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Appropriate Technology And The Energy Crisis

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Abstract

The proposal is to initially outline the cognative aspects - the knowledge needs - necessary to generate a technological base which will be fitting, germane, and appropriate over against the society it must seek to serve.

It is proposed, secondly, to indicate the value - laden and sensitive aspects - the elements of care and concern - so vital in creating a technology which will be thoughtfully supportive and, insofar as is humanly possible, non-injurious with respect to the people served.

Finally, the paper would seek to apply the appropriate technological concepts; both the knowing and the caring aspects, to the expanding and very real and immediate technical problems associated with the energy crisis.

Introduction

The central tasks of professional technologists are concerned with human creative design. This God-given and patterned ability to couple previous experience and perception with new and exciting insights to produce creations that are truly innovative and original is a dynamic and personally fulfilling earmark of the Creator in the creature. Technologists, viewed in this context, may themselves be creator-designers with sensitivity and responsibility and their creations have the potential, in turn, to witness to fellow humans what a service-oriented, value-conscious child of God can provide in the way of a positive, empathizing design-statement of love and concern.

Just what is this slice of reality that is the domain of technologists? An apt description of technology might characterize it as the sum of the ways and means utilized by society to transform available resources into goods and services to fulfill human needs. The heart of the matter would seem to relate to the transformational techniques; the specialized processes, agencies or methods that one utilizes to effect the transformation of resources. A technologist employs human resourcefulness and ingenuity to discover and perfect performance methods needed to achieve a goal, whether it be as elemental as the tying of a shoelace or as complex as the production of a tractor. Technology is typically a combined means-end operation and it is regularly of vital concern to a technologist to find a "better way" to improve performance as judged by some calculus such as the conservation of energy, material resources, social costs, time, or money. Thus "efficiency" and "optimization" are terms native to technological practice.

Science and technology are terms which are frequently used together and this is understandable and appropriate. Science, at root, may be viewed as that body of human conceptual schemes or models of natural objects and, or, their behavior to provide operational understanding and prediction. As scientists discover a new or expanded paradigm, technologists characteristically use scientific knowledge to construct working prototypes and finished products. A modern illustration might be the transistor. The fundamental transistor effect was modeled by scientists Bardeen, Brattain, and Shockley. In short order technologists were producing operational transistors which used this effect to amplify electronic signals and using scientifically modeled processes such as diffusion, polymerization, and nucleation as steps in the actual sequential production transformational method.

As can be readily discerned, science and technology are both legitimate areas of human activity and concern and both demand their own measure of creativity and insight. However, technology differs from science in several basic respects. The creations arising from technology are the "works of man" -- designed and wrought by people, reflecting human judgement and understanding over against society, and ultimately evaluated as to worth or merit by society and its standards. Not so with science, for though its designs are of human construction, it is more intimately concerned with the physical-biological world than with "human" creations. Further, scientific theories and their degree of certainty, their merit index, if you will, can usually be assessed utilizing physical-biological data as standards. Then, too, creativity in science basically relates to the design of experiments to obtain new insightful data from the physical-biological world and then to order the data through the creation of some sort of human paradigm, or vice versa. Obtaining new data often involves technological content since it is frequently concerned with "transformational techniques."

Creativity for the technologist is different, allowing the generation of "whole-cloth" new objects or processes providing "what never was before" for man's possible use or abuse. Technology calls for a large investment of knowledge and procedural sequences, of both the state-of-the art and new-to-the art types. These must be thoughtfully employed with judgement, sensitivity, and discernment as they relate to the society and environment - the recipients of the created entity.

With a bit of thought, one can readily sense that these human creations have real possibilities for illustrating and tracing out the marvelous potential of God's children as it is reflected in their works. But here, as in all areas of human activity, we see the effects of human introversion and lack-of-concern and, instead of a responsive and responsible technology - a service-oriented expression of concern, support, and healing - we all too often see, self-serving and insensitive statements. These alienate and injure in an arena filled with real possibilities for powerful positive witness by technologists possessing the appropriate vision and insight.

Dimensions of Appropriate Technology

In the concepts section of the Handbook of Appropriate Technology published by the Canadian Hunger Foundation - an eminently helpful statement - the question of "What is Appropriate Technology?" is addressed in some detail, and what seems to be a reasonable consensus of the material found in the literature of today emerges. Briefly capsuled, here are the basic characteristics - the dimensions - of Appropriate Technology as detailed by this source.

"Appropriate Technology is technology which is most suitably adapted to the conditions of a given situation. It is compatible with the human, financial, and material resources which surround its application."

