The *Why* Behind DIY

Your First Step into Assistive Technology Innovation

Created by the RESNA Maker SIG

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Preface

Who is the document for?

We see three audiences for this document:

1. People with disabilities (i.e., "users") that have needs that are not met with commercial products.
2. Professionals that have clients that need unique solutions.
3. People in the community "makers" who are knowledgeable about how to create products or solutions, or are interested in doing so.

The overall purpose of this document is to introduce the idea of making for assistive technology (AT) purposes to these three audiences.

For people with disabilities, it is often the case that there is simply no commercial product that meets their exact need. This is where a custom solution can address the specific need that the user has in a way that specifically works for them. We would like this document to help users find the right solution in a safe and effective way.

There are a host of professionals that interface with people with disabilities. These professionals have the disability/medical knowledge and can be good at identifying the problem. But, for users with very custom needs, the professional may not have the knowledge or resources for providing the needed solution.

There are many "makers" out there that have the knowledge to create custom solutions. We would love to see more of these individuals applying their special abilities to assist with unique solutions to the needs of people with disabilities. Having a maker provide a solution should be approached in a thoughtful way as to not reinvent items that already exist and to not cause harm to the user. Having proper input from users and professionals can create a solution that is safe and truly addresses the needs of the user in a robust way.

If you do not yet consider yourself a "maker," this document is meant to introduce you to the world of assistive technology, and the kind of projects that are possible.

This document is meant to be a primer to introduce all three of these audiences to the world of assistive technology (AT) and the possibilities available in the "maker" world to create solutions.

What is this document about?

This document is to be a primer for these three audiences to understand why, when, and how makers, disability professionals, and AT users can work together to make solutions that are not available in other ways. If we get you excited about the possibilities, then we have succeeded! This is not meant to be a guide to finding specific solutions for specific problems, but to explain these disparate worlds to each other and how they can collide in a useful way.

What is this document *not*?

This document is not meant to teach HOW to make things. It is meant to introduce the needed concepts to all stakeholders. Our hope is that after reading this document you would engage in your community in your role.

Note on Language

The authors of this guide recognize that there are differing perspectives on the use of person-first versus identity-first language. In an effort to be inclusive and respectful of the multiple language preferences in the disability community, this guide will use both types of language, utilizing the phrases "disabled individuals/users" and "individuals/users with disabilities" interchangeably, as well as using "nondisabled individuals/users" and "individuals/users without disabilities" interchangeably.

Thank You!

This document was created with much collaboration and input from members of the RESNA Maker SIG as well as others in the Maker/AT world who provided valuable feedback. We want to formally thank everyone who donated their time to make this document a reality!

Ch 1: Assistive Technology Overview

Assistive Technology (AT) is a constantly evolving field that is working to make the world a more accessible place. Formally, assistive technology is defined 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" (H.R. Rep. No. 100-819, 1988).

This chapter is intended to provide an overview of Assistive Technology, including commonly used terms, service delivery models, and traditional roles and professions.

Why does AT Matter?

Accessibility impacts everyone! Whether due to a short-term injury, aging, or an acquired disability, we will all at one point or another likely need support to ensure the world is accessible to us. From curb cuts and ramps to crutches and even jar openers, assistive technology makes everyday tasks easier and allows for increased independence for us all!

Common Terms

Just like any other field, there are some words and phrases that are used often, especially throughout this guide. Below are a few common ones to make this document as approachable as possible!

Accessibility – Design and modification of environments, products, and services to ensure usability for people with disabilities.

Activities of Daily Living (ADLs) – Essential tasks for self-care, such as dressing, bathing, eating, and grooming.

Adaptive Equipment – Tools or devices modified or designed to support individuals with disabilities, helping them to perform daily activities.

Augmentative and Alternative Communication (AAC) – Techniques or devices that assist individuals with communication difficulties, ranging from simple picture/communication boards to advanced speech-generating devices.

Autonomy – The ability of individuals to make decisions and have control over their own lives, a core goal in assistive technology and therapy.

Caregiver/Care Partner – A person who provides physical or emotional care for someone with a disability or health issue, often part of the therapy or intervention team.

Durable Medical Equipment (DME) – Medical devices that are meant to be used repeatedly over a long period of time. Examples of DME would be wheelchairs, walkers, and hospital beds.

Early Intervention – Services and supports provided to young children with developmental delays or disabilities.

Equitable Access – Ensuring individuals with disabilities have fair and just access to resources, environments, and opportunities, customized to their specific needs.

Environmental Control (EC) – Devices that allow individuals to control various home devices, such as lights and TVs, often via switches or voice commands.

Funding – Financial support from various sources which can include government programs, insurance, grants, etc.

Functional Mobility – The ability to move around in various environments effectively and safely, often a focus in Physical Therapy and mobility training.

Low Vision Devices – Tools that assist individuals with visual impairments who have useful vision. This can including magnifiers, specialized lighting, and screen readers.

Mobility Aids – Devices such as wheelchairs, scooters, and canes, supporting individuals with limited movement to accommodate their mobility deficits.

Motor Skills – Skills involving muscle movement and coordination, such as grasping and walking. *Gross motor skills* involve large muscle groups, whereas *fine motor skills* involve dexterity and precision movement.

Occupational Therapist (OT) – Healthcare professional focusing on helping individuals improve their ability to perform activities of daily living and work-related tasks.

Orthotics and Prosthetics – Custom devices fabricated by individuals with expertise that support or replace body parts. For example, braces, splints, and prosthetic limbs.

Physical Therapist (PT) – A health professional trained to evaluate and treat people who have conditions or injuries that limit their ability to move and do physical activities

Positioning – The practice of arranging the body for optimal function, comfort, and safety, essential in seating and mobility contexts.

Rehabilitation – Therapeutic process aimed at restoring or improving functional ability and quality of life for those with disabilities or injuries.

Rehabilitation Engineer - A practitioner who has an engineering background that works in the assistive technology field.

Seating and Mobility – A field of assistive technology focused on assessing and providing appropriate equipment to address deficits in mobility. Seating specifically refers to the parts of this equipment that interfaces with the users body such as cushions and back rests.

Sensory Processing – The neurological process by which the brain receives, interprets, and responds to sensory information from the environment. This includes information from the five traditional senses (sight, hearing, touch, taste, smell), as well as the vestibular sense (balance) and proprioceptive sense (body position).

Setting – The environment where assistive technology or therapeutic services are delivered. For example school, home, clinic, community center, etc.

