

Development of Accessible Design Curricula and Materials

Project Purpose

Wayne State University's Enabling Technologies Laboratory (ETL) proposes to develop curriculum material and educational modules that present the principles of accessible design. From a market perspective, it is practical to design products, facilities, and services that will attract as large of a market as possible. To attract this market, which includes the aging "baby boomer" generation, products and services must be accessible to people with a wide range of abilities. At present, only biomedical/rehabilitation engineering, some industrial engineering programs and some architectural programs offer training in accessible design. With such a small population working to serve such a large audience of people with special needs, it is nearly impossible to meet everyone's needs. By presenting accessible design techniques within a broader academic context, more people will have an appreciation for the needs of these populations, and thus be able to apply the techniques to their professional activities.

Statement of Needs

Cynthia Waddell, the ADA Coordinator for the City of San Jose, CA, mentions in her article "Applying the ADA to the Internet: A Web Accessibility Standard" that "web accessibility issues are now being faced by educational institutions" (58). For example, Kathy Williams, a blind student at the University of Utah, has taken eight classes toward her Masters degree online. She reports having had problems participating in online chat rooms, but that she has been able to work through most of the accessibility issues without great difficulty. Williams mentions that:

I can say that the degree of accessibility we have attained thus far at Utah State University has permitted me to take higher education [classes] that otherwise would have been closed to me, not just because of my impaired vision, but because of medical problems that keep me from traveling far enough from home to attend a university

otherwise. I was delighted by the opportunity to get a graduate degree at just the time when a change in careers became necessary (60).

Having a fully-accessible web site is a necessary accommodation for Williams and other students with disabilities taking classes online, just as wheelchair ramps and Brailled signs are necessary accommodations for students with disabilities taking classes in a traditional classroom.

Kathy is not alone in her need for accessible web sites and computer software. The American Foundation for the Blind reports that:

one-third of blind and visually impaired Americans have a computer in their homes, a ratio almost on par with fully sighted Americans. That same study found that nearly 40 percent of blind people overall had used a computer, and a third of those had access to the internet or other online services (59).

Thus, users with disabilities represent a large proportion of today's Internet traffic. Regardless, such users are still confronted with unconquerable barriers that multiply with each technological "upgrade." Waddell speaks to this issue in the following argument:

Whenever existing technology is 'upgraded' by a new technology feature, it is important to ensure that the new technology either improves accessibility or is compatible with existing assistive computer technology. For example, web-authoring software programs that erect barriers in their coding of webpages fall under this scrutiny...therefore, all technology improvements must take into account the removal of barriers and ensure that new barriers to access do not occur (58).

If designers are educated on the principles of accessible design, there is less of a threat of creating new barriers with the emergence of new technology. Designers will be aware that such threats exist and thus be able to take measures to avoid creating new problems.

Until such consciousness among designers is raised, people with disabilities will continue to experience problems associated with these unacceptable barriers. Thus, legal action is beginning to take place. The first formal complaint against a website was filed in November of this

year, citing non-compliance with the ADA (59). The plaintiff, Randy Tamez, comments that “a website is like a public building...you open it up to the public, and you can’t discriminate against people who can’t get up the stairs. Why should a disability make you a second-class citizen in cyberspace?” (59). In addition to this suit, complaints have been filed in both San Francisco and Washington against computer-operated information kiosks that do not meet ADA standards for accessibility (59).

Although these particular examples apply to the World Wide Web, the principle is the same across numerous disciplines. As new buildings are erected, new software is introduced, and new cars are manufactured, the threat of new accessibility problems compounded with existing problems exists. Educating those responsible for making design choices as well as those who will market and sell the product will decrease the likelihood of new barriers excluding certain populations. Such a process involves ethical, marketing, legal, and educational considerations.

Ethical

For years, businesses and communities have striven to meet the needs of all their customers and neighbors. One means of accomplishing this end involves the application of accessible design techniques. A statement as to the ethical imperative for accessible design is the June 3, 1998 SBC (Southwestern Bell Communication) policy on universal design (accessible design): “SBC’s commitment to universal design principles is a tangible demonstration of the value SBC places on the worth and dignity of all individuals, including people with disabilities. SBC is committed to universal design.” (48). This statement is only one example of the ethical and compassionate efforts being shown in the business community for individuals with disabilities.

The difficulty in issues related to universal, or accessible, design arise from the perceived value for the return of investment used for accessible design. The highly competitive nature of

today's marketplace has businesses seeking market niches that years ago they may have disregarded. Legal mandates for accessibility have changed the rules and reintroduced accessible design as a potential key to securing large market shares. Hence, market and legal factors have created imperatives of their own for the use of accessible design principles, and these are being superimposed on an ethical background which generally supports accessibility for individuals with disabilities.

Marketing

A market study performed by the Electronic Industry Foundation states that: "NCHS and the Census agree that roughly 15 percent of the total population have some type of functional limitation. More than one-third of the total cannot perform major life activities like working, going to school, playing or caring for themselves" (8). It is further agreed that this is an underestimate because people with disabilities do not tend to classify themselves as disabled or functionally limited.

A Pacific Bell study estimates that there are about 10 million people with disabilities in California alone (18, 19). More significantly, their research shows that, "many people with disabilities are avid purchasers and users of products that help them communicate more effectively" (18). It is an emerging realization that individuals with disabilities represent a potentially huge market for a large variety of products and services (18, 19).

Another dominating factor is the aging "baby-boomer" population. This population has influenced markets all through its maturation processes. The rise in popularity of minivans coincided with the "baby-boomers" need for family oriented transportation. Fifteen to twenty years ago there were reading glasses or bifocals for reading and far vision. Today there is a variety of product: bifocals, coordinated pairs of contact lenses one eye for far vision the other

eye for near vision, most recently contact lenses with alternating concentric rings prescribed for near and far vision. In terms of demanding more accessible products, services, and jobs, markets are beginning to feel the impact of this group.

