many respects. Why invite car dealer and car buyer complaints?

When polyester fiber was introduced (Fig. 11), it satisfactorily met the OE auto tire criteria, and as its price came down and cost–benefit ratio improved, it began to penetrate the OE market.

With the introduction of the bias-belted tires in 1968, the symbiotic effect of combining polyester carcass fibers with glass belts gave the vehicle manufacturer a tire with a superior cost–benefit ratio. This tire offered 40% to

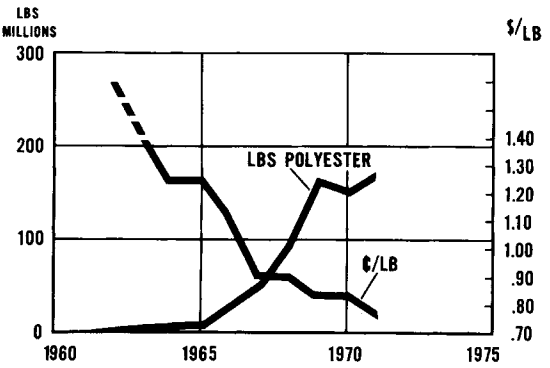

Fig. 11. Polyester tire cord consumption vs. price.

100% more mileage, better handling, and much greater safety through improved hazard resistance and traction than the bias ply tire it replaced at a small increase in cost relative to the total price of the car.

This innovation came at a time when the vehicle manufacturer was seeking improved performance to meet increased vehicle requirements and demands for more mileage. As speeds increased, distances driven increased, more convenience options such as power steering, power brakes, and air conditioning purchased, and horsepower-to-weight ratios increased, the new car owner found he was wearing out his two-ply tires faster. The bias-belted tire carries most car buyers through the first two years of car life, thus reducing complaints for the vehicle manufacturer and dealer.

Replacement tire buyers, on the other hand, seek more variety of price and service—the greatest possible performance in the price category he can or is willing to afford. He will buy no more than he thinks he needs nor will he knowingly buy more mileage than he feels he requires. In general, the older the car, the lower the price he is willing or able to pay. For these

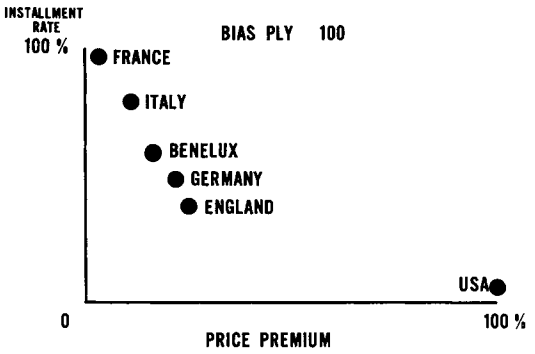

Fig. 12. Radial auto tire price premium vs. substitution rate.

reasons, the replacement tire buyers in the U.S.A. have limited their purchases of the longer-wearing bias-belted tire to 35% of the total market.

In the truck tire segment, utility and low operating cost is paramount. The cost–benefit ratio of nylon is such, based upon strength, durability, long life, and retreadability, that nylon has virtually 100% of the tire cord usage.

At this point, I suppose, the next question is, "What about the radial tire, particularly the steel radial tire? Isn't it a better tire? It has swept through Europe. Won't it do that here? If so, what will be the effect on the use of fibers?"

The crucial question, at least as far as the U.S.A. is concerned, is, "Is the radial tire, particularly the steel-belted radial tire, a better tire for the money?" Our studies to date indicate that at this time, it is not necessarily a better value in the U.S.A. than the bias-belted tire. Since some kind of a cost–benefit ratio affects the acceptance of a type of tire and/or fiber, the importance of price in market acceptance cannot be overlooked. The importance of radial auto tire price in market acceptance is seen by examining the relationship of the radial auto tire price premium and the substitution rate in the U.S.A. and abroad (Fig. 12). The radial auto tire price premium is calculated as a per cent of the price of an OE level bias ply tire which on an index basis equals 100.

Thus, in France, where a radial tire has little premium over a bias ply tire, the radial tire has almost the entire market in both the OE and replacement market segment. At the other extreme, where the premium is almost 100%, the total market penetration of the radial tire has up to now been very slow. The charted pattern seems to indicate that where the premium is quite high, rather substantial reductions in price premium are required for increases in market share. Where the price premiums are moderate, far smaller reductions in price premium bring much larger installation rates. This implies that at the lower premium levels improved cost benefit ratios are more quickly realized with smaller premium reductions.

