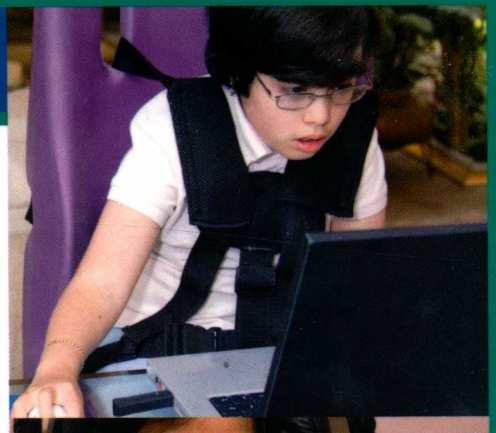
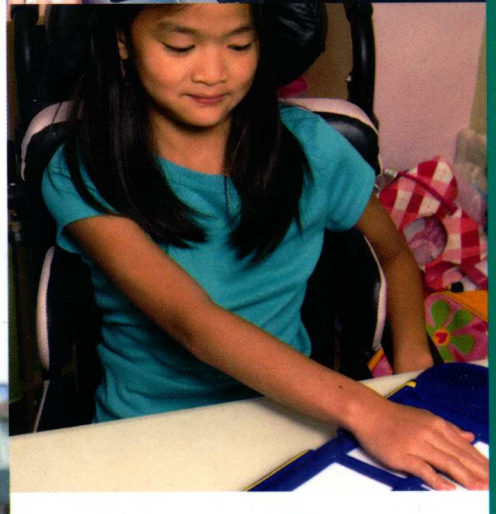
4th EDITION

Assistive Technologies

Principles & Practices

Albert M. Cook • Jan Miller Polgar





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Assistive Technologies:

Principles and Practice

Fourth Edition

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Assistive Technologies:

Principles and Practice

For giving us the reason and the direction for this work,
we dedicate this book to all of our students and to consumers of assistive technologies,
especially Elizabeth Cook, Brian Cook, Charles and Evelyn Miller.

Preface

Writing is no trouble: you just jot down ideas as they occur to you. The jotting is simplicity itself—it is the occurring which is difficult.

Stephen Leacock

Technology use is pervasive in almost everything we do. Technology development occurs at a rapid pace, making it difficult to keep current with the latest devices and software. The field of assistive technology (AT), commonly considered to be technology designed for individuals with some form of impairment, is expanding at a similarly rapid pace. The revisions in this latest edition of *Assistive Technologies: Principles and Practice* reflect the constant and rapid pace of change as well as the changing perspective of what constitutes AT. The book is written to support students in rehabilitation, engineering, and other relevant programs and service providers in the acquisition and application of knowledge that supports the provision of AT services.

Both of us are from North America and primarily understand AT issues from that perspective. However, in the years since the first edition of this textbook was published, we know that it has been used outside of this context and has been translated into multiple languages. Similarly, events such as the signing and ratification of the United Nations Convention on the Rights of Persons with Disabilities by many nations and the publication of the World Health Organization's *Report on Disability* position AT provision and use as global concerns. Consequently, we have attempted to provide a more global perspective to this edition through descriptions of processes that can be applied in different contexts and discussions of issues of appropriate and sustainable AT service delivery. The rapid development of AT applications for mainstream technologies has also made AT more accessible in underresourced countries. These topics are evident throughout the first few chapters discussing the Human Activity Assistive Technology (HAAT) components, ethical issues in AT and AT service delivery, as well as in the discussion of different categories of AT.

Assistive technology service delivery is founded on five principles that are clearly articulated in this book. Earlier editions contained three basic principles describing a person-centered approach, focused on functional outcomes supported by evidence, to which we have added two more reflecting ethical and sustainable service delivery practices. We have attempted to make the application of these principles more explicit throughout this edition in the description of the elements of the HAAT model and the service delivery process and in the discussion of categories of AT. Chapter 1 presents foundational ideas for the subsequent chapters in this edition. In addition to the principles and the HAAT model, definitions of AT, complementary models of health and functioning, legislative aspects, and a summary of some of the research applying the HAAT model are covered in this introductory chapter.

The HAAT model guides assessment and evaluation of AT use by clients. It provides a framework for assessing the usability of technology and guides product research and development. The basic structure of the HAAT model remains unchanged from earlier editions. However, in this edition, we have provided considerably more depth to the discussion of each of the individual elements. Furthermore, we discuss how the elements interact with and influence each other to support a human doing an activity in context using AT. Chapters 2 to 4 expand significantly on the concepts and application of the HAAT model.

Chapter 2 introduces AT, discussing the blurring of technology that is designed specifically for persons with impairments and mainstream technology. Everyone knows about the "explosion" of mainstream technologies. When our previous edition was written, tablet computers did not exist, cell phones were not all that smart, and the Internet and connectivity were just beginning their global expansion. Today these things are old news, but they have dramatically impacted the technology options for people with various disabilities. There are both positive and negative consequences for people with disabilities. Particular attention is paid to the international impact that these developments might have for people with disabilities in underresourced countries.