Speech-Language Pathologist (SLP) – A specialist who diagnoses and treats speech, language, cognition, communication, and swallowing disorders.

Switch/Assistive Switch - A piece of equipment that can harness a physical movement to control a device. Assistive Switches commonly have a 3.5mm mono cable jack as a connection to devices. For example, if a child cannot press the button that is built into their toy, the toy can be adapted to include a switch, which the user can operate.

Switch Access – A feature of a device that allows for control via use of a switch.

Recreational Therapists – Recreational therapists promote health and recovery through leisure activities, including adaptive sports.

Universal Design – A design approach that creates products and environments accessible to as many people as possible, regardless of ability.

User – The individual utilizing assistive technology or receiving therapeutic support, central to device design and intervention planning.

Visual Supports – Tools like schedules, symbols, or images that aid individuals in understanding and processing information, often used in AAC and autism support.

Vocational Rehabilitation – Services, such as workplace accommodations, that help individuals with disabilities prepare for, obtain, and retain employment. Every US state has an agency that provides vocational rehabilitation services.

Who is involved in AT solutions?

Stakeholders in the Assistive Technology Making Process

AT User or Person who uses AT - This is the most important person! Whenever a solution is being designed, the needs and criteria of the user are paramount.

Caregiver - This is a person who assists the AT user. If the assistive technology would require their help to use, it is important to get their input on the solution.

Maker - This is a person who has special skills specifically for designing and/or fabricating a solution. This can be a physical object or software. Makers come from all different backgrounds, but have creative problem solving as a common trait.

Occupational Therapist - Occupational Therapists (OT) use daily activities to promote health, participation and well-being. OTs specialize in evaluating tasks and identifying where AT intervention can promote achieving functional goals. They analyze how a person might be able to access a device or environment, and

Physical Therapist - Physical Therapists (PT) help maintain, restore or improve someone's ability to move and perform daily activities. In the AT field, PTs are "body experts;" they analyze how an individual's body operates at rest or in motion (whether seated or in standing), and then identify what physical supports might be needed to improve someone's posture, gait, or arm movements.

Speech Language Pathologist - Speech Language Pathologists (SLP) are experts in treating speech, communication and swallowing disorders. In AT, SLPs may be heavily involved in assessing for augmentative and alternative communication and using speech generating devices.

Rehabilitation Engineer - Rehabilitation engineers specialize in the design, development, and implementation of assistive technology. Rehabilitation engineers may

have a variety of backgrounds and specialties, such as mechanical engineering, biomedical engineering, computer engineering or electrical engineering, and can provide technical expertise to the AT Team.

Assistive Technology Professional (ATP) - An Assistive Technology Professional is a certified professional who has "demonstrated competence in analyzing the needs of consumers with disabilities, assisting in the selection of appropriate AT for the consumers' needs, and providing training on the use of the selected devices." Many different types of professionals can obtain an ATP. The achievement of the ATP does not denote expert knowledge, it simply notes that the professional is knowledgeable about meeting the needs of people with disabilities and technology in a thoughtful and ethical manner.

Many other individuals and professionals may interact with assistive technology, such as teachers, librarians, aides, family members and more. There are many roles that may be involved in making an AT project.

How is AT Developed and Provided?

AT Service Delivery Models

Service delivery is the process of providing or designing assistive technology to people with disabilities.

The models described here help us visualize what factors need to be considered when providing someone with an assistive technology device. These models are meant to help guide and direct the provision of assistive technology.

Two common ones are the Human Activity Assistive Technology (HAAT) model and the Student Environment Tasks Tools (SETT) framework:

HAAT Model

A person centered framework, which promotes matching the device to the person and not the person to the device. This framework includes the human with a disability and the specific context of the activity in an environment that limits their participation, driving the unique selection of the individualized assistive technology

or tool. The "H" is for **Human**, which represents the individual's unique strengths, weaknesses, attitudes, and needs that need to be considered. The "A" is for **Activity**, which represents the specific action or goal that the Human is wanting to perform, and the "AT" is for **Assistive Technology** which represents the tool or strategy used by the Human to achieve the Activity. See the figure below for a visual representation of the HAAT model and its components.

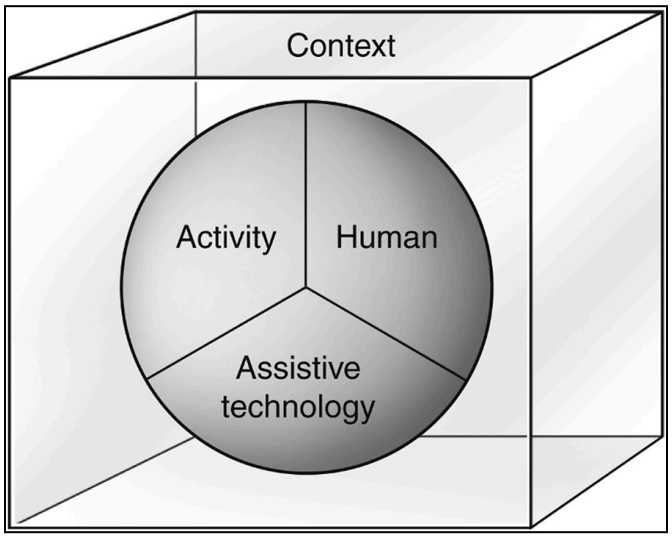


Figure 1: HAAT Model (Cook et al. 7)

SETT Framework

Created by Joy Zabala, the SETT framework was created to provide "a systematic approach to making decisions regarding the provision of assistive technology devices and services for students with disabilities" (Zabala). This framework is commonly used in the school system, when considering if a student needs additional technology to support their learning and, if so, what technology best fits their needs. The **student's individual needs**, the **environment** in which they are learning, and the **tasks** they need to complete to participate as actively and independently as possible are first considered. From this information, the team, which should

include the student, can then determine some options for technology, or **"tools,"** that could help level the playing field in the classroom and support the student's success. See the figure below for a more in-depth look at the SETT model.

