Perspectives of Outcome Data from Assistive Technology Developers

Kathy Longenecker Rust
Roger O. Smith
University of Wisconsin Milwaukee

Abstract: The assistive technology (AT) field acknowledges that different stakeholders vary in their perspectives of service delivery outcomes. While the literature delineates consumers, caregivers and providers as stakeholders with distinct views, very little research documents these unique perspectives. This study reports on the perspectives of (a) research-based federally funded, and (b) commercial AT product developers. Developers who received federal funding in 2001 were queried on their outcomes methodologies. Also, a random sample of manufacturers drawn from the ABLEDATA database and technology exhibitors at RESNA and AOTA conferences were surveyed. The data revealed that developers acknowledge the usefulness of outcomes data and relate that they would use outcomes information if available. Commercial manufacturers perceived cost as different from other outcome dimensions, interestingly, with lower importance. Also, formal research methods were used more frequently than anticipated. This same group of commercial manufacturers also stated a gap between outcome measures they used and what they would use if available. This study contributes an important empirical snapshot of AT product developers and their perspectives of AT outcomes.

Key Words: Assistive technology outcomes, Product developers, Manufacturers

The Assistive Technology Outcome Measurement System (ATOMS Project) has undertaken a comprehensive needs assessment related to outcomes measurement and assistive technology (AT). This study surveyed the field to better understand how AT product developers and manufacturers view outcomes measurement. The field of AT outcomes has long recognized that there are various stakeholder views. DeRuyter (1998) stated that the clinical service delivery system must respond to several different performance monitoring dimensions: goals attainment/results; functional status quality of life; satisfaction; and cost. DeRuyter recognized that, "Each of these different dimensions in turn have varied significance to each of the different stakeholders, agencies, and sectors. While all stakeholders seek a successful outcome, not all stakeholders seek the same outcome" (p. 9). This discussion is followed with charts that delineate the perspectives of different stakeholders in terms of importance of various outcome dimensions and aspects of AT service. The "administrator," "client," "clinician," and, "payer" (DeRuyter, p. 11-12) are on the list, but "manufacturers" or "product developers" are not. Lane (1997a) stated that, "while we often focus on assistive technology service delivery, there is a business context that is equally important" (p. 105). Addressing the needs for AT outcomes requires the consideration of what outcomes mean to product developers. This paper reports the results of a research effort to meet this need.

Background

The federal government funds technology-related research and development projects through multiple sources. The Small Business Innovative Research Program (SBIR), the

Small Business Technology Transfer Research Program (STTR), the NIDRR sponsored Rehabilitation Engineering Research Centers (RERC), and technology-related Research and Development (R&D) projects funded by the Office of Special Education Programs (OSEP) exist to promote state-of-the art development of AT. These investigators need to measure the success of their products under development. Similarly, private sector manufacturers and developers must do the same. In 1998, DeRuyter stated,

> Whether it is doing things right the first time or doing the right thing, accountability, performance monitoring, and the evaluation of outcomes has become the expected norm. While this has been embraced widely for many years by manufacturing, it needs to be fully embraced by the assistive technology community. (p. 8)

Fuhrer (2001), however, suggests that developers struggle to find appropriate outcomes instruments and methodologies for their products. Fuhrer, Jutai, Scherer, and DeRuyter (2003) list a variety of factors that may contribute to the shortfall of AT outcomes as compared to the growth of the AT industry. They comment that one of these factors is that there is a "greater emphasis of AT developers on demonstrating the technical performance of newly developed technology than on evaluating users' performance with it" (p. 1244). The need is identified, but what actually is the state of outcomes measurement from the perspective of product development? There is a paucity of published work on this subject.

The literature describes the importance of consumer input in product development and consumer evaluation during technology transfer to improve products. Multiple authors have discussed the importance of consumer input in the development of AT (Batavia & Hammer, 1990; Ryan, Rigby, & From, 1996; Vernardakis, Stephanidis, & Akoumianakis, 1994; Wessels, Willems, & de Witte, 1996). Compton (1995) states that many manufacturers test their concepts qualitatively to see how consumers perceive a potential new product before it is even produced. Lane (1998) describes the participatory action research approach of the Rehabilitation Engineering Research Center on Technology Evaluation and Transfer (RERC-TET) at the University of Buffalo. The Center involved individuals with disabilities in all aspects of its work, from grant development to program implementation. Consumers contributed to the evaluation of inventions, device commercialization, and the definition of ideal products. This last step resulted in a benchmarking process for AT product development. Benchmarking involves developing evaluation criteria using a methodology. Lane explains the value of this work.

> Manufacturers may use them [the benchmarks] to improve the product's capabilities and gain the most return by focusing their design modifications in areas most important to the consumer. Vendors can use the benchmarks to emphasize desired attributes – and possibly down play undesirable attributes – when communicating their product's value to customers. (p. 115)

In discussion of the universal design process, Sanford, Story, and Ringholz (1998) also emphasize the importance of consumer inclusion. Such participation, they state, "has the potential to result in a number of outcomes that directly and indirectly benefit participants" (p. 161).

The European AT sector has also published discussions of the importance of user-centered design in AT. Poulson and Richardson (1998) describe the development of the USERfit design methodology in the UK:

> General consumer research has much to offer the assistive technology (AT) sector, and it is apparent that many AT companies now adopt a more marketing oriented approach to product development rather than a purely engineering perspective. AT companies are generally aware of the importance of understanding their customers wants and desires, but as yet many are not expert in obtaining such information from users or obtaining user feedback about the quality of their products (p. 163).