Chapter 3 discusses the activity, human, and context components of the HAAT model, including how they influence and interact with each other. Here we apply ideas of social and occupational justice to the access to and use of AT, understanding the ability to access affordable, appropriate AT to be a right for all individuals for whom the technology will support engagement in daily activities and participation in their communities. The social and cultural components of the context element of the HAAT model were enhanced to reflect issues of sustainability that affect AT provision and use. AT provision has to make sense for the context in which it will be used: technology that works well in an urban area may be quite useless in remote areas such as the outback of Australia, remote areas of South American or African countries, or the far north of Canada. We sought to bring issues of AT service provision in underresourced areas to the forefront in Chapter 3 and in other relevant sections of this book, recognizing that all we can do is scratch the surface of this topic in a book of this complexity.

As technologies become more and more pervasive and consequently have a greater and greater impact on the ways people with disabilities live and interact with the world around them, ethical considerations become important. Some of these are the direct result of the application of AT in particular ways, for example, monitoring or tracking of individuals with dementia. Other ethical concerns are related to secondary effects of AT application such as the dependence on technology for storage and retrieval of private information. Still other ethical issues arise as a result of particular disabilities such as cognitive limitations. We have added Chapter 4 to explore these ethical issues in some depth.

The application of the HAAT model is made explicit in each of the chapters discussing different types of AT. A consistent format is followed in these chapters to (1) discuss the activities supported by the technology that is the chapter focus; (2) describe the individuals who benefit from use of the technology, as well as impairments that affect the ability to engage in the activity supported by the technology; (3) discuss contextual factors that influence use and service provision; (4) discuss assessment to identify the need for and most appropriate AT; (5) discuss specific technologies; (6) describe outcome evaluation; and finally (7) summarize the research to support the use of the specific technology. In some chapters, the format is followed in the order in which it was just stated; however, in others, the order of these within chapter topics varies to fit the specific topic area.

In Chapter 6, we discuss the various ways in which individuals who have upper extremity motor limitations can access controls for electronic ATs. Chapter 7 describes the major approaches to the design of control interfaces that are used with ATs for computer access, power mobility, communication, and environmental control. In Chapter 8, we focus on the general principles underlying the utilization of mainstream technologies as ATs as well as computer access for individuals with motor disabilities.

Chapter 9 discusses seating and positioning technology, including both the different types of seating and positioning systems and hardware as well as the features of materials and construction techniques. Chapter 10 describes the structure of and means to control manual and powered wheelchairs. It identifies principles to guide recommendation of these technologies and introduces advances in these areas. Chapter 11 has two main components: (1) technology for safe transportation when traveling in a vehicle, either while seated in the vehicle seat or in a wheelchair, and (2) technology for driving.

In Chapter 12, we discuss the use of ATs to replace or augment manipulative ability. This area has seen a huge expansion of available technologies and applications since the previous edition. We include both low- and high-technology devices, but here greater attention is given to the devices that are used to manipulate the environment, such as smart technology as their availability and use become more prevalent. We also discuss advances in robotics that will be available to individuals in their homes, and study and work locations.

Chapter 13 provides an overview of technologies to support individuals with low vision or blindness. The increasing use of mainstream technologies has created a need for visually accessible design in tablets and smartphones for those with low vision and for alternatives to visual access for those who are blind. In Chapter 14, we discuss technologies that aid individuals who are hard of hearing or deaf. Developments in hearing technologies have expanded the options for treatment for both partial and total hearing loss. The area of deaf-blind communication has been significantly impacted by the utilization of mainstream technologies.

Chapter 15 addresses the area of AT applications for individuals who have cognitive disabilities. Again, the use of mainstream technologies with appropriate apps has dramatically expanded the options in this area. The use of monitoring technologies for individuals with dementia has also grown. The area of augmentative communication has perhaps had the greatest impact of mainstream technologies with many new communication applications appearing almost daily. However, in this area, the very practice of assessment and implementation of communication alternatives for those with speech and language difficulties has been impacted by the changing technology landscape. This topic is analyzed in Chapter 16.

It is our hope that individuals familiar with ATs will find something *new* in this text and that readers who are new to this subject will develop *familiarity* with ATs and appreciate their potential.

Acknowledgments

We received tremendous support from two of our doctoral students, both of whom successfully completed and defended their own work during the completion of this edition, Dr. Liliana Alvarez and Dr. Laura Titus. Lili has experience in both clinical practice of occupational therapy in Colombia and as a professor at Rossairo University in Bogota, where she taught assistive technologies (ATs) using the previous edition of this text. The breadth of her background was valuable in helping us understand the global perspective of AT application, and her assistance in finding and reviewing the current research literature in AT enriched the content of the text. Laura is an experienced clinician whose own research explores why and how individuals use power tilt on wheelchairs in their daily lives. She was always ready for a discussion about seating and mobility technologies, pointing out what should and should not be included, identifying key resources, and providing feedback on drafts of the seating and mobility chapters. When pictures were needed, she arranged to have devices available so these pictures could be taken. Laura's support, knowledge, and friendship made the writing of seating and mobility chapters easier and their content stronger.

