Socio-Economic Contributions To Technological Assessment: The Tics Approach

. . . a shadow hangs over social science contributions to technology assessments

Technology assessments (TA's) evaluate the potential social benefits and costs associated with the development of new technologies. Although specialists sometimes disagree, basically a technology assessment is:

the systematic identification, analysis, and evaluation of the potential secondary consequences (whether beneficial or detrimental) of technology in terms of its impact on social, cultural, political, economic and environmental systems and processes . . . (It) . . is intended to provide a neutral, factual input into the decision-making process. (V.T. Coates *Readings in Technology Assessment* 1975:11)

The demand for technology assessments began in Congress during the late 1960s, resulting in the establishment of the Office of Technology Assessment (OTA) within the legislative branch of government (PL 92-484 signed 13 Oct 1972). Recently, OTA assessments have focused on sensitive science/society issues such as applied genetics, cancer risks in the environment, land productivity, and United States food and agricultural research. The National Science Foundation has also sponsored significant technology assessments of the regulation of the automobile's impact on the environment, earthquake prediction, and other important socio-economic problems. Similar concerns and TA's have been developed outside the United States and are reviewed by Marvin Certon and his colleagues in *Technology Assessment in a Dynamic Environment* (Gordon and Breach Science Publishers, New York, 1973).

It might be anticipated that if a central purpose of technology assessments is to forecast potential harmful and beneficial impacts of developing technologies on society, then social analysts would show considerable interest and innovations in this endeavor. Unfortunately, this is not the case. The social sciences received strong criticism in a recent NSF comprehensive review and evaluation of technology assessments. The reviewers, Joe Armstrong and Willis Hanman (*Strategies for Conducting Technology Assessments*, Westview Press, Boulder, 1980, p. 39) concluded that:

Even though the identification and assessment of social impacts is a central feature of technology assessments, their application constitutes one of the weakest aspects of the process. No new approaches to social impact assessment emerged from our investigation . . .

Thus, a shadow hangs over social science contributions to technology assessments. How can the practicing anthropologist, or any other social scientist, contribute to technology assessments?

By now, most of our non-social science colleagues are aware of the importance of "socio-economic factors" in technological change. Excellent books and articles, such as Ed Spicer's *Human Problems in Technological Change (1967)*, have identified social anthropologists as potential contributors to technology and society discussions. Unfortunately, a simple awareness of the importance of social and economic factors in a technological process is insufficient to permit contributions to specific TA problems. Problems are exacerbated by non-social scientists misunderstanding the potential contributions of sociologists, anthropologists and even economists. And despite their sympathy for our work, their patience wears thin when we do not repay their confidence with specific contributions.

. . . we establish our social science identity by the questions we ask

An excellent indicator of the failure of the socio-economic approach to become fully integrated in a technology assessment occurs when a decision is made to package the socio-economic questions into a distinct chapter in the TA, perhaps creatively titled "socio-economic implications," "socio-economic consequences," or "other factors." This decision marginalizes our potential contributions, pushing our work into a corner along with the specialists on saline seep, plant genetics, and groundwater hydrology. More importantly, it reduces our effectiveness in the assessment process.

We can escape such a trap by emphasizing, early in the TA discussions, that every technology will have immediate, intermediate and long range effects on the economic and social structure. We might also stress what I have begun to call the TICS approach to socio-economic evaluation. Basically, the TICS approach involves a package of questions that can be asked of any technological change. In brief, we establish our social science identity by the questions we ask.

To illustrate this approach, I describe an example of its application in a recent technical assessment workshop, organized by the Office of Technology Assessment. The workshop's objective was to assess new agricultural technologies for facing the changes occurring in dryland and irrigation farming in the Western United States. I was to provide "socio-economic" input. Although agricultural technologies is probably of little interest to most *Practicing Anthropology* readers, some general issues arose which continually reappear when social scientists have the opportunity to contribute to technological assessments.

THE TICS APPROACH

The TICS approach assumes that every technology may be evaluated in terms of its Timing, Integration, Costs and Sustainability (i.e. TICS). We proceed to ask a cluster of questions which are relevant to any technology.

1 Timing. Technologies both solve and create short, intermediate and long range problems. In the workshop, some production scientists were advocating the elimination of summer fallowing in the Northern Great Plains as a measure to counteract the problem of saline seep that is destroying thousands of acres of previously productive land. In contrast to this short range solution to an immediate problem, several plant scientists were proposing the development of previously underutilized crops (jojoba, guayule, and so on). These latter technologies were intended to address a long term solution to a long term problem. TICS asks advocates of technological solutions to agricultural problems to evaluate the changes along a temporal dimension. If we assume that (a) most technologies involve a cluster of components rather than a simple, single innovation and (b) that technologies tend to develop piecemeal, with the development of some components preceding others, then the TA may address the following questions:

- *How much research and development time will be necessary on each component of the proposed technology?*
- *How much time will be necessary to integrate the components into an operational system?*
- *How much time can be expected until adoption?*

Based on the information generated by the above questions, the social scientist may assess any conflicts that emerge between the expected time for development of a technology to solve a problem and the expected impact of the problem, in the absence of the proposed technologies. Moreover, the analysis permits a detailed scheduling of events to be compared to expected impacts.