They go on to state, "It is a common weakness of [product] design that little emphasis is placed on evaluation activities, as it can be both difficult and expensive to carry out effectively" (p. 167). Consumer involvement in the design process, however, is not an outcome but a method by which it is hypothesized that better outcomes may be achieved.

Similarly, the process of technology transfer provides some relevant discussion around the issue of outcome measures for AT product developers. Technology transfer is the process of taking product designs through the manufacturing process to maximize the success of the device in reaching the consumer. But again, this is a method directed towards improving outcomes. By itself, it does not produce outcome data. Lane (1997b) describes the sequence of the technology transfer process: (a) identification (of a technology and application); (b) research and development; (c) evaluation (testing with one or more clients); (d) transfer (of the technology to a buyer); and (e) commercialization.

Evaluation of the product speaks to multiple aspects of AT outcomes. In an earlier publication, Lane, Usiak, and Moffat (1996) list consumer product evaluation criteria as: (a) reliability, (b) effectiveness, (c) physical comfort/acceptability, (d) operability, (e) physical security/safety, (f) durability, (g) learnability, (h) portability, (i) securability, (j) maintenance/reparability, and (k) affordability. Krass (1997) also writing on the issue of technology transfer, but from the perspective of one manufacturer, provides a detailed description of his company's (Maddak, Inc.) two-step evaluation process:

1. Initial evaluation:
2. Does the invention fit current product line?
    a. Product type
    b. Estimated retail price
3. Is the product unique?
4. Does it provide a clear benefit for users?
5. Does product match Maddak's manufacturing capabilities?
6. In-depth evaluation:
7. Who are the expected users?
8. What is the market size?
9. What is the competition?
10. Is it safe to use?
11. What is the manufacturing cost?
12. Is tooling required and what is the cost of it?
13. What is the acceptable retail price?
14. Do the manufacturing cost and retail price match up?
15. What is the estimated profit/year?
16. Can tooling costs be paid for with two year's profits?
17. Is it esthetically pleasing?
18. Is it patented?
19. What is the "hunch" factor?
20. What is the level of potential 'ownership'? (p. 57)

However, as Tobias (1997) states,

> As important as product development is to the business process, it is only one stage in a product's life cycle and one element in its success. Product design lies within a constellation of activities such as market analysis, marketing, advertising and customer support. (p. 63)

And so, as we look at the issue of outcomes measurement for the developers and manufacturers of AT, there is very little information available.

> Many within the assistive technology community have developed the assumption that better outcomes are derived simply through improved technological solutions such as smaller, newer, faster, more portable and more sophisticated systems. Consequently, technological solutions have been looked toward for improved outcomes without data to support the assumption. (DeRuyter, 1997, p. 90)

This investigation attempted to identify gaps in the current state of outcomes measurement instruments and systems in the area of AT product development targeting both federally funded and private sector development.

Research Questions

Six primary questions directed the framework for this study. One general question focused on federal research projects: (A1) What methods for collecting AT outcomes data do currently funded federal projects project to use? Five questions focused on commercial product developers: (B1) What importance do product developers place on outcome dimensions of AT? (B2) How frequently do product developers use specific strategies to measure outcome during development? (B3) How frequently do product developers use specific types of formal instrumentation to quantify outcome? (B4) How do product developers perceive the appropriateness of different types of standardized instrumentation? (B5) How would product developers use valid outcome data?

Methods

Sample

Two samples were tapped to cover the two question domain areas.

Sample (A): Federally funded projects. Two sampling methods identified federally funded projects. First, we examined the Computer Retrieval of Information on Scientific Projects (CRISP) database maintained by the Office of Extramural Research at the National Institute of Health (n.d.) on "assistive" and "assistive technology." The search selected 32 appropriate projects. Second, the NIDRR Program directory web page (National Rehabilitation Information Center, n.d.) listed 61 records for their category "Research Priority: Technology for Access and Function." A review of these abstracts identified 24 appropriate projects. In all, 56 projects were identified (with 3 researchers having two funded projects each) to make up the federally funded product developers group.

Sample (B): Commercial product developers. Two methods were used to identify the commercial product developer group. The first method randomly sampled the "Directory of Manufacturers and Distributors" available on May, 2002, at the ABLEDATA (n.d.) website that provided a population of commercial product developers. It contained more than 2,500 listings. Prior to random selection, the list was limited to companies in the U.S. that

were coded as (a) active, and (b) manufacturers. They totaled 1,124. From this, a statistical analysis software program generated a random sample of 500. The second method identified all U.S. based technology exhibitors from the RESNA 2001 Conference (n = 33) and the American Occupational Therapy Association (AOTA) 2001 Conference (n = 35). Some manufacturers exhibited at both conferences. The random sample (n = 500) was crosschecked with the exhibitor lists (n = 68), removing duplicates, for a final set of 555 companies.

Procedures

Procedure (A): Federally funded projects. Due to the proprietary nature of much of the content of grant proposals, only the abstracts were available as public information. To obtain the necessary information, the project sent the 53 identified principal investigators a letter explaining the purpose of the study and requesting the methodology to test the outcomes of their product(s) under development that was submitted with their proposal.

Procedure (B): Commercial product developers. The survey sent to commercial product developers (see Appendix) was drafted based on findings from the AT service provider and consumer/user focus groups (Taugher, 2004) and suggested by the literature set, some of which is cited in this paper.

Results

Descriptive analyses of results are presented separately for each of the two groups surveyed as the groups and survey methodology differed.

