Rehabilitation Engineers, Technologists, and Technicians:
Vital Members of the Assistive Technology Team

Introduction

Rehabilitation Engineering is the application of science and technology to improve the quality of life for individuals with disabilities. The rehabilitation engineering profession includes rehabilitation engineers, rehabilitation technologists and rehabilitation technicians throughout the world. Rehabilitation engineering professionals primarily work in the fields of assistive technology (AT), rehabilitation technology (RT) and universal design (UD). As these fields have advanced, so has the role of rehabilitation engineering in providing more educational, social and vocational opportunities.

Initially, rehabilitation engineering professionals (REP), which for the purpose of this paper includes engineers, technologists and technicians, focused on research, design and fabrication of custom devices in clinical settings. As more AT and RT devices have become commercially available (figure 1), and more consumer products are designed using universal design principles, the role of REPs have evolved. REPs now have a greater role in AT and RT, which include the following areas.

1. Customization and integration of existing AT and RT
2. Research, development and production of devices
3. Analysis of human performance, and
4. Application of outcome measures throughout the assistive technology service delivery process.

The advancement of the AT and RT fields has lead to a change in the practice of rehabilitation engineering. In order to address this change, the Rehabilitation Engineering and Assistive Technology Society of North America (RESNA), Rehabilitation Engineer and Technologist (RE&T) Professional Specialty Group (PSG) commissioned an ad-hoc committee to generate a white paper that defines the current roles and responsibilities of Rehabilitation Engineers, Rehabilitation Technologists and Rehabilitation Technicians in practice.
Current Definitions

Though the field has evolved, and numerous definitions for rehabilitation engineering have been described in the literature [1]–[5], the simplest and most straight-forward definition is provided by the IEEE Engineering in Medicine and Biology Society. The definition simply states: “Rehabilitation Engineering is the application of science and technology to improve the quality of life for people with disabilities.” [6] The definition is eloquent in that it first describes engineering as an activity, and then defines the population for which the activity is applied [7]. This clearly identifies the uniqueness of engineering professionals, as opposed to inventors or scientists, and the uniqueness of rehabilitation engineers, rehabilitation technologists and rehabilitation technicians.

Utilizing the definitions of engineer, technologist and technician found in the Oxford English Dictionary [8]–[10], the following definitions for the Rehabilitation Engineering Professions are as follows:

**Rehabilitation Engineer** is defined as a person who uses specialized knowledge or skills to design, build, and maintain complicated equipment, systems, processes, etc. for individuals with disabilities.

**Rehabilitation Technologist** is defined as a person who specializes in technology for individuals with disabilities. Often a technologist is equivalent to a technician.

**Rehabilitation Technician** is defined as a person qualified in the practical aspects of one of the sciences or mechanical arts as it relates to individuals with disabilities.
Integration of Rehabilitation Engineering in the AT Service Delivery Process

Rehabilitation engineering professionals collaborate with numerous professionals to meet the needs of individuals with disabilities. In order to synthesize the unique characteristics of each individual with a disability, REPs must have an understanding of the roles and responsibilities of each profession (e.g. engineers, clinicians, educators). As with other professional groups, overlap in roles exists across professionals, which is necessary for the transfer of information, and the effective collaboration of a multi-disciplinary team. A multi-disciplinary team is recognized as best practice for providing assistive technology to individuals with disabilities whether in the healthcare, home, school and vocational settings [11]–[13]. Though all of the professionals that work in the field of assistive technology focus on technology, the REP excels as the professional with the skills, knowledge and expertise in development and application of technology for individuals with disabilities.

REPs are unique in comparison to other engineering professionals in their interaction with individuals with disabilities. No other engineering profession works as closely with children or adults on a daily basis. It is this direct interaction that facilitates the REPs successful integration in the multi-disciplinary team. The unique skills, knowledge and expertise position REPs as key stakeholders in the development of personalized health and wellness plans, individualized education plans, and individualized work plans in medical, educational and vocational settings, respectively.
Figure 2. Assistive Technology Service Delivery Process as described by Cook and Polgar[11] and Szeto[14].
Role of Rehabilitation Engineering Professionals

The rehabilitation engineer participates in the full AT service delivery process and will take a lead role in the assessment process, which includes the customization and integration of AT, as well as the analysis of human performance. Furthermore, the rehabilitation engineer directs the training and education of stakeholders on the proper use of AT and RT. The rehabilitation engineer leads the research, development and production activities of AT & RT. Finally, the rehabilitation engineer will lead the AT Centers within different settings (e.g. medical, educational, vocational). This includes the application of outcome measures (performance, user satisfaction, quality of life) as part of a closed-loop feedback system to insure quality improvement throughout the service delivery process. The rehabilitation engineer may supervise the rehabilitation technologist and rehabilitation technician in the implementation, follow-up and follow-along processes.