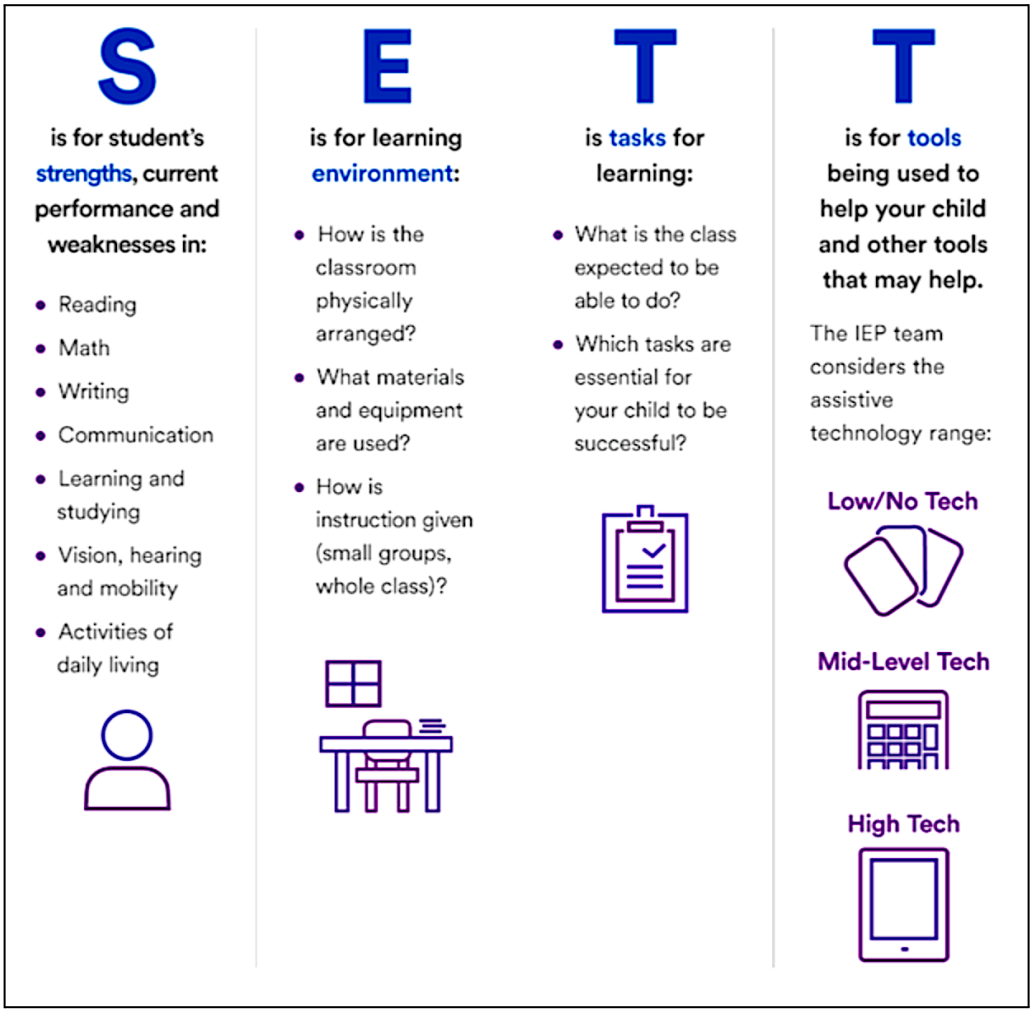


Figure 2: SETT Framework (Hollingshead et al.)

Types of AT: The Assistive Technology Continuum

Below is a figure depicting the assistive technology continuum in pyramid format. Starting at the bottom of the pyramid is **Universal Design**, which is a process of designing a product that can be used by the widest population of people with no modifications needed. **Off-the shelf consumer products** would be something that is available for the general public. An off the shelf product can be used as AT, but it was not specifically designed for people with disabilities. **Assistive technology** is a product that was specifically designed for the smaller market of people with disabilities. As we go up the pyramid, products would be more custom and less available to the general public. For those problems where there is not a solution that can be purchased as is, this is where AT professionals or makers would get involved. In general, we would want to start with an available product and simply **modify** it for a specific person's use. If a modified item does not suit the need, then a **customized product** may be the solution that is needed. Then, at the top of the pyramid are devices or solutions that are specifically **designed and fabricated** for a small population, possibly even a population of one.

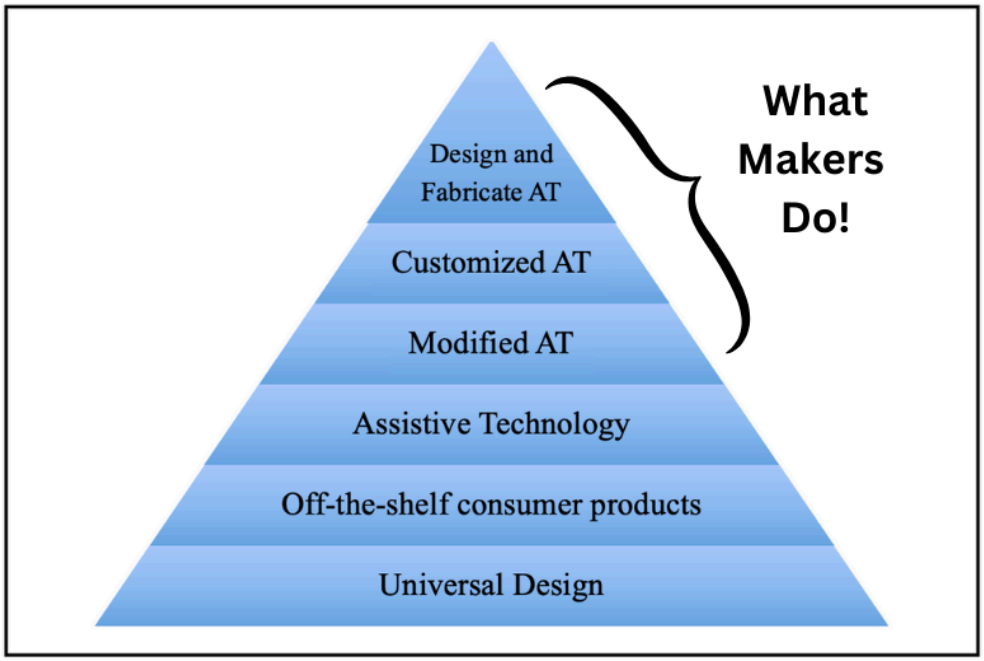


Figure 3. Pyramid of AT Continuum (DiGiovine et al., click here for link).

