NOTES ON THE SOCIAL SCIENCES

AS PRODUCERS OF TECHNOLOGIES

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The focus of this conference is on computerization--the premier technology of the late twentieth century--and what it has meant for the social sciences. In these remarks I consider the production of new technologies by the social sciences themselves. Social science research is the source of a number of technological innovations that have proved their utility and value in the commercial market place. This assertion can be supported by examples and by rhetoric, but not yet by systematic research and quantitative measurement. In this paper I develop approaches to the measurement of social science technologies (SST) and suggest research questions that I would like to see social scientists address in this area.[1)]

Definitions and examples of social science technologies.

A simple dictionary definition of technology is "applied science." A somewhat less broad definition refers to a technical method of achieving a practical purpose. Neither definition conveys the sense that technology requires a physical process or hardware, but we easily lapse into the equation of technology with tangible things. That fallacious equation has led to the virtual exclusion of SST from official statistics and research on technological innovation and diffusion, and this exclusion has costs for both the science and the society.

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1) I draw most of my understanding of technology and of the role of the social sciences in society from that society with which I am most familiar, the United States, and I would therefore like to avail myself of the international character of this conference by learning the applicability of my remarks in other contexts.

There are many different sorts of practical knowledge that can be put to use. What distinguishes technology from other applications of knowledge is that technology has its roots in scientific research. Almost all of the sciences produce technologies, and I shall show that the social sciences are well-represented in this company. Where our technologies perhaps most differ with those produced by physics, chemistry, and biology is that our knowledge often directly competes with knowledge based on tradition, experience, and "common sense." But that competition has been strikingly successful in the last fifty years, perhaps because of the growth of our body of knowledge--facts, generalizations, methods, concepts, and theories.

There are many applications of social science other than SST. Social commentary and criticism, whether by accredited social scientists or by others, has shaped our present world, but by SST's I do not mean these or more general contributions to knowledge, culture, or enlightenment. Nor do I mean the design and evaluation of public programs and public policy, or the data gathering and societal monitoring activities that are intrinsic to the information systems of every advanced scientific-industrial society. I do not mean the study of human factors in technologies from other sciences, or the social impacts of these technologies. Nor, finally, do I mean the various techniques that the social sciences have developed in pursuit of their own research aims, such as coding of open-ended questions, computer manipulation of large data sets, and computer-assisted interviewing, except insofar as these techniques have also entered the market place.

Kenneth Prewitt, president of the U.S. Social Science Research Council, listed a number of SST's in his annual report for 1979-1980. He writes: "Standardized educational and intelligence testing, economic forecasting, political polling, psychotherapy, man-machine system design, programmed language instruction, consumer research, cost-benefit analysis, behavior modification, and demographic projection are examples of, but do not exhaust the list of, multimillion dollar industries in the United States that started as social science discoveries" (Prewitt, 1980). I would of course add to this list, while taking away psychotherapy, which I do not understand to have much of a base in social science research. Among my additions would be self-paced programmed instruction, life tables for the writing of mortality insurance, quality control circles in Japanese automobile factories, behavioral profiles of assassins and airplane hijackers, "total immersion" language instruction, and standardized personnel testing procedures.

Most of these technologies are rooted in more than one of the social sciences. Mathematical and statistical methodologies undergird them, just as they undergird technologies produced by our sister sciences of physics, chemistry, and biology. As with most other technologies, persons using them are now largely responsible for their further development and broader application, and social scientists may or may not make further contributions. But each of these technologies was dependent in its early stages, at least, on a seed of knowledge from social science research: self-paced programmed instruction grew from laboratory studies of learning and reinforcement; standardized personnel testing grew from studies of personality and ability; and quality control circles grew from research on group dynamics, productivity, and morale. Each is based in some way on concepts or models that social scientists have developed: life tables, on a special case of stable population theory; econometric forecasting models, on either demand-side or supply-side models of national economies; and behavior modification, on organismic responses to reward and punishment. Social science even has its own engineering departments and technical advice-giving programs, many of which use SST: city planning, social work, public finance, organizational administration, communication, land use management, public law, and program evaluation.