The rehabilitation technologist participates in team meetings about an individual’s assistive technology needs, and assists in training individuals and their team about unfamiliar technology. The rehabilitation technologist participates in the AT service delivery process, but will not take a lead role, especially during the assessment process. They will provide continuity for the implementation of appropriate AT. They will also play an important role in supporting research and design, as well as manufacturing. The rehabilitation technologist may supervise rehabilitation technicians to complete tasks required for an individual to use assistive technology.

The rehabilitation technician’s interactions with clients focuses on the set-up, adjustment and repair of equipment during the implementation, follow-up and follow-along phases of the service delivery process. Rehabilitation technicians also play an important role in supporting AT and RT production. They often work under the guidance of another rehabilitation professional such as the rehabilitation technologist or rehabilitation engineer.

Employment Opportunities

Rehabilitation engineering professionals typically work in either the indirect consumer service delivery market (e.g. research and development, manufacturing) or the direct consumer service delivery sector. Cook and Polgar describe the connection between the direct and indirect consumer service delivery sectors[15]. Overall, there are nine indirect sectors that support the direct sectors. The nine indirect sectors include basic research, applied research, product development, manufacturing, product distribution, information and referral, and education and training. Each one of these sectors provides an employment opportunity for the REP. Furthermore, Cook and Polgar describe eight different settings in which the direct consumer delivery process takes place[15]. These settings include rehabilitation programs, university programs, state agency programs, private practice, rehabilitation technology supplier / durable medical equipment supplier, Department of Veterans Affairs, local affiliate of a national nonprofit disability organization, and volunteer organizations. Each one of these settings provide an
opportunity for REP employment. In the remainder of this section we highlight some of 
the employment opportunities within a sampling of these sectors and settings.

Indirect consumer service delivery 
Manufacturing 

Rehabilitation engineers are involved in the development and application of voice 
activated systems to operate computers, electronics, and smart-mobile devices. 
Rehabilitation engineers design and produce wheelchair mounted power supply 
systems to provide ventilator back-up power. Rehabilitation engineers also design 
technology with a focus on injury prevention, universal design, or enabling 

In manufacturing, rehabilitation engineers develop tests for consumer safety and 
compliance, while technicians will conduct the tests to insure they meet state, federal 
and international standards. The engineer analyzes the safety of the assistive 
technology based on the results. Wheelchair tie down and occupant restraint systems 
are an excellent example of where engineers and technicians collaborate to ensure the 
wheelchair tiedown system meets national and international standards. 

The rehabilitation engineer in manufacturing brings the clinical knowledge, skills and 
experience of working with people with disabilities to the manufacturing process. The 
rehabilitation technician often is involved in execution of the designs provided by the 

Basic Research 

Engineers, technologists and technicians will work together to get a better 
understanding of the human/technology interface, and how disability plays a role in this 
interaction. The engineer will develop the foundational content for the research proposal, 
and lead the research project, while the technologist and technician will collect the data. 
Finally, synthesis of the data will be a collaborative process based on observations 
documented during the testing, and the overall data. 

Applied Research 

Rehabilitation engineers, rehabilitation technologists and rehabilitation technicians work 
for independent testing laboratories. They conduct stress, performance and failure 
analysis tests to determine the structural integrity of assistive technology (e.g. 
wheelchairs, wheelchair transportation equipment and emergency stair travel devices). 
Rehabilitation technologists and technicians play a critical role in operationalizing the 
testing procedures. 

Some rehabilitation engineers also work in research and design to develop and test new 
products. Others conduct applied research to solve practical problems for people with 
disabilities. They test new equipment in multiple environments prior to product launch.
In this scenario, rehabilitation technologists and rehabilitation technicians fabricate custom testing equipment and carry out the testing procedures. The rehabilitation engineer will then analyze the data and generate the reports.

