

Maintenance and Repair of Assistive Technology Symposium III
Bridges to Work /UW-CREATe

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Research Presentation Room – 1025 Engineering Centers Building
University of Wisconsin-Madison

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Synopsis

The third installment of the Maintenance and Repair Symposia presented the attendees with the progress made by the UW-Create/DHFS collaboration since the last symposium took place in August 9, 2005. The current efforts presented were: a survey of user experiences with the maintenance and repair system, a model of employment outcomes and costs resulting from increased absenteeism during the time their assistive devices are being repaired, and an attempt to develop design guidelines for powered wheelchairs to improve their maintainability. The newest effort presented symposium attendees with a proposal for a web based portal that integrates information on all different aspects of AT M&R. The attendees were invited to comment on the work presented and their feedback was noted. The feedback will be used to improve the current work. An update on the status of this work will be presented at the *Maintenance and Repair of Assistive Technology Symposium IV*, which has been tentatively scheduled for June 2007.

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Introduction

The Maintenance and Repair Symposia began as a joint initiative between Bridges to Work/Pathways to Independence and the University of Wisconsin Center for Rehabilitation Engineering and Assistive Technology (UW-CREATe) to address concerns on the performance of the current maintenance and repair (M&R) structure for assistive technology (AT).

The first symposium, held in November 2004, had two overall objectives, learn about the roles and experiences of different groups involved in the maintenance and repair process; and have each group identify specific issues or shortcomings in the process. These groups were:

- Users of assistive technology
- Durable medical equipment repair and maintenance providers
- Insurance and health maintenance organizations
- Government support agencies
- Healthcare practitioners

The information obtained from the participants and additional research identified the following characteristics for the AT M&R system:

- Complexity
- Lengthy Time for Repair Services
- Lack of knowledge

The second symposium intended to address these concerns. The need for better understanding of the AT Repair Process was clear, prompting a detailed study of what the process encompassed. This information was compiled and presented to the participants of the second symposium to verify accuracy. A broad outline of this process is included in figure 1. The steps in the outlined process consist of many more sub steps that greatly complicate the process. The complexity of the process manifests itself in the length of time that repairs take. This extended period can hinder the AT user's ability to work resulting in absenteeism and lost wages. During the second symposium a model was proposed to examine two measures of potential gains that would result from improving employment outcomes of the disabled population:

- Direct Employee Cost: Lost wages due to absence
- Indirect Employee Cost: Lower income and employment

However in order to complete the model there was a need for more recent data. This motivated the creation of a Mobility Device Repair Survey to gather data about the time component and funding of repairs, the impact of AT problems on user's activities (particularly work), and demographic information of the users. The survey was presented to the symposium participants and feedback was taken into account.

Finally, participants were briefed on the shortcomings of the M&R system as identified in the first symposium and a brainstorm session was organized for ideas on improving the M&R of AT. The ideas obtained are summarized in figure 2.