The conclusions that we have reached from these studies is that markets are there and businesses are recognizing the potential dollar value of what were once considered “niche markets.” While the changing perceptions may have started as a rationalization and a coming-to-terms with the legal mandates, marketing to this particular consumer group is now recognized as smart, ethical business. This is a powerful combination.

Legal

Recent legislation has mandated that the principles of *accessible design* be incorporated into a wide variety of facilities, products, and services. Such legislation includes the Americans with Disabilities Act (ADA), the Telecommunications Act of 1996 (TA 96), and Section 508 of the Rehabilitation Act (RA 92). As federal agencies provide clarification regarding the enforcement of this legislation, it is imperative that engineers, business owners, information/telecommunication system designers, web authors, and others be cognizant of the legal and social concerns that surround the issue of accessible design—an issue that will have significant impact on the products, facilities, and services that such professionals provide.

In addition to ensuring that Americans of all capabilities have access to buildings and government programs and services, the ADA mandates job accessibility. The ADA prohibits discrimination in all employment practices, including job application procedures, hiring, firing, advancement, compensation, training, and other terms, conditions, and privileges of employment

(1) An individual can not be discriminated against for job hiring if he/she is qualified, i.e., has the skills, training, and education required for the job, and be able to perform the “essential functions”

of the job with or without reasonable accommodation (1).

The ADA also mandates that information sources also be accessible. In the past, this need was met with Braille texts, large print, captioning, and other types of aides. With the introduction of the World Wide Web and other telecommunications-related information sources, however, many businesses and communities are falling short of meeting their ADA obligations for accessibility. More specific than the ADA in this regard is the 1992 revision and reinstatement of the Rehabilitation Act, which ensures in Section 508 that “individuals with disabilities [be able to] produce information and data, and have access to information and data, comparable to the information and data, and access, respectively, of individuals who are not individuals with disabilities” (54). Section 255 of the Telecommunications Act reinforces this right to information access with its focus on telephony. According to the United States Access Board:

Section 255 [of the Telecommunications Act] provides that a manufacturer of telecommunications equipment or customer premises equipment shall ensure that the equipment is designed, developed, and fabricated to be accessible to and usable by individuals with disabilities, if readily achievable. A provider of telecommunications services shall ensure that the service is accessible to and usable by individuals with disabilities, if readily achievable. Whenever either of these is not readily achievable, a manufacturer or provider shall ensure that the equipment or service is compatible with existing peripheral devices or specialized customer premises equipment commonly used by individuals with disabilities to achieve access, if readily achievable (2).

Thus, the legal motivations for the production of accessible products and services exist and are longstanding. The laws mandating accessibility for telecommunications products and services, however, are relatively new.

Educational

Wayne State University’s Enabling Technologies Laboratory (ETL) has solicited input from businesses as to their perceptions of accessible design. The attached letters of support

reflect the concerns of a segment of the business community we have contacted. The current workforce does not possess the knowledge and skills required to seriously address the legal and market needs for accessible design. Businesses are scurrying to develop guidelines, training programs and internal policies that address the evolving and expanding needs of accessible design.

The need for training in issues regarding accessibility in design is demonstrated by research conducted at Ford and General Motors Corporation. Studies show that while the design phase constitutes only 5% of product development costs, it influences approximately 70% of the production costs (20, 21, 31). For example, a poor design may cause problems during product assembly, necessitating recalls and other expensive setbacks. Robert Bury, director of Ameritech's Strategic Alliances Program, furthers this observation with regard to accessibility in product design:

With the growing diversity of our population, accessibility consideration can no longer be considered as 'after thoughts' or 'add-ons.' Based on our experience, the incremental cost of including universal design principles at the beginning of the planning or production process is far less than adapting or retrofitting later (taken from Bury's letter of support, Appendix 3).

The impact of design decisions on product development and service costs emphasizes the importance of including accessible design principles during product design. However, based on a review conducted by the ETL of approximately thirty university engineering curricula nationwide, university engineering design courses are not covering accessible design principles. Consequently, many practicing and student engineers are not aware of the legal, ethical, and market issues presented by accessible design. This represents a serious knowledge gap with potentially serious consequences for institutions that cannot or will not apply these principles.

Target Areas and Target Populations for the Proposed Accessible Design Curriculum and Educational Material

Target areas for accessible design include consumer products, services, job placement, and facilities—both private and commercial. A few specific examples include those businesses covered by Section 255 of the Telecommunications Act of 1996 and related legislation. Specifically targeted are telecommunications and information products and services, which include web based services. The automobile companies are concerned about the aging population and hence are more aggressively addressing issues of accessibility, e.g., heads-up displays, larger doors allowing easier entrance and egress, and greater adjustability in seating systems. Lastly, the appliance industry has become very sensitive to and interested in issues of accessible design, e.g., more washing machines and dryers that are front loading as opposed to top loading, larger displays, more clearly marked displays, and Braille over-lays for microwaves, to mention a few examples.

Other broad areas of concern are the job market as impacted by the ADA, the aging workforce (31, 32, 39), and demands for higher quality, lower cost, and more diversified products (7, 20, 28, 29, 30, 57). The automotive manufactures have developed, embraced, and are requiring all suppliers to adhere to QS 9000 quality standards (25). It is a rigorous process to become QS 9000 certified (25). At the heart of QS 9000 is Kaizen, or “continuous improvement,” and the application of quality tools and techniques throughout the business (20, 21, 29, 31). Any business wishing to trade with European Community businesses must conform to one or more of the ISO 9000 quality standards. Again there is a rigorous process to achieve ISO 9000 certification (46). Thus, most businesses are coming into compliance with either QS 9000, ISO 9000, both, or some other industry standard for quality assurance.