Explication of the basic statement relates principally to applications in rural agricultural areas of developing countries. Common characteristics of "appropriate" action in these cases are said to be:

(1) Labor intensive - since labor is plentiful and typically low-cost and capital is scarce.
(2) Simple - so that it can be used by people with limited education and skills.
(3) Small-scale - to insure that it is affordable and operable at a community (village, family, etc.) level.
(4) Low-cost - the implication being that it will not depend heavily on importation of expensive materials, components, or high cost energy sources.

In addition to the above, and a bit more general in scope, are the following factors of concern when attempting to provide an "appropriate" solution to a real need or problem. These are given as follows:

(1) The technology should benefit as many people as possible.
(2) It should not conflict with local ecological systems.
(3) It must consider the dynamic cultural inter-relationships between the proposed technology and:
    a. the attitudes and values of its users
    b. the resource base of the region
    c. the economic and political structure of the area
(4) It should be flexible - adaptable to changing community needs.
(5) The technology should be acceptable to its recipients and willingly utilized by them.

A new concept of economics - "economics as if people mattered" - suggested by E.F. Schumacher in his arresting book Small is Beautiful presumably leads to some additional suggestions as to what constitutes appropriate or "human-face" technology. Schumacher insists this kind of technology should:

(1) Lighten the burden of work man has to carry in order to stay alive
(2) Develop man's human potential
(3) Provide skillful, productive "human-hands" work in touch with real materials-make work joyful and interesting
(4) Provide production by the masses - not mass production
(5) Move to "intermediate" technology - simpler, cheaper, freer technology
(6) Base itself on refined goals - redefine concepts of "growth", "progress", "success" leading to a new life-style
(7) Help people help themselves - not create dependency and loss of human potential

Utilizing an alternative approach, I would suggest that three fundamental concepts would seem to be foundational to what has been said thus far to characterize an appropriate technology.

There is first of all the intellectual or cognative aspect - the technology is knowledgeable so as to be a "good fit" when given to its recipients.

Secondly, there is the decisional or ethical factor - the technology is empathetic and caring - goes beyond knowing to healing and liberating.

Finally, the knowing and caring aspects are together focused on a problem-solving process in which the creative aspect of technology can be thoughtfully employed to provide a truly helpful and original solution.

More expansively, what are the aspects of the knowing, caring, and creating dimensions of technology as they relate to people who would practice "appropriately"?

The cognative or intellectual dimension should insure that the "best" answer is based on an honest recognition that technical problems are inherently multi-faced, and, if one really cares, he will insure that he really knows. It involves knowledge and understanding of such matters as:

a. Mathematical and scientific principles and processes needed to serve as a solid problem-solving base for technological involvement.

b. Persons and cultures to recognize and evaluate what constitutes a societally appropriate solution to a technological problem.

c. The knowledge of a series of selected technological procedures and methods needed to provide exciting and creative sequences for innovative problem solving.

d. The expansion of knowledge in a whole series of disciplines due to the inherent interdisciplinary nature of technological projects and involvement.

To illustrate this foundational knowledge need as applied to an energy-related problem, let us assume we wish to look at an energy recovery from solid waste system for a certain community. In general, rather than narrowly specific terms, what are our so-called "intellectual" requirements? Using the classifications given above, we will rapidly indicate some examples of each as they relate to this problem.

a. Mathematical and scientific principles: The evaluation of data, the desire to optimize procedures, and a need to analyze systems might call for exposure to statistics, linear programming, and La Place transforms.

   Processes under study, such as incineration, pyrolysis, and biodegradation, could relate to a need-to-know about heat transfer, thermodynamics, combustion theory, reaction kinetics, biochemistry, and the like.

   Understanding of persons and cultures: Social science and humanities needs in such disciplines as sociology, psychology, economics, political science, history, or philosophy are real and immediate because entities like social groups, political subdivisions, current and past cultural attitudes, and funding and budgetary considerations are central factors in the decision-making process.

c. Knowledge of technological methods and procedures: Innovative problem-solving involving "transformational techniques" in new combinations as they relate to the problem of "energy-from-waste" typically call for a previously acquired concept-base in topics such as manufacturing processes, applied energy conversion, mechanical design, reliability considerations in design, mechanical behavior of solids, and power generation systems.

d. Interdisciplinary knowledge: Cognative needs in this area relate to educational process for technologists which is 1) genuinely multi-faceted coupled with formal exposure to design process in theory and practice to gain knowledge and confidence in an oft-repeated sequence that calls for the synthesis and focusing of all the varied "knowing-needs" on an "open-ended" problem. Interdisciplinary requirements as illustrated in this problem could be selection criteria for processing options, environmental constraint factors, or marketing (product variables, freight and tax factors, demand and price, research and development) considerations.