The contributions of others who supported the writing of this edition are also acknowledged and appreciated. Linda Norton, from Shopper's Home Health and a doctoral student at Western University, was a valuable resource on the topic of wound prevention and pressure redistribution technologies. Dave Farr of Motion Specialties and Andrew Smith of Thames Valley Children's Centre in London Ontario opened up their stock room and clinic to provide access to seating and mobility technologies for pictures. Drs. Alex Mihailidis, University of Toronto; Ian Mitchell, University of British Columbia; and Pooja Viswanathan, University of Toronto provided current information on smart wheelchair technologies.

Work of this magnitude does not happen in isolation. We were privileged to work with Jolynn Gower, our editor from Elsevier, who guided us through the publication process. Jolynn's support was invaluable as she offered guidance on various resources, helped us make decisions, and was always understanding when life circumstances intervened and deadlines had to be changed.

Albert M. Cook
Janice M. Polgar

Jan Polgar and I have collaborated on both the third and fourth editions of this book and *Essentials of Assistive Technology*. The fact that we have continued to find ways to work together speaks to the value I have for Jan as a collaborator. Collaboration is always challenging and often produces unexpected outcomes, especially when it occurs by phone and email rather than face to face. Jan has made that collaboration easy and productive. She is thoughtful, critical, and highly productive, all qualities that contribute to quality outcomes. An added bonus—that got us through those impossible deadlines—is her sense of humor and her consistently positive attitude. Working with Jan has been a delight from start to finish. Always thoughtful, always critical, and most important always kind, she has made many major improvements to the parts that I wrote and shown her typical insight and care in the parts she led. Thank you, Jan, for all of the effort and for the quality product that resulted.

I cannot adequately express the appreciation I have for the continuing support, love, and understanding of my wife, Nancy, and the support of my daughters, Barbara and Jennifer. Finally, my son, Brian, continues to inspire me to understand the ways in which technology can ameliorate the problems faced by individuals who have disabilities.

Albert M. Cook

Again, it has been an absolute pleasure to write a book with Al Cook. This book is the third collaboration between Al and me. As we begin each revision, we spend considerable time discussing changes to the content and the organization of the book. Our conversations with this revision were particularly energizing as we discussed and debated the changes in theory, practice, and technology that influenced how we modified the content and organization of this book. Issues of global provision of AT, blurring of mainstream and AT, and ethics are more prominent in this edition. The ideas discussed are the results of much lively discussion and debate.

Anyone who has engaged in and completed a project that spans a significant length of time knows the ebb and flow of enthusiasm for the work involved. Al's presence as my coauthor was most welcome during those times in the past couple of years when my energy for writing flagged. Al is a generous man. Most appreciated are his generosity of time and his unending support. When work and personal issues competed for my time for writing, Al stepped in, taking on additional responsibilities. He is generous with his knowledge and experience; as the senior author of this book, he frequently guided me through the pragmatic aspects of writing a book. He was

always generous with his feedback—constructive comments, of course. I continue to feel fortunate that Al asked me to come on board as a coauthor several years ago and value the friendship that has coalesced over those years.

My family continues to make my life meaningful and full. As my parents, Charles and Evelyn Miller, age and become users of AT themselves, the importance of focusing on the person using the technology is reinforced. I value the ongoing love and support of my husband Roger and my children Andrea and Alex, both of whom completed secondary school and moved on to university during this project. Our lively dinner debates, adventures, and many occasions of laughter are the great joys of my life.

Janice M. Polgar

Contents

CHAPTER 1

Principles of Assistive Technology: Introducing the Human Activity Assistive Technology Model

CHAPTER OUTLINE

LEARNING OBJECTIVES

On completing this chapter, you will be able to do the following:

1. Define assistive technology (AT).
2. Describe key principles of AT service delivery.
3. Describe contributions of existing ecological models of health to the conceptualization of the Human Activity Assistive Technology (HAAT) model.
4. Describe the purpose of the HAAT model.
5. Describe the activity, human, context, and AT components of the HAAT model.
6. Describe four applications of the HAAT model for AT research and clinical applications.

KEY TERMS

Activity
Activity Output
Assessment
Assistive Technology
Assistive Technology Service
Beneficence
Context
Enabler
Ecological Models
Environmental Interface
Evidence Informed
Ethics
High Technology
Human
Human Rights
Human Technology Interface
Low Technology
Mainstream Technology
Nonmaleficence
Outcome Evaluation
Processor
Social Justice
Usability

INTRODUCTION

Contextual Background of the Book

Disability is seen as a socially constructed phenomenon that results from barriers that are present in the environment. This view of disability locates it within the environment rather than within the person. The World Health Organization's (WHO's) International Classification of Functioning, Disability and Impairment (ICF) views disability as the result of an interaction between the person and his environment. Viewed this way, disability is possible in everyone's experience (Bickenbach et al., 1999).

The worldwide prevalence of disability is difficult to estimate because of challenges of definition of cohesive

definitions of disability and technical aspects of data collection. However, the WHO *Report on Disability* (2011) estimates that approximately 720 million people worldwide experience some form of disability (WHO, 2011, p. 27). Furthermore, approximately 190 million (or 3.8% of the world's population) experience "severe disability" that limits their ability to participate in daily activities.