Research conducted by the ETL has demonstrated that applications of quality tools and techniques such as Design for Assembly (DFA) and “poka-yoke” (error-proofing) improves job performance and creates jobs for individuals with disabilities (10, 11, 12, 15, 16, 17). The application of quality tools and techniques tends to reduce both the physical and cognitive demands of tasks, rendering them more accessible. Hence, the application of Kaizen or quality tools and techniques create more accessible jobs. By rendering the jobs physically and cognitively less demanding they tend to redefine the “essential functions” of jobs. This relationship between quality enhancement and accessibility is not generally recognized.

It is vital that those involved with quality standard certification processes be aware that the application of quality tools and techniques is an important component of accessible design. The practical results of applying accessible design principles are dependent upon an intention on the part of designers, planners, and policy makers to make their jobs, services, and products more accessible.

Another area of focus is the education process itself (K-12), including both general education and special education. Under mandates from federal laws (26) and local area policies (24, 27, 34, 40, 56), there are tremendous pressures to provide “inclusive” education, i.e., educational facilities, curricula, and materials that allow for the involvement of as broad a segment of the student population as possible. These efforts at the primary and secondary school levels are an indication of the need for accessible design in all educational processes, facilities, activities, curriculum and materials. Fragmented efforts across the country have demonstrated the effectiveness of an accessible design approach.

The Minnesota Academic Excellence Foundation (MAEF) has developed a successful program that utilizes quality tools in the classroom, not only as a planning tool for the teachers

and staff, but as a higher order problem-solving and decision making tool for the students (22, 35, 36, 37, 51, 55). The MAEF Classroom Quality program has shown these approaches to be effective from the first grade through high school (35, 36, 55). In this program, *successful* means that student performance on standardized state assessment tests have dramatically improved and that the students and staff feel better about the educational process. Success also means that a much more diverse student population is being served by the inclusive education model. Here, as with the business arena, quality tools are demonstrating their effectiveness as accessible design tools.

In collaboration with General Motors and eight intermediate school districts in southeastern Michigan, the ETL is demonstrating the powerful impact quality tools and techniques can have in improving student performance and teacher effectiveness (10, 13, 14, 42, 43, 45). Again, the tools and techniques are creating more accessible process by reducing the physical and cognitive demands of the educational tasks. As with the business community, many teachers and educators are not aware of the synergistic benefits of the application of quality tools and techniques in educational environments.

Given this very broad spectrum of potential beneficiaries of accessible design principles, our target training groups include engineers of all disciplines, teachers, occupational therapists, lawyers, psychologists, and business majors of various disciplines. Each group has specific motivations for being educated on the principles of accessible design. Engineers, for example, need to be familiar with these techniques in order to design products and services to meet the needs of as broad of a population as possible, while those in business fields may use the application of these techniques to attract a more diversified market. Hence, we envision a broad based cross-disciplinary population.

Working Assumptions

Legal, market, and ethical imperatives establish the need for professionals involved with product and service design, management and marketing to be knowledgeable of accessible design issues, principles, and resources. Next, there is a knowledge gap between what is currently required by the legal, market, and ethical imperatives, and the training and expertise level of the effected professionals. University programs which train the effected professionals do not typically contain material on accessible design.

There are conflicting pressures on engineering and other undergraduate curricula. On the one hand there is pressure to reduce the number of credit hours required for the Bachelor of Science in Engineering degree. On the other hand there is pressure to include more new material. In light of these conflicting pressures it is unlikely that most undergraduate programs would introduce a course on accessible design. Exceptions would include Rehabilitation Engineering programs and Industrial Engineering programs which include accessible design in their ergonomic and human factors classes. However, while most programs would not deem accessible design as significant enough for an entire class, most would recognize the need to incorporate such material into their current design programs.

Goals: (For the overall project, Proof-of-Concept and the second Phase, development and implementation.)

These working assumptions lead us to the two overall project goals. One, the need to develop curriculum material and educational modules that present the principles of accessible design in a manner that can be: 1) incorporated into existing university courses that train professionals who design, manage, or market products and services, and 2) used by industry to train their current workforce. The second goal is to facilitate national awareness of the need for

inclusion of accessible design issues and principles to faculty through workshops, short courses, and other forms of dissemination such as web based material.

The Proof-of-Concept Phase is not intended to directly satisfy these goals, but rather to put in place a team and process which can then prepare a Second Phase - development and implementation proposal which does directly addresses these goals. Hence the objectives for the Proof-of-Concept Phase are designed to demonstrate that the current team 1) has a sound starting point in terms of need, concept, expertise, and resources, 2) has the ability to follow through on the second Phase proposal, and 3) in a limited fashion, can demonstrate the efficacy of the proposed concepts.

Objectives: (For the Proof-of-Concept Phase)

1. Form the curriculum and educational material development team.
2. Develop the curriculum outline.
3. Specify and prioritize dissemination mechanisms for the curriculum and educational materials.
 - 3.1 Books and written material
 - 3.2 Accessible Design Modules (ADMs) for hands-on experiences.
 - 3.3 Web based material - CD ROM
 - 3.4 Distance Learning Material
4. Develop the educational materials consistent with the curriculum outline and dissemination mode.
 - 4.1. Outline and research content of book on accessible design principles
 - 4.2. Specify the principles to be addressed by the Accessible Design Modules (ADMs)
 - 4.3. Specify the exercises and demonstrations to be used in the ADMs
 - 4.4. Finalize the structure of the ADMs
 - 4.4.1 Specify the outline content of the ADM exercise manuals
 - 4.4.2 Specify the specific exercises and demonstrations to be used.
 - 4.4.3 Specify any hardware, computer equipment, software etc. to be used.
5. Develop an Accessible Design Lab Model
6. Develop and field test a sample Accessible Design Module
 - a) Physical components & materials
 - b) Draft Exercise Manual
 - c) Field test the ADM at Wayne State University and GM's Ergonomic Laboratory
 - d) Evaluate effectiveness and student reactions to ADM
 - e) Revise ADM as required by field test results.

