Integrating technology in the workplace for people with spinal cord injury

Sylvia A Rodger, Desleigh M de Jonge

Computer technology can overcome mobility and functional limitations resulting from spinal cord injury (SCI) and enable re-employment. This study aimed to identify barriers and supports to effective technology use at work from the unique perspectives of technology users themselves. A qualitative research design was used to explore the perspectives of 11 technology users with SCI. In-depth, open-ended interviews and observations were conducted at each person's workplace.

Five major themes emerged: identifying the best or right technology; acquiring the technology; customizing and learning to use the technology; supporting the technology; and empowerment. Understanding these consumer perspectives enables professionals to empower people with SCI to optimize their work potential.

Key words: spinal cord injury, assistive technology, workplace

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Assistive technology (AT) refers to 'any item, piece of equipment or product system, whether acquired commercially, modified or customized, that is used to increase, maintain or improve the functional capacities of an individual with a disability' (Galvin, 1997). This article primarily refers to computer AT used to facilitate or enhance a person's performance at work. This technology may be mainstream (i.e. used in a modified or unmodified way by members of the general community) or assistive (i.e. specifically used by people with disabilities).

Computer technology can decrease the impact of mobility and functional limitations following spinal cord injury (SCI) and enable people with SCI to return to employment. Kruse et al (1996) believed that the computer revolution may potentially expand employment and other opportunities for people with severe physical disabilities, provided they have access to appropriate training and technology.

Technology has enabled people with disabilities to participate more equitably in employment. Return to work in the competitive labour market following SCI has increased from 12.6% 2 years after injury to 38.3% 12 years after injury (De Vivo and Richards, 1992).

Althanasou and Murphy (1993) reviewed employment rates for compensatable spinal injuries in Australia. They found that return-to-work rates ranged 16%–53%. Krause (1992) investigated employment in 286 people post-SCI in the United States. He found that 48% were working at the time of the study and that of these, only 12% had returned to the same job after injury. Younger age at injury was associated with higher employment rates and 95% of all participants with ≥16 years of education had worked after injury.

Post-injury employment figures reported in various studies vary depending on the following:

- The amount of time post-injury at which follow-up occurs
- Whether people are employed full- or part-time
- Whether people are employed in supported or open employment
- Age at injury and follow-up
- Level of lesion.

Interpreting study findings is difficult, as these variables are infrequently reported.

Althanasou and Murphy (1993) and Krause (1992) concluded that vocational rehabilitation services often failed to assist people to return to work, or were terminated once work had been found, resulting in lack of workplace follow-up, monitoring of change in physical status or workplace modifications.

Several authors have argued that while technology may well assist people with disabilities to gain employment, this opportunity has been slow to be realized owing to high costs, lack of training of rehabilitation specialists in the prescription and customization of technology, lack of computer training for people with disabilities and technology

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abandonment (Phillips and Zhao, 1993; Scherer, 1998).

AT is often divided into two categories: 'low' and 'high' technology devices. Low technology devices are those that are inexpensive and made of readily available materials (for example; wrist supports and adapted keyboards). Devices that are complex, expensive, more difficult to make and harder to obtain are known as high technology devices (Cook and Hussey, 1995; Scherer and Vitaliti, 1997); examples are voice-recognition software and keyboard and mouse emulators.

Technology cannot be viewed as a panacea. Other strategies, broadly classified as 'work rehabilitation', are also needed if people with SCI are to experience fully integrated employment opportunities. The social context must also be considered (Cook and Hussey, 1995; Westmorland et al, 1998).

This article describes barriers to effective AT use in the workplace and the practices that support its successful integration for people with SCI, from the unique perspective of technology users themselves.

METHOD

A qualitative research design was used, as this was an exploratory study. Qualitative methods allow researchers to gain in-depth knowledge about people's lived experiences. Semi-structured interviews with open-ended questions were used.

Participants

Participants were sought via mailed newsletters to disability organizations and service providers in Queensland, Australia. Eleven people with SCI were recruited. All participants had cervical spinal lesions, worked in paid employment for 10–40 hours a week and were male, aged 18–60 years. Six lived in metropolitan Brisbane, one lived in non-metropolitan south-east Queensland and four lived in non-metropolitan north Queensland. Three were self-employed, one was a contract worker, three worked in small businesses, three worked for state and local governments and one worked for the commonwealth government. Four classified themselves as administrators, three as managers, one as an educator and three as professionals.

The participants used a range of assistive technology: seven used typing splints, two used access software, four used specialized keyboards, six used trackballs, eight had modified telephones and six used voice-recognition software.

