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THE ROLE OF THE ACADEME IN TECHNOLOGY APPLICATION AND PROMOTION

Francisco L. Viray, Ph.D.
Professor
Department of Electrical Engineering
College of Engineering
and
Executive Director
National Engineering Center
University of the Philippines
Diliman, Quezon City

ABSTRACT

The paper defines three (3) parallel streams of human activity and their interrelations, namely, Science, Technology and Utilization. Based on these definitions, the role of the academe in technology application and promotion is described.

INTRODUCTION

The role of the academe, or any institution for that matter, in technology application and promotion can only be clearly stated if we know the scope of "technology application" and "technology promotion". Experience will tell us that interpretations are quite subjective.

Allow me therefore to give you my own understanding of "technology application" and "technology promotion" based on readings on the subject, my experiences at the University of the Philippines and my contact with industries through consultancy. I will then use these as the bases of what, I believe, the academe should do in technology application and promotion.

There are three (3) parallel streams of human activity that could be involved in "technology application and promotion" (TAP). First is "Science" which is the stream of human activity devoted to building a body of knowledge over time, and which can be traced back to the beginning of recorded history.

Second is "Technology" which is a human activity that incorporates human knowledge into physical hardware that will eventually meet some human use. Third is "utilization" which is a human activity that puts ideas of science and hardware of technology into actual use in the stream of human affairs.

Figure 1 shows the normal progress from one stream to another. The illustration depicts the familiar notion that science provides the bases upon which technology is built to be later utilized in commerce or industry. However, such is not the real situation.

Science builds on previous science, technology builds on prior technology and utilization grows and spreads in response to needs and benefits.

Figure 2 shows information processing in science and technology. They are both ardent consumers of verbally encoded information. But the striking difference is the output. Scientists are heavily motivated to publish scientific papers which are the key to their satisfaction and which they use to lay claim to discoveries.

Technology on the other hand is the body of research where the main product is not paper but hardware like machines, a drug, a product or a process. The research front is at current state-of-the-art. The published material which is usually in the form of documentation is just a by-product because tradition is to conceal in order to have a new product or a process before others.

Normal path from science to technology is at best one that requires a great amount of time. Research work in Western countries has shown that technological innovation can be traced to underlying basic sciences which were studied some 14 - 15 years back, some even well beyond 20 years. In other words, there is a considerable lag of technology to science.

Figure 3 provides a topological view of the desired relationship between science, technology, and the ultimate uses of science and technology. The model presents, through time, the flows of science, technology, and the utilization of technical outputs. The various paths of transfer that may take place, and the possible sources of idea generation are indicated. Transfer can occur between the three flows (e.g., from technology to use or from science to technology) or within a channel (e.g., printed circuits used in radio and then in television).

Transfer from the technology to the utilization channel could mean making a decision to use a form of technology where it has not previously been used. This transfer may be merely the acceptance by a user of a practice common elsewhere called "adoption", or it may be a different application of given techniques designed originally for another use, labeled "innovation". The spread of these "adoption" and "innovation" is called "diffusion of technology".

Note that a form of use occurs in both cases. If technical elements are brought together in a new way and a new technology results, this would be called an "invention" until it is used to satisfy a demand, at which point an "innovation" occurs.

"Use" requires at least one user in the broadest meaning of the word. A product must be sold, a piece of equipment must be used, or a unit of cookstove must be put into production in order to qualify as examples of transferred technology. The economic meaning of "use", therefore connote utilization to satisfy a demand or need for a product or service.

Can we now see in Figure 3 the scope of TAP? When the term "TAP" is used, what do we exactly mean? Should we be concerned with the transfer from science to technology? Are we interested in the transfer of technology to initial use, or the wide use of a given technology in a new market or manner? Are we interested in the value of the new use? A new use may be a most creative transfer, yet have little value. A transfer trivial in terms of technical difficulty may be of significant consequence in terms of usefulness.

So where does TAP begin and end? While there is a big argument on where TAP starts, its end is quite obvious. That is, it must find "use".

The beginning of TAP is a difficult thing to define. If one has to be literal, only the last two channels of activities are involved in TAP. But if academe has to be asked, all three are involved, which means that science is the beginning of TAP.

If academe has to play a role in TAP, must it engage in only a portion of TAP or the whole of it? In either case, how do you measure success of academe in TAP? Let us bear in mind that despite tremendous technical progress made on a given technology, it can still be described as a "serious failure" if the economic need had not yet appeared.

The role of the University as a source of ideas for (industrial) innovation is fairly small and that university science and industrial technology are two quite separate activities which occasionally come into contact with each other.

Most university basic research do not consider societal needs and can be only partially justified for its contribution through training of students. Available scientific knowledge has not been and is not being adequately used by the people for whom rigorous scientific researches are continuously done.