7. Establish a plan for cross-disciplinary faculty development and dissemination of the Accessible Design curriculum material through regionally and nationally offered workshops, short-courses, professional conferences, and other dissemination modes, e.g., web based material.
8. Prepare a second Phase proposal for development and implementation which is based on the planning efforts of the curriculum and educational material development team and field test results of the ADM.

Thus, by the end of the Proof-of-Concept phase, we will have established a team, developed a detailed, researched outline of the accompanying text on accessible design, instituted a plan for cross-disciplinary development of faculty, and prepared a second-phase proposal for development and implementation.

With respect to the NFS's Course, Curriculum, and Laboratory Improvement (CCLI) program, the long term goals of this project will produce educational material for national distribution and implementation, and also facilitate national dissemination of the materials and practices by providing workshops, short courses, and presentations to promote the professional development of faculty. The curriculum and educational material will utilize proven and effective pedagogical techniques and methods.

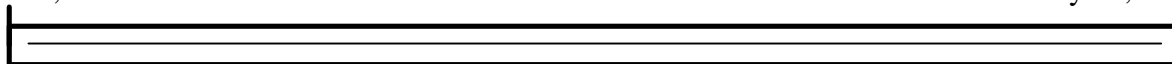
Development Process and Schedule

This section will discuss our Proof-of-Concept development plan and schedule, demonstrating how we will satisfy the stated objectives.

A June 1, 1999 starting date is assumed.

June 1, 1999

May 31, 2000



The core team is in place. Work will start immediately to add additional team members. Team building will be an on-going activity.

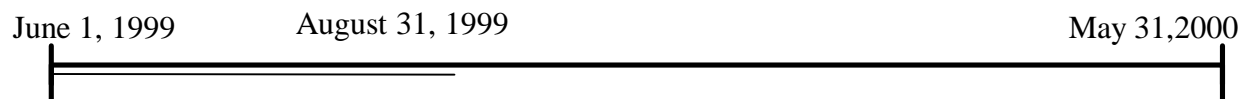
Proof-of-Concept Core Team and Full Team

Accessible design principles will be drawn from a variety of sources and it is important from the Proof-of-Concept perspective that our core development team has an adequate spectrum of experience and expertise. The full development team will include individuals from other organizations who will be providing information, comments and resources as required.

The core development team includes: Dr. Robert Erlandson, Dr. Brian Peacock, David Sant, and Kristine Bradow. As noted in the Personnel section each team member has considerable experience and expertise in accessible design, spanning products, services and jobs.

Curriculum Outline

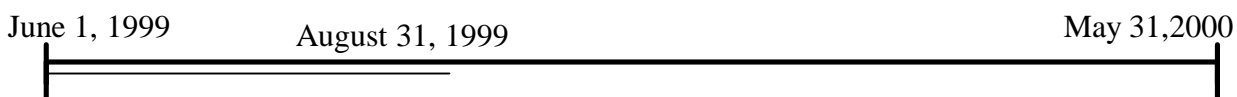
Work on the curriculum outline will start immediately and be completed in about three months.



The core team will start work on the curriculum outline. Feedback and comments will be solicited from members of the full team. The curriculum outline will specify the issues, principles, and ADMs to be developed during the full development and implementation phase (phase two). Also during this period, the team will finalize the ADM to be developed for the Proof-of-Concept phase.

Dissemination Mechanisms for curriculum and educational materials

Work on selecting and prioritizing the dissemination mechanisms will run concurrently with creation of the curriculum outline.

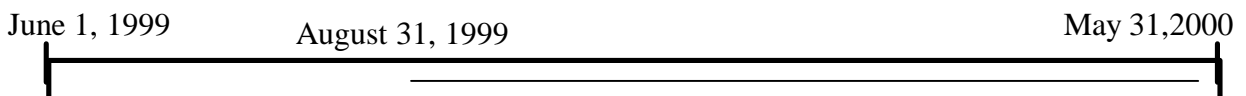


The core team, with feedback and comments from the full team, will establish a priority for the development and implementation of dissemination mechanisms. This stage is important in that

each dissemination mechanism, which includes books and written material, ADMs, web based materials, CD ROMs, and distance learning devices has unique pros and cons. For example, ADMs provide direct hands-on experience with the principle under study. Such direct hands-on experiences are not easily replicable using web based delivery mechanisms.

Develop the educational materials consistent with the curriculum outline and dissemination priorities.

Work on this objective will start in August and probably overlap the previous two activities. It will continue to the end of the project.



This activity is central for the Proof-of-Concept phase in that it forms the basis of the second phase proposal. Members of the core team have already engaged in a great deal of discussion over the form and structure of the material. The working assumptions and resultant goals reflect these discussions. The following model develops these initial thoughts a bit further.

The Model

We propose a process that will allow accessible design issues, principles, and resources to be naturally integrated into existing courses or used as stand alone modules in a workshop format such as those used by Motorola University, GM University, and other corporate, “in-house” continuing education programs. The educational material would be developed in a hierarchical format starting with a basic awareness of the issues, principles and resources and move toward more detailed presentations of principles and issues leading to the acquisition of skills necessary for a design practitioner (Figure 1).