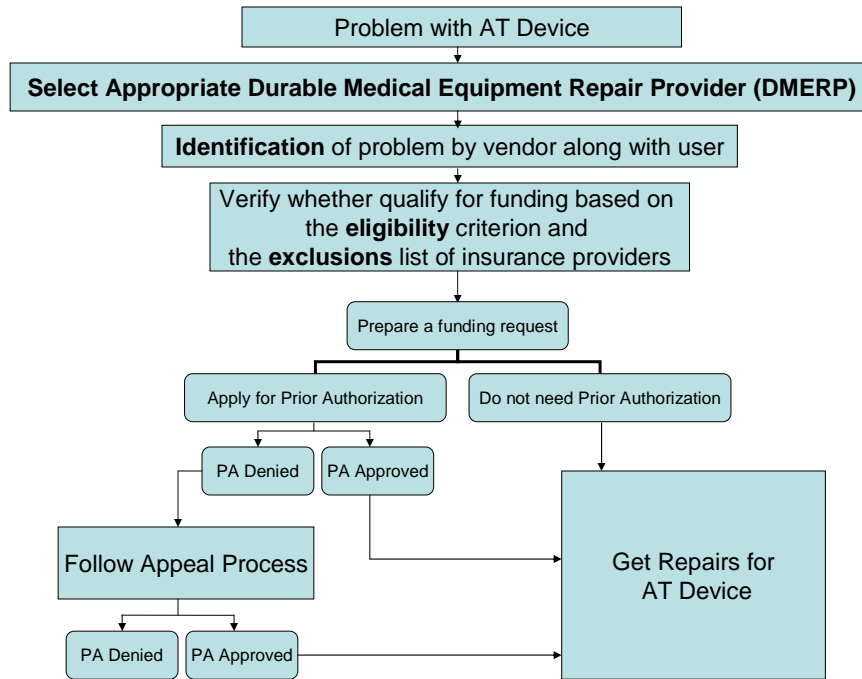


Figure 1 – Outline of AT Repair Funding Process

Strategies for Improvement of Maintenance and Repair

- Enhance funding for assessment services
- Need for standardization of equipment
- Understand mis-prescription problems
- Recognize preventive maintenance as a cost saving measure
- Improved manuals for equipment
- Allow for annual equipment “check-up”
- Require reasonable loaner equipment
- Enhance education and communication among all parties. One-stop shop for consumer reviews etc.
- Licensure for trained individuals to provide repair services
- Eliminate prior authorization if repair under an established annual amount. Increase PA limit.
- Chip technology to monitor repair needs
- Nationwide facility for overnight delivery of parts

Figure 2 – Strategies for Improvement of M&R

Current Efforts

An update on the work accomplished since the last symposium was presented during the first half of the third symposium. These were the two projects that were introduced in the second symposium: The Mobility Device Repair Survey and the Employment outcome modeling effort. In addition a new project was presented involving the effect that the design of AT equipment has on its eventual maintenance and repair.

User Experience with Maintenance and Repair of Mobility Assistive Devices *-Yong Jun Shin*

The objective of the survey was to determine the effect of current practice in maintenance and repair of mobility assistive devices, such as wheelchairs, on the experience that individuals with disabilities have when their mobility devices require repair, and the potential impact on user employment outcomes. Specifically, from the prior discussions with those involved in maintenance and repair of assistive technology at the two symposia at the University of Wisconsin-Madison in 2004 and 2005, the procedural complexity of AT maintenance and repair system was identified at the two symposia. In addition, prior research has shown a variety of technical and procedural issues and employment outcomes by current practice of AT maintenance and repair system.

Based on those identified problems on AT maintenance and repair, we aimed to conduct a survey of those who have disabilities and use mobility devices in order to determine mobility device users' experience with current maintenance and repair system of assistive technology, to assess how important it is to improve the current system, and to provide data to assist in measuring effects of current practice on cost and employment outcomes. For an empirical study, we hypothesized that current practice in maintenance and repair of assistive technology; 1) Has an effect on user independence and employment outcomes; and 2) In need of improvement. In addition, we had a research question about whether current practice in maintenance and repair of assistive technology is more costly than it needs to be.

As the results, the online survey, with 109 completed responses, could identify that current practice in AT maintenance and repair has an effect on user independence and employment outcomes. That is, a significant percentage of participants indicated that they are not able to work during their mobility device repair period. Many participants expected an improvement AT maintenance and repair system to affect their ability to work, social interaction, daily living, recreation, etc. Many respondents indicated out-of-pocket expenses for repairs.

Second, we could identify that the current practice in AT maintenance and repair needs to be improved. Despite the participants' maturity and professional status, lengthy repair periods were reported. Also, a significant percentage of the participants were not satisfied with the current AT maintenance and repair system and considered improvement of the current system to be important.

In addition, we could identify a variety of problems on AT maintenance and repair from the respondents, by using open-ended question. The most frequently indicated problem was lengthy repair period. In addition, inventory availability and high

costs of AT parts and repair service were significant problems. All these three identified problems are directly related to repair service providers whereas the problems relating funding agencies were also identified: reluctant assistance from funding agencies (e.g., insurance company, Medicare, or Medicaid); and prior authorization. Besides, lack of external funding, long distance of repair service provider, lack of back-up equipment, and so on were identified.

However, we could not identify whether current practice in maintenance and repair of AT is more costly than it needs to be, because of the sampling problem.

In sum, as a whole, despite the participants' maturity and professional status, the mobility device users have still confronted difficulties in AT maintenance and repair. However, given the survey participants' more skilled, professional, and experienced characteristics than the general population with disabilities, we suggest that need for improvement of the maintenance and repair system for mobility devices is more critical than indicated by the survey results.

When the survey report was presented at the 3rd symposium, the symposium participants were very intrigued by the findings of the survey and expressed that further pursuit of this effort would be worthwhile. There was concern about the length of the survey; however, there was also interest in obtaining more detailed information. Some of the details that were requested were the nature of repairs, the type of disability of the user, the type of job/environment where the AT device is being used, and how M&R affects the job outcomes of parents with children that use AT. Other details requested were the age of the equipment, length of time for repair, and whether or not backup equipment was available.

