The Indiana State Highway Commission, through its continuing practice of funding research at Purdue University, provides such benefits to the researcher, to the economy, and to society. The opportunity to do likewise exists for every state transportation agency and for all federal transport agencies. In fact, it is a responsibility.

Past and Future Value Systems in Research: An Industrial Perspective

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The value of research to an industrial researcher is intrinsically related to the researcher's value system and the judgment of the free market system in this nation. The researcher's value system is shaped by his or her formative professional years and the market acceptance or rejection of his or her developments. In the United States, the free enterprise market system has historically provided the judgment of developments and selected only those that successfully benefit society and thus the economy and the researcher.

Although there are many value systems that can be considered, one of the keys is the value system held by the individual researcher. It is not always clear whether one is dealing with value systems or motivational systems when one relates to individual researchers.

If one can obtain just a little insight into the value and motivational systems of a researcher, the first step has been identified to enhance the creative and constructive environment so important in the technological community.

One measure of our nation's strength is the technological value of research done in our nation's three major professional segments--university, government, and industry. If our nation is to move to new thresholds, as measured by any set of values, then the three segments of our research society must extend the cooperative spirit that has brought America to this point in history.

The importance of cooperative spirit to the value of research cannot be overstressed. Other nations may cooperate by edict and may be controlled by monolithic governments, industrial cartels, or university extremists. Our nation cooperates through the free enterprise system. As long as free enterprise and free choice of research remain the cornerstones of our triangular research society, America will continue to provide technological improvements to better mankind and give each of us time in our lives to reach our personal goals.

HISTORICAL VIEW

To talk about the value of research, it is interesting to look at a perspective of mankind. If we look at the short-term history of the United States, we realize that the settlers of this nation worked from sunup to sundown to survive. It was hard, physical, and sometimes death-dealing work to just survive. The selection of what research to do and the value to these individuals of a research improvement are easy to measure in retrospect. In most cases the improvement grew out of urgent needs for a better plow, better ax, or better home and the strong desire to have some free time.

As the frontier of this country moved westward, needs appeared, solutions occurred, industries grew, cities evolved, and man became civilized. Research made contributions of significant value to the individual, to the economy, and to society.

As one traces the American history of industrial research, significant events that have occurred affected the lives of our forefathers and continue to affect our lives today. The most significant areas in this respect are transportation, electricity, communications, medicine, agriculture, and energy. An analysis of these six areas reveals one commonality: The end result of these developments benefited individual man so that life was better and he could reach out to his fellow man. This broad perspective leads one to conclude that the frank judgment of history on research value is intrinsically tied to societal benefits.

The research history of the United States has brought this nation to the threshold of a golden opportunity. This nation can provide the population of the world with significantly better living through the technological developments from our research community.

Whether this nation accepts the challenge or not will define what historians will record about the United States. We live in a different era. For the first time in recorded history a large fraction of mankind has time to think, plan, and spend more than half a lifetime on activities other than those required to survive. What is done in the next few decades will determine whether this nation is the beginning of attempts to reach new heights of civilization.

This time element may be the major underlying factor today that drives many industrial researchers. It is interesting to speculate how our forefathers would look at this phase of America in the stream of history.

The question before the individual industrial researcher encompasses all three subjects discussed in this symposium: What is the value to me, to the economy, and to society?

VALUE TO SOCIETY

The value of industrial research to society could be measured in charts and graphs by comparing gross national product to industrial research expenditures, basic to applied research, ratio of the number of engineers trained, or any number of other solid technical pieces of information. However significant these correlations may turn out to be, they would speak primarily to the technical community and, no doubt, be argumentative. It seems important to step back from the maze of detailed technical

correlative data and look for a simpler value measurement.

In the last 60 years at least two significant and easily identifiable contributions to society have resulted from intensive cooperation between the three segments of our professional society. One is the survival of this world, as we know it today, through the research and development effort during World War II. During the perilous years 1942-1945, our nation agreed that the goal of survival was the centroid of all our lives. From those efforts many technical benefits to society resulted in the decades following World War II.

The second event was the national goal to put a man on the moon during the 1960s. From this event, the list of benefits to society is almost denumerable.

