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ASSISTIVE TECHNOLOGY RESOURCE CENTER AT WPI

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Abstract

The purpose of this project was to investigate the development of an Assistive Technology Resource Center (ATRC) at WPI as a means of strengthening the coordination between the WPI Project Centers. By researching past projects and assistive technology organizations and interviewing individuals with previous experience with assistive technology projects, we were able to identify several problem areas regarding coordination and obtain recommendations to correct these problems. The information from these sources was combined to complete the model for the ATRC.

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1. Introduction

This project focuses on assistive technology in modern and developing countries around the world and the importance of assistive technology to the WPI Projects Program. Assistive technology is any device or other technology that helps an individual overcome the effects of a specific handicap and perform everyday tasks that would not otherwise be possible. Each country has its own social and economic climates that influence the level of technology with respect to assistive technology. Over the years, many students at WPI have researched the connection between society and technology, in particular assistive technology, through IQP project activity at global project centers around the world. However, MQPs dealing with assistive technology have only focused on applications in the United States. MQPs have not developed prototypes that are suitable for specific regions of the world. The goal of this project is to develop an assistive technology resource center for WPI that will address these issues and many others. A preliminary list of the possible functions of the assistive technology resource center was established when this project began, and these functions have been modified and combined to develop a comprehensive model for a center in this area.

2. Results

The results of this project are presented as a final model for the Assistive Technology Resource Center (ATRC) at WPI. The results of this project are intended for an audience comprised of all of the students, advisors, and project center directors who have an interest in assistive technology or would have an interest with more available information. Hopefully, the results from our model will actually arouse more interest in the development of an assistive technology center at WPI and lead to its implementation in some form or another. The ATRC could make WPI a well-known research entity in this area and give students new opportunities that are not currently available.

3. Background

3.1 Assistive Technology and Disability Projects Completed at WPI

Many IQP and MQP activities based on topics related to assistive technology and issues pertaining to disabled persons have been completed over the years at WPI, and this overview will look at the projects that have been completed since the beginning of 1986. Eleven IQPs have been conducted at Global Project Centers, and seven IQPs have been conducted on campus at WPI. Eleven MQPs have been completed at WPI.

Many of the IQPs conducted at the Global Project Centers in recent years have dealt with Internet web access for individuals with visual impairments. Other IQPs involving software design and museum accessibility for the blind have also been conducted overseas. In the area of mobility impairments, IQPs dealing with housing accessibility and using mobile arm supports have been completed at the Global Project Centers. A list of the assistive technology related IQPs conducted at global project centers appears in Appendix A1. IQPs that were completed on location at WPI, shown in Appendix A2, have dealt with accessibility issues and job training for disabled individuals as well as other issues.

Many of the assistive technology related MQPs that have been submitted by the mechanical engineering department since 1986 have dealt with designing assistive accessories for wheelchairs such as bumpers, trays, suspension systems, and joysticks. MQPs involving other areas of assistive technology include the design of powered arm orthoses, an adaptive feeding device, and a walker. A complete list of these MQPs appears in Appendix A3.

The following three sections give detailed descriptions of several of these previous projects including an IQP completed at WPI, four IQPs completed at Project Centers, and an MQP completed at WPI. These projects were selected to illustrate the wide range of projects that have been completed through the Projects Program at WPI and at the various Global Project Centers. By observing the differences between these projects, the need for more coordination in regard to assistive technology projects can be seen. This will be discussed further in section 3.2.

3.1.1 IQPs Completed at WPI

97D005I: Assistive Technology in Public Schools

This project analyzes the role of assistive technology in a public school system. The delivery of assistive technology in this system is the focus of the project. The availability of assistive technology is an essential factor in enhancing educational opportunities for disabled students. Assistive technology allows disabled students to take part in mainstream schooling through the public school system. However, the expense of assistive devices, and the complexity of the system that is used to deliver those devices, impedes implementation in public school districts. This project examines the delivery of assistive technology to disabled students of specific school districts in Worcester County. The project also proposes improvements to the system, and attempts to create connections between collaborative rehabilitation programs and the Rehabilitation Lab at WPI.