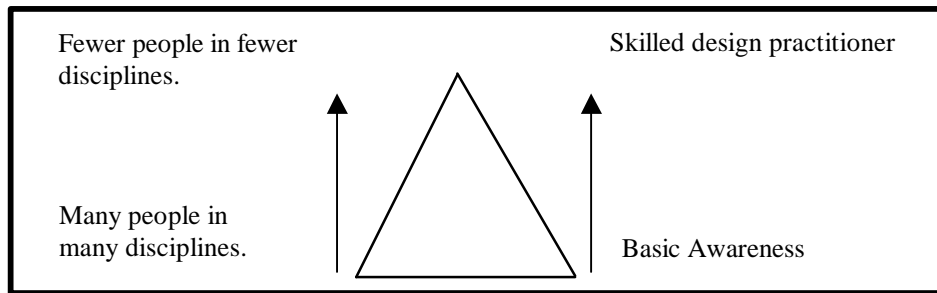


Figure 1: *The narrowing of knowledge as disciplines become more refined.*

Most engineering programs have an introductory freshman level class. This would represent an opportunity to introduce the accessible design issues, the legal mandates, the potential markets and of course the ethical imperative. This would be an awareness-building process. As the students advance through their respective programs, they would again be brought in contact with accessible design issues and principles, only more in depth and as appropriate for the specific class. Civil engineers might have a different set of ADMs than the Electrical & Computer Engineer or the Industrial Engineer. Occupational therapists, teachers, industrial psychologists, and business majors would all have yet different reasons for being exposed to the ADMs and accessible design material. Ideally, the developed material would enable individual instructors to assemble a collection of ADMs and material that would serve their purposes so that, as the students progress and eventually graduate, they will be able to apply their accessible design training to their professional activities (Figure 2).

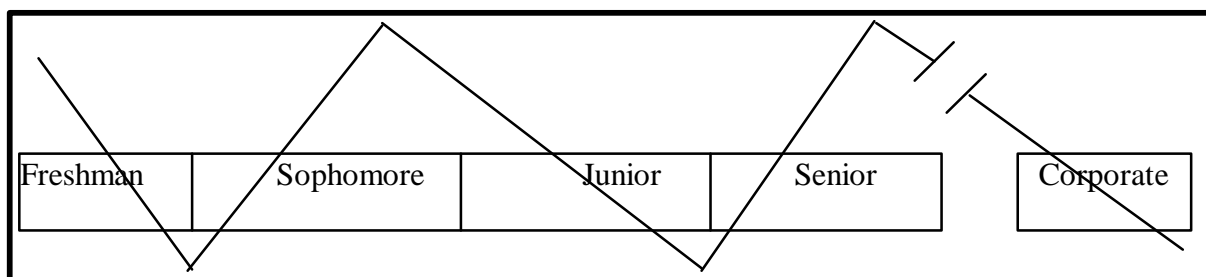


Figure 2: *The thread of accessible design modules & educational materials integrated into existing classes over the student's academic carrier.*

Objective 4.4 addresses the structure of an ADM. There is an increased efficiency of presentation if there could be a single structural framework for the ADMs. In addition to the form and structure of the ADM module, the team will develop an evaluation rubric for ADM performance as measured by student assessments, student performance and observational data collected as students work through the module activities.

Appendix 1 provides an example of an ADM. It follows the following format:

1.	Title of the ADM
2.	Statement of the goal for the ADM
3.	Statement of the specific educational objectives
4.	An evaluation rubric will be provided with each ADM. The rubric will help students understand what they are required to master and how they will be evaluated.
5.	Basic theory or background material introducing the concept or principle
****	The students will work in groups on items 6-8. Each group will prepare a group portfolio or report with a section for each of the next three activities.
6.	Exercises—one or more hands-on exercises with required data or information gathering
7.	Student specified examples of products, services or jobs exhibiting the concept or principle under study. The students will analyze the examples with respect to the specific concepts or principles under study. The analysis results and notes will be recorded.
8.	A re-design exercise—students will be given a device, process or job that exhibits the concept or principles under study, but presents a poor design. The students will analyze the entity and record operational error and difficulties. The students will then redesign the device, process or job using the module's concepts or principles. The students will then analyze the redesigned entity and record how it addressed the problems and difficulties of the original design. The students will present their results as appropriate—such as to the instructor or to the class.
9.	Lastly, there will be a written quiz wherein the students will be required to answer specific questions about the concepts, principles and their relationship to accessible design.

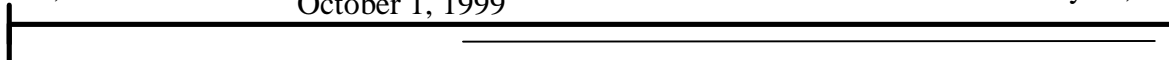
Develop an Accessible Design Laboratory Model

Starting after the curriculum outline and dissemination mechanism priorities have been established and there is an evolving consensus on the ADM structure and principles to be addressed, work will begin to establish an Accessible Design Laboratory Model.

June 1, 1999

October 1, 1999

May 31, 2000



Again, based on the preliminary thinking of the core group, an initial idea for a model has emerged. The lab would be based on an agile/lean philosophy, i.e., be able to provide the required instructional material (flexible) at just the time it is required in a course (21, 29, 44, 57) One way to accomplish this would be through the use of a cross disciplinary laboratory. This would be modeled more along the lines of a computer lab, wherein instructors would schedule time for their students in the lab, with a lab instructor, to complete a specified set of ADMs. Such a structure would maximize the facility's utilization in that it would be available to a large number of classes across a spectrum of disciplines. It also creates a natural environment for assembling and providing cross disciplinary team training for students. Lastly, it provides a structure that facilitates the integration of accessible design material into existing classes. In today's educational environment it is essential that we leverage our resources to the fullest, this model allows for such effective leveraging.