2 Integration. Each proposed technology will become part of a socio-economic system. For example, sprinkler irrigation technologies utilized by Great Plain's farmers involve private sector manufacturers, distributors, banking credit systems, extension agents research institutions, work schedules of farmers and farm workers, and many more social groups. Complete integration of a system occurs when (a) there are few conflicts between all the social groups necessary for the working of the technology and (b) when information concerning the technology and its associated uncertainties are known by all parties that might be influenced by such uncertainties. Any proposed technology should be evaluated in terms of the difficulties, costs and time necessary to achieve technological-social-economic integration.

- *What specific interest groups might favor or work against the acceptance of the technology by users?*
- *What social institutions would be influenced by the proposed changes?*
- *How could these groups and institutions be expected to respond to one another concerning the proposed technology?*
- *What counter responses might be expected?*
- *What opinions and bias exist among potential users of the technology concerning similar technologies that had been introduced or rejected?*

3 Costs. An exceptional TA would provide a realistic estimate of the following questions:

- *What are the estimated research and development costs of developing the individual components of a proposed technological solution?*
- *What are the expected costs of integrating the components into a working system?*
- *What are the estimated use and maintenance of such a technology?*
- *What are the estimated costs to transform from the currently used technology system to the proposed system?*

. . . in some technological changes, the transition costs may exceed the gains realized by the new technology

Transitions from one form of technology to another invariably involve costs. For example, high energy costs are forcing some farmers in the Ogalala Basin to abandon circular irrigation fields and return to dry farming or pastures. To prevent soil erosion, the abandoned fields

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and as more contracts and contract anthropologists and contracting firms appear, some sort of certification for applied cultural anthropologists will also be necessary. From my brief recounting of some of SOPA's conflicts and problems, cultural anthropologists may gain some insights that will be useful in the future.

archaeology . . . is a technical service rather than genuine scientifc research" (Raab et al., *American Anthropologist* 82:539, 1980; this article serves as a good example of the rapid growth of applied archaeology; of the 35 references cited, one is from 1972, two from 1974, and the rest from 1975–1979). Others argue that

many forms. The appearance of sampling techniques in applied archaeology with accompanying statistical machinations of data, often aided by computers, has changed the very way in which we conduct field research and it has enabled us to state the veracity of our conclusions with more authority than ever before (or, in

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must be seeded with native grasses and fallowed for at least a year during the transition process. The lost revenue during this transition represents part of the cost of shifting from one farming system to another. It is not surprising that in some technological changes, the transition costs may exceed the gains realized by the new technology. Such transition costs must be paid by someone, therefore:

■ *Who might pay the transition costs? If subsidies or private industry research will be necessary, then this should be explicitly stated and estimated.*

■ *What is the relative capital/labor intensity of the proposed technology?*

With rising interest rates, capital intensive technologies that might require farmer loans might have negative impacts on certain farmers. We have the answers to these questions ahead of time. Moreover, this question is extremely important in evaluating technologies which might be of potential benefit for our foreign assistance programs. And finally:

■ *Is there a current or anticipated future demand for the proposed technology? If so, by whom?*

4 Sustainability. Sustainability is an important assessment criterion used by the Office of Technology Assessment in its present evaluation of agricultural technologies for semi-arid and arid land agriculture. Members of the Anthropological Study Group on Agrarian Systems concerned with agricultural development have stressed this criteria in previous issues of *Culture and Agriculture*. Basically, the idea is that optimum production may not always yield stable ecological and socio-econmic conditions and that slightly lower production with higher socio-economic stability may be preferable to higher production with higher instability. Sustainability may be approached from three perspectives:

■ *Technical sustainability. Will the system hold together and can it be maintained through time?*

■ *Economic sustainability. How important are interest rates, inflation, energy costs, market prices and other economic factors to maintenance of the proposed technology?*

■ *Farm unit sustainability. Can the proposed technology sustain a farm family or corporation over time?*

■ *Community sustainability. Will the proposed technology lead to increased community solidarity in our rural regions? or increased social disruption?*

For example, some of the technologies being proposed deemphasize large scale farm and irrigation equipment. Since the distributors of such equipment form a key economic and political group in the rural west, such technological changes might have a strong influence on community politics and social structure by eroding the economic base of a segment of the community.

IMPLEMENTATION

Imagine yourself faced with the task of evaluating scores of alternative technologies being suggested for a cluster of agricultural or any other technological problem. It becomes readily apparent that conducting a TICS assessment exceeds the capabilities and knowledge of a lone wolf consultant or social scientist. Our society produces so many technologies so fast that the social scientists lack TA specialists to evaluate them. Moreover, graduate and undergraduate training programs continue to ignore training in this area, despite its obvious potential for active social science involvement in the pressing social-technology issues of our society. Consequently, it is preferable to have the technological advocates themselves address these questions, assisted by the social or economic scientist. The approach demands information that only the technological advocate themselves will have. In the case of the agricultural water use TA, the following approach has been advocated.

■ *Each technology advocate will be asked to consider these above questions in their proposals.*

■ *A panel of 3–4 socio-economic reviewers will suggest changes, additional considerations and, on rare occasions, work directly with the advocate to ferret acceptable responses.*

■ *Finally, the panel reviews all the proposed technologies and TICS responses and compares the proposed technologies.*

In this manner, socio-economic questions not only are integrated into each step of a technology assessment but also are less likely to become unread appendixes in government reports.

Theodore E. Downing

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Downing recommends two references to those wishing to further explore this discussion: [illegible]