The background research for this project focused on defining the various disabilities of students that the Worcester County school districts are faced with, and the factors involved with implementing assistive devices for each disability. The disabilities

that are described in the project are hearing disabilities, visual disabilities, physical disabilities, and learning disabilities. Also examined in the background research are the regulations imposed on the school districts by the Individuals with Disabilities Education Act, which states that public school districts must ensure that assistive devices and services are available to disabled children.

The data collection portion of the project focused on using surveys and interviews to gain more information on the delivery of assistive technology for each specific school district. The survey focused on the finding specific information in the following areas: (1) the types of assistive devices and services that are currently used, (2) the problems with the current assistive technology, (3) the needs for new assistive technology, and (4) names of contacts that could provide more information on the delivery of assistive technology to Worcester County school districts. The interviews were done with some of the contacts that were found from the surveys. The interviews were focused on: (1) the number of students that had a specific disability and the devices that the students received, (2) the criteria used by the school district to determine what assistive devices and services are provided to the students, (3) the method that the district used to maintain its assistive devices, (4) the staff involved with services relating to assistive technology and (5) the source of funds for any assistive technology related services.[1]

From the surveys and the interviews, information was gathered to make some of the following conclusions: (1) there are several problems associated with the lack of storage space for assistive devices, (2) there is a lack of appropriate computer equipment for many disabled students, and (3) there is a problem with the fact that students have to wait up to a year before receiving assistive devices.[2] The interviews also revealed that

most of the assistive devices that were provided by the school districts were wheelchairs and visual assistive devices, and that a combination of doctors, manufacturers, and collaborative programs decided which types of assistive devices and services that the districts would provide.[3] The report authors suggested that there needs to be more central planning in the assistive technology programs at the school districts, and this could be improved with the addition of a database that would contain a broad range of assistive technology information. The authors also suggested that colleges in the Worcester area could work on designing and customizing assistive devices, to relieve some of the burden on the school districts.

3.1.2 Description of IQPs Completed at Project Centers

96D006I: Studying the Handicapped Residents of Klong Toey

Rapid industrialization after WWII has caused overpopulation in Bangkok leading to the development of slum communities such as Klong Toey where handicapped people are neglected and discriminated against. Klong Toey is the largest slum district in Bangkok, and Port Authority workers, who wanted to be close to their jobs, established it in the 1940's. The low cost of living and the constant availability of work have attracted many people to Klong Toey. The "disabled individuals in Thailand face three major obstacles: a lack of access to public facilities and services, denial of the opportunity to work, and existence as invisible entities."[4] This project investigated the discrimination of disabled individuals and made recommendations for defeating this discrimination and improving the lives of these individuals.

The Duang Prateep Foundation sponsored this project, and it is located right at the center of Klong Toey. The five main interests of this organization are education, health,

social services, human development, and emergency relief. One of the major goals of the Duang Prateep Foundation is to obtain registrations for slum residents, which allows them to receive electricity, water, and the right to enroll their children in school. The Foundation also coordinates a special education program for hearing impaired children from ages five to eleven.

The literature review for this project involved gathering information about the economic status of Thailand, researching disabilities and their symptoms, and reading newspaper clippings, the Thailand Rehabilitation of Disabled Persons Act, and an Americans with Disabilities Act pamphlet. The Thailand Rehabilitation of Disabled Persons Act states that disabled citizens must be registered at the Department of Public Welfare to receive medical rehabilitation services, education for their children, and the same services as any other citizen.

The first step of this project was to develop an understanding of the various disabilities present in Klong Toey with a survey. The survey conducted by this project team established five categories of disabilities that exist in Klong Toey, and these categories are visual impairments, hearing impairments, muscular impairments, physical deformities, and mental impairments. The survey was conducted with a questionnaire that was designed to collect information on factors such as level of education, age, cause of disability, and time of disability onset. In order to begin the survey, the team had to receive permission from slum community leaders. A statistical distribution was plotted for all of the different disabilities that were found.