To depart for a moment from these existing technologies, it is an interesting and possibly profitable endeavor to speculate about the SST's that may be important in the future and the research they would require. A critical problem facing a nuclear society is the disposal of wastes that will remain toxic for tens of thousands of years. The technological solution is not solely to be found in concrete, steel, glass, and deep burial. Assuming that the chemical, geological, and structural problems are solved, what is the technology that will communicate across the generations the specific message of danger and ensure that this message is believed and acted on? This technology must work for a longer time than has existed complex human society and for many multiples of the time that any human government has stood. It must carry its message undistorted despite the evolution of language for a period longer than was required for the appearance of the many languages of Europe and Asia. It must survive what could be massive social change, disruption, and war. Even over a forty-year period there appears to have been some deterioration of knowledge about those toxic wastes generated by the Manhattan Project, which was the World War II atom bomb program that had sites scattered in half the states of the U.S. (Walsh, 1981). If the social sciences have knowledge that bears on this problem, it may be found in anthropology's study of priesthoods and ritual, and in history's study of long-lived institutions such as military tradition and religious authority.

We could engage in similar speculations about technologies for a globe that will bear double its current population or a society that will implement the communications capabilities the electronic engineers have readied. My guess is that society will demand much more from SST's in the future than it does today, and that technological development will become a recognized part of the work of the social science disciplines.

Indicators of social science technologies

In most of the advanced scientific-industrial nations of the north there exists a body of official statistics that provide quantitative descriptions of aspects of science and technology. These statistics have proved to be useful in setting national science policies and in assessing strengths and weaknesses in the various scientific disciplines and the technological industries that draw on them. Legislators and program administrators look to these statistics for descriptions of the conditions of science and for an accounting of what science brings to a society. Scholars use these indicators to pursue their own studies of scientific innovation and technological diffusion (Elkana et al, 1978; Zuckerman and Miller, 1980).

Missing from these national statistics is evidence of the technologies that the social sciences have developed. Investments in testing geological strata for oil deposits are tabulated, but investments in testing students for the potential to learn to program computers are not. Investments by computer scientists in developing compiler-level languages are recorded but research by linguists on the sign language of the deaf is not. Most industries known to man are accounted for except those built on SST's.

Official indicators of science and technology in the United States began in 1953, with the publication of data from surveys on the "funding and performance" of research and development. In 1979 the U.S. National Science Board published Science Indicators 1978, the fourth in a series of quantitative assessments of U.S. science and technology. This report concentrates on the "inputs" to science of money and people, classified by field, economic sector, and industry. The "outputs" of science and technology are recorded in patents and published articles. As might be surmised from this characterization of the data employed, both basic research and technological development in the social sciences are inappropriately or inadequately treated. In a review of the 1976 report, the General Accounting Office (an agency of the U.S. Congress) observes that the model inherent in these statistics assumes that "physics, chemistry, biology, and math are the most important sciences, and hence deserve the most complete coverage (1979:20)". One cannot look to this report for quantitative information on SST's.

Nor can one look to The Measurement of Scientific and Technical Activities, the influential "Frascati Manual" proposed by the Organization for Economic Cooperation and Development (1976) as a guide to standard practice for surveys of research and experimental development. The Frascati Manual generally excludes technologies from its purview, and explicitly excludes SST's from its three categories of basic research, applied research, and experimental development. The Manual says the following: "Many social scientists perform work in which they bring the established methodologies and facts of the social sciences to bear upon a particular problem, but which cannot be classified as research. The following are examples of work which might come in this category and are not R[esearch] and D[evelopment]: interpretative commentary on the probable economic effects of a change in the tax structure, using existing economic data; forecasting future changes in the pattern of the demand for social services within a given area arising from an altered demographic structure; operations research (OR) as a contribution to decision-making, e.g., planning the optimal distribution system for a factory; the use of standard techniques in applied psychology to select and classify industrial and military personnel, students, etc., and to test children with reading or other disabilities" (OECD, 1976:24).[2)]

We cannot incorporate SST into official statistics by adopting the

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2) Nor is any guidance to be found in a book on social forecasting by Olaf Helmer, to which he gave the title Social Technology (1966).

categories and concepts that are used for other technologies. The industrial categories that have apparently proved to be useful for the measurement of physical, chemical, and biological technologies will not, I think, prove useful in the design of indicators of SST's.

These technologies are crosscutting, put to work in more than one industry. Personnel testing pervades all industrial sectors; demographic projections are used by manufacturers of baby food and by electric utilities; and the technology for securing toxic waste will serve both the chemical and nuclear industries.