People with disabilities are much more likely to live in countries that are considered to be of low or middle income. Estimates suggest that 89% of people with vision impairment, 76% with hearing impairment, and 92% of those with a disability resulting from an intentional or unintentional injury live in a low- or middle-income country (Samant, Matter, & Harris, 2012, p. 1). Similarly, women, older adults, and people living in poverty have a greater prevalence of disability (WHO, 2011).

Disability has significant consequences on an individual's life. Persons with a disability have a greater likelihood of being under- or unemployed; they and their families are more likely to have a lower socioeconomic status; they experience poorer health; they are less likely to receive an education; and they experience more social isolation, less community participation, and less safety and security (they are more likely to experience physical, mental, or financial abuse).

Assistive technology (AT) is one of many opportunities that are necessary to reduce the disabling influence of many environments. Technology is a ubiquitous part of our everyday lives, which for the most part, makes our daily tasks simpler to do. This book focuses on the different aspects of using technology to meet the needs of individuals with a variety of disabilities. We will present a model that guides service delivery, **outcome evaluation**, and research and development of AT.

CONSTRUCTS OF DISABILITY IN KEY DOCUMENTS

The United Nations (UN) Convention on the Rights of Persons with Disabilities (CRPD) opens with a statement that recognizes the "inherent dignity and worth and the equal and inalienable **rights** of all members of the human family as the foundation of freedom, justice, and peace in the world" (UN, 2007, p. 1). It recognizes that disability occurs at the intersection of the person and the **context** in which they live and consequently, that the extent of disability is different for individuals living in different contexts. This document describes rights of persons with disabilities, with the explicit expectation that member states who are signatories to the document will enact legislation, regulations, and other measures to ensure these rights for their citizens.

The CRPD enshrines the rights of persons with disabilities to be treated as equals before the law and to be "entitled without any discrimination to the equal protection and equal benefit of the law." Persons with disabilities have the right to be recognized as "persons before the law" (UN CRPD, p. 8). In other words, the presence of a disability does not nullify the state's recognition that the individual is entitled to the full benefits and responsibilities of citizenship. This convention prevents a member state from declaring a person with a disability to be a nonperson, which means he or she is not entitled to vote, own property, participate in civic governance, or enter into a legal contract. If you recall the limitations on the rights of women before the suffragette movements of the early 1900s, you will better understand the intent of this particular article of the CRPD.

Women and children with disabilities are given particular attention given their vulnerability to discrimination and abuse because of gender or age.

Beyond rights and protections afforded to all global citizens, the CPRD identifies several that are specific to persons with disabilities (Table 1-1) and describes the articles that are relevant to AT use, service delivery, and research and development.

Assistive technology is mentioned specifically in many of the sections of this convention, calling for research and development of all types of AT, requiring many other forms of technology (information and communication technology in particular) to be accessible in terms of use, availability, and information; promotion of AT accessibility; and provision of information about AT in accessible formats. It further calls for education of professionals to support all aspects of AT service delivery (UN, 2007).

DEFINITIONS OF ASSISTIVE TECHNOLOGY

Formal Definitions

Definitions allow us to frame the construct of interest and convey to others what we include and exclude in the use of a term. In a legislative or policy context, definitions delimit the scope of the law or policy, influencing how each is interpreted and applied. For example, in jurisdictions where AT funding is supported through government, a definition is used to determine what constitutes an assistive device that is eligible for funding versus one that is not. Definitions outside of this context can also help to conceptualize the term and understand the perspective of the individual or collective that conceived the definition.

Two formal definitions of AT, which are commonly used, come from the United States legislation The Assistive Technology Act of 1998, as amended (2004) and from the WHO. The US legislation defines AT as: "Any item, piece of equipment or product system whether acquired commercially off the shelf, modified, or customized that is used to increase, maintain or improve functional capabilities of individuals with disabilities."

Similarly, the WHO (2001) defines AT as "any product, instrument, equipment, or technology adapted or specially designed for improving functioning of a disabled person." These two definitions both focus exclusively on the technology and limit it to a tangible object that is usable by a person with a disability. The US definition is more inclusive of mainstream technologies than the WHO version.

TABLE 1-1 Articles of the United Nations Convention on the Rights of Persons with Disabilities Relevant to Assistive Technology