It is instructive to analyze car buyer's willingness to pay for certain options or accessories (Fig. 13). Notice that those which give convenience,

REASONS FOR PURCHASE

	ENDURANCE LONGEVITY	SAFETY	CONVENIENCE COMFORT	APPEARANCE STATUS	PRICE	PERCENT INSTALLED
AUTO TRANS			X		$ 250	91
POWER STEERING		X	X		100	83
WHEEL COVERS/OR STYLED WHEELS				X	100	70
AIR CONDITION			X		500	64
POWER BRAKES		X	X		45	56
VINYL ROOF				X	125	43
POWER WINDOWS			X		125	21
WSW TIRES				X	60	81
AIR SPRINGS			X		40	0
RADIAL TIRES	X				200	2

Fig. 13. Optional auto equipment.

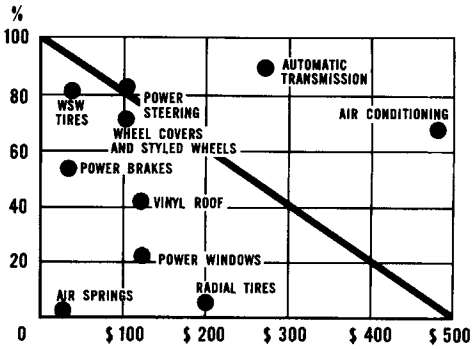

Fig. 14. Installation rate vs. price of auto options and accessories.

comfort, or status are more popular than those which give merely safety or longer life. Radial tires, for example, when offered as extra price options, and not tied to an option package including other desired items, have had relatively low sales, as was the experience with air springs.

When auto options and accessories are charted with the installation rate on the vertical axis and price on the horizontal axis (Fig. 14), it is quite apparent that some items are much more popular for the money than others. Compare automatic transmission with white sidewall tires. Or compare air condition with power windows. And note the experience to date with radial tires.

In the near-term future, a steel-belted polyester carcass bias-belted tire offers a better cost–benefit advantage than the polyester–glass bias belt tire to the OE auto tire market. Its benefits ratio is markedly better than that of the textile-belted radial tire which appears to have already been rejected by the vehicle manufacturer and dealer as not satisfying the criteria.

For the replacement tire buyer who wants longer mileage, the polyester–glass tire seems to offer the best cost–benefit ratio. The steel-belted *radial* tire is justified when very long mileage is needed.

From the foregoing discussions, it is quite clear that no longer does one fiber control the tire fiber market. No one fiber satisfies the criteria of all the tire product and market segments, and in fact the tire seems to be evolving into a complex assembly of fibers each selected for specific performance.

Looking out into the near-term future—1975—a variety of factors may affect the use of fibers in tires and change the current use pattern. Present concern over safety and the improved performance levels required by the customer and consumer are leading to larger and heavier tires using better fibers. This explains in part the move to the bias belt tire. Yet at the same time, growing popularity of the small car due to its low cost and economy of operation has caused some movement back to the bias ply polyester tire in the OE segment. The bias ply tire for the small car appears satisfactory and gives long mileage, thus reducing the requirement for glass or steel belts, at the small end of the market. At the same time, the big and standard-size cars are increasing the requirement for tougher carcass and belt fibers.

Substantial reductions in the cost to make the more complex tire constructions such as bias belt or radial belt types could result in an increase in their use as their cost–benefit ratio improves. The fibers most satisfactory to these constructions would increase at the expense of the other fibers.

Presently, estimates vary as to level of penetration of the radial construction in the next few years depending on the optimism of its cost outlook. The fact that the radial tire uses greater quantities of steel in the belts than other constructions and substantial trends to radial constructions could sharply increase the requirement for wire.

One set of factors which must be borne in mind and cannot be forecast are arbitrary decisions made either by the government in the name of safety or at the OE level for a variety of reasons: safety, competitive advantage, or just plain emotion.

For the longer term, there are other factors affecting the usage of fibers that must be considered. Fiber B, for example, is currently under development. It appears to offer properties similar to steel, may be somewhat easier to use, and result in somewhat better cost–benefit ratios which then could improve the possibility of a newer construction such as radials to dominate the market, thus causing substantial shifts in tire fiber usage. Still newer constructions in the long term may obviate the need for cord, for instance, cast or molded tires made of improved rubber or using random fiber for reinforcing.

If a construction change takes place and a longer-wearing tire results, will the market for fibers change and shrink, or will the requirement for improved performance to meet customer and consumer requirements literally use up all the improvements made by 1980?

The history of the tire industry to date is that improvements in materials and construction are not used for mileage alone but are traded off for better safety, traction, handling, ride, and the like.