Utilization Scheme for a Cross disciplinary Accessible Design Laboratory

Classes ADMs	Class 1 M,W 1:00-3:00 PM	Class 2 T, Th 9:00-11:00AM	Class 3 M,W 4:00-6:00PM	Class 4 M,W 9:00-11:00 AM	...	Class n T,Th 1:00-3:00PM
ADM 1	X		X			
ADM 2		X	X	X		X
ADM 3	X		X	X		X
...	X					X
ADM k		X		X		X

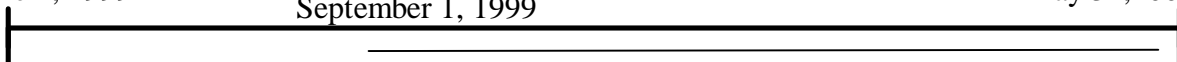
Develop the prototype Accessible Design Module

By the end of August the team will have selected the concept or principle for the prototype ADM. At that time work will begin on the design and development of the prototype ADM. This effort will be coordinated with Objective 4.4 and represent a test case for the evolving structure. Part of this effort will be to develop the evaluation process for the prototype ADM. (See Appendix 2).

June 1, 1999

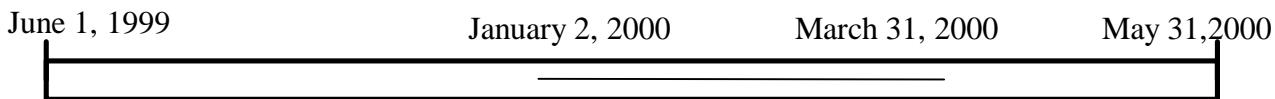
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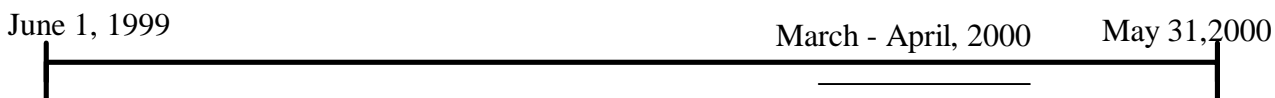
Field test the prototype ADM

The prototype ADM will be field tested during the Winter semester of 2000. There will be two test sites: the ETL design class at Wayne State University and the GM Ergonomics Lab. This protocol will provide feedback and evaluation for university students and individuals currently in the work force.



Evaluate the field test results

Students will be asked to evaluate the ADM material as to clarity, ability to facilitate learning, and engaging the student in the process. Quantitative measures such as the time to complete the module, evaluation scores based on the ADM's rubric, number and type of error students made.



If necessary modify the prototype ADM and standardized ADM structure.

Based on the field test results it may be necessary to modify the prototype ADM and possibly the standardized ADM structure.



Establish a plan for cross-disciplinary faculty professional development and dissemination of information about the curriculum and materials

This activity needs to start early and evolve as the project unfolds. We will determine how many workshops and short-courses to hold as well as where to hold them. Cost projections for workshops and short-courses, presentations at professional organizations, travel and logistical considerations all have significant impact on the budget.

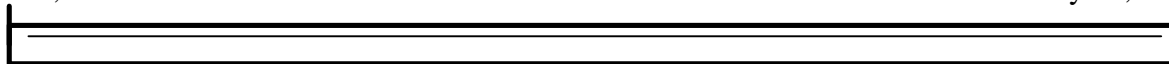


Preparation of the second phase proposal.

This will also be an on-going activity. Work on background material, need statements, reference material can start immediately. As the project evolves more detail can be added to the proposal.

June 1, 1999

May 31, 2000



Accessible Design Principles - Existing and Prior Work

The previous section presented the integrative curriculum model for accessible design issues, principles and resources that evolved from the working assumptions and project goals. It is an integrated, hierarchical approach that fits into the constraints presented by today's university environment. The model is not just a compilation of information, data and facts, but rather draws on the experiences of current work and products to create a new entity, one based on a solid pedagogical foundation and designed to be efficiently and effectively delivered within a cross disciplinary university or business setting. As the distribution of existing materials on accessible design is widely fragmented, this model will bring together accessible design fundamentals into a coherent whole that can be naturally integrated into the overall design process. It is this integrated, hierarchical, cross-disciplinary pedagogical approach targeted at university and business-education which distinguishes this initiative from the work and information being conducted and delivered by other Rehabilitation Engineering centers, such as The Center for Universal Design At North Carolina State University, The TRACE Center at the University of Wisconsin-Madison, and other professional organizations (5, 38, 52).

Essential features of accessible, or "universal," design extend across several planes, which include the use of quality tools and techniques (design for assembly, error-proofing, visual structuring). Also essential are variation reduction and lean/agile devices. All of these techniques

and devices have been successful in reducing both the cognitive and physical demands of tasks, thus making them more accessible (3, 5, 7, 16, 17, 18, 19, 20, 22, 23, 28, 37, 47, 49, 50, 53, 57).

The ETL's experience has been that the application of accessible design principles transcend specific domains or areas of application. The accessibility principles used to design consumer products or services are essentially the same as the principles brought to bear when redesigning work sites, or job process, or educational processes. The jargon is somewhat different across these application areas. The expression of the principles appears different, but in essence they all strive to reduce the physical and cognitive demands of the process.

Personnel

Robert F. Erlandson, Ph.D. (Principal Investigator)

Dr. Erlandson is Director of the Enabling Technologies Laboratory, College of Engineering, Wayne State University. He has a BS in Electrical Engineering and Ph.D. in Biomedical Engineering. He worked at Bell Telephone Laboratories before joining the faculty at Wayne State University. At Bell Labs he worked on the design and development of the long distance computerized switching and advanced software systems development. He also received training on curriculum and course development before developing classes and teaching in the Bell Laboratory In-Hours Continuing Education Program.

While at Wayne State University he has maintained an active research program in addition to his teaching responsibilities. He is an inventor on a patent (Erlandson, F., R, *Method and Apparatus for Rehabilitation of Disabled Patients* Patent Number: 4,936,299, Date of Patent: June 26, 1990), a robotic smart exercise system for recovering stroke patients. He was on loan from the University to serve as Vice President for Technology Development, at the Metropolitan Center for High Technology, an economic development center funded by the state of Michigan.