Article Number	Article Title	Relevance to Assistive Technology
4	General Obligations	Articulates agreement to undertake research and development of assistive technologies, with emphasis on affordable devices Agreement to provide information about AT and related services and supports in an accessible format
9	Accessibility	In support of full participation by all, member countries agree to provide equitable access to transportation, information (and information communication technology), public buildings, and services.
19	Living independently and being included in the community	Persons with disabilities have the right to choose where they live in the community and to participate fully in necessary and chosen life activities.
20	Personal mobility	Requires provision of personal mobility choices, including mode of mobility and time, with an affordable cost Quality mobility aids will be accessible and affordable. Persons with disabilities will receive training in the use of mobility aids. Requires production of mobility aids to consider the full range of mobility requirements of persons with disabilities
21	Freedom of expression and opinion and access to information	Persons with disabilities have the same rights to express their ideas and opinions as others, in a manner of their choice. Information will be provided in accessible formats. Use of alternate forms of communication (e.g., Braille, sign language, alternative and augmentative communication) is required for all official interactions. Private enterprise will be encouraged to similarly use these alternate forms of communication; mass media, including the Internet, is encouraged to use and accept alternate access and forms of communication. Sign language is used and promoted.
24	Education	Persons with disabilities have equal access to an education. Reasonable accommodation to educational needs of persons with disabilities is made, including individualized programs as required.
25	Health	Persons with disabilities have the right to the "highest attainable standard of health" (p. 14).
26	Habilitation and rehabilitation	Member states will support habilitation and rehabilitation with the desired outcome of achievement and maintenance of maximal functional independence. Availability, knowledge, and use of AT will be supported.
27	Work and employment	Persons with disabilities have the right to equal access to gainful employment of their own choice. Reasonable accommodation of needs of the person with disability is required in the workplace.
29	Participation in political and public life	Ensures accessibility of location and means to enable persons with disabilities to exercise their right to participate in political activities, including their right to vote Active promotion of an environment that enables full participation in community activities of choice
30	Participation in cultural life, recreation, leisure, and sports	Accessible formats, materials, and environments are required to support the participation of persons with disabilities in all aspects of cultural life, recreation, leisure, and sports.

AT, Assistive technology.
From United Nations: *Convention on the rights of persons with disabilities (CRPD)*, Resolution 61/106, New York: United Nations, 2007. Available from: www.un.org/disabilities/convention/conventionfull.shtml.

Informal Definitions

Hersh and Johnson (2008a) argue that these formal definitions link AT too tightly to a medical model, which highlights the use of AT to overcome limitations and improve function for the individual. The definitions cited above, although useful in some contexts, also limit our concept of AT to simply the technology. Hersh and Johnson propose a definition of AT that is inclusive of products, environmental modifications, services, and processes that enable access to and use of these products, specifically by persons with disabilities and older adults (2008a). They further describe the use of AT to assist users to overcome infrastructure barriers to enable full societal participation and to accomplish activities safely and easily.

This broader understanding of AT is congruent with the position we take of AT. We understand AT as inclusive of mainstream technologies and those developed specifically for persons with some form of impairment. The importance

of services and infrastructure is highlighted in this book; it is not simply the provision of a device; the opportunity to use it for desired occupations, across multiple environments, and without prejudice is critical. Throughout this book, we focus on activities broadly categorized as communication, cognitive, mobility, and manipulation and the technologies that enable them. However, we do so by incorporating mainstream and specialized technologies and by presenting the evidence that supports their effectiveness in enabling users to engage in the political, social, and economic occupations of their communities.

Differentiating Assistive Technology from Other Technologies

Discussions and writings about participation and function of individuals with disabilities include a vast array of terms that include constructs of technology. Some of these include rehabilitation technologies, educational technologies, accessible and universal design. The latter two will be discussed in more detail in Chapter 2 where we engage in a more detailed discussion of the AT component of the Human Activity Assistive Technology model (see later in this chapter for an overview of this model). Sanford (2012) adds a dimension to the conceptualization of AT that helps differentiate it within the concepts of accessible and universal designs. He describes AT as "individualized and usually follows the person" (Sanford, 2012, p. 55) in contrast to designs that make environments more accessible to individuals with a variety of abilities such as automatic door openers and ramps that stay fixed in a location and are used by many users who come to that particular location.

We do not include rehabilitation or educational technologies in this book, although some of the devices that we discuss do have application in a rehabilitation or educational setting. We understand rehabilitation technologies to be devices that have a primary use in a clinical setting, such as parallel bars, overhead slings, and tilt tables, and that are primarily used for habilitation or rehabilitation purposes. Educational technologies are those that make educational materials more accessible, such as software programs that provide educational curricula in some alternative, accessible format. Many of the devices that promote communication, positioning, and computer access; support cognitive activities; and augment hearing and vision assist the learner to engage with these educational technologies with the difference being the emphasis on enabling participation versus achieving specific education goals.

Summary

Formal definitions of AT are used by different groups to delimit what constitutes AT for the purposes of funding and regulation of requirements to make environments and services accessible to individuals with a broad range of disabilities. Their focus is on the promotion of function of an individual with a disability. Informal definitions add context to the formal definitions and are inclusive of social and other environmental dimensions that affect AT design, use, and implementation. Although both formal and informal definitions are inclusive of **mainstream technology**, it is more apparent in the informal definition presented. This book discusses both mainstream technology and that designed specifically for persons with disabilities, describing different types of technology, and a service delivery process, with a focus on how technology use enables full participation in desired activities.

PRINCIPLES OF ASSISTIVE TECHNOLOGY SERVICE DELIVERY

Assistive technology is presented in this book primarily from the perspective of the application of a clinical process to identify the need for AT, determining the most appropriate device(s), obtaining the device and then providing follow-up and outcome evaluation to ensure the user is able to use the device. Service delivery is formally defined as "any service that directly assists an individual with a disability in the selection, acquisition, or use of an assistive technology (AT) device" (118 STAT. 1170).