For example, let's use the iPad as an example of a universally designed product. The iPad has been designed to allow as many people as possible to use it. But, there are those that may have trouble with their hands where they are unable to properly touch the screen. One solution could be to use an off the shelf stylus. This type of stylus

would be something that is available widely to the general public, and for some with disabilities, it would suit their needs. But, if the user's disability was more severe, they may need a stylus that was designed specifically as assistive technology. These styluses may be designed to address specific hand issues and are only available through specialty stores. There are those where even these specially designed styluses do not meet the need. Maybe someone has a deformity in their hand where they cannot hold the stylus. In that case, an existing product may be modified to have a strap to help to hold it on. Or, maybe they also need the stylus to be shorter, so it is customized in its size to fit their needs. There could also be those who need a fully bespoke - one of a kind - stylus because their disability is such that this is the only way to provide a solution due to their unique needs.

When we get to the top three levels of the pyramid, this is where makers get involved.

Ch 2: Making Overview

Making involves **the design and fabrication process of turning an idea into a usable product**. These creators, often called Makers, use their creativity and knowledge of science, technology and engineering principles to create do-it-yourself (DIY) solutions to everyday problems.

Makers can be anyone, and anyone can be a Maker! Makers often have knowledge or interest in engineering or design, or may have a need or idea for a DIY solution to a problem. A Maker may work as an individual, or may work together with a team of experts or other Makers. Many makers have a background in STEM fields (Science, Technology, Engineering and Mathematics), however anyone with an interest in DIY solutions can be a part of a Making team. Making teams rely on communication, creativity, collaboration and diverse skill sets to create an effective product.

The process of making a product typically follows the **engineering design process**. The engineering design process is an iterative process, which involves researching a problem, developing a solution, then creating and testing a prototype to develop a final design. See below for a depiction of the cyclical nature of the engineering design process.

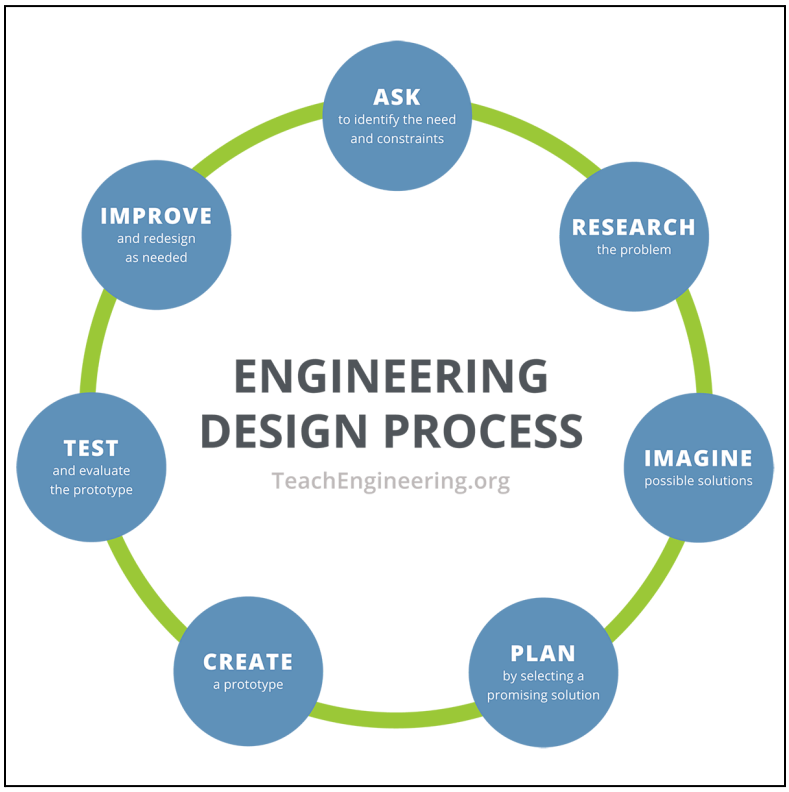


Figure 4: Engineering Design Process

Making may use a variety of skill sets, depending on the product being created, such as 3D modeling, electronics, coding, sewing and using power tools. A few common tools used in Making include:

- 3D printer
- CNC laser cutter
- Soldering iron
- Sewing machine
- Heat gun
- Small hand and power tools

Makerspaces are community spaces which provide many of these tools for members to use. Makerspaces are also a great place to connect with others to share ideas or learn from expert makers. Makerspaces can often be found at libraries, universities, community centers or medical centers. There are also member-based Makerspaces which you can join for a fee to access their tools and services. Making culture is often open to collaborating and sharing ideas. Many makers choose to share their designs 'open-source' on the internet, so others who may need their product can benefit from their design. (See *Fabrication Resources* in Appendix for open-source sites). The term 'open- source' comes from the world of software programming to allow for any project to be viewed, shared, and remixed. There are a wide range of licenses (Creative Commons, MIT, CERN OHL) that may be applied to open assistive technology clarifying the parameters for the project.

Making and assistive technology go well together for many reasons. Often, individuals require a specific assistive technology solution to meet their individual needs and goals, which may not be met with off-the-shelf commercial products. Making provides the opportunity to design and adapt a new product to meet someone's unique specifications. Making also allows an AT user to be directly involved in the product design process from beginning to end, which helps ensure that a final product will accomplish the design goal.

In the maker world there is a strong culture of sharing information and keeping designs open source (available for anyone to use).

Ch 3: When should I DIY?

While DIY (do it yourself) solutions can be a fantastic opportunity to collaborate with users to create accessible designs, there are several factors that should be considered when determining if this is the most effective path for your use case.

Commercially available products should be the first consideration. It is not a good use of resources to remake something that can simply be purchased. The next step in most cases would be to modify a commercially available product. Most users may simply need a small customization to an existing product. Commercial products will typically be more readily replaced if broken or worn over time. Commercial products typically have some sort of warranty and/or support available included with the purchase. Commercial products can be discontinued or no longer supported - this is where makers can be useful.

There are times where it is not advisable to make a solution for safety reasons. For example, products that perform essential life functions, such as power wheelchairs, orthotics and prosthetics, hospital beds, or breathing equipment, go through significant testing and regulation. Therefore, they would not be appropriate to DIY.

Making a solution is advisable when a commercial product is not (or no longer) available or cannot be modified to meet the need. If funding will take a long time or is not available. The need is so unique that no commercial entity would mass produce the solution.

Below are some essential questions to ask when you are deciding if DIY is the best path forward.

Commercial Availability

- ➔ Is there a solution to the problem presented that is commercially available?
- ➔ If so, does this adequately address the user's needs? Why or why not?

Safety and Liability

- ➔ Is this potential product something that the user would be relying on for essential tasks (ie: mobility, emergency notification, etc.)?
- ➔ What could be the impact if the device malfunctions?