Procedure

AT users telephoned the researchers in response to newsletters. At this time, demographic information was collected to determine study eligibility. Participants had to have worked in paid employment for at least 10 hours a week and used at least one type of mainstream technology or AT at work.

Participants provided written consent before the interview. All interviews were completed in the person's usual workplace. Field notes were made after each interview, noting observations, technology used and personal reflections. This provided a means of taking into account researchers' personal reactions to the visit and possible bias with interpretation. This helped to address reflexivity (assessment of the investigator's background, perceptions and interests on the research process), as recommended by Krefting (1991) as a means of addressing research credibility.

Open-ended questions were developed by the researchers in consultation with a project reference group comprising a consumer of AT with a physical disability and representatives from a service provider organization. The questions were influenced by the clinical experience of the authors, the literature and the study's objectives. Interview questions aimed to identify the following:

- Appropriate technology
- The person's work-related tasks and the type of AT used
- The person's general technology use
- The customization of the technology solution
- The integration of AT into the workplace
- Any critical incidents experienced with the technology.

The interview was piloted with one AT consumer and minor modifications were made. Interviews ranged 1–2 hours in duration. The project reference group provided a means of ongoing peer examination throughout the data collection, coding, analysis and writing phases, adding further to the credibility of the findings (Krefting, 1991). All interviews were audiotaped and transcribed verbatim.

Analysis of data

Each investigator read interview transcripts independently and identified key words and emerging themes. They classified transcripts according to recurring key words and clustered these into emerging themes. Discussion ensued to develop consensus. Peer examination and code re-code procedures were used, adding to dependability (Krefting, 1991).

Three forms of triangulation (Patton, 2002) as a means of attending to the validity and reliability of study design were used. Data collection was triangulated using investigator field notes and observations of the technology in the workplace. Investigator triangulation (using several researchers from different backgrounds) was used in the development of coding and analysis of the transcripts.

Theory triangulation was used in order to gain multiple perspectives for data interpretation.

Member checking was also used to strengthen the credibility of the data (Krefting, 1991). Participants were sent individual summaries of the key themes identified. These were read, signed and returned to acknowledge agreement with researchers' interpretative summaries.

RESULTS AND DISCUSSION

Five major themes emerged:

- Identifying the right technology
- Acquiring the technology
- Customizing and learning to use the technology
- Supporting the technology in the workplace
- Empowerment in the workplace.

These will be reported and discussed in turn by focussing both on the barriers identified and practices supporting technology use.

Identifying the right technology

Barriers to identifying the right technology included:

- Isolation from others with similar needs, necessitating reliance on trial and error
- Not knowing the right person or questions to ask
- Being unaware of what was technologically possible
- Lack of time to explore options
- Being unaware of or having limited access to information and resources.

Five participants were uncertain about technology and how to use it more effectively. These participants used less than ideal techniques or referred the problem to a computer literate friend:

> **'I relied on my knowledge, and that was limited. There was no one who sat down and looked at the technology and said "You know, this is what you can do, you know this will be a help, how about trying this?".'**

These results concur with those of Scherer and Vitaliti (1997), Galvin (1997) and Cowan and Turner-Smith (1999), who found that many consumers have limited access to information and awareness of alternatives.

Despite having access to service providers, several participants discovered voice recognition technology through friends or employers, indicating possible delays in the acquisition of new technology by specialist information resources. Angelo et al (1997) urged service providers to stay current with technology developments in order to meet clients' needs.

Alternatively, some consumers are often overwhelmed by the variety of technology options and can only deal with new technology solutions gradually. Ongoing access to information (rather than one-off contact) and services about technological solutions may be useful. The potential for technology to assist people with disabilities may have been hindered by the lack of training of rehabilitation specialists in prescription and customization. The following quote illustrates that exploring solutions takes time:

> **'I first heard about Naturally Speaking [ScanSoft Inc, Peabody] in September 1997 when it was released as a demo. A friend of mine had it and asked me whether I knew about it. I didn't, so he gave it to me. I did some further investigations and went to a computer expo in May 1998...'**

Several participants were unaware of existing AT information services. Others tended to rely on their own limited knowledge and resources, often leaving technological problems unresolved for long periods.

Some strategies and supports identified were:

- The importance of knowing what you need
- Assistance from an occupational therapist
- Contact with other users
- Being informed about options
- Using specialist technology services
- Arranging short-term equipment trial in the workplace.