Estimating Cost and Employment Outcomes from Current Practices in Maintenance and Repair of Assistive Technology
-Swati Dhingra

The modeling effort came about to address the need to quantify effects of current practices in M&R of AT on users in the labor force. The objectives were to predict the effects of absenteeism resulting from current practices on wages and employment outcomes. We used existing data to provide upper and lower bound estimates of the costs imposed by the current AT M&R system on an individual. The data used was obtained from the National Survey with Data on Absenteeism Rates (SIPP 2001), and the 2001 US Census (PUMS).

The annual earnings of population with physical & employment disability is \$28.2 billion. The estimates reveal that individuals with physical and employment disability lose \$11.2 billion, 40% of their annual earnings due to increased absenteeism. Figure 3 breaks the loss down into the direct and indirect costs.

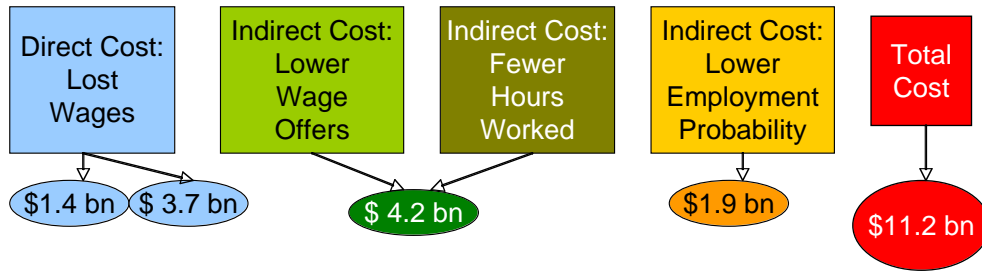


Figure 3 – Detail of Direct and Indirect Costs

In conclusion, if a significant portion of the potential earnings are due to the time lost on account of the current AT M&R system, then it makes economic sense to effect changes in the current system. Making the supposition that 1% of the absenteeism is due to AT M&R, persons with physical and employment disability would gain at least \$ 112 million every year.

Symposium participants expressed interest in the inclusion of fraud cost in the analysis.

Maintenance and Repair of Powered Wheelchairs ***-Luis E Lopez-Garcia***

In addition to the work proposed at the previous symposium, a different approach to the M&R problem is also being explored. This approach is founded upon the basis that aside from the complications incurred in the policy of M&R; the design of the actual AT devices is also an important factor. M&R can be greatly simplified, improved as well as be made more efficient by implementing good design practices; however these design practices are largely missing in most AT devices; the scope of this research is limited to powered wheelchairs. The objectives of this approach have been to characterize the offerings current powered wheelchair market and their functionality in terms of M&R, Identify common M&R tasks, their shortcomings and their virtues; the main goal of this research is to develop guidelines for designing and creating AT equipment which is inherently easy to maintain and repair. The characterization of the wheelchair market was done using a sample of 246 wheelchairs from 39 different makes by compiling information on their max speed, capacity, weight, etc. The *typical* chair yielded from this information has the following characteristics: rear wheel drive, max speed: 5 mph, unloaded weight: 130 lbs, weight: 200 lbs, capacity: 321 lbs, range: 21 mi, etc.

Preventative maintenance tasks for a wheelchair can be summarized into cleaning, lubricating, and general tightening and alignment of mechanical parts. Other tasks are based on a periodic lifespan of certain elements of the wheelchair such as changing batteries or tires. The actual execution of these tasks varies greatly in terms of difficulty and time required. Two case studies for changing a tire were presented that demonstrated the variability of steps required to do the same task depending on the design of the chair.

The case studies served to introduce the concept of *maintainability*, which is the aspect of product design that ensures that the proper functioning of a product can be preserved at the minimum expenditure of money and effort. Maintainability is affected by

aspects such as standardization of parts, accessibility to areas where work must be performed, labeling of parts, number of tools required to complete a task, etc.

Maintainability however, is just one aspect of design which can be improved in the design of AT. Additional considerations for the design of AT are being compiled to form a set of Design Guidelines for AT devices. These guidelines take their cue from the concept of *Universal Design*, which is a set of rules for ensuring that products are designed to be usable by anybody with varying abilities without the need for adaptation. The Design Guidelines for AT include considerations for safety above all, maintainability, customizability, intuitiveness, etc.

The feedback obtained from the symposium participants indicated that although the ideas presented were good, they are subject to implementation by the wheelchair manufacturers. There does not appear to be a mechanism for these design considerations to be required. The implementations need to be justified in terms of money for manufacturers and funders to take notice.

New Efforts

The second half of the symposium focused on presenting a new undertaking that will be set in motion in the following year in order to obtain feedback from the symposium participants.