Durability and Support

- ➔ If the device breaks, are you able to support repairs or replacements of the device long term?
- ➔ Are you able to support appropriate materials for the device?
    - ◆ Will the tool be subjected to large forces over time, requiring a specific material consideration?
    - ◆ Can the chosen material be sanitized appropriately, particularly if the device is accessed with the mouth or lips?

Funding

- ➔ What resources are available to the user to fund this solution?
    - ◆ There are grants and organizations that may be able to help with funding. Often solutions that are made vs purchased commercially are self funded.
- ➔ Could this solution be considered medical equipment and potentially be covered by the user's health insurance?

Expertise

- ➔ Do the members of your design team have appropriate expertise in the area to support a DIY solution? (e.g., electronics, soldering, 3D printing)
    - ◆ Makers should have appropriate experience in the area they're making in to operate all equipment safely and create a working design
- ➔ Who can you add to your design team to fill any gaps in expertise?

Depending on your answers to the above questions, you can collaborate with users and other stakeholders to determine the best option to pursue. When in doubt, feel free to connect with our RESNA Maker SIG for advice and support!

Ch 4: Collaborating with Users and Stakeholders

Maker assistive technology leverages the strengths of each member of the collaboration team, allowing their own unique perspective and skill set to support the design process. Teams generally consist of the person with a disability, the maker, and a disability professional which may facilitate the process (see below figure). Effective collaboration between each stakeholder is key to ensuring the delivery of assistive technology that meets the needs of the user. Co-design is a key component.

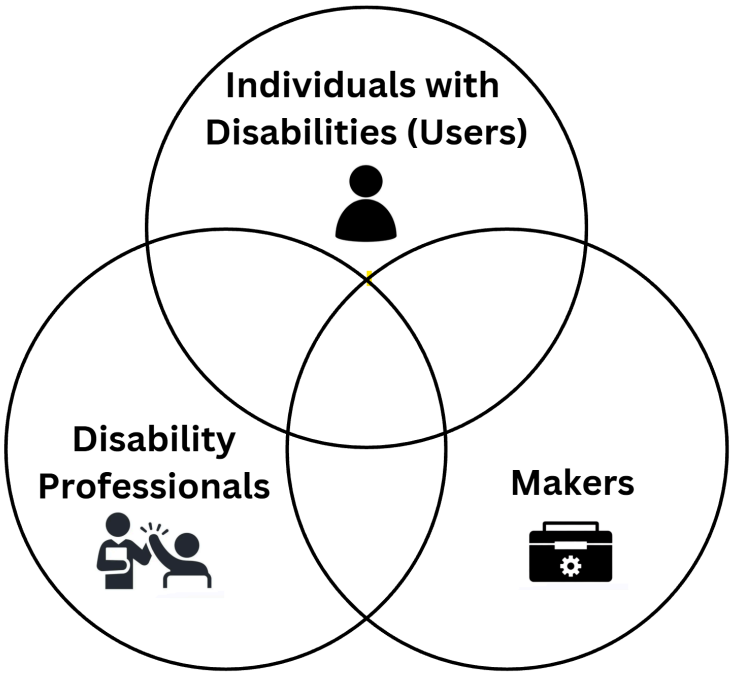


Figure 4: Collaboration Between Key Stakeholders

Roles frequently overlap. A person with a disability may also be a maker. A clinician may also fabricate prototypes. Collaboration is not hierarchical; it is goal-oriented.

Person with a Disability (*User*)

The main collaborator in this model is the person with a disability* who is often best able to describe or demonstrate the challenge and need. In addition to the person with the disability who will directly be using the solution, auxiliary stakeholders such as family members and caregivers may be involved in the design process. The term "user" will be used as an umbrella term to describe all involved parties that will directly utilize the solution.

The user should be closely involved throughout the design process to ensure that the final design meets their needs and goals.

Users may choose to explore community resources to access support for their custom needs or reach out to disability professional resources and/or directly to makerspaces for assistance. See below for examples of these community resources.

*Best practice is to ask the user if they prefer person-first or identity-first language.

Community Resources

➔ Online Communities

Users may access online communities to engage with the AT maker community for discussions, collaborations and support requests. A list of available groups and communities may be found in the Appendix.

➔ Commercial Vendors

Commercial vendors for existing assistive technology tools may be able to support users in customizing settings and features to meet their needs. A list of vendors and contacts may be found in the Appendix.

➔ Libraries and Governmental Organizations

A growing number of public libraries are developing maker spaces to provide access to fabrication tools to their patrons. Librarians and fellow patrons may assist in fabrication of existing designs.

Additionally, at the state and local levels, users may seek assistance from offices such as Mayoral offices of Disability, Community Boards, and state level AT Act programs.

Disability Professionals

The disability professional's role in the maker assistive technology design process includes actions such as supporting collaboration and networking between the user and maker. They can provide information on currently available assistive technology and barriers these technologies present to the user, and provide information about the user's disability in general and any contraindications or safety measures to consider during the design process. Depending on the skill level of the disability professional, they may also

take on the role of maker and fabricate initial stage designs that can be iterated on by more skilled makers. For example, a disability professional may fabricate a customized lateral seat support using tri wall cardboard that meets the user's needs. A maker would then build on this design to fabricate a more durable and sustainable version using wood and fabrication tools such as CNC routers.

Disability Support Settings

There are wide ranging settings and organizations that support users with disabilities in order to provide medical care, support services, and logistical support. These various settings often have on staff rehabilitation professionals with general background in assistive technology and creating adaptations. These professions include occupational therapists, physical therapists, and speech therapists. Additionally, Assistive Technology Professionals may be present in these settings with more specialized skills in assessment and procurement of AT.

➔ Medical/ Hospital Makerspaces

A growing number of hospitals and medical settings are beginning to innovate in the area of having in-house makerspaces in order to fabricate and support clients within their organizations. These makerspaces often have on-staff rehabilitation engineers and work closely in collaboration with stakeholders to develop novel solutions due to lack of successful options with commercially available solutions. A list of operating hospital based maker spaces may be found in the Appendix of this document.

➔ Nursing Homes and Skilled Rehab Settings

Nursing home and rehabilitation settings often support adults and seniors in order to provide medical care and support due to illness or injuries. These settings often have rehabilitation professionals with general knowledge of commercial assistive

technology and some ability to modify existing equipment to meet the needs of a user.