Real success, therefore, lies on the ultimate use of their findings by people at large.

How can University therefore redefine its role in TAP with success? These are my views;

1. Recognizing the need for science in the advancement of technology, academe has to face the challenge of orienting its scientists to write for the technologists. Scientists are writing for their colleagues in science and they are simply not writing the sort of material that the technologists want to read. This frustrates the technologists, for somewhere in those pile of material, there would be a very valuable information that they are looking for to make new products.

2. Emphasis on what is called "gap tilling science" Science and technology advance quite independently from each other and technology can even develop without a complete understanding of the science upon which it is built. But when advance in technology is impeded by a lack of understanding of the scientific basis of the phenomena with which it is dealing, technology is forced to forfeit some of its independence. This occassional acceptance does make technology define important problem for scientific investigation. And when this problem is attacked and resolved by scientists, its solution is passed immediately into technology. This is called "gap filling science" as differentiated from "frontier science". "Gap filling science" is directly responsive to

technological need while on the other hand, advance of technology is often contingent upon the pursuit of "gap filling science."

3. The breeding of technologists from among the ranks of its faculty and students with a very strong scientific orientation. Thus, it can do more science based "inventions" or "discover" new applications of technology. Because many innovations are achieved on the basis of readily available knowledge, it follows that training and experience of the persons involved would be a critical factor. When research is required for invention, the same qualifications would be essential. The level of educational attainment can be related to the nature of the technology. Newer, more advanced technology require technologist with higher average level of education than those in older, less dynamic technology. The role of educational process in responding to the needs of advanced technological activity is therefore very significant.

4. Academe can play a big role in the actual transfer of technology to the "use" channel by the infusion of its people into industry; that is, manufacturing R & D. The mechanism of technological transfer is very effective if done with agents, not agencies; of the movement of people among establishments rather than in the routing of information through publications or documentations. This can be accomplished by encouraging positively the academically deviant practice of consulting work. Besides, the instance of the rewards - social and economic, as well as personal - which arise from breaking through the institutional confines which have grown up around academic research and engineering technology is very much welcomed by academic scientists.

5. Another way by which academe can address the role of using people as the medium of transmission is through the method of formal and non-formal education where a man gets the current state-of-the-art in science and technology.

6. Attract industrial research funds in universities that will help develop the personnel with the expected new educational experience and training. Moreover, cooperative research with industries should be pursued because working in applied projects in industries enables academic scientists to become aware of the problems or needs toward which they can apply their specialized training.

7. Costs of technology are not often within the reach of the rural and urban areas because university research is not incoporated into the mainstream of development. If academe will address this problem by itself, it has to strengthen its internal capability to recognize demand and to determine technically feasible projects which has a good economic value. At present, communication gap exists between the academic researcher and the people at large who are ultimate users of the results of the research.

8. The only way academe can participate in the diffusion of technology is to encourage entrepreneurship among faculty. This movement from a major academic establishment into entrepreneurial activites could be effective.

I can conclude that, as of now, the role of the academe in TAP is hardly recognized. It is, therefore, my wish that University administrators, government bureaucrats and private industries will soon realize the value of this role in TECHNOLOGY APPLICATION AND PROMOTION and consequently use it to its full potential.

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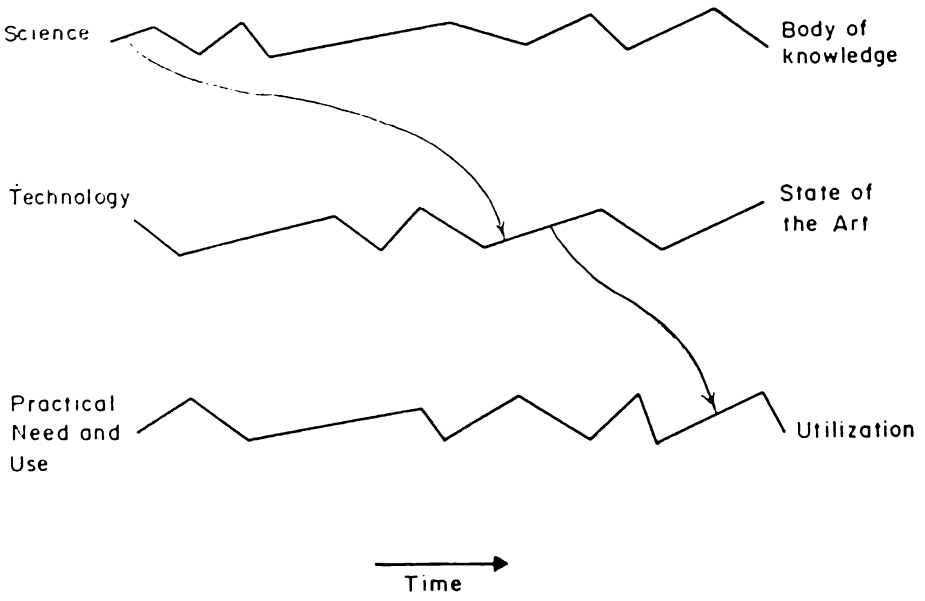