Most participants appeared to be well aware of what AT they needed. Two stated that it was essential to be clear about their needs, or if unsure, to access a service provider. One said:

> **'If I didn't know what I wanted, I'd be more than happy to go to the Independent Living Centre or an occupational therapy or spinal unit, or to somebody with the knowledge and expertise.'**

Seven participants reported that they identified their needs independently, through anticipation or experience. Two participants reported that they would often fall behind with their work before realizing that changes were needed.

Receiving assistance from an occupational therapist for ergonomics and collaborative problem solving was highly regarded by participants, as was contact with other technology users. A number of participants wished to have contact with other users to benefit from their experience and knowledge of the technology:

> **'If I had somebody in a similar situation to me that I could talk to that had been using the technology and get some idea from them as to which was the best technology, that would have been easier.'**

Using information services such as the Independent Living Centre was also perceived to be useful. Nine participants reported that they would use a specialist information service such as the Independent Living Centre Technology or Commonwealth Rehabilitation Services therapists to identify technology. One said:

'I've never bought a new wheelchair without professional advice and the same [should apply] to technology. You just don't ask yourself all the questions that need to be asked.'

Being well informed about options enabled participants to make appropriate AT decisions. This required monitoring new developments and keeping in touch with computer literate friends or professionals, using the internet, the Independent Living Centre and suppliers. Finally, the importance of trialing the equipment on-site in the workplace was raised.

With the rapid development of technology, users must be prepared for the future, rather than limiting themselves to current technology options. Phillips and Zhao (1993) recommended involving consumers in decision-making and accommodating their long-term technology needs in order to avoid abandonment. Turner et al (1997) found that identifying a variety of options was important for optimizing personal choice and for ensuring selection of the right device. They suggested that input from other individuals with SCI might be beneficial, a sentiment echoed by Turner et al (1997), who also recommended formal technology evaluation in situations where complex high technology options were necessary.

The importance of assessment of the person and his or her potential and actual work environments was also stressed by Bain et al (1996), who argued for the importance of fitting technology to the needs of the person with respect to his or her goals and functional abilities. Short-term workplace technology trial was identified by various authors and by participants in this study. Hammel and Symons (1993) recommended on-site extended trial, particularly in order to help identify pain and discomfort associated with technology use.

Acquiring the technology

One barrier identified was lack of control over decisions owing to funding bodies preferring cheaper and often less useful technology options. Many experienced delays in supplying, installing and servicing the technology.

Another difficulty was incompatibility between the AT and the work computer platform or network. Inexperienced suppliers exacerbated such problems and the costs involved in effective workplace support. Suppliers were often inexperienced in dealing with users' problems. One participant said:

'It wasn't just a simple matter of calling [the supplier] and getting them to come out and test the environment or the computer...they were very much stumbling their own way as well.'

The lack of technology use at work, the cost of technology and limited funding were also identified as barriers. The prohibitive cost of technology was raised many times by participants. Not only is reliable, sophisticated technology (such as voice recognition software) expensive, but it often requires a powerful platform for effective use. Self-employed participants generally had to purchase their own technology, thereby limiting options.

Participants expressed a need to keep up with the latest technology and to update their systems in order to remain competitive:

'If you are going to compete with people who have all their physical attributes, then you need cutting edge technology.'

Funding submissions were often slow and time-consuming, and rarely successful. Sowers (1991) identified financing AT as the most significant problem faced by individuals with disabilities. Galvin (1997) believed that efficient delivery of services and timely acquisition of technology were also critical.

Regarding best practice in technology acquisition, participants identified having control over decisions, access to responsive IT support and access to funding as major contributors to successful integration of workplace AT. Access to a technician experienced in installation was perceived as essential. Those working in large government departments tended to have ready access to IT support, hence encountering fewer installation or maintenance problems.

Four of the 11 users received initial financial assistance, which they attributed to being essential in gaining employment. Bain et al (1996) surveyed 100 occupational therapy administrators regarding the AT assessment for individuals with SCI. Consistent with findings in this study, their recommendations included the need for client involvement throughout the process, the need for client self-advocacy in assessment and the need for opportunities for pre-purchase trials.

Customizing and learning to use the technology

Customization refers to the process of modifying and adapting technology to accommodate specific individual needs, and to optimizing technology use to enhance performance. Barriers to customization and learning identified were:

- Poor awareness of issues
- Complexity of the technology
- Relying on trial and error
- Lack of time at work
- Cost
- Reliance on informal supports.

Because of a lack of awareness of issues, participants tended to respond to difficulties as they arose. They were often unaware of how technology could improve their work effectiveness and did not consider potential long-term implications such as neck strain.