(*A) Federally funded projects.* Overall, the federal project survey obtained a 50% response rate. (Four letters were returned as undeliverable.) Questions were coded to

Table 1
Percentage of Methodology and Instrumentation Choices for 26 Funded Projects

Strategy/Method	% of uses
Strategies for measuring outcome during product development	
Testing in lab by developers	27%
Focus groups of providers	12%
Focus Groups of persons with disabilities	15%
User usability testing in lab	23%
General field testing soliciting feedback from persons with disabilities	19%
General field testing soliciting feedback from providers	12%
Formal research design: Single Subject design	35%
Formal research design: Group comparison	58%
Other	0
Use of formal instrumentation	
Standardized, valid measure of functional status	70%
A "homemade" or adapted measure of improved functional performance	62%
A measure of client satisfaction	23%
A measure of cost	15%
Other	0

correspond to the strategies for measuring outcome and types of measures, as were presented in the commercial developers' survey (see Appendix, Question #3 and reported in Table 1). Due to the number of variables and complexity of the development process it was not uncommon for a reviewed project to cite more than one method or type of instrumentation. Nine different strategies or methods were identified as being used by these developers, with formal group designs being the most frequent, occurring in 58% of the projects. Two methods that sampled providers rather than consumers were the least frequently occurring, at 12% each. Regarding formal instrumentation, the use of standardized measures (used in 70% of the studies) slightly eclipsed the use of "homemade" or adapted measures (62%). No respondents reported themselves as using "other" instrumentation. This demonstrates an element of the validity of these categories established during the ATOMS service provider focus group process. See Table 1 for the distribution of responses.

(B) Commercial product developers. Of the 555 mailed surveys, 135 were returned as undeliverable. Of the remaining 420 surveys, 10 individuals responded that they were no longer involved in production of AT devices or that they did not wish to participate. A total of 40 competed surveys were returned. The overall response rate was 12%. Interestingly, in 2003, the U.S. Department of Commerce Technology Assessment of the U.S. Assistive Technology Industry received a similar response rate. It mailed 1,600 surveys and received only 232 responses, or 14.5% initially.

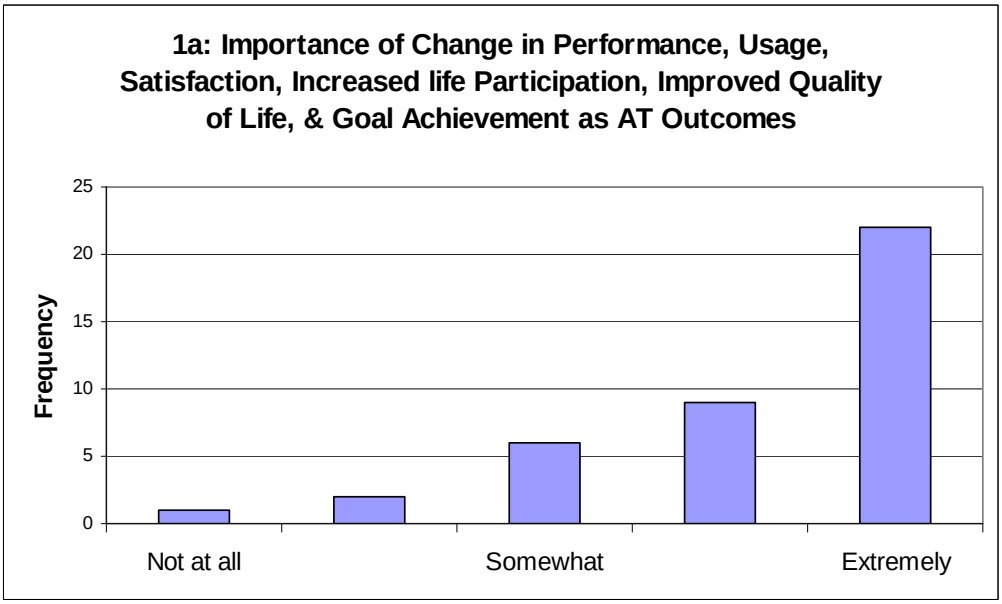
This low response rate was perplexing, but careful scrutiny provides a plausible explanation. It appeared that two different types of companies were reached through our sampling efforts. Indeed, the ABLEDATA (n.d.) Directory of Manufacturers and Distributors contains many companies who do not specialize in adaptive equipment (3M Co., Kohler Co., L.L. Bean, and Union Carbide Corporation, to list a few). It would not be surprising that these companies would not be motivated to respond to a survey about AT outcomes. Could we distinguish disability-focused companies and if we could, would that help explain the low response rate?

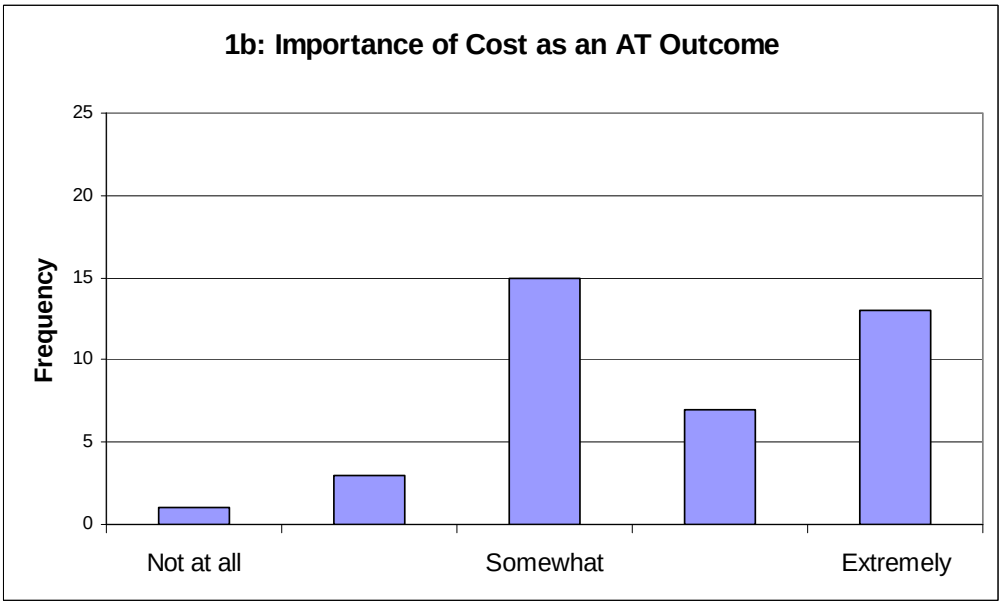
We first examined the origin of the 40 completed surveys to determine if they came from companies that were identified from the random sample of ABLEDATA (n.d.) companies or if they came from the specifically selected conference exhibitors. In fact, 38% (n = 15) of the 40 completed surveys came from companies that had exhibited at either the AOTA or RESNA annual conferences in 2001.