Figure 1 Science, Technology, and the utilization of their products, showing the normal progression from one to the other

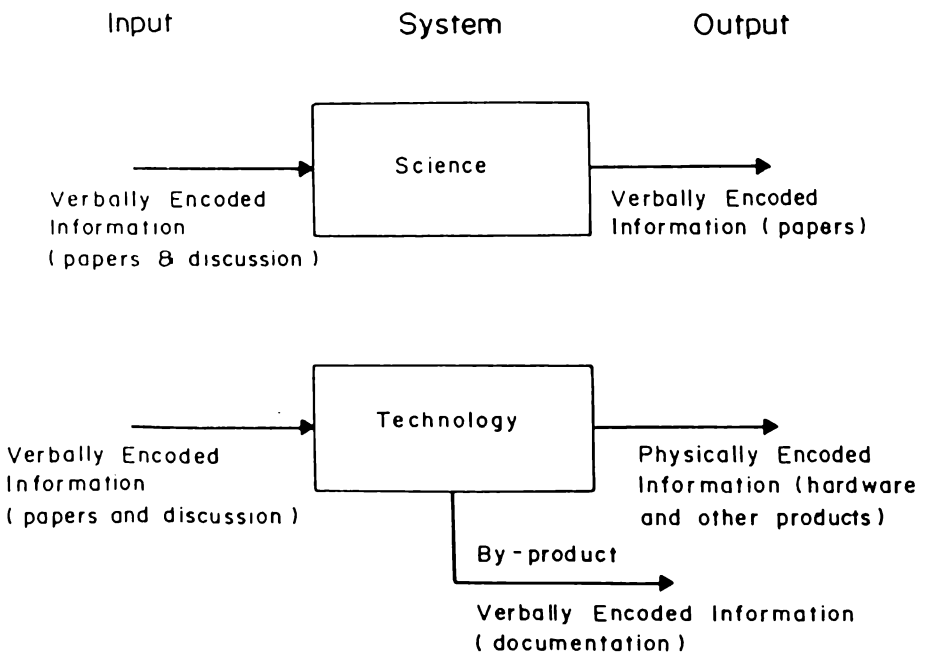

Figure 2 Information processing in Science and Technology

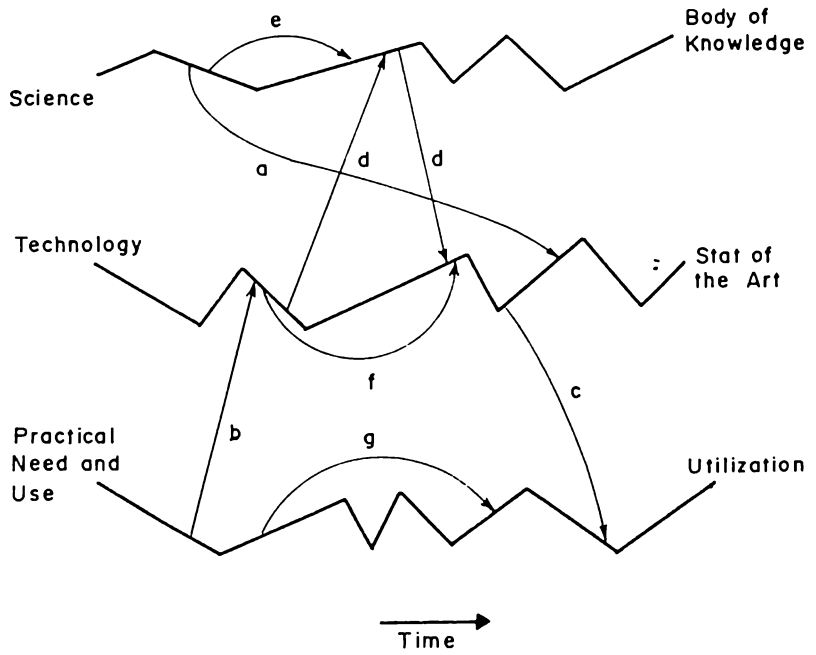

Figure 3 Science, Technology, and the utilization of their products, showing communication paths among the three streams,

(a) The normal process of assimilation of scientific results into technology.

(b) Recognized need for a device, technique, or scientific understanding.

(c) The normal process of adoption of technology for use.

(d) Technological need for understanding of physical phenomena and its response (gap filling).

(e) Science to science;

(f) Technology to technology;

(g) Use to use (diffusion)