Several users found voice recognition software complex and difficult to use. Some found it frustrating to use and were limited to using only basic functions. Trainers were unaware of users' disability-specific limitations and had difficulty teaching to each user's level of understanding. Hence, participants relied extensively on trial and error and self-teaching, which they found frustrating and inefficient:

> **'It's difficult working on your own because you're repeating your own errors...I'd love to have someone just give me a few hours to help get me straightened out on some of these problems.'**

Because of the extensive cost of customization, participants often attempted to modify equipment inexpensively. While some modifications were initially successful, better long-term outcomes could have been achieved with adequate funding. Cost of training ranged $150–$300 an hour, which was frequently prohibitive. While reliance on informal networks was useful for some in the home, this did not appear to be a reliable method of workplace support owing to its inconsistent and transient nature.

These findings are consistent with those of Gradel (1991), who found that users experienced technology difficulties as a result of fear, frustration, equipment malfunction, delays, need for fine tuning and entrenched bad habits. Cowan and Turner-Smith (1999) also found that users did not receive sufficient training in equipment use.

In terms of best practice in customization and learning, participants proposed the following:

- Being aware of what is possible
- Accessing the right people
- Using occupational therapists for specialist support
- Having the opportunity to explore and practice
- Accessing support for learning and training.

Participants who were aware of alternative options (such as the use of remote headset technology) were able to use them to improve their effectiveness. Fully understanding the capabilities of the technology was considered important for effective use. Participants were resourceful in finding people to make splints, customize voice recognition technology or modify keyboards. They seemed to be exploring similar issues in isolation and could have benefited from contact with other users or a central resource to help resolve these issues.

Turner et al (1995) also found that many people did not seek out appropriate agencies or services to assist them with technology choices, mainly owing to a lack of awareness and shortfall in funding.

Occupational therapists helped some participants to customize their workstations and to refine adaptations. For example:

> **'I had an occupational therapist as a case worker and getting that independent advice was really important, making sure that things were right. The occupational therapist knew about ergonomics and posture as well as the technology.'**

Several participants felt they needed more opportunities to explore and practice using their technology and it became evident that the user's home was an important venue for this. One reported:

> **'I was coming up for leave and I took the computer home...and got [my skills] up to reasonable proficiency. I would have found it very difficult to fit it in while I was at work, combining work with it all.'**

They also identified the need for training, for access to support and information as they required it and for access to other AT users. Product support was also identified as being useful, particularly relating to hardware errors and technical back up. Access to people who could provide timely and reliable after-sales service was also critical.

These findings are consistent with studies such as Lash and Licenziato (1995), which reported that training needs are highly individualized according to disability, experience and work-related goals. Phillips and Zhao (1993) also emphasized the importance of training in consumers' usual environments.

Supporting the technology in the workplace

Workplace barriers identified included pain and discomfort, the physical environment, software incompatibility, ageing technology and cost. Five of the 11 participants reported experiencing technology-induced pain and discomfort. For people with SCI, wear and tear on the neck from use of mouth pointers and headsets is a significant issue. Alternative input methods (such as voice recognition) and using macros often decreased pain and discomfort.

Workstation design and attention to ergonomics, posture and usage patterns are important components of assessment and intervention. Architectural factors and assessment of the physical environment need to be considered as part of comprehensive assessment.

Software incompatibility frequently led to inability to use appropriate technology, such as difficulties using trackballs with voice recognition software. Some participants reported variable performance of voice recognition software. One person said:

'If I have a cold or if I'm tired it's not nearly as good [and therefore the technology] just exacerbates your frustration.'

The cost of upgrading AT was considerable for all users and prohibitive for many. Suggestions for supporting AT in the workplace included:

- The use of low technology adaptations
- Access to IT support
- The need for funds to upgrade technology
- Consideration of mainstream technology developments
- The use of laptop computers.

Low technology adaptations (for example, writing and typing splints) often enabled participants to work effectively. Other adaptations considerably extended the working life of one person:

'Introducing the Roho cushion (Roho Inc, Illinois) meant the difference between me not being able to work and to work...until retirement.'

Bell and Hinojosa (1995) interviewed three people with SCI about the impact of assistive devices on their daily lives. A key theme was that 'simpler is better'. Choice of low technology options was found to be important, and participants in this study echoed this theme.

Having access to mainstream technology developments offered many benefits to people reliant on AT. Four of the participants felt that laptop computers offered them more flexibility in a range of work environments. One reported:

'We went to the laptop so that I wasn't harnessed to a work station. With paralysis you can often end up in bed for extended periods...with the laptop you can sit it where you want. It's small and you can lift it up. It starts automatically and away you go. As [it is possible to get] infra red now, you don't even have to have leads tying you back to peripherals [such as] printers.'