In that capacity he worked closely with the Detroit area business community on economic growth and development.

In addition to his regular teaching load, he serves on the Electrical and Computer Engineering's Undergraduate Committee and the College's Academic Affairs Committee. He has received numerous awards for excellence in teaching; the IEEE Transaction on Education Best Paper of the Year Award (9), the Tau Beta Pi Best Teacher Award and most recently the College of Engineering's Excellence in Teaching Award. (1997-1998).

Dr. Erlandson worked with the Occupational Therapy Department to develop a cross-listed course on Enabling Technology. He co-teaches that class with an Occupational Therapist. A major component of that class deals with the accessibility of products, services, and jobs. The ETL also runs senior engineering cross-disciplinary design classes. The student design projects include accessible universal remote controllers, interactive software designed for inclusive school settings, labeling devices, talking scale systems for counting and weighing tasks, and process analyses and improvements to create more accessible classrooms. Dr. Erlandson is the Principal Investigator for an existing NSF grant that funds many of these student design projects (NSF BES9707720).

Through Project Enable, a joint ETL General Motors project, Dr. Erlandson has co-taught workshops and short-courses training over 750 non-engineers in the principles of process improvement, error-proofing, visual structuring, workplace organization, and standardized work. He has worked with schools and local area businesses to design and implement more accessible jobs, e.g., the use of talking scales controlled by a Poka-Yoke (error-proofing) Controller (17).

Brian Peacock, Ph.D.

Dr. Peacock is the manager of the Manufacturing Ergonomics Laboratory, at the Manufacturing Center, General Motors Technology Center in Warren, Michigan. He has a BS in Ergonomics and Cybernetics as well as a Ph.D. in Engineering Production. His responsibilities include conducting training workshops for GM employees. The workshops deal with ergonomics, human factors, cognitive psychology, and accessibility (to both jobs and products).

The Ergonomics Lab has a variety of exercise modules that are used to demonstrate basic ergonomic, human factors, and accessibility (again for both jobs and products) principles. These exercise modules will form the core group for our Accessible Design Modules. The current GM modules are not comprised into a formal curriculum with specified goals, objectives, or rubric. Rather, it is fashioned after a more intuitive, informal approach. This approach has worked well for GM's purposes and represents a starting point for this more structured endeavor.

Dr. Peacock's responsibilities are to document the current GM exercise modules to a fuller extent and to formulate them into the proposed ADM model structure. He will work with us on the design and implementation of the Proof-of-Concept ADM, and one of the initial field test sites will be the GM Ergonomics Lab. He will also work with us on the development of the second Phase proposal. Furthermore, he will be part of the second Phase development and dissemination team.

David Sant

Mr. Sant has a BS in Electrical Engineering and is the ETL Project Engineer. He is responsible for the day-to-day operations of the ETL. He is responsible for ETL product replication and sales, as well as the redesign of student design projects prototypes into usable

products. These redesigns are based on feedback from field testing. Mr. Sant also works with the NSF student design groups.

Mr. Sant has been with the ETL since 1995. He has considerable experience and expertise in the design of accessible devices and systems.

Kristine Bradow

Ms. Bradow is an information specialist and webmaster for the ETL. She has a BA in English with a concentration in technical communications, and she started working with the ETL two years ago. She has written the users manuals for ETL products and prepared resource material detailing applications of Creform™ Material Handling Systems for use by the Michigan Region IV Intermediate School Districts' Assistive Technology Consortium. Ms. Bradow has also worked on several research projects with local school districts, her most recent project focusing on the viability and effectiveness of auditory prompting for individuals with cognitive impairments. This research is taking place in conjunction with faculty at three special education schools.

Ms. Bradow has developed an expertise on accessibility issues. In particular, she has exercised her expertise on the design, implementation, and maintenance of the ETL web site. This web site is fully accessible for all types of browsers and for people with disabilities as evaluated by several accessibility evaluation programs, such as CAST Organization's tool, called "Bobby" (www.cast.org/bobby). She has consulted closely with the W3C committee on the application of accessibility standards and has provided consulting services to local area schools and units within the College.

Ms. Bradow is an essential member of the team. She will develop accessible design material with respect to web site accessibility. As the technical writer she will bear significant

responsibility for the final editing, revisions and preparation of the draft manual, Accessible Design Module written material, and the creation of the second phase proposal. She will be responsible for conducting the research for and developing a detailed outline of the accompanying Accessible Design text. She will also be responsible for team correspondences and the scheduling of team meetings.

Proof-of-Concept Core Development Team & Areas of Experience and Expertise

	Experience & Expertise	Accessible Design
R Erlandson	Electrical Engineering Biomedical/Rehabilitation Engineering Quality Network techniques Education	Products Services Jobs
B Peacock	Industrial Engineering - Ergonomics/human factors Education	Products Services Jobs
D Sant	Electrical & Computer Engineering Quality Network techniques Education	Products Services Jobs
K Bradow	Technical writing web master/designer Quality Network techniques	Products Services Jobs

The team has experience and expertise in both the teaching and application of accessible design principles. The team has experience and expertise in the design and development of curriculum and educational material.

Resources

Enabling Technologies Laboratory

The ETL started in 1992 as a vehicle for student design projects (41). ETL has collaborated with outpatient facilities, hospitals, the ISDs and their constituent schools, local area businesses, and area job placement and sheltered workshop organizations on a wide variety of student design projects. When Easter Seals and RESNA (Rehabilitation Engineering Society of

North America) cosponsored a national student design contest, the ETL had three winners out of six entries over a three year period (4, 6, 33).