The following organizations are beneficial in identifying local skilled nursing or rehabilitation facilities in your region:

- Medicare.gov comparison tool
- The Joint Commission
- CARF International

➔ Vocational Rehabilitation Supports

Persons with disabilities are entitled to workplace accommodations to support their independence and ability to complete their work tasks. Assistive technology may serve an integral function as accommodations. Rehabilitation professionals in various non profit organizations as well as state and local governments may facilitate this process between users and employers.

➔ Special Education Schools

Special education schools support students with complex medical needs or significant physical or cognitive disabilities. These settings often have a wide range of support services such as special education teachers, nurses, assistive technology professionals, and rehabilitation services (OT, PT, ST).

➔ Early Intervention

Early intervention settings provide support from birth through 3 years of age to children exhibiting developmental delays in motor, language or cognitive domains. Services may be provided either within facilities or through home care services.

➔ Disability Advocacy Organizations

A disability advocacy organization is a group dedicated to championing the rights and well-being of individuals with disabilities by advocating for inclusive policies, combating discrimination in areas like employment and accessibility, providing crucial information and resources, raising public awareness, empowering self-advocacy, and striving for systemic changes that ensure full participation and equality in all aspects of life. A list of US Disability Advocacy Organizations may be found in the Appendix of this document.

➔ Adaptive Gaming Organizations

Adaptive gaming has grown significantly over the past decade with an increasing number of devices and organizations that support gaming for users with disabilities. Adaptive gaming allows individuals to meaningfully engage in social

networks and is critical in limiting isolation. There are a variety of devices on the market that support joystick and button control customization with a role in maker fabrication to provide further customizations to meet the unique needs of users. A list of adaptive gaming organizations and resources may be found in the Appendix of this document.

Community Networks

➔ Professional Conferences

Professional conferences are usually held annually and may either occur in person or virtually. These conferences offer disability professionals and users an opportunity to collaborate and develop best practices. A list of professional conferences may be found in the Appendix of this document.

Maker

The role of the maker in the fabrication process involves their application of technical knowledge and expertise in various fabrication methods. Makers are able to provide the team with crucial information about what is possible and provide various options and solutions for design challenges. Their skills may include: 3D design and printing, woodworking, computer programming, and physical computing. A list of fabrication resources can be found in the Appendix of this document.

Professionals who often support the fabrication process include: electrical engineers, industrial designers, robotics engineers, mechanical engineers, and rehabilitation engineers.

Makers often follow the design process steps of: information gathering → prototype fabrication → testing → evaluating → and iterating (*Click here to see the engineering design process graphic in Chapter 2*). It is critical that the user is included in the design process and is supported in self advocacy.

Makerspaces and DIY Makers

Standalone makerspaces are designated locations where patrons are provided with access to a range of shared fabrication tools including: 3D printers, laser cutters, CNC routers, soldering station, sewing machines, 2D cutters, and more. Many maker-spaces also provide instruction (e.g., classes, standard operating procedures, etc.) on

how to safely and efficiently use these tools. Patrons typically pay dues or subscription costs to access these spaces and are responsible for their own supplies. A list of makerspaces may be found in the Appendix of this document.

3D printing in particular has increased access to customized assistive technology as it allows for low cost repeatability of designs. Makers with basic knowledge of 3D printing and design are now able to support access to AT. Printers are now becoming more accessible through a wide range of organizations such as public libraries, volunteer printers, and local small businesses.

University Programs

A growing number of colleges and universities are beginning to develop courses that integrate real world applications for concepts with some emphasizing accessibility and ways to support the disability community. As part of the courses, universities are investing in creating makerspaces for students to access. The following degree programs may be suitable for supporting maker assistive technology: electrical engineering, biomedical engineering, computer engineering, industrial design, and occupational therapy.

K-12 Makers

In an effort to introduce elementary and secondary school students to STEM fields, programs such as robotics clubs and organizations are provided. These programs allow students to work collaboratively to develop engineering and design skills as they solve a variety of design problems while learning technical skills to fabricate a robot. These same skills may be applied towards the fabrication of customized assistive devices.

Guiding Considerations

To ensure effective collaboration with these stakeholders collaborators must consider the most effective communication platforms and locations. Considerations include:

- Is the user able to travel outside the home or residential setting?
- Is the user able to access virtual collaboration tools such as Zoom, Email, Social Media or Messaging Platforms (Slack, Discord, etc.)?
- Is the user interested in participation in the fabrication process?
- What are the user's strengths that can be leveraged during design fabrication?

(Continued on next page)

- What is the user's understanding of existing technologies and technical skills?

- Are there language or communication barriers that need to be addressed?
- Are there social or cultural barriers that need to be overcome?
- What commercial AT is currently being utilized and what are barriers to access?

Chapter 5: Real Life Examples of AT and Programs

If you have a case study to share, please share it with us at this link: click here for share-form link.

Program/Initiative Case Studies

- ***Robotics Team Connections***: Roaring Riptide: FIRST Robotics Competition (FRC) Team 4118, was founded in 2011 at P.K. Yonge DRS in Gainesville, Florida by Dr. Carl Crane, a professor at the University of Florida, along with Dr. Lynda Hayes, former Director of P.K. Yonge. Beyond participating in Lego FIRST robotics competitions, they also spearheaded the #FIRSTwithAT initiative started in 2019 with an aim to get other robotics teams involved in making low-cost AT solutions for members of their communities. Riptide works to donate custom AT devices and open-source designs to the Gainesville, FL area and beyond.
- ***Connecting with college/university groups***: University of Delaware's student-run organization Assistive Medical Technologies takes in requests for modifications to equipment/toys from local community members
- ***Collaboration with local schools***: A 5th grade class partnered with a local university to build GoBabyGo cars for local families: https://www.delawareonline.com/story/news/education/2025/06/10/lorewood-grove-elementary-school-fifth-grade-builds-toy-cars-for-middletown-kids-with-disabilities/83389747007/
- ***Starting a Makers Making Change Local Chapter***:

Makers Making Change, a division of Neil Squire, is a Canadian organization that connects volunteer makers to people with disabilities who need assistive devices. This helps to increase access to devices as cost is an often cited barrier. Along with in house developed devices, MMC also supports a growing repository of open

source projects containing documentation to support fabrication. The chapter model is supported for more localized involvement and education opportunities allowing any academic, medical, or makerspace setting to become a chapter.

As an example, the NYC Metro chapter began in 2020 and is being organized by co- chapter leaders coming from both an engineering education and health provider setting. This chapter is a loose network of engineers, educators, students, health professionals and AT users throughout the NY/ NJ region. There is no central location for this chapter which allows it to develop networks with local universities and makerspaces for support. It meets monthly virtually to plan buildathon events for both educational purposes to develop maker skills in the community and fabricate devices for a lending library. Typically, items from the MMC Assistive Devices library are selected for building. In addition, the chapter supports local disability organizations and individuals for device requests. To learn more about the NYC Metro Chapter, check out this video.

For more information and questions about the NYC Metro Chapter email nycmetrommc@gmail.com. To contact MMC and start your own chapter, visit the Chapter Page on their website.

Individual Custom Solution Case Studies

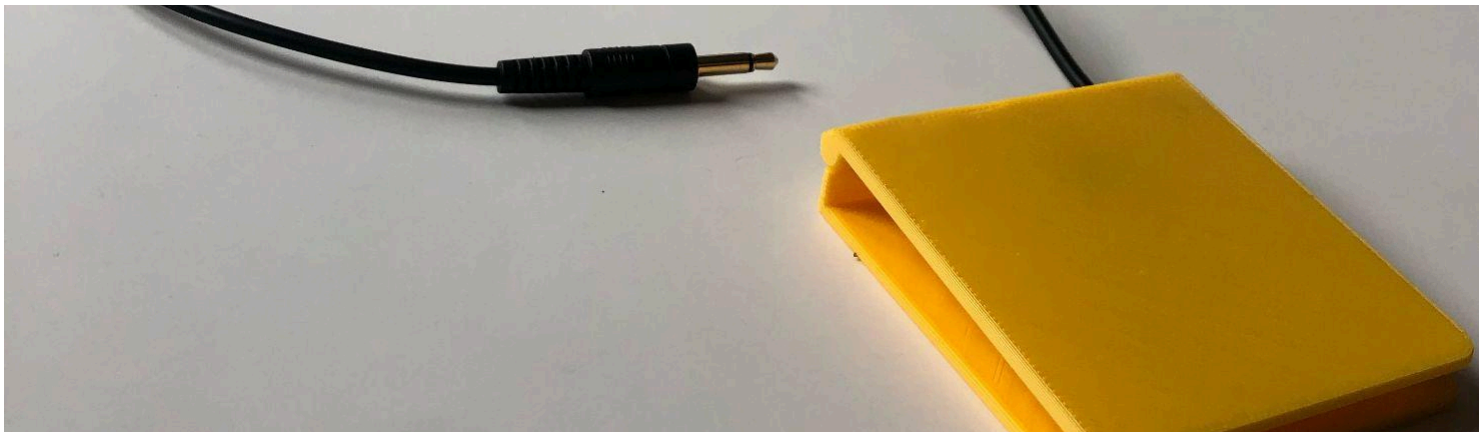
- ***Duquesne University Assistive Technology Studio Course***

  Duquesne offers a 3-credit course for Occupational Therapy and Biomedical Engineering students on making assistive technology. The course is taught in collaboration with the Watson Institute schools in the Pittsburgh area. Students visit the schools each week to meet with teachers, therapists and students and identify needs. Students choose what projects they want to work on. They can work individually or in groups.

  An SLP at the Watson Institute asked for "a robot arm that students could use to clean objects off their desks or trays". After some discussion, the need was narrowed down to "a switch-activated arm for sweeping objects off a desk or tray". The SLP wanted to use the arm with students who were working on a goal of cleaning up after activities. (Cont'd on next page)

A Duquesne OT student designed several iterations of an arm that could clamp to a desk or tray. The system was based on a Raspberry Pi Pico microprocessor and a servo motor. The student used Tinkercad to design an arm that attached to the servo motor and a case for the microprocessor and batteries.

Link to the student's online portfolio, with pictures: https://docs.google.com/document/d/1ZMdXM_ZrKaxQ7SrnVeQckKwtrhTBKgKeVPqk6Pd_q0Y/edit?tab=t.0



Appendix

If you have a resource to add to this appendix, please share it with us: click here for share-form link!

Current Research

A Zotero library is available to view references to current and ongoing research papers related to assistive technology fabrication methods and design processes.

FABRICATION RESOURCES

3D Printing Resources	
Link or File	**Description**
3D Printer Troubleshooting	A summary document of most common 3D printer errors and ways to correct.
Makers Making Change Library	A repository of open source AT devices with filters based on fabrication technique, disability support, and more.
Printables	Repository website of available 3D print files
Thingiverse	Repository website of available 3D print files
MMC Ask an Expert- 3D Printing	Makers Making Change web page answering common questions about 3D printing.
How 3D Printers Work | How	Nat Geo Kids video explaining how 3D printing works

3D Printing Resources

Link or File	Description
Things Work with Kamri Noel	
PrintLab	Tutorials on designing assistive technology in Tinkercad and Fusion
Prusa	Open source 3D printer and filament store
Bambu Lab	3D printers and filament store
Microsoft Adaptive Accessories- 3D print files	Link to 3D print files for custom tops that support the Microsoft Adaptive Accessories line of peripherals

AT Fabrication Books

Link or File	Description
Assistive Technology Solutions in Minutes: Book 1 (2005)	Dr. Therese Willkomm shares her experience with over 50 basic tools and materials used in quick solution development and rapid prototyping
Assistive Technology Solutions in Minutes: Book II	Demonstrates creative DIY problem solving without the need for power tools or electricity, empowering everyone to be spontaneous and create solutions to everyday challenges using everyday materials.
Make Stuff and Love People: Book 3	Solutions and devices or modifications for smartphones, iPads; mobility impairments; self-care; eating and drinking; reading and writing; reaching and holding; communicating; solutions for blind and low vision; and assistive technology ideas for leisure and play.
Practical Versatile Cheap (PVC) AT Supports	A guide on using PVC pipe to create a variety of low tech devices and mounting options.
Makerspace Playbook	A digital resource on how to get started with creating a makerspace.

Microcontroller Resources	
Link or File	**Description**
Adafruit	Hobby-oriented electronic supplies with a Learn page providing step by step tutorials for various projects.
Digikey	Electronic supplies (industry, but sells to anyone)
Mouser	Electronic supplies (industry, but sells to anyone)
SparkFun	Hobby-oriented electronic supplies
DFRobot	Hobby oriented electronic supplies and board makers.
Circuitpython School with Prof. G	A series of easy to follow video tutorials on how to use circuitpython for microcontroller projects.

COMMUNITY OUTREACH RESOURCES

Independent Makerspaces	
Name	**Description**
FabLab Map	International list of FabLab affiliated makerspaces
Makerspace.com	International list of makerspaces from Make magazine.
Makerspace Directory	List of makerspaces and similar.
Maker Works Community Workshops	Makerspace w/machine shop, wood shop, lasers, 3D printers, etc. Home of Switch Fixer project, switch adaptation workshops, Fix-It Friday located in Ann Arbor, MI

Hospital & School Based Makerspaces	
Name	**Description**
Blythedale Children's Hospital	A children's hospital located in Valhalla, NY with a

Hospital & School Based Makerspaces

Name	Description
	dedicated makerspace and rehabilitation engineer to support custom AT designs.
Stan Cassidy Center for Rehab	A rehabilitation hospital in Fredericton, New Brunswick supporting custom AT fabrication for their clients.

Online Assistive Technology Communities

Name	Description
Autism Little Learners - Visual Supports FB Group	A Facebook community to support AAC
TD Snap Core First English (Tobii Dynavox)	Tobii Dynavox Facebook group to support AAC
Smartbox Community	Smartbox Facebook group to support AAC
PECS User Support (Pyramid Educational Consultants)	A Facebook group to support AAC
AAC Language Lab (PRC-Saltillo)	PRC Facebook group to support AAC
Core Word Of The Day	Facebook group to support core word communication
Lesson Pix Users	Facebook group to support LessonPix use
Weave Chat AAC	Weave Chat Facebook group to support AAC
The AAC Connection	A general Facebook page to support AAC
AT Makers-Makers & Users	A Facebook group to support custom AT fabrication and problem solving.
Assistive Technology Group	A Facebook AT group

Online Assistive Technology Communities

Name	Description
Tikun Olam Makers	International organization with university chapters, host need knower hackathons and post open source design.
Makers Making Change Forum	Canadian-based organization with chapter model, forum available for design challenges, and requests for device fabrication.
Makers Making Change Discord	Discord messaging platform to connect with the maker community for design support and requests.
Assistive Technology Discord	Discord server run by TechOWL in Temple University. Mixed community of users and makers
Meetings with AT Profs and communities	Meetings for people to learn about AT and ask questions for projects and events
Makers Making Change (NY Chapter) Virtual Monthly Meeting	Monthly meeting to discuss events for the Chapter. Also for asking questions and getting help for AT projects held on second Monday of each month at 7pm EST.
Maker Roundtable. (ATAC, Missouri AT)	Monthly meeting to discuss our AT Projects and chat about AT.
PA AT Network Meeting (Tech OWL)	Meeting every other month to discuss AT projects and events happening in Pennsylvania. Email Alanna Raffel for join details
May We Help	Groups in Ohio, Michigan, and others, connect users and makers to address specific needs.
Switch Fixers	Volunteers repair assistive technology switches and VOCAs.
Tetra Society of North America	Chapter-based volunteers who create novel assistive technology by request.

Commercial Assistive Technology Vendors

Name	Notes
Tobii Dynavox / Board Maker	
PRC-Saltillo	Many different websites under this company

Commercial Assistive Technology Vendors

Name	Notes
Talk To Me Technologies (TTMT)	
Smartbox	
Everway (Formerly N2Y)	Partners with Text Help
LessonPix	
Enabling Devices	
Switched Adapted Toys	
Switch It Up With Issac	

Professional Conferences

Name	Description
RESNA	Held annually both in person and virtual with changing locations.
Assistive Technology Industry Association (ATIA)	Held annually with in person and virtual options held in Orlando, FL
Closing The Gap (CTG)	Held annual in Minneapolis, MN
American Speech-Language-Hearing Association (ASHA)	Speech Therapy-AAC, held annually in changing locations.
CSUN	California State University Northridge Assistive Technology Conference held in Anaheim, CA
AOTA	Occupational Therapy annual conference with changing locations
APTA	Physical Therapy annual conference with changing locations
ATAC AT Summit	Held annually in NJ

Adaptive Gaming Resources

Name	Notes
Seven Mile Mountain (Ron Nelson)	Etsy shop featuring a variety of maker made joysticks and interfaces
Makers Making Change Adaptive Gaming Page	A getting started with adaptive gaming resources and how to page
Pushing Buttons	A shop for 3D printed switch and joystick tops
One Switch	Website featuring one switch games and gaming resources
AbleGamers	Nonprofit to support adaptive gaming through mentorship, advocacy, and development.
Gaming Readapted	Resource website on equipment and getting started with adaptive gaming
Make code Arcade (Make Switch Games)	Microsoft website to create custom games that are keyboard/ switch accessible. Games may be placed on computers, xBox consoles, or DIY arcades using Raspberry Pi Zero boards.
Makecode Arcade Game Padlet	Variety of free Assistive Switch Games developed using the Makecode Arcade platform

AT Fabrication Organizations

Name	Notes
Switched Adapted Switches	Sells adapted toys and switches as well as provide open source resources. Supports local chapter models.
Makers Making Change - Maker Wanted	Makers Making Change webpage for volunteer making devices.
HuskyADAPT	University of Washington organization with a focus on adapting toys and providing resources as well as supporting the Go Baby Go project.
Adaptive Design Association	A non profit fabricating custom seating and positioning using cardboard carpentry. Provides training and workshops to the community.

AT Fabrication Organizations

Name	Notes
AT Makers	Supporting makers and AT users with custom solutions and fabrication.
TOM Global	International organization that supports need knowers in accessing custom devices to meet their needs. Support local chapters in universities and provide access to documentation and design in repositories.
Make Good	Organization that supports access to open source assistive technology and custom designs. Design various positioning systems and support the toddler mobility project.

Disability Advocacy Organizations

Name	Description
United Cerebral Palsy	A network of affiliates and partners has been committed to creating a world where people with disabilities can live life without limits. Through advocacy, research, education, and a wide range of resources and programs, we work to promote inclusion, independence, and opportunity for all.
ALS Association	The national association supports education, research and community resources.
Christopher and Dana Reeves Foundation	Dedicated to curing spinal cord injury by advancing innovative research and improving the quality of life for individuals and families impacted by paralysis.
United Spinal Association	Empower and advocate for people with spinal cord injuries/disorders and all wheelchair users to achieve their highest quality of life.
Lighthouse for the Blind	Private, not-for-profit social enterprise providing employment, support, and training opportunities for people who are blind, DeafBlind, and blind with other disabilities.