Some of us believe a third event is on the nation today--energy. It too is a survival issue. It will require marshalling our technological community to reach an energy solution. From the solution will emerge benefits to society that we cannot foresee, forecast, or enumerate. If energy problems are not resolved, society as we know it will not survive. Since the opportunity is here, and we have the time to think about it, the need, and the technology, then what is missing? There are many answers to this question. As our nation wrestles for the solution, we must remember the past, learn from our failures as well as our successes, and recognize what brought us to this point in history. The key advances in this nation were made in the free enterprise system.

The free enterprise system can provide the best solution. If the free enterprise system is allowed to function, the judgment of the marketplace will select the solution for our nation that will continue to provide the highest value for society through the millions of decisions made in the marketplace daily. This is the thrust that will produce a new societal threshold from which our nation can reach new heights.

VALUE TO THE ECONOMY

Webster provides this definition of economy: thrifty management, frugality in expenditures, an act or means of thrifty savings, management of the resources of a community, and prosperity or earnings of a place. The concept of economy here relates to thrift, frugality, management of affairs, and prosperity. In industrial research, most of the effort is directed toward providing improved products and services to our society at the lowest price and at minimum cost. We call that competition in the marketplace. If the research of company A produces more efficient and economical products and services than that of company B, then A wins and B loses. It is through our failures that research learns most and can regroup and reenter the market in a better competitive position. The competitive market is the only way to measure the economic benefits of research. Companies will come and go into the market with new products and services from research; the value to the economy will be determined by the marketplace.

VALUE TO THE RESEARCHER

The remaining portion of this paper deals with the value to the researcher. The value system of an individual is extremely complex.

Morris Massey of the University of Colorado observed that individual value systems have changed over the last 60 years. An individual's value system is shaped during his or her formative years. This can be seen by looking at the significant emotional events of the decade: in the 1920s--the end of World War I, the close family, and money talks; in the 1930s--the depression and need for security; in the 1940s--mobility prompted by World War II, the onset of family decay, and the drive to win and survive; in the 1950s--permissiveness, television, and affluence; in the 1960s--computerization, moon landings, civil rights, and Vietnam; in the 1970s--the jaded expectation of Watergate; and who knows what in the 1980s!

Massey further concludes that, with the rapid advances in technology today, value systems in the 1980s will probably change every 3-5 years instead of every 10 years as cited. The computer technological revolution of the 1980s will alter society as it is now known.

Among individual researchers, different value systems exist and change continually. The value system of industrial researchers may differ somewhat initially from those of their counterparts in government and universities. However, as time passes, these value systems coalesce to one that has been characterized in a variety of ways.

One basic trait of researchers is that a goal-oriented and accomplishment-seeking activity is a necessary segment of their life. The individual's definition of accomplishment is a key factor and varies from individual to individual. After a researcher has accomplished several technological successes, his or her value system will shift as he or she gains confidence. This maturing of the researcher leads to activities that will reward him or her in their new value system.

The complexity of the value system has been described by Maslow in his famous triangle that shows progression from survival motivation. As Maslow indicates, once needs for survival, food, and shelter are met, needs for social and accomplishment are fulfilled. When these are met, the challenges appear and must be conquered.

In the industrial technological society, the value system of the researcher must be fulfilled, otherwise the individual will seek employment elsewhere or retire from the technical community--in either case a serious loss.

Although any attempt to characterize the value system cannot be all encompassing, certain key factors must be present to satisfy personal goals and accomplishments for a researcher to dedicate his or her life to technological developments. Some of these are

1. Societal-related accomplishments,
2. Peer recognition,
3. Personal financial rewards,
4. Freedom to develop technological solutions,
5. Solutions tested in the marketplace, and
6. Technical society recognition.

Clearly, these factors would relate to most researchers regardless of which leg of the triangle they choose to dedicate their professional careers. As mentioned earlier, maturity brings the value systems closer. Indeed, near the career end point the systems probably become identical.

CONCLUSIONS

Since all research emanates from an individual's effort, the researcher's value system will ultimately determine the arena in which advances and contributions will be made. Value systems are shaped predominantly by the formative decades in

one's professional life. In this nation, the free enterprise system has been a major segment of the researcher's value system. It is the penultimate arena in which acceptance or rejection results. Historically, the millions of marketplace decisions, uniquely characteristic of the free enterprise system, select only those developments that benefit the society, the economy, and, hence, the researcher.