We propose several principles that foreground **AT service delivery**: (1) the process is **person centered,** not AT centered, (2) the outcome is enablement of participation in desired activities, (3) an **evidence-informed** process is used for service delivery, (4) AT service delivery is provided in an ethical manner, and (5) AT services are provided in a sustainable manner. These principles are introduced here, explored in greater detail in chapters 4 and 5, and applied in subsequent chapters that discuss specific categories of AT. They should be interpreted from the context within which AT services are provided.

Person Centered, Not Assistive Technology Centered

The provision and development of AT are not about fitting the person to the technology. Rather, they are about using a process with the outcome of meeting the needs of the user when engaging in relevant activities across necessary contexts.

On the product development side, technology that is developed without the input of consumers throughout the design process or without knowledge of how the technology will be used is less likely to be adopted for its intended purpose. The resulting technology may be designed to meet a need that does not exist for the intended user.

On the service delivery side, AT that is recommended or prescribed without input from the user and relevant others ends up abandoned or not used to its full potential. One participant in a project that collected stories of individuals with spinal cord injuries and their use of AT illustrated this point well. He described his abandonment of complex technology that did not provide him with any perceived advantage over simpler devices. Furthermore, the necessary devices were not recommended before returning to live at home; some devices were not needed, and others that were

useful had not been acquired (SCIPILOT, nd). More will be said about device discontinuance in a later chapter. There are many reasons stated for device discontinuance; a large proportion of them are the result of a process that does not adequately involve users of AT.

Focus Is on the Functional Outcome and Participation

Similar to the ideas expressed in the first principle, this second principle indicates that what a person does with a device is important rather than simply providing access to the device. Our conceptualization of AT includes the activities in which the user engages. It is important to understand what a person wants and needs and is expected to do throughout the AT service delivery process. More important, though, is the recognition that simply noting whether a person is able to use a device for a particular function is insufficient.

It is more important to understand how the person is using the device and whether it is used in a manner of her choosing. For example, an alternative and augmentative communication device can support the user's ability to engage in a conversation (i.e., the function of conversation is supported by the device). However, it is equally important to understand whether the device supports the user's vocabulary, inflection, and pace of speech. The idea here is that the device becomes an extension of the person for some users (i.e., it conveys part of their image). When its use contributes to an undesired self-image, it is not used to the full advantage. It is not sufficient for the device to enable function; it must do so in a manner that supports how the user wants to engage in that function. This concept is discussed in more detail in Chapter 3.

Evidence-Informed Process

Use of an **evidence-informed** process benefits the user of AT through ensuring that elements of AT service comprehensively include steps to identify technology that is most appropriate for the user; to provide necessary training and support for initial and ongoing use of the technology; and to evaluate adequately the outcome of the technology, not only for the individual user but for aggregate groups as well. Evidence may come from data collected systematically through the service delivery process and through research studies investigating a wide range of questions surrounding AT. The different types of evidence and research that support them are discussed in Chapter 5.

Amassing aggregate data concerning different aspects of the AT service delivery process is key to building the evidence base. Evidence is present to support the AT assessment and recommendation processes, training, ongoing evaluation, and functional outcomes. This evidence is presented throughout this book for different AT applications. As will be seen and as professionals experienced in AT are aware, more research is necessary to support this area. Funders frequently require evidence that supports specific outcomes of AT use before they will support the purchase of AT.

Ethical Process

An ethical process includes multiple perspectives: professional or clinical code of ethics along with embodying constructs of beneficience and nonmaleficence and broader philosophical and ethical worldviews that speak to means of creating an inclusive society that enables meaningful engagement in community participation for all. Key ideas that form the background for ethical AT service delivery are introduced briefly here. We expand on these ideas in Chapter 4.

Professional and Clinical Code of Ethics

Many reading this book are engineering or health care professionals or students whose practice is guided by a formal code of **ethics**. A review of several different codes of ethics (e.g., from Rehabilitation Engineering and Assistive Technology Society of North America [RESNA], Canadian Association of Occupational Therapists, American Physical Therapy Association, World Confederation of Physical Therapy, and Swedish Association of Occupational Therapists) uncovered many commonalities across the various codes. Box 1-1 shows the RESNA Code of Ethics.

The principles of **beneficence** (do only good) and **nonmaleficence** (do no harm) are prominent in these professional codes. These principles are translated into practice through actions that embody professional integrity, accountability, and maintenance of continuing competence and professional standards.

They explicitly describe the client/patient–clinician/provider relationship. Simply stated, this relationship is guided by respect for the welfare, rights, and self-determination of the client. In practice, the clinician recognizes the client's autonomy and right to be fully engaged in the clinical or service delivery process. The clinician or service provider acts in a trustworthy and truthful manner, maintaining client confidentiality. These codes assert the balance between client–service provider roles while concurrently declaring the responsibilities for providing competent, honest, and respectful service.