Table 2
Percent of Survey Response by Type of Company

Company Type	Responded	No Response
Disability Manufacturers	38%	62%
Non-Disability Manufacturers	9%	91%
Total	12%	88%

Figure 1. Distribution of product developers' responses for importance of AT outcomes. Six of seven categories show distributions similar to 1a. The importance of Cost (1b) demonstrates the seventh, a bi-modal distribution.





Secondly, we wondered if any companies in our sample, the 555 mailed surveys, were members of the Assistive Technology Industry Association (ATIA). We retrieved the membership list from the ATIA Web site to see if any of the companies in our sample were members. From the original mailing of 555, 15 of the surveys were sent to companies that belonged to ATIA. Two of these were returned as undeliverable. Five surveys (38%) were returned from the remaining 13 companies.

We then combined the identified exhibitor companies and the identified ATIA companies, removing duplicates, to form the

Table 3
Mean Responses to Importance of Specific AT Outcomes, Product Developers

Category	M
Change in performance or function	4.5
Cost	3.7
Usage: Why or why not used	4.2
Consumer satisfaction	4.6
Increased life participation	4.2
Improved quality of life	4.4
Clinical result/goal achievement	4.1

new category "disability manufacturers." The remaining companies became "non-disability manufacturers." See Table 2 for percentages of response rate for these two categories. Clearly, it appears that companies that are actively involved in marketing to professionals in the AT service delivery system and who are active in developing AT are more likely to take part in research regarding AT outcomes.

Descriptive statistics, as appropriate, were performed on the survey responses with SPSS (Statistical Package for the Social Sciences) version 11.5 for Windows. Data are discussed in order of the research questions delineated earlier.

1. What importance do commercial product developers place on outcome dimensions of AT? Respondents were asked to rate seven outcome dimensions of AT on a scale of "not at all important" to "extremely important."

Table 4
Frequency of Methodology Use, Product Developers

Methodology	Not at all	Less than half of the time	More than half of the time
Testing in lab by developers	12.5%	12.5%	75%
Focus groups of providers	25%	30%	44%
Focus groups of persons with disabilities	17.5%	32.5%	48%
User usability testing in lab	22.5%	22.5%	55%
General field testing soliciting feedback from persons with disabilities	10%	15%	75%
General field testing soliciting feedback from providers	20%	17.5%	62%
Formal research: Single-subject design	45%	15%	35%
Formal research: Group comparison design	45%	10%	37%
Other	0%	0%	0%

Table 5
Frequency of Use of Formal Instrumentation During Product Development for Commercial Product Developers

Instrumentation	Did not use	Less than half of the time	More than half of the time	Total
Standardized measure of functional performance	47.5%	12.5%	40%	100%
A "homemade" or adapted measure of improved functional performance	35%	15%	50%	100%
A measure of client satisfaction	25%	7.5%	67.5%	100%
A measure of cost	20%	22.5%	57.5%	100%
Other	0%	0%	0%	0%

Again, the seven categories evolved from the focus group process mentioned earlier, and correlate with DeRuyter's (1998) categories. The categories were: (a) change in performance of function, (b) cost, (c) usage-why or why not used, (d) consumer satisfaction, (e) increased life participation, (f) improved quality of life, and (g) result/goal achievement. The histogram of response to the category "Increased Life Participation" is shown in Figure 1a. It demonstrates the similar pattern of response that was observed for six of the seven categories. Cost, however, demonstrated a significantly different pattern with a bi-modal distribution, as demonstrated in Figure 1b.

Table 3 lists the mean responses to all categories in this question. While the mean score for the importance of cost is slightly lower than for the other categories, the bi-modal distribution of this variable suggests that the importance of cost as an outcome is important, but not for everybody.

2. How frequently do commercial product developers use specific strategies to measure outcome during development? Table 4 lists the frequency reported by the commercial product developers for their use of specific strategies. Formal research designs are the least frequently employed strategies for the commercial developers group. The results are not surprising as commercial companies may not have research-trained staff in-house. Consultation is costly. While it is difficult to compare the results of the open needed question responses of the federally funded researchers with the Likert-like scale responses from the survey, the PIs reported using single-subject designs 36% of the time and group comparison designs 58% of the time (see Table 1). Interesting, however, was one comment from a respondent from the federally funded group. That researcher, receiving SBIR funding, complained about how difficult it was to set up a solid research design to meet the requirements of the grant. She felt strongly that there are not adequate resources available for small businesses to achieve consulting services at reasonable costs.

