

Part Two:

Technology

5. Technology and Its Appropriate Application

Man is a tool-using animal . . . Without tools he is nothing, with tools he is all.

—*Thomas Carlyle*

Contents

	<i>Page</i>
Introduction	51
Technologies and Disabled People	51
Appropriate Application of Technology	52
Some Suggested Elements To Structure Framework	54
Specifying the Decision Perspective	54
Specifying the Range of Relevant Decisionmakers.	54
Explicitly Stating the Goals for the Use of Technology.	55
Specifying Needs, Desires, and Capabilities	55
Identifying the Full Range of Possible Technological Options.	55
Identifying and Analyzing Characteristics of Technologies.	55

5.

Technology and Its Appropriate Application

INTRODUCTION

Policies in the disability area must take into account large numbers of technological possibilities, organizational factors, resource allocation demands, and competing levels of decisionmaking. OTA finds that an approach that helps to structure analysis and decisionmaking is needed to fulfill the goal of matching the technology needs of disabled people with the ability to develop and deliver the needed technology. The idea of matching technologies to users and to delivery capabilities is one of the two principles that guided the OTA study. A concept of “appropriate technology” is one of the necessary conceptual bases for an examination of policies related to technology and disabled people.

It is important to remember that, as the text of this chapter points out, OTA uses the term “appropriate technology” to refer to technology that is developed or adapted in response to the needs, desires, and capabilities of disabled people and applied appropriately. This concept should not be confused with the “small is

The second principle is one of matching decisionmakers’ resource capabilities to their allocation goals. Despite the many problems associated with the processes of developing technologies for disabled persons, a perhaps more critical problem lies in the reaction of society and its institutions to existing technological capabilities. This country’s ability, imperfect as it is, to deliver technologies is running ahead of decisions about what ends society seeks through technology, about who shall receive technologies that already exist, and about how those technologies will be provided and financed.

beautiful” intermediate technology movement, although there are important similarities. “Appropriate technology,” to OTA, may be complex or simple, expensive or inexpensive, fascinating or mundane appearing. The key is whether it matches the situation of use.

TECHNOLOGIES AND DISABLED PEOPLE

Technology in its broadest sense is the application of an organized body of knowledge to practical purposes. This definition encompasses physical objects, such as wheelchairs or subway elevators, and also processes, such as vocational rehabilitation or reimbursement systems—in short, a tremendously varied and complex collection of society’s tools. A full study of “technology and disabled people” would in effect be a study covering nearly all issues related to disabilities and handicaps, an impossible task. For the purposes of this study, OTA accepts the broad definition of technology as valid, but primarily will focus on technologies designed for and used by individuals with the intent of eliminating, ameliorating, or compensating for (bypassing) one or more

functional limitations of individuals as opposed to populations. Elevators in subway systems, for example, are not designed to address the needs of specific individuals but instead are oriented to “populations.” Thus, this study focuses on what are sometimes called personal assist (or assistive) devices and services.

Drugs and medical devices are clearly within this study’s boundaries. So, too, are Autocom communications devices, modifications of automobiles and vans, employment technologies (including training and skills counseling), and special typewriters. The working definition, however, eliminates or reduces in emphasis technologies designed to address population-oriented needs.

Examples of such technologies are transfuses, transportation systems, education systems as a whole, or systems of providing rehabilitative therapy.

This leaves a set of technologies in the middle—those that are established and operated for groups of disabled people and yet are oriented to individuals. An example of this form of technology is “sheltered employ merit.” Other examples are education programs designed to provide appropriate educations to individuals (as opposed to entire systems of education, as noted above), vocational counseling programs, and centers for independent living. There was no clear-cut way to decide whether to include such technologies. Therefore, technologies of this sort were considered individually and in most cases were included in at least the research phases of this study.