BOX 1-1 RESNA Code of Ethics

RESNA is an interdisciplinary association for the advancement of rehabilitation and assistive technology. It adheres to and promotes the highest standards of ethical conduct. Its members:

- Hold paramount the welfare of persons served professionally.
- Practice only in their area(s) of competence and maintain high standards.
- Maintain the confidentiality of privileged information.
- Engage in no conduct that constitutes as a conflict of interest or that adversely reflects on the profession.
- Seek deserved and reasonable remuneration for services.
- Inform and educate the public on rehabilitation and assistive technology and its applications.
- Issue public statements in an objective and truthful manner.
- Comply with the laws and policies that guide the profession.

Modified from Summary of RESNA Code of Ethics. Available from: http://resna.org/certification/RESNA_Code_of_Ethics.pdf

RESNA, Rehabilitation Engineering and Assistive Technology Society of North America.

Some codes *suggest* that practice be based on principles of **social justice**, which is described in more detail in the following sections. Social justice in this context refers to accessibility of AT services for all who require it. The code of ethics of the American Occupational Therapy Association (AOTA, 2010) specifically mentions that practice is guided by principles of distributive justice (see later discussion); the Philippine Physical Therapy Association states that physical therapy services will be accessible to all (PPTA, 2009).

Social Justice

John Rawls expressed foundational principles of social justice that inform our discussion. Social justice concepts were initially framed from an economic perspective, referring to equitable access to rights and resources (e.g., income and material goods) within society (Rawls, 1999). Capability theory advances Rawls' ideas to further suggest that all individuals have equal access to basic rights and freedom of choice (Nussbaum, 2011; Sen, 2009).

Applying these ideas to persons with disabilities (i.e., persons who use AT in their daily lives) recognizes the economic disadvantage they experience through fewer opportunities to participate in income-generating activities and the concomitant reductions in their incomes because of the greater expenses incurred because of the disability. Lack of access to AT keeps some people with disabilities in poverty (Samant et al., 2012). Specifically, the lack of availability of or access to AT services and technology limits the ability of a person with a disability to engage in community occupations, in particular, it limits his or her ability to participate in economic activities that in turn afford sufficient resources to support themselves or their families (Samant et al., 2012; WHO, 2011). For example, a person who has difficulty communicating with unfamiliar others, but who could do so with the use of an augmentative and alternative communication (AAC) device is barred from employment and other civic activities (among other things) when access to such a device is not available. In this situation, societal elements are the limiting factor, restricting the individual's full participation in his community and beyond.

A second source of inequity is seen in a situation in which two people with the same level of income, one with a disability (or who supports a family member with a disability) and one without, will have very different incomes when the costs associated with the disability are taken into account (Samant et al., 2012; WHO, 2011). Persons with disabilities have many expenses that those without disabilities do not encounter, such as personal assistant costs; higher transportation costs; home modification costs; and, of course, the cost of AT, which is significant. Globally, the purchase of these devices is inconsistently supported, with the result that a person or family that must obtain AT will have less disposable income than someone without a disability with the same level of income who does not need to purchase AT.

A formal approach to social justice is seen in legislation such as the Americans with Disabilities Act of 1990 that attempts to legislate formal mechanisms to remove barriers to full participation in society for individuals with disabilities (Danermark & Gellerstedt, 2004). Similarly, the UN CRPD identifies basic rights that all member countries must support for their citizens and explicitly states that AT must be accessible regardless of gender, age, or impairment. Throughout this book, we identify and apply formal social justice mechanisms as they relate to AT service delivery. In Chapter 3, we identify key pieces of legislation that aim to legislate accessibility for persons with disabilities and discuss the aspects of the legislation (e.g., the definition of disability and who is eligible for consideration under the legislation) that need to be identified and applied in clinical practice. When relevant, we discuss these issues as they relate to individual categories of AT.

Distributive Justice

Distributive justice is a second theory of social justice. This theory is premised on the idea that inequities occur at the intersection of the person with a disability and the context in which he or she lives. One way of reducing the influence of these inequities is more equitable distribution of resources, which include financial resources as well as opportunities for education, employment, and health and access to infrastructure that supports full social participation. Distributive justice advocates for a redistribution of resources to account for this inequity. It is based on principles "designed to guide the allocation of the benefits and burdens of economic activity" (Cook, 2009, p. 10).

Assistive Technology Services Are Provided in a Sustainable Manner

In general, **sustainability** means providing AT products and services in a manner that ensures that people who need them have access in a timely and continuing manner. This basic idea is enacted somewhat differently in well-resourced and underresourced economies. Many well-resourced countries face a population shift that is well known; their populations are aging, with the largest proportional increase seen in the "old-old" (i.e., persons older than age 75 years). These individuals experience a greater incidence of disability, including multiple disabilities, and account for the largest proportion of health care spending. The cost of health care is significant in developing countries to the point that current systems are not sustainable.

Some of the health care dollars in these countries are used to support the cost of selected AT products and services associated with **assessment** of and training in the use of AT. Clinicians contribute to sustainability by balancing the rights and needs of clients with the reality of limited health care dollars. This statement does not mean not advocating for the needs of clients; rather, it means use of an evidence-informed process to identify AT that will meet the client's needs, including the client in this process, to ensure that devices obtained are used (i.e., do not end up in a closet, drawer, or the garage) and are used to their maximal potential.