3. How frequently do product developers use specific types of formal instrumentation to quantify outcome? Table 5 contains the aggregated response data from the question, "If you have used formal instrumentation as a form of

quantifying outcome during product development, how frequently have you used…?" for those who responded that they used formal instrumentation.

Not surprisingly, commercial manufacturers infrequently use standardized measures. This is compared to a 70% use rate for the federally funded projects (see Table 1). Clearly, client satisfaction dominated as the type of instrumentation used by the commercial developers group,

Returning to the issue of cost, it is interesting that cost is reported as being used so frequently, despite it's low ranking on the importance dimension (commercial product developer research question #1, above). Considering that the survey question asks about use of formal instrumentation, it could be argued that cost data is much easier for commercial manufacturers to obtain.

4. How do product developers perceive the appropriateness of different types of standardized instrumentation? Figure 2 shows the commercial product developers' responses to the question, "If standardized instrumentation were available for each of the following outcomes. How appropriate would each of the following be for your product development?

Commercial product developers felt that self-satisfaction measures, cost measures, functional performance measures and focus group protocols would all be appropriate measures for them if standardized instrumentation were available. The mail and survey measures were not considered as useful. These findings reflect the "hands-on" perspective of manufacturers with less of a mandate for longer-term follow-up, presumably the function of mail and telephone surveys. Figure 3 shows the rank ordering of the categories when focusing only on those who responded "always" for potential use of each of the types of standardized instrumentation. It appears that standardized instrumentation for change in functional performance would be useful for product developers.

5. How would product developers use valid

Figure 2. Appropriateness of each type of standardized instrumentation, if available, for commercial product developers

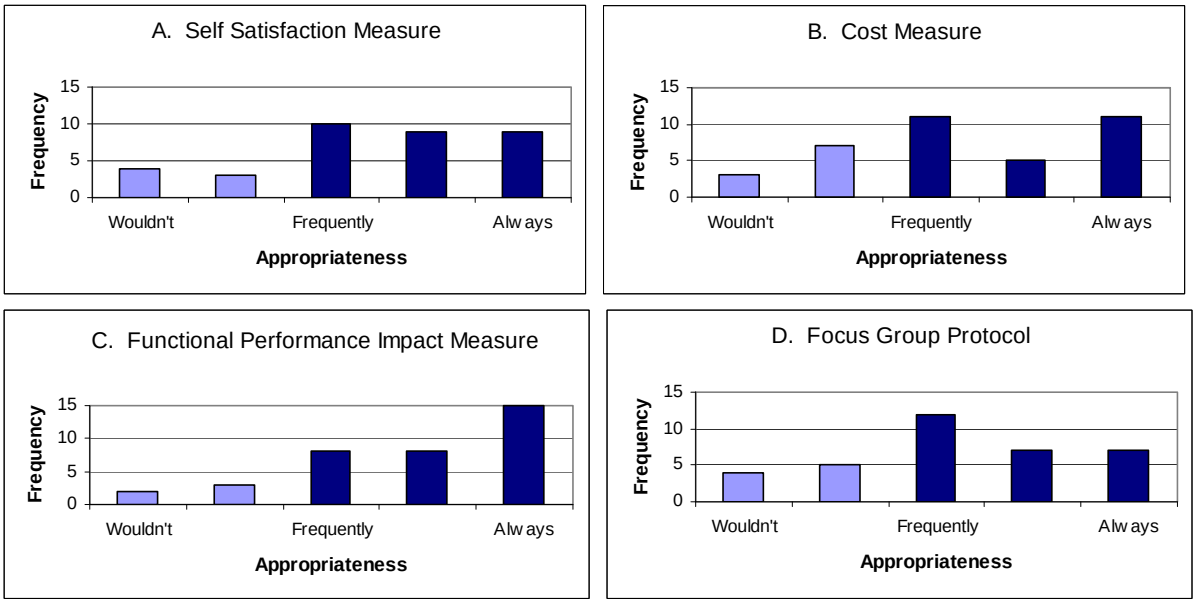
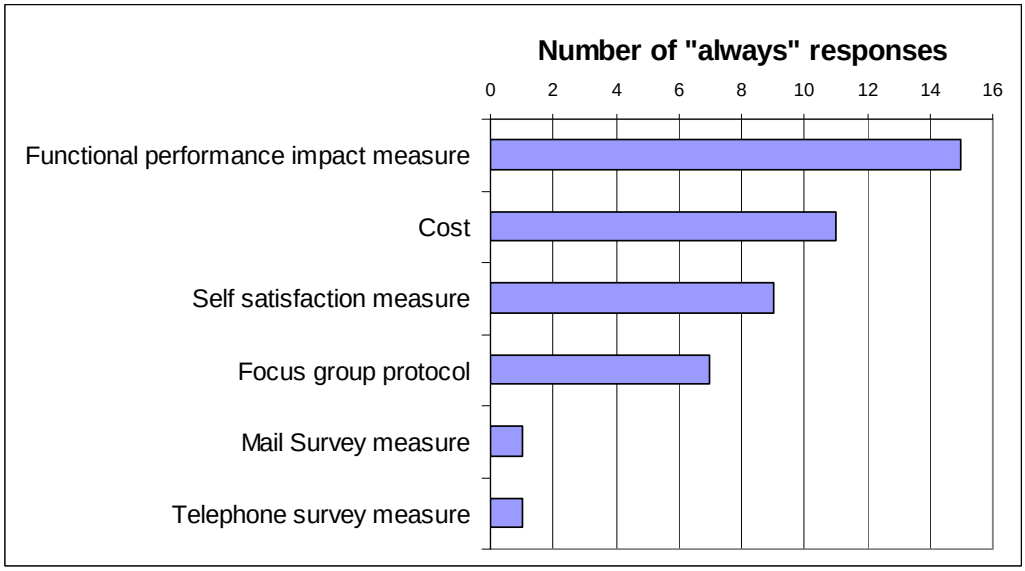


Figure 3. Number of product developers responding "always" (giving a score of 5) for potential use of each type of standardized instrumentation if available



outcome data? Figure 4 shows the distribution of responses to the question, "If you had valid outcome data about your products, how likely would you be to use it for the following business purposes?" The lines on each graph separate the responses and form two general categories, "wouldn't be used much" and "would be used a lot."