In the place of a classification of technology by industry, I suggest experimenting with a classification in terms of the aspect of social, economic, or political affairs that an SST serves. There is a great variety of suitable classifications available in the literature on social indicators. For example, the preliminary social indicators guidelines of the United Nations identify twelve areas: learning and educational services; health, health services, and nutrition; time use; public order and safety; and so forth (UN, 1978:43-50). The Frascati Manual offers a classification by particular socio-economic objectives for research and development, which incidentally also includes twelve categories: production and rational use of energy, protection of the environment, transport and telecommunications, defense, and so on (OECD, 1976:43-50). Another level of classification could categorize the unit of society that is directly affected by an SST: individuals, business enterprises, governments, other organizations, relations among organizations, and relations among individuals and organizations. Still another level of classification could be based on the concept of basic human needs, of which Johan Galtung(1980:66) has provided a working list. In the four major categories of security, welfare, identity, and freedom Galtung itemizes the basic needs of individual human beings. These classifications have potential for informing the study of all technologies, not just the SST's produced by the social sciences; but because they begin with social concepts, they may be particularly appropriate for our analyses.

Statisticians count the patents awarded for physical, chemical, or biological innovations; count the scientists and engineers involved in research and development; and count the money spent by governments and industry on research, development, and adoption of technologies. Economists estimate the costs and benefits of specific technological changes, sometimes extending their analyses to estimates of the impact on the length or quality of human lives. Are such statistics appropriate as points from which to begin the measurement of SST's? I suspect that they are, with the exception of patent statistics, chiefly because they are reasonable things to study and also because such statistics will permit comparisons among the various technologies. For example, we could compare the costs and benefits of social science and solutions to problems of urban transportation, and the increase in productivity and hardware accounted for by quality control circles may be compared to the increase that automation provides.

In parallel to these conventional objective measures, we should collect subjective reports from individuals on their perceptions of how SST's have affected their lives, with particular regard to their attitudes, feelings, happiness, and levels of satisfaction. These subjective indicators have been illuminating in such diverse areas as crime statistics and studies of economic growth, and they probably have much to tell us about personnel testing, behavior modification, quality control circles, and man-machine system design.

Research on Social Science Technologies

Research can determine which sectors of society control the use of the various SST's and who benefits (or suffers) from their use. It is my impression that most SST's are in the hands of organizations, not of individuals, and that it is often organizational ends, rather than individuals' needs, that they serve. Personnel testing serves an organization's needs for differentiating among candidates for a position, but is rarely used to serve the individual's needs for choosing an occupation. Demographic and economic forecasting are useful to governments and large businesses, and are under their control. Schools elect methods of instruction, and unions or companies organize quality control circles. With the exception of psychotherapy, the practitioners of SST's usually deliver their services to organizations, not to individuals. It is perhaps not odd that SST's, being rooted in understandings of social life, serve the ends of collectivities such as businesses and governments, and not necessarily those of individuals, but I admit I find this disquieting.

We need studies of the effect of SST's on the welfare of entire societies. To what degree does a technology serve a society's goals? In the United States what is known as the "social indicators movement" partly grew out of the perception that one SST, economic accounts and econometric forecasting, was not adequate for the needs of society and was in fact rather dangerous. The social indicators movement proposed to create a competing SST for enabling a society to shape its collective fate.

Lastly, we need assessments of the quality of the knowledge that underlies an SST. Life tables, and the more general stable population models, are the products of a research tradition of unusual strength for the social sciences. Demographers have a data base of fairly high quality that contains observations extending over many years for many societies. Their equations are based on well-understood, straightforward theory, and years of experience in the insurance industry have shown that life tables can be relied upon. Is the research base equally strong for quality control circles, behavioral profiles, and personnel testing? I suspect that there are some technologies in wide use that are based on defective research and partial knowledge, and that not all of these are from physics, chemistry, and biology. There is a degree to which social science remains responsible for the scientific quality of the technologies it creates, just as nuclear physics recognizes its continuing responsibility for nuclear engineering.

Conclusion

Social scientists have conducted important research on the technologies produced by the physical, chemical, and biological sciences. Their research encompasses the nuclear accident at Three Mile Island, Pennsylvania;

the social effects of aviation and of the elevator; the Jacquard loom; highways and airports; and water irrigation systems. Social science theorists such as Ogburn, Lenski, and Hawley give a prominent place to technology. International journals publish scholarly articles on science and technology by economists and sociologists.

Missing from our own research, from our theories, and from the advice we give to official statisticians is the concept of the social sciences as part of the system of science that produces technologies at work in the economy. It is almost as if we discriminate against applications of our own knowledge, preferring the exotic work of other disciplines.

Comprehensive statistics and research on science and technology must include the SST's in their domains. The SST's are important to the society, the polity, and the economy, and scholars of science and technology will profit from study of them.

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