Thus, a major priority of the Enabling Technologies Laboratory (ETL) is to design and/or adapt and implement technologies that create opportunities for individuals with disabilities to competently participate in activities that are otherwise inaccessible or of limited access. The ETL enjoys broad based support from businesses, schools, foundations, and an recently-acquired NSF grant (NSF BES9707720) earmarked for student design projects. The philosophical foundation of ETL activities is grounded in *Kaizen* or “continuous improvement” techniques (28, 29).

The ETL works in conjunction with the General Motors Quality Network Group and its Productivity Lab (Lean/Agile devices and Systems) in what is known as Project Enable. Dr. Erlandson and GM facilitators have conducted workshops and short courses at facilities throughout southeastern Michigan. Since its inception in 1993 Project Enable has trained over 750 non-engineers, teachers, special education teachers, occupational therapists, vocational rehabilitation placement specialists, parents, individuals with disabilities, and administrators in the principles of Kaizen or quality improvement tools. These tools include process analysis tools, error-proofing techniques, visual structuring, workplace organization and standardized work.

Research at the ETL has demonstrated that the systematic application of Kaizen techniques tend to reduce the physical and cognitive demands of jobs, making the jobs more accessible. As businesses use these techniques they concurrently eliminate or remove barriers to individuals with cognitive and physical impairments. These new procedures were not developed to create options for individuals with disabilities—they were developed by industry to make businesses more competitive and cost/effective in today's world market economy. The fact that these design approaches might concurrently be cost/effective and provide reasonable job

accommodations for individuals with disabilities is not generally recognized. The key point is that the Kaizen or quality improvement tools and techniques utilize essential aspects of accessible design. The “product” is the job process, the consumer is the worker.

ETL personnel have a strong background in accessible design in terms of products, services, and jobs. The ETL has a strong network of collaborators and a long history of success, and it possesses the expertise and experience necessary to lead the Proof-of-Concept project and the subsequent second phase of development and implementation.

ETL/Region IV Consortium

In February 1995 the Enabling Technologies Laboratory entered into a consortium agreement with the member districts in Region IV Intermediate School Districts (ISDs), eight counties in southeastern Michigan (Oakland Schools, Wayne County Regional Educational Service Agency, Macomb ISD, Washtenaw ISD, Lenawee Intermediate School District, Jackson ISD, St. Clair ISD, and Monroe County ISD). The ISDs work with the local school districts within their respective counties to provide special education and vocational rehabilitation services. ETL and the ISDs work closely with local businesses on school-to-work and other transitioning programs. The students/workers range from severely multiply impaired (both physical and cognitive impairments) to mildly retarded.

A major reason for forming the consortium was to create the infra-structure and resources necessary to replicate the technology being developed by student design projects at the ETL. Through the consortium, the ETL provides devices and systems to consortium members for only the cost of materials.

Intellitools, Henter-Joyce, Inc., and FutureForms and the Development of Accessible Educational Material

Since 1979, **Intellitools** has been a leader in helping people use computers for learning, productivity, and communication. They design and manufacture an alternative keyboard called Intellikeys and curriculum software for special education, early childhood education, and elementary education. The ETL development team believes that the educational material presented in our modules should serve as a standing example of accessible design. To this end, Intellitools has committed to provide staff and support to help develop the second phase proposal with respect to the accessible design of educational materials, review and critique the educational material developed during the Proof-of-Concept phase, provide examples of systems and products that utilize accessible design principles, and continue support in the second phase should it be funded.

Henter-Joyce, Inc. manufactures equipment that enables individuals who are blind or visually impaired to access computers. They manufacture JAWS (Job Access With Speech) for Windows, a software program which enables people who are blind or visually impaired to use computers by hearing them, using synthesized speech. In support of this project they will provide their accessibility software, JAWS for Windows and the MAGic screen enlarger, for testing and training purposes.

FutureForms is a developer of electronic form and workflow solutions that are accessible to individuals who are blind or visually impaired. These forms allow for features such as calculations, database operations, field help and validation, and email support. The form navigation and error-proofing features of FutureForms systems make them popular to sighted individuals since the forms are much easier to fill out correctly. FutureForm staff will be part of

the second phase planning team. They will provide examples of accessible products and services and contribute to the development of the Accessible Design Modules.

Telecommunications Support

At this point, the Proof-of-Concept team has received input and comments from **SBC Technology Resources, Inc.** (Southwestern Bell Communications) and **Ameritech**. Both companies have expressed their desire to work with us on the Proof-of-Concept project; in particular, they plan to work with us on the planning and review of the second phase proposal.

The General Motors Manufacturing Ergonomics Laboratory

The GM Manufacturing Ergonomics Laboratory will serve as a field testing resource and model for an ETL teaching lab. The GM lab was developed in 1990 to support investigative, training, and demonstrative functions led by divisional and place ergonomics specialists. The lab has four general features. First, there are the models essential for teaching human anatomy, physiology, and cognitive psychology. Second, there are traditional devices for measuring human physical and cognitive performance. Third there are artifacts of the vehicle manufacturing process, including a current model car and a wide selection of workplace facilities and tools. Finally, a range of computers enable the development of training material, network communications, databases and analysis tools.

The lab is particularly useful as a demonstration center for human performance and manufacturing matters. Well-defined modules such as reaction time, Fitts' Law, vision testing, strength testing, endurance measurement and anthropometry are complemented by typical task demonstrations from foundries and materials handling to vehicle assembly. These modules are also integrated into the awareness (1 hour), introductory (1 day), technical (1 week), and advanced (1

month) training modules that are offered to GM engineers. From time to time, special research projects are conducted to confirm or fill the gaps in the published literature.

The lab facilities will be made available on an occasional basis for the field demonstration of modules related to the Enabling Technologies demonstration project. It is hoped that the laboratory and its demonstrations will serve as a model for the development of a similar facility at Wayne State University.

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