The three classes of technologies for disabled individuals presented above form one possible taxonomy or method of classifying technologies. Others, however, are also necessary. One method is to classify technologies by their broad goals. OTA used the following scheme:

- | | |
|-----------------------------|--------------------------------------|
| • communication | • education |
| • sensory input | • security (physical, psychological) |
| • mobility | • health (medical care) |
| • manipulation (of objects) | |

- employment (for activity, satisfaction, livelihood)
- social interaction, recreation
- daily living (e.g., shelter)

The items on the left are more basic goals; those on the right are broader goals. One way to view technology is as a method of enhancing the ability goals on the left in order to accomplish goals on the right.

The usefulness of a taxonomy lies in its ability to guide the development of further sets of goals for the development and evaluation of technologies. If one knows the human need that a technology is designed to address, one has identified the broad goal of the technology. The subsequent process is one of refining the statements of functional goals of the technology to arrive at outcome measures that can be used for development and evaluation. Wheelchairs are obviously intended to fulfill the primary need for mobility. An evaluation of wheelchairs, however, should be based on criteria that take into account the secondary functions for which mobility is necessary. For example, reliability of wheelchairs and ease of service are important evaluation criteria when travel to and use in employment is viewed as one of that technology's functions.

APPROPRIATE APPLICATION OF TECHNOLOGY

By using the terms “appropriate technology” or “appropriate application of technology,” OTA is not necessarily referring to the “intermediate technology” or “light capital technology” movements, although the background of those movements has many elements in common with the OTA use of the term. Appropriate application does not require that a technology be simple or that it be inexpensive, only that it be suitable for the intended effects and that it take into account any constraints, such as the resources available.

Appropriate technological use for even a single individual may span the full range of cost and complexity possibilities. For example, one person

might need a complex, \$3,000 microcomputer-based, voice-synthesizing communications device; a \$300 manual wheelchair; attendant care for certain periods of the day; and relatively simple and inexpensive aids such as special eating utensils and a pole with a “velcro” attachment for retrieving fallen keys from the floor.

Appropriateness cannot be defined until and unless its context is specified. That context will always involve *value*, as well as *technical*, considerations. Thus, a technology may be considered appropriate when its application is: 1) in reaction to or in anticipation of defined goals relating to problems or opportunities, 2) compatible with

constraints, including resource constraints, and 3) results in desirable and sufficient outcomes with acceptable negative consequences or risks to parties at interest.

There are, logically enough, degrees of appropriateness. The most appropriate technology in a given situation is one that provides the greatest ratio of desirable outcomes to negative effects and resources consumed, providing that outcomes and consequences have been defined and are of sufficient value as judged by appropriate parties at interest.

“Appropriate parties at interest” introduces an involved concept, one that is extremely sensitive as well. An “appropriate party at interest” is one who has a stake in the development and use (especially as regards outcomes) of technologies for people with disabilities. The primary party is the disabled individual or population. But the relevant set of parties will vary from situation to situation. Disabled individuals affect or define the appropriateness of technology not only by their judgments of outcomes, but also by their judgments on the worth of those outcomes in relation to resources required (especially when they will personally allocate those resources).

Other parties at interest include parents and family members; physicians and other health professionals, vocational counselors, biomedical researchers, electronics scientists, and other R&D people; the public at large; governmental and private policy makers; voluntary health and social organizations; industry; school systems; insurance companies; and many other groups. All these people and groups provide definitions of “appropriate” from their perspectives. It is their values and goals that give meaning to the appropriate application of technology.

Attention to the concept of appropriate technology and the attendant role of parties at interest serves to put policies regarding the development, evaluation, diffusion, and use of technologies into perspective. One line of reasoning, for example, is that a technology should not be developed simply because a researcher finds it a fascinating challenge. Although this argument is a strong one, it ignores the many substantial contributions made by research that was seen as unrelated to its even-

tual uses. Thus, the difficult but necessary approach is placing policy decisions into perspective—trying to find an appropriate balance between practical directed research and research with a less visible connection to near-term applications. Nor, for example, should society expect disabled persons to use a technology that is not compatible with their needs, desires, and capabilities.