This shows that if valid outcomes data were available, commercial product developers would most likely use it for advertising and product development. It does not appear that there is a strong interest by this group to use it for funding or monies acquisition.

Discussion, Outcomes, and Benefits

This study investigated the current use of outcomes measures by two groups of AT developers, those who received federal funds for their development projects and those who developed AT within their businesses without federal support. The analysis of federally funded investigators was based solely on what they defined in the evaluation plans of their federal grant proposals that received funding. Commercial developers of AT provided specific survey data on their use and perception of outcomes measures. Perhaps one of the most surprising findings was the response of the commercial product developers to the importance of cost as an AT outcome dimension. While cost would seem to be overt and prominent in a business setting, the descriptive data demonstrates that commercial manufacturers saw cost as different from the other outcome dimensions. Its bimodal distribution demonstrates a lower importance for cost as an outcome. Also, the reported use of formal research design methods and data collection was more prominent than what we thought to be the case for "inventors." Finally, for the commercial respondents there is a gap between what outcomes measures they would use, if available, and what they currently use. This appears to be a technology transfer problem. Outcome instruments do not appear to be making their way to the commercial sector. Maybe this reflects the relatively young age of outcomes instrumentation and that many outcomes instruments remain in the research and development phase.

Figure 4. Commercial product developers likelihood of use of valid outcomes data if available

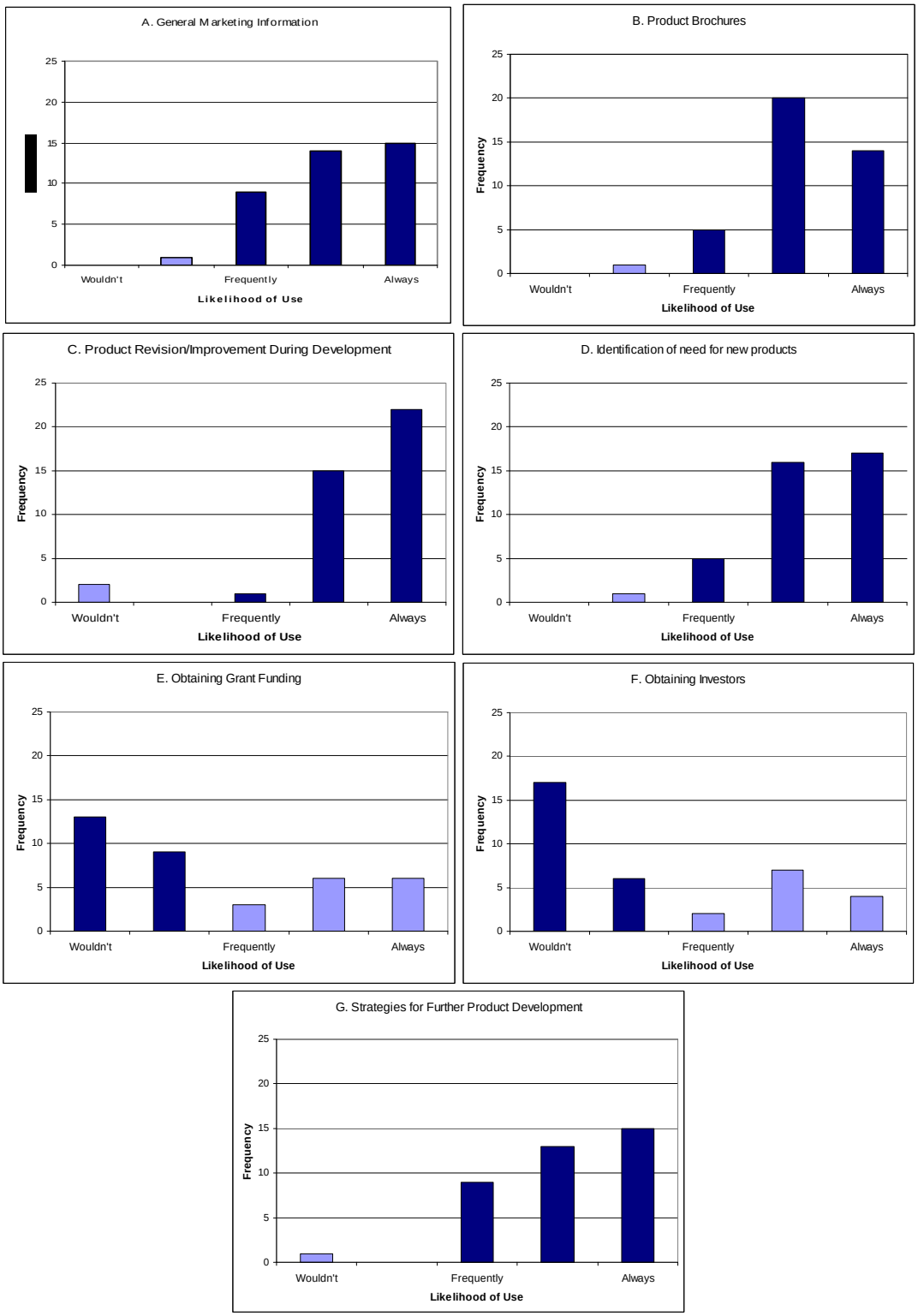


Table 6
Comparison of Objective (Funded Proposals) and Subjective (Commercial Developers) Data