Empowerment in the workplace

For most participants, personal self-advocacy skills were critical for successful AT workplace integration. It is important for service providers to collaborate with AT users to share information, knowledge and expertise, in order to enable these users to become their own experts with respect to their own needs. This is consistent with the findings of Turner et al (1995), who also identified the need for people with SCI to be self-advocates in the face of patronizing attitudes among service providers and potential employers. These attitudes form substantial barriers, which can only be overcome with persistence, assertiveness and self-advocacy.

Some participants identified proactive work environments as one way of overcoming the problems associated with self-advocacy. Supportive workplace environments have also been identified by Westmorland et al (1998) as important for the integration of people with disabilities. In proactive workplaces, managers actively work to integrate the employee and to anticipate issues such as workplace redesign and mainstream software upgrades. It is incumbent on service providers to be sensitive to the workplace issues for the AT consumer and to support consumers in advocating for their own, often very specific needs. Gradel (1991) advocated for the need to empower AT users to become their own 'long-term technologists'.

CONCLUSION

Despite the current focus on consumer involvement, there is a dearth of literature addressing the views, opinions and needs of AT users in the workplace. Understanding the experiences of users who rely on AT is necessary in order to provide consumer-focused services.

This study has provided insights into how 11 AT users with SCI integrated their technology at work. Although efforts were made to ensure AT users were recruited from a range of sources, they tended to come from sources and services known to the investigators. Caution should be used when applying the views of these participants to all workplace AT users. However, their experiences provide a basis for understanding issues faced by users with SCI in the workplace. Further research is also required to ascertain whether work performance using AT can be improved with better customization and training. Technology issues experienced by people with SCI who are unemployed requires further investigation.

Technological developments are likely to bring about environments that can be tailored to the needs of individuals such that the negative impact of physical disabilities can be minimized. The challenge for rehabilitation professionals and employers is to enable people with SCI to optimize their work potential by using AT for their ultimate benefit and through their vocational endeavours for society at large. IJTR

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KEY POINTS

- Participants recommended that service providers identify users' technology needs, identify the best technology option and customize assistive technology (AT) to meet current and changing needs.
- Service providers need to recognize that this is an ongoing process, requiring review and redesign, and provide workplace training and support to enable maximal use of technology and optimize productivity and efficiency.
- Since AT users vary with respect to the amount and type of information and support needed, suppliers and service providers must work collaboratively to provide information and individualized advice and support.
- Information resources need to be funded adequately so that they are accessible and affordable.
- AT needs to be available for workplace trial before purchase.

Assistive and other technologies that enable people with disabilities to work has been an understudied area, certainly from the perspective of those who use these supports – or who are unable to obtain them.

Rodger and de Jonge have made an excellent contribution to the literature in this description of the results of a qualitative study of individuals with spinal cord injury and workplace technologies. While rich qualitative studies of individuals with disabilities are available (Iezzoni, 2003; Scherer, 2005a), this is a rare peek into how well current assistive technology practices and services are doing in vocational environments.

It is not uncommon today to hear that services are client-centered and being provided in a manner supportive of consumer involvement. Problems can arise, however, when clients or consumers have not been provided with the requisite information and other resources to empower them to make informed choices and wise decisions.

When clients cannot be an equal member of the partnership or team because of lack of information and knowledge, then they are being further disenfranchised. Worse, when the desired outcomes are not achieved, they may receive the greater part of the blame. Rodgers and de Jonge found in their sample that information was not provided regularly or reliably. This situation exists in Australia, the US, Canada, Europe and elsewhere.

But the blame does not typically belong to the rehabilitation specialists, either. They, too, lament the lack of information and training they receive in (a) how to conduct a good and comprehensive initial assessment given limited time and support, (b) how to identify the latest technologies available in the marketplace and (c) the operations, customization and maintenance of the more complex, high-tech products.

The lack of time and funding for conducting quality assessments are no longer acceptable reasons for the failure to determine the consumer's needs and preferences, personal characteristics and influences from family and culture – including the subculture within the workplace. This, too, is an area where a peer network and peer mentoring can provide invaluable support.

Some models exist for the use of peer mentors as initial data gatherers as well as role models and trainers in product use and maintenance (Heerkens et al, 1997).

Research evidence now exists that shows the positive impact a thorough assessment of consumer preferences and needs can make in matching person and technology and determining the success of that match (Scherer et al, 2005b). When shortcuts are taken and such an assessment is not done, it can be said for both consumers and rehabilitation specialists, 'You just don't ask yourself all the questions that need to be asked.'

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