The next step in the completion of this project was to get a third person view of the disabled in Thailand, which was accomplished through meetings with government

and non-government organizations. Members of the project group requested information about programs designed to assist the disabled from these organizations.

The final step in this project was to analyze newspaper clippings to get a feel for public opinion towards the disabled population of Thailand and to analyze the Thailand Rehabilitation of Disabled Persons Act to show how the government has dealt with the disabled population. The people of Thailand feel that the disabled are "to be hidden from society."[5] This stems from the Buddhist belief that people who commit wrongs in a previous life are punished with the onset of disabilities. The disabled are "pitied due to their apparent inability to serve a useful purpose."[6] This attitude leads to the perception that the disabled are unable to work, and therefore education of the disabled is considered pointless. Also, the disabled population is not seen in the major cities due to accessibility issues so their needs are considered unimportant. The general public feels that money would be wasted on access and facilities for the disabled. The government doesn't make much of an effort to pass legislation for the disabled. All of these factors together lead to the following situation: "an absence of education, social interaction, and vocational skills stunt the growth of a handicapped individual such that they become little more than grown up children."[7]

There are several difficulties that the disabled residents of Klong Toey must face. The alleys are narrow and uneven, and the bridges are unstable therefore mobility aids are useless. The houses are very small and cannot accommodate any special assistive mechanisms. Also, the low income of these disabled individuals prevents them from receiving adequate medical attention.[8]

As a result of the research completed during this project, the project team made several recommendations concerning the disabled residents of Klong Toey. The team first recommended that the Duang Prateep Foundation should work to raise the level of awareness concerning the needs of the disabled. The second recommendation for the Foundation was to notify the disabled about services and accommodations that already exist. The third and final recommendation was to initiate a prevention campaign to reduce the occurrence of disabilities due to birth defects. These recommendations could be fulfilled with the distribution of information to the disabled residents of Klong Toey and their families. According to the project team, the best way to accomplish this would be with information packets that could be distributed by the Duang Prateep Foundation.[9]

97D013I: Klong Toey Slum Outreach Program

This IQP is a continuation of the project discussed above, and the Duang Prateep Foundation also sponsored it. The two objectives of this project were to make the physically disabled residents of the Klong Toey slum community aware of services that were available from the Thai government and to make pregnant women living in the slum more aware of the importance of prenatal care.[10] In order to receive any services, disabled residents in Thailand must register with the government as discussed above, and they must have a government-approved form of identification to register, which is difficult for them to obtain. This identification includes a medical exam, an identification card, and a housing certificate. At an informational forum held at the Duang Prateep Foundation at the completion of this project, the chairman of the Association for the Physically Handicapped of Thailand proposed a self-help alliance for the physically disabled residents of the slum. The Duang Prateep Foundation was able to convince the

Department of Public Welfare to bring workers to the slum to register people with the government to make the process easier. To make pregnant women from the slum more aware of the importance of proper prenatal care, the causes of birth defects in Thailand were researched and incorporated into posters and pamphlets by the project team to be distributed to women in the slum by the Duang Prateep Foundation.[11]

The procedure for the completion of this project involved conducting interviews concerning prenatal care and services available for the physically disabled and then designing informational campaigns for both objectives. The aspect of this project regarding the physically disabled required students to determine available services, inform residents about these services, and develop a means to make these services accessible. The aspect of this project regarding proper prenatal care required students to establish the major causes of birth defects in Klong Toey and design an awareness campaign to promote proper prenatal care.

Upon the completion of this project, the project team made the following recommendations with regard to the work involving the physically disabled:

- Registration is difficult but should be encouraged.
- There should be more community-based rehabilitation.
- Vocational training should be available to the disabled.
- Accessibility needs to be addressed.
- A new survey of the disabled residents of the slum needs to be conducted.
- WPI and the Duang Prateep Foundation need to complete IQPs that focus on other disabilities.[