Strategy/Method	Objective of Use[1] %	Subjective Report of Use[2] %
Strategies for measuring outcome during product development		
Testing in lab by developers	27%	87.5%
Focus groups of providers	12%	72.5%
Focus groups of persons with disabilities	15%	80%
User usability testing in lab	23%	77.5%
General field testing soliciting feedback from providers	19%	90%
General field testing soliciting feedback from providers	12%	77.5%
Formal research design: Single subject design	35%	47.5%
Formal research design: Group comparison	58%	42.5%
Other	0	0
Use of formal instrumentation		
Standardized, valid measure of functional status	70%	52.5%
A "homemade" or adapted measure of improved functional performance	62%	65%
A measure of client satisfaction	23%	75%
A measure of cost	15%	80%
Other	0	0

[1]Reported in federally funded proposals
[2] Commercial product developers survey

A post hoc comparative analysis of the data from funded R&D projects and commercial developers reveals interesting differences, but must be read with caution. Two different methods were used to gather the information in this project. The federally funded developers submitted the actual "methods" section from their grant proposals. We have no evidence that these are the methods they actually used as their projects evolved; it speaks only to their planned evaluation process intent. The commercial product developers, however, responded to a survey with Likert-like response scales, thus providing a subjective response to the questions as they have dealt with the questions in their businesses over time. Accepting these differences, we created Table 6. Data from the federally funded proposals are exactly as they appear in Table 1. To obtain the numbers for the commercial developers, we subtracted the percentage of "not at all" responses (Tables 3 and 4) from 100% to obtain the numbers in the right hand column of Table 6. Some interesting comparisons appear. Clearly, during product development for the federally funded researchers, there is a dearth of consumer or service provider input. This represents a rich source not being tapped without input from AT device users. Also, the instrumentation data for this group demonstrates a proclivity for performance, a somewhat myopic perspective of outcome. While these comparisons are presented for discussion purposed only, they are a reminder of the fact that a comprehensive model of AT outcomes

information must consider both objective and subjective data.

A limitation of this study was the low response rate for the commercial product developers. Compared to federally funded projects, commercial developers did not use standardized methodology or instrumentation as frequently. However, they did express an interest in outcomes. The reporting of the use of homemade measures of functional performance and client satisfaction measures represent their current efforts to keep the consumer in mind as they advance their technological solutions. They acknowledge that standardized outcomes data would be useful and relate that they would use standardized outcomes data if it was available.

This investigation is an important first step in understanding the perspectives of AT developers toward outcomes. AT outcomes measurement activity has been a relatively new phenomenon and publications and discussions on AT instruments have only occurred in the past decade or so (Smith, Rust, Lauer, & Boodey, 2004). Their AT outcomes historical review highlights the impressive increase of attention in AT outcomes instrumentation. In future research it would be beneficial to specifically target disability manufacturers to attempt to improve response rate. Additionally, using the same survey methods for both groups would allow for reliable comparisons between the two groups. Finally, the data clearly point to the need to target research and development of AT outcomes instruments to and for product developers.

Acknowledgements

This project is supported in part by the National Institute on Disability and Rehabilitation Research, grant number H133A010403. The opinions contained in this paper are those of the grantee and do not necessarily reflect those of the NIDRR and the U.S. Department of Education.

References

ABLEDATA. (n.d.). *Directory of manufacturers and distributors.* Retrieved May 17, 2002, from http://www.abledata.com/

Batavia, A. J., & Hammer, G. S. (1990). Toward the development of consumer-based criteria for the evaluation of assistive devices. *Journal of Rehabilitation Research and Development, 7*, 425-436.

Compton, D. O. (1995). A note on new product development: why things cost what they do. *Generations*, Spring, 30-31.

DeRuyter, F. (1997). The importance of outcome measures for assistive technology service delivery systems. *Technology and Disability, 6*, 89-104.

DeRuyter, F. (1998). Concepts and rationale for accountability in assistive technology. In *Volume I: RESNA resource guide for assistive technology outcomes: Measurement tools* (pp. 2-14). Arlington, VA: RESNA.

Fuhrer, M. J. (2001). Assistive technology outcomes research: Challenges met and yet unmet. *American Journal of Physical Medicine and Rehabilitation, 80*, 528-535.

Fuhrer, M. J., Jutai, J. W., Scherer, M. J., & De Ruyter, F. (2003). A framework for the conceptual modeling of assistive technology device outcomes. *Disability and Rehabilitation, 25*, 1243-1251.

Krass, A. E. (1997). Technology transfer: one manufacturer's perspective. *Technology and Disability, 7*(1/2), 55-62.

Lane, J. P. (1997a). Development, evaluation and marketing of assistive devices. *Technology and Disability, 6*(1/2), 105-125.

Lane, J. P. (1997b). Technology evaluation

and transfer in the assistive technology marketplace: terms process, and roles. *Technology and Disability, 7*(1/2), 5-24.

Lane, J. P. (1998). Consumer contribution to technology evaluation and transfer. *Technology and Disability, 9*, 103-118.

Lane, J. P., Usiak, D. J., & Moffat, J. A. (1996). *Consumer requirements for assistive devices: Information for product development/improvement.* (Technical Report 96C3). Buffalo, NY: AZtech, Inc.