The decisional or ethical dimension of a germane - a fitting-technology is concerned with an understanding of what it means to be a true neighbor and servant to society. Difficult and frequently agonizing decisions relating to justice, mercy, responsibility, and stewardship take carefully honed sensitivity and insight. Care-filled decisions must be made which:

a. Conceive of technology as a process to gain liberation for my neighbor from hunger, disease, poverty, ignorance, or isolation; from suffering or hurt of any kind.

b. Work toward my neighbor's long-range benefit and thoughtfully evaluated need; not to their short-range immediately conceived wants.

c. Utilize sound spiritual-moral concepts such as honesty, justice, and stewardship, to insure decisions that work for the best interests of the recipients, and employ technology as a means for the cultural-spiritual growth on the part of practitioner and consumer.

The use of this ethical-moral concept of an appropriate technology as applied to an energy-related problem can again be illustrated with ideas associated with a community energy-from-solid-waste system. Using the three fundamental concepts outlined above we will attempt to briefly sketch some examples of potential applications as they are associated with this specific design goal.

a. Technology as a liberating and healing process:
The solid waste problem arises from ever-expanding per capita waste generation and from the fact that traditional disposal techniques are becoming increasingly socially, economically, and environmentally unacceptable. In attempting to generate energy from the non-recoverable portion of the solid waste stream society is "liberated" from the problem of disposal, and resources (glass, paper, metals) and energy are retrieved for societal use and reuse.

b. Long-range benefit and honest need vs. short-range want:
Several possible approaches to alleviate the solid waste problem relate to policies suggested to persons and to governmental entities that reduce solid waste at the source and, in effect, urge a reassessment of priorities and life-style - a long-range perspective. These concepts might include excluding, as consumer or government, non-refillable bottles and bi-metallic cans, the legislating of regulations to improve the freight rate and tax structure for recovered materials, and the general reduction of convenience and non-essential packaging.

c. Technology as a means for cultural-spiritual growth for practitioner and consumer.
As can be readily sensed, there are a series of opportunities, in this problem, to employ sound moral principles - especially those of responsible behavior over against environment and people who have become energy dependent and thoughtful stewardship of land, earth's reources, and municipal financial means. Hopefully, use of such principles on the part of the designer and design-recipient can indeed result in personal growth and an expanded sense of appropriate values in an age of increasing scarcity.

The creative dimension of a sensitive technology is the aspect where the knowing-caring factors come together in an exciting and potentially satisfying human activity -- activity where one of the highest expressions of individuality and personhood can be devoted to -- shared with -- dedicated to the service of fellow humans. Creativity, in this case, involves

a. Sensing that the knowing and the caring - the intellectual and ethical dimensions - are normative for and dynamic in creativity.

b. Open-ended problems and the human challenge of coupling previous perception with new insight to provide innovative and beneficial solutions make the technologist's activity more akin to that of the artist than to that of the scientist and thus relate to all the excitement and satisfaction inherent in such creative endeavor.

To illustrate this creative aspect of an appropriate technology, as it might be related to our energy-from-waste project, we only need recall the innovative dimension of the basic idea; namely using the non-recoverable portion of solid waste as an energy source. This central concept, coupled with the generation of new "transformational methods" to pre-process the waste residue, extract it's energy, and responsibly handle the final residue are indicative of the occasion provided by technology for an expression of personally satisfying human endeavor and individuality.

Yes, appropriate technology as herein described is demanding, possibly somewhat idealistic. But we must strive in technological education and professional practice to indeed incorporate the knowing and caring into our artistry. Let's really give our creative statements to our neighbors a "human face."

References

(1) Canadian Hunger Foundation, A Handbook on Appropriate Technology, Ottawa, Canada, 1976

(2) Schumacher, E.F., Small Is Beautiful, Harper and Row, 1973.

Biography

James P. Bosscher is a professor of engineering and department chairman at Calvin College in Grand Rapids, Michigan. A native of Michigan, he received his B.S. and M.S. degrees in aerospace engineering from Purdue University in 1950 and 1957, and his Ph.D. degree in mechanical engineering from the University of Michigan in 1968. His professional experience includes some early work in industry and teaching experience in secondary schools and on the college level. He has been with Calvin College since 1954 and is active in professional and civic organizations, is the author of more than a dozen technical publications, and founder of a recycling organization in Grand Rapids.