The expansion of an appropriate technology approach from a concept to a framework that can be used to analyze questions of legislative and regulatory policy, resource allocation, and general decisionmaking will be a difficult and frustrating task. Such an approach, however, holds great promise for the goal of developing a more coherent and efficient set of policies, especially in an era of increasingly constrained resources.

It is possible to state some of the critical elements that will have to be taken into account. That is, some of the elements that can be used to structure decisionmaking or analysis can be suggested. Paramount among these is the forced, explicit identification of parties at interest, positive and negative outcomes relevant to each such party, resources needed or consumed, conflicts among parties at interest in terms of desirability of various outcomes, methods of compromise or reconciliation between the various parties, and the differing motives and goals of the parties.

The development of methods for assuring appropriate development and use of technologies implies the importance of a coordinated and coherent system for:

- involving the potential users and their associates in all the steps possible—from identification of needs, to design of the technology, to evaluation of the resulting technology;
- identifying functional limitations of potential users;
- identifying individuals with limitations;
- identifying the need for technological aids to eliminate or reduce limitations;
- specifying the goals sought for technology before design begins;
- identifying existing technologies that may provide such aid;
- conceiving, designing, and developing new

- technologies or modifications in existing technologies to provide such aid;
- conceiving, designing, and developing the necessary training programs, support services, financial services, and information dissemination services to allow the appropriate use of any such technologies;
- being aware of attitudes and values that facilitate or hinder the application of technologies;
- being aware of statutes or regulations, or needed changes in statutes or regulations, that will affect the success of the application of the technologies;
- eliminating or reducing marketing, especially financial, hindrances to successful application of the technologies;
- evaluating, prospectively to the maximum extent feasible, the safety, efficacy, sufficiency, quality, costs and other implications of the technologies;

- considering the application of any such technologies in relation to the many other types of technologies to be used by the individuals and the range of life functions to be performed;
- conducting followup evaluations to determine: 1) actual v. predicted performance and benefit of the technologies, and 2) whether any modifications or adjustments are needed to better match the goals; and
- sharing successful efforts with other potential users of the technologies.

If such a framework can be developed (and it need not be a quantitative one; identification of critical factors and subsequent qualitative analysis may be sufficient for many aspects of decisions), then analysis of costs and benefits can be better accomplished at the varying levels of the individual, program, and society.

SOME SUGGESTED ELEMENTS TO STRUCTURE A FRAMEWORK

The key to appropriate application of technologies lies in finding a fit, which will always involve tradeoffs, between: 1) the needs, desires, and capabilities of users and other relevant parties, and 2) the costs, risks, and benefits of technologies. Based on the conceptual and system factors presented above, this section lists factors that might be part of a policy approach to increasing the appropriateness of technologies. The information to be presented is not intended to be a definitive analytical framework. Instead, it is intended to provide examples of the types of considerations that would have to be used in the structuring of any such analytical approach. Also, it is important to remember that no framework is a solution; it will at the most be an organized method of structuring policy and technological problems and decision processes.

Specifying the Decision Perspective

Analysts, those supporting or funding the analysis, and decisionmakers must decide clearly the perspective from which the analysis is to be done—i.e., the decision to be made might be an indi-

vidual one, a program-oriented one (e. g., Medicare), a geographic or regional one, or a societal one. If the decision and analytical perspectives are societal but not concerned with specific technological applications, a resource allocation framework, as discussed in chapter 11, would also be very important. Specifying the decision perspective is necessary before decisions can be made about the range of costs, risks, and benefits to be considered in the analysis. It also affects the relative weight to be given to the various parties at interest,

Specifying the Range of Relevant Decision makers

This step also influences the analytical focus. It is particularly critical when a societal perspective is to be used. Even when an individual perspective is relevant, however, the task is difficult. Besides the individual directly involved, there may be other important decisionmakers: parents, counselors, physicians, insurance companies, teachers, social workers, and so on. The follow-

ing steps should be examined from the viewpoint of each of the relevant decisionmakers.