Education and Training

The rehabilitation engineer develops curriculum to provide engineering instruction at a university. They also provide commercial product training in a clinical, school, or vocational setting, or develop instructional materials for new products.

The rehabilitation technologist will often participate in training other professionals who are entering the field and broadening their rehabilitation technology skillset. They teach assistive technology courses and certificate programs at many universities, using their clinical expertise to enhance their instruction.

The rehabilitation technologist often provides training for commercially available technology provided to the user. The training takes place in the different settings and applications that it is intended to be used. It includes the end-user but when necessary, it also includes their support team.

Direct Consumer Service Delivery

Vocational Rehabilitation

Many rehabilitation engineers and technologists provide consultation regarding the wide range of equipment that might meet the needs of a person with a disability. They suggest and integrate commercially available devices to solve a problem for a person with a disability. For example, a rehabilitation technologist will meet with an individual and recommend what computer access system is required to optimize the consumer’s efficiency. A rehabilitation engineer will work with a consumer who has Parkinson’s and wants to continue working as a drywaller to develop a custom solution to overcome limitations imposed by tremors and fatigue. The rehabilitation technician would often assist with building the prototypes and final product as specified by the rehabilitation engineer.

Another example includes developing a workplace accommodation for an individual with cerebral palsy. A rehabilitation technologist can assess their office needs and find solutions to increase their computer efficiency and other office tasks. A rehabilitation engineer would get involved when the commercially available assistive technology don’t meet the person’s needs. The rehabilitation engineer would develop a custom phone access solution that allows the individual to utilize the existing phone system and meet the workplace productivity requirements.
Center for Independent Living

A rehabilitation engineer working at an independent living center with a woman with limited mobility recommends electronic aids to daily living for her to activate appliances and lights in her kitchen.

A rehabilitation technologist would assist the consumer with trying different tools to increase safety and independence in the home. They will assist the consumer in determining off the shelf products that increase their safety with transfers, cooking, and household chores. A rehabilitation engineer will develop customized solutions when off the shelf assistive technology doesn’t meet the consumer’s goals.

School District

When commercial equipment does not meet the needs of a person with disability, the rehabilitation engineer designs modifications. The rehabilitation engineer adapts and customizes technology and fabricates unique solutions to fit the needs of an individual with a disability. For example, a rehabilitation engineer working in a school system with a preschooler with limited lower extremity movement adapts a battery operated toy car so that it can be driven with hand controls rather than foot pedals.

Often the schools either employ or contract a rehabilitation technologist who assists students with using technology to meet their academic goals. They may use screen reading software to overcome a print limitation, computer access devices technology to help during computer lab, or a recorder to assist with note taking.

Rehabilitation Program or University Program

The rehabilitation engineer leads the AT team by setting goals with measurable results over specified timelines. This includes trials with assistive technology used in educational, employment and community settings. The data collected during trials with equipment is critical in evidence based practice, and increasingly important component of the service delivery process.

Rehabilitation Setting

In a medical setting, REPs are involved in increasing patient’s access to medical equipment such as call systems and phones, integration of therapies, and increasing the patient’s independence. In this model, a rehabilitation technician would be the person involved in setting up and repairing call systems and equipment after the assessment was done by the rehabilitation technologist. The rehabilitation engineer would be involved as part of the assessment team and would work with the clinicians and medical team. The rehabilitation engineer would develop and integrate solutions to increase the patient’s independence. The rehabilitation engineer collects and analyzes performance measures to maximize the effectiveness of the technology during the assessment and implementation phases. For example, a rehabilitation engineer working
at a medical rehabilitation center integrates a camera mount on a wheelchair for an
amateur photographer.

Rehabilitation Technology Supplier / Durable Medical Equipment Supplier

The rehabilitation engineer or rehabilitation technologist will be the direct consumer
contact, and will collaborate with other rehabilitation professionals (e.g. occupational
therapist, physical therapist, speech language pathologist) to provide appropriate
assistive technology. The rehabilitation technician will set-up equipment for evaluations
and for fittings, but generally will not interact directly with the consumer.

Department of Veterans Affairs.