Online AT M&R Information Portal

As was learned at the first symposium, two of the biggest concerns with current the AT M&R system are its complexity and the lack of knowledge about its workings. As a response to both of those issues a proposal for an online repository of information about the repair of AT was suggested. An extremely simplistic mock-up of the web portal was created which demonstrated a step-by-step system to guide a user through the M&R process. A user would simply fill out some forms and answer some questions pertaining to the location of the user, the type of repair required, the source of funding, etc. The idea behind this was to automatically locate local DME providers and to obtain and fill out any necessary forms in order to streamline the process. In addition, the web portal would include databases with AT device performance characteristics, consumer ratings and reports, repair and parts manuals, and user manuals. Online training for repair technicians was also proposed.

Much feedback was generated from the proposal pointing out various flaws in the proposal. There was much concern about users creating complications by attempting to diagnose their own problems with their equipment; trying to get service from multiple DME providers simultaneously for quicker service; or simply accidentally committing to a DME provider that does not support the user's equipment. DME providers did not generally see a need for a centralized parts/schematics system because they generally only work with certain manufacturers and can contact them directly if needed. Users who perform their own maintenance and repairs did express interest in access to technical information about their equipment. A symptom based guide for troubleshooting is would be helpful to these users.

The possibility of having anonymous reviews by users as well as DME providers about the performance of different funding agencies was entertained; however, an important detail mentioned is the fact that if the site receives federal funds, ratings and consumer report would not be possible. There was interest in a system that could keep records of repairs and maintenance performed on individual chairs to identify abuse or fraud by registering equipment serial numbers. Twenty-four hour telephone help lines would be ideal, particularly for emergency situations. Assistance for obtaining help when outside the local DME provider's jurisdiction is also an important consideration. Finally, there is much need for a section to comprehensively explain to users how the funding procedure works, and what their benefits are.

Conclusion

The third installment of the Maintenance and Repair Symposia had two main objectives, bring the participants up to speed with the efforts that are being conducted and to assess the possibility of a web-based system to centrally provide information of all different aspects of M&R of AT. The results of user experience survey show that there is a concern among users with the length of repair periods. Users indicated that the current system for AT M&R does in fact limit their yield at work and employment outcomes. The goal of using the survey data to actually model employment outcome could not be fulfilled due to the sampling technique used. Modeling of employment outcomes and costs was accomplished then by using the 2001 National Survey with Data on Absenteeism Rates and the 2001 US Census. The model revealed then that out of \$28.2 billion earned yearly by people with physical & employment disability \$11.2 billion is lost; this equals to 40% of their annual earnings. The other current effort focuses on evaluating the maintainability of current powered wheelchairs and developing guidelines for improving the overall design of AT devices.

The symposium attendants' responses to the current work were noted and these indicate interest in further development of the user experience survey. There was interest in investigation of costs and losses related to fraud as a complement to the employment outcome model. The improvement of maintainability for AT devices was considered to be a meaningful pursuit; however, they also expressed that the design improvements should be translated into cost improvements.

The idea of web based portal for integrating information on all different aspects of AT M&R generated much feedback particularly useful for organizing the structure of the portal. There was talk about what information would be available, who could access certain information, what functionality would the site have, etc. One role for the portal was identified as a DME provider directory, particularly for out of state and emergency situations. Other proposed functions were anonymous reviews by users and DME providers on different equipment as well as different insurance providers. The insight obtained from the symposium participants was invaluable to the further development of this project.

A follow-up to these projects will be presented at the fourth *Maintenance and Repair of Assistive Technology Symposium* which has been tentatively scheduled for June 2007.

Acknowledgements

Waisman Center.

References

Agenda – Maintenance and Repair Symposium III

June 14, 2006

Research Presentation Room – 1025 Engineering Centers Building
University of Wisconsin-Madison

8:30 AM-9:00 - Coffee and Rolls

9:00 AM - Introductions, Review of the Day

9:15 AM - Review of Maintenance and Repair Projects, M&R Symposium I and II

Jay Martin

9:45 AM – User Experience with Maintenance and Repair of Mobility Assistive Devices

Yong Jun Shin

10:05 AM - Break

10:20 AM – Estimating Cost and Employment Outcomes from Current Practices in
Maintenance and Repair of Assistive Technology

Swati Dhingra

10:40 AM – Maintenance and Repair of Powered Wheelchairs

Luis Lopez-Garcia

11:00 AM – Assessment of Current Studies

11:30 AM – Report Out

11:45 AM - Lunch

1:00 PM – Improvements in the Current Maintenance and Repair System

1:30 PM – Identification of Needed Repair and Repair Provider

2:00 PM – Determination of Funding

2:30 PM – Acquisition of Parts

3:00 PM – Repair and Parts Manuals and Training

3:30 PM – Group Summary

4:00 PM - Report Out

Informal Dinner for those staying in Madison