In underresourced economies, sustainability often means development and establishment of AT services. Products and

services that are readily available in developed countries may not be present in these emerging economies, generally because of cost, legislation, lack of infrastructure, and other resource limitations (Samant et al., 2012). Establishment of AT services and an AT industry means working with local manufacturers, using local materials, and designing products that are functional in the local context (Borg, Lindstrom, & Larson, 2011, Owen & Simonds, 2010; Samant et al., 2012). It also means providing technology that can be maintained and repaired using local knowledge, technology, and materials (Owen & Simonds, 2010). Furthermore, it means provision of products and services that are affordable by persons with disabilities (WHO, 2011).

THE HUMAN ACTIVITY ASSISTIVE TECHNOLOGY MODEL

Cook and Hussey (1995) introduced the Human Activity Assistive Technology (HAAT) model in the first edition of *Assistive Technology: Principles and Practices* (1995). The model describes someone (**human**) doing something (**activity**) in a context using AT. This simplistic explanation of the HAAT model is deliberately worded to demonstrate where AT fits in the model. The emphasis of the model is on the person engaged in an activity within chosen environments. Consequently, any application of the model starts with someone doing something in context and then introduces the AT.

This order prevents the AT from assuming prime importance with the result that the person adapts to the technology rather than the technology meeting the needs of the person. The model has been used to development of AT, research, and assessment involving the initial selection of AT and ongoing evaluation of the outcome of its use. Figure 1-1 illustrates this model.

The HAAT model is introduced briefly in this chapter. Chapter 2 provides foundational ideas related to AT. Chapter 3 discusses the activity, human, and context elements in greater detail as well as the interactions among all of these elements. The model is applied to specific categories of AT in the middle section of the book.

Foundational Concepts

The HAAT model shares many features of other models that integrate activity (occupation), the person, and the environment. It has evolved in parallel with influential models such as the WHO's ICF (WHO, 2001), Canadian Model of Occupational Performance and Enablement (CMOP-E) (Townsend & Polatajko, 2002, 2013), and Person-Environment-Occupational Performance (PEOP) model (Baum & Christiansen, 2005). These related models inform the different elements that comprise the HAAT model, which differs from these other models through its explicit consideration of AT.

International Classification of Functioning, Disability, and Health

The WHO's ICF (WHO, 2001) is a well-recognized and frequently applied model that classifies components of body structures and functions, activities and participation, and the environment in terms of their influence on health. Four aims are stated for the ICF, two of which have relevance to our discussion: to provide a basis for research on health and its determinants and to establish a common language that will foster effective communication across different users (WHO). Relevant components of the ICF are described in greater detail in subsequent chapters that discuss the components of the HAAT model.

The WHO definition of AT was described earlier in this chapter. AT is located in the environment component of the ICF, which can pose a challenge when thinking about and providing AT. Specifically, AT is primarily located in Chapter 1 of the ICF, "Products and Technology of the Environmental Factor." AT for certain participation contexts, such as education, is also identified. The ICF describes environmental factors as external to the person. The challenging aspect of this concept when considering AT is that although AT is certainly external to the user, it is much more personal than other elements of the environment, such as an elevator that is adapted to meet the needs of individuals with mobility or vision impairments. AT is commonly recommended for a specific person who brings the technology with him or her to different situations. Similar to other environmental elements, AT is designed and modified to suit the needs of the person. However, the personal nature of most devices requires the consideration of the person using a certain device when thinking about activities and participation within and across environments.

Ecological Models in Occupational Therapy

Models that describe the relationships among the person, the environment, and occupation inform the practice of occupational therapy. Two particularly influential models are the CMOP-E (Townsend & Polatajko, 2002, 2013) and the Person-Environment-Occupation-Performance (PEOP) model (Baum & Christiansen, 2005). The CMOP-E does not explicitly identify AT; however, the PEOP, which is based on the ICF, locates AT within the environmental component.

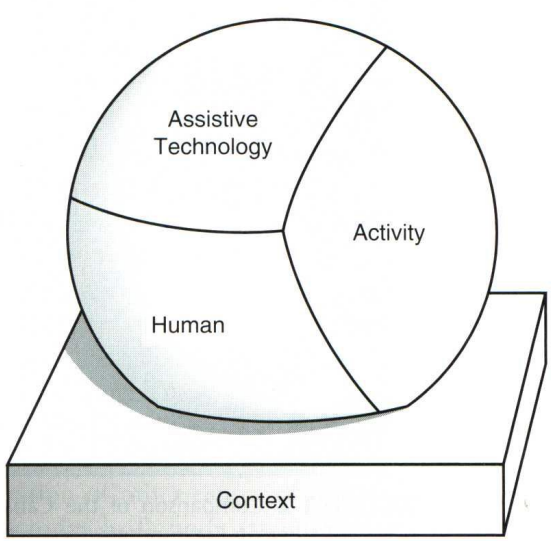

FIGURE 1-1 The Human Activity Assistive Technology model.