The rehabilitation engineer and technologist typically work for the clinical services.
While the technician works for the prosthetics service. The rehabilitation engineer will
assess the Veteran’s need for assistive technology in collaboration with the
transdisciplinary team. The engineer will also verify the proper implementation of the
technology. The technologist will assist with set-up and trial of evaluation equipment.
The technician will acquire the recommended equipment, and set-up the equipment in
preparation of the implementation.

Case Study

Joe is a 37 year old male with a spinal cord injury at the level of the 4th cervical
vertebrae. His level of impairment was characterized as ASIA C. He has dysarthria, and
decreased inspiratory/expiratory strength and volume, and no movement below the
neck. Joe and his fiancée were seen by a trans-disciplinary team of occupational
therapy (OT), physical therapy (PT), speech-language pathology (SLP), rehabilitation
ingineer (RE), and multiple assistive technology manufacture representatives. When
the RE joined the treatment team, Joe had already received a mobility evaluation and
been issued a front wheel drive power wheelchair with multiple seat functions (tilt,
recline, stand, seat elevator, leg elevate). He was also in the beginnings stages of an
augmentative and alternative communication (AAC) evaluation. He was successfully
utilizing a chin control consisting of a swing away micro joystick for drive control and
egg switch for mode and power functions. The RE relied on documentation from the
treating clinicians for details about the Joe's functional abilities.

Due to Joe’s spinal cord injury he was unable to communicate verbally, which severely
decreased his ability to participate in conversations, especially with anyone other than
his fiancé. Consequently, independent direction of his care and participation in
recreation activates was very difficult. Other activities difficult or impossible for Joe,
included independent walks outside of the home, watching television, and online
communication. To enable Joe to leave his home independently, he requires a door
opener accessible from in and outside of the home.
Joe's primary goals were to access the home and community environment, communicate effectively, access a computer independently for email and internet browsing, text messaging, and to make telephone calls. The professionals’ (RE, OT, and SLP) objectives for this part of the overall assessment were to select an AAC device and determine AAC device access method. The team would evaluate potential computer access methods and environmental control systems (aka electronic aids for daily living) in future evaluations.

The primary objective of the RE was to integrate all new equipment with Joe's existing technology. The RE assisted with setup and trial of 3 AAC devices, with 3 different access methods, and multiple access locations. The 3 AAC devices were dedicated devices with dynamic displays. The access methods included a head mouse with dwell or external switch, USB chin joystick control, and Bluetooth wheelchair chin joystick control.

The most successful access method to any of the AAC devices was chin control and dwell clicking. The RE recommended using the wheelchair’s Bluetooth capability for simplicity of integrating with the existing power wheelchair electronics. This gave Joe independent control of the AAC when it was mounted on the wheelchair. Joe selected the AAC device which he preferred, and it was mounted to the wheelchair on an easily removable mount arm allowing for safe and efficient transfers via lift. Also, Joe was concerned with the battery life of the AAC, so the RE integrated the AAC’s power supply to the wheelchair’s 24V power system. Additionally, the RE made a custom cable to interface an input/output module on the wheelchair to the AAC device’s switch input configured for on/off control. This gave Joe the ability to turn on and off his device independently, which was important to him. A floor style AAC device mounting system and USB chin control were issued to Joe for AAC access when not in his wheelchair. The chosen AAC system had infrared output enabling it to function as an environmental control for lights, telephone, a door opener, and television control.

The Quebec User Evaluation of Satisfaction with Technology (QUEST) and Psychosocial Impact of Assistive Devices (PIADS) outcome measures were administered pre and post of the RE intervention. Additionally, the objectives were met through demonstration in the clinic. This implementation was then adapted and transferred to the home setting. Follow-up continues on a regular basis (approximately every 6 months) when Joe contacts the RE with new goals and ideas about his current assistive technology. The implementation has remained fluid and is adapted to grow with Joe’s changing life. The RE is the primary point of contact for integrating Joe’s technology requirements, for communicating with the trans-disciplinary team and assistive technology device manufactures, and providing the technical support for a successful outcome, and documenting quality assurance through outcome measures.

Educational Background of Rehabilitation Engineering Professionals

While some rehabilitation engineers have master’s degrees in rehabilitation engineering, most rehabilitation engineers have undergraduate or graduate degrees in
biomedical engineering, mechanical engineering, or electrical engineering. Their university training includes formal training in principles of design, ergonomics, biomechanics, mechanical and electrical systems, material sciences and life sciences. They also gain an understanding of the functional capabilities and prognosis of people with disabilities.