Explicitly Stating the Goals for the Use of Technology

What are the goals and objectives of each of the parties affected by these decisions? These must be stated explicitly because they will very often be different, usually competing, depending on the relevant party. Successful tradeoffs can only be made when there is an open admission and examination of conflicting desires with regard to the technology's application. For each goal: How was it set? Based on what information or data? What is the quality of such information? When goals are based on different data about the problem to be addressed, the desired objectives to move toward, and the interventions that will bring about such movement—and when goals of various relevant parties are in conflict—what is the relative quality of the different data? And how can differences in data be reduced or eliminated? When information gaps are present, how can the needed information be collected or acquired? Who will do so, in what ways, and with what support or funding? Are goals and progress toward them measurable? Will the evaluation information be in a form that will allow modifications in the interventions being used? Who will monitor progress and be responsible for reporting it to relevant parties?

Specifying Needs, Desires, and Capabilities

This step primarily applies to the direct party at interest—the disabled individual or discrete population. The need for a technological intervention must be assessed. The disabled person must either specify the need or be extensively consulted in its specification. Need should be expressed in terms of minimal functional levels required to perform tasks—the “threshold” standard. *In addition*, however, the desires (goals, aspirations) of the parties must be taken into account, as should the capabilities of the parties to effectively and efficiently use the intervention. Whereas it is most common to specify the need for a technology based on a problem definition, this step assumes

that a blend of needs, desires, and capabilities must be explicitly identified. The needs, desires, and capabilities of other relevant parties besides the disabled individual or population must also be considered. (An example is the case of teachers who must implement provisions of the Education for All Handicapped Children Act.)

Identifying the Full Range of Possible Technological Options

An attempt should be made in this step—at least at first—to identify as broad a range of technological options as feasible. Information on possible technological applications should be combined with information based on goals and on needs, desires, and capabilities. This step involves consulting with other disabled individuals, identifying technologies used in the past, and obtaining information from professional sources, data banks (ABLEDATA, etc.), advocacy groups, Government agencies, trade journals and newsletters, manufacturers, etc.

Identifying and Analyzing Characteristics of Technologies

For each of the technologies considered to be potential interventions, the following types of information should be analyzed.

- its availability;
- its simplicity of operation;
- its initial cost, including installation if applicable;
- its reimbursement or financing status;
- its future adaptability (add-ons, cost, flexibility);
- its repair record (including ease and time);
- the extent and quality of performance or evaluation data;
- its cost of operation, if any; and
- its ability to provide desired functions to the necessary level.

These are examples of characteristics; others certainly can be added to the list. For each technology, the traits above should be compared to the following characteristics of the potential users and their needs, desires, and capabilities. Again the list is illustrative, not exhaustive.

- the functional limitations of the user.
- the physical and mental capabilities of the user to apply the technology;
- the user's affinity or preference for the various types of technology (e. g., computers, or power assists);
- the user's desire for independence;
- age, sex, and other demographic characteristics of the user;
- the physical location of the user—geographic and environmental;
- type of transportation services available;
- the occupation or potential occupations of the user;
- the vocational and avocational aspirations of the user;
- income or other funds available;
- any ways in which the above characteristics might change over time; and
- the specific performance level requirements of the activity/environment in which the individual will be involved.

The discussion above has focused on the individual. No matter what the decision and analytical perspectives are, the need for the information above will still usually apply. If the decision perspective is other than the individual's, however, the information outlined above may have to be supplemented by similar information on the characteristics of the new decisionmaker. Information on desires and resources available will be especially critical.

Selection of the technological intervention to be applied can then be based, *in part*, on completing the above steps for each technological possibility. "In part" is highlighted because decisions will rarely if ever be based entirely on the results of analysis, no matter how informed or structured the process of analysis and decisionmaking has been. Structure *informs*, and ideally improves, the decision; it does not and should not *make* the decision.