National Institutes of Health. (n.d.). CRISP - *Computer retrieval of information on scientific projects.* Retrieved May, 2002, from http://crisp.cit.nih.gov/

National Rehabilitation Information Center. (n.d.). *NIDRR program directory.* Retrieved May, 2002, from http://www.naric.com/search/pd/

Poulson, D., & Richardson, S. (1998). USERfit - a framework for user centered design in assistive technology. *Technology and Disability, 9*, 163-171.

Ryan, S., Rigby, P., & From, W. (1996). Understanding the product needs of consumers of assistive devices. *Canadian Journal of Rehabilitation, 9*, 129-135.

Smith, R. O., Rust, K. L., Lauer, A., & Boodey, E. (2004). *Technical report - History of assistive technology outcomes (1.0).* Retrieved September 18, 2006, from http://www.uwm.edu/CHS/atoms/archive/technicalreports/fieldscans/tr-fs-history.html.

Sanford, J. A., Story, M. F., & Ringholz, D. (1998). Consumer participation to inform universal design. *Technology and Disability, 9,* 149-162.

Taugher, M. (2004). *Technical Report-Focus groups on assistive technology use and outcomes: A consumer perspective (1.0).* Retrieved September 18, 2006, from http://www.uwm.edu/CHS/r2d2/atoms/archive/technicalreports/tr-consumerfg.pdf

Tobias, J. (1997). Universal design applied to business practices. *Technology and Disability, 7*(1/2), 63-71.

U.S. Department of Commerce Bureau of Industry Security. (2003). *Technology assessment of the U.S. assistive technology industry*. Retrieved September 18, 2006, from http://www.bis.doc.gov/defenseindustrialbaseprograms/OSIES/DefMarketResearchRpts/assisttechrept/index.htm

Vernardakis, N., Stephanidis, C., & Akoumianakis, D. (1994). Rehabilitation technology product taxonomy: a conceptual tool for analyzing products and extracting demand determinants. International *Journal of Rehabilitation Research, 17*, 201-214.

Wessels, R. D., Willems, C. G., & de Witte, L. P. (1996). How to select a method to evaluate usability of assistive devices. *Journal of Rehabilitation Sciences, 9*, 53-57.

Previous web-posting of a preliminary report on this work: Rust, K. L., & Smith, R. O. (2004). *Technical report - Outcome measures used in AT research and development* (1.0). Retrieved September 19, 2006, from http://www.uwm.edu/CHS/r2d2/atoms/archive/technicalreports/fieldscans/tr-atproddev.pdf

Filling out this survey indicates that I am at least eighteen years old and I am giving my informed consent to be a participant in this study.

Product Developer AT Outcomes Survey

1. Please list up to 3 products you have recently developed or have in process.

_____

_____

_____

2. The following are outcome dimensions of assistive technology. Please rate how important you believe each one of these dimensions is for product outcomes.

	Not at all Important		Somewhat Important		Extremely Important
Change in Performance or Function	1	2	3	4	5
Cost	1	2	3	4	5
Usage: Why or why not used	1	2	3	4	5
Consumer Satisfaction	1	2	3	4	5
Increased Life Participation	1	2	3	4	5
Improved Quality of Life	1	2	3	4	5
Clinical Result/Goal Achievement	1	2	3	4	5

Categories from ATOMS Service Directors Focus Group, April 2002

3. How frequently have you used any of the following strategies to measure outcome during your process of product development?

	Not at all		Half of the time		All of the time
Testing in lab by developers	1	2	3	4	5
Focus groups of providers	1	2	3	4	5
Focus groups of persons with disabilities	1	2	3	4	5
User usability testing in lab	1	2	3	4	5
General field testing soliciting feedback from persons with disabilities	1	2	3	4	5
General filed testing soliciting feedback from providers	1	2	3	4	5
Formal research: Single subject design	1	2	3	4	5
Formal research: Group comparison design	1	2	3	4	5
Other: _____	1	2	3	4	5
_____	1	2	3	4	5

4. If you have used formal instrumentation as a form of quantifying outcome during product development, how frequently have you used

	Not at all		Half of the time		All of the time
a standardized, valid measure of functional status?	1	2	3	4	5
a “homemade” or adapted measure of improved functional performance?	1	2	3	4	5
a measure of client satisfaction?	1	2	3	4	5

a measure of cost?	1	2	3	4	5
other? _____	1	2	3	4	5

5. If standardized instrumentation were available for each of the following outcomes, how appropriate would each of the following be for your product development?

	Wouldn't				Frequently	Always
Product self-satisfaction measure	1	2	3	4	5	
Cost measure (device, acquisition, fitting, learning)	1	2	3	4	5	
Functional performance impact measure	1	2	3	4	5	
Focus group protocol and group survey measure	1	2	3	4	5	
Mail survey measure	1	2	3	4	5	
Telephone survey measure	1	2	3	4	5	
Other: _____	1	2	3	4	5	
Other: _____	1	2	3	4	5	

6. If you had valid outcome data about your products, how likely would you be to use it for the following business purposes?

	Wouldn't				Frequently	Always
General marketing information	1	2	3	4	5	
Product brochures	1	2	3	4	5	
Product revision/improvement during development	1	2	3	4	5	
Identification of need for new products	1	2	3	4	5	
Obtaining grant funding	1	2	3	4	5	
Obtaining investors	1	2	3	4	5	

Strategies for further product development	1	2	3	4	5
Other: _____	1	2	3	4	5

Thank You!
Please use the enclosed postage-paid envelope to return your completed survey.