Rehabilitation technologists have associates, undergraduate or graduate degrees in health and rehabilitation sciences such as nursing, counseling, psychology, biological sciences, computer science, occupational therapy, physical therapy, speech therapy, vocational rehabilitation and engineering.

Rehabilitation technicians usually have a diploma from a vocational school in areas such as computer technology, industrial electronics and machine tool technology. The rehabilitation technician usually gains knowledge of working with people with disabilities by working in rehabilitation facility, a durable medical equipment provider or a vocational rehabilitation agency. The rehabilitation technician may eventually qualify for the role of the rehabilitation technologist through several years of apprenticeship as a rehabilitation technician and demonstrating competency through a mechanism such as the assistive technology professional (ATP) certification.

Future of Rehabilitation Engineering Professional’s Education and Training

As the field of Rehabilitation Engineering advanced through the late 1970s and 1980s, most notably with the start of the Rehabilitation Engineering Society of North America (RESNA) in 1979, so did opportunities for education and training. A call for education and training in rehabilitation science and engineering was described in 1997 in “Enabling America”[16]. In this book, the authors make four recommendations, one is to increase doctoral and postdoctoral education “...to help encourage the development of the field and respond to the expanding research needs.” Therefore, the education and training opportunities have primarily focused on activities surrounding the Rehabilitation Engineering Research Centers, which continues today. Furthermore, in 2000, an entire issue of Technology and Disability was devoted to the field of rehabilitation science and the role of graduate education. The articles focused on masters and doctoral level education, as well as opportunities for collaboration between the Schools of Engineering and Health and Rehabilitation Sciences[17], [18]. Though the articles focused on graduate education, their emphasis often impacts the development of undergraduate education. As technology translates from the research and development stages to full-fledged consumer products, there will be an increased need for rehabilitation engineering professionals.

As existing REPs continue to advance the field of rehabilitation engineering, more opportunities for REP training programs will develop through academic and apprenticeship programs. Traditional programs in the rehabilitation engineering professions do not currently exist at the undergraduate level. However, the principles of rehabilitation engineering are incorporated in existing engineering and engineering technology programs, most notably in the health sciences and engineering fields.
Considering the associates degree, an opportunity exists for training rehabilitation technologists and rehabilitation technicians through existing community colleges. Furthermore, considering the bachelors or professional degree in health sciences, an opportunity exists for training rehabilitation technologists through existing health science programs. Finally, at the level of the bachelors or masters degree in engineering, an opportunity exists for training rehabilitation engineers through existing engineering programs (Figure 3). Therefore, even though few formal educational programs in rehabilitation engineering exist, numerous opportunities for specializing in the rehabilitation engineering professions are currently available within multiple engineering and health science disciplines through community colleges and universities. In the future, these opportunities may turn into dedicated training programs within the Engineering and Rehabilitation Sciences curricula.

Figure 3. Example engineering educational programs that feed into RE, and the associated areas of employment.
The roles of Rehabilitation Engineering Professionals have evolved as the field has matured with more adjustable, commercially available products available to meet the needs of people with disabilities. The evolution has lead to more engineers moving to research, development, and production of products, with technologists and technicians available to assist with customization and integration of commercial products. Engineers continue to bring analysis of human performance to the service delivery team, with all REPs measuring outcomes.

Many service providers perform more than one REP role throughout their work. On the surface, the delineation among the rehabilitation engineering professional’s roles and responsibilities is challenging, but upon further investigation, the unique roles of each professional becomes clear (Figure 4). The various settings that REPs work further defines the unique roles of each professional. Although there are strong similarities across the disciplines, the environment defines the roles of the REP.

In general, rehabilitation engineers become involved when research, design, production, performance analysis and project management skills are required in the indirect and direct consumer service delivery settings. They have an educational background in engineering and disabilities. Rehabilitation technologists have a strong background of technology and use that during assessments and other areas of work, but do not take the lead in modifications, design or development of tools and technology. Their
Educational background is often in a health, education or rehabilitation sciences field. Rehabilitation technicians primarily are involved in the execution of modifications and adjustments to technology under the direction of another professional. Their education is generally a technical diploma and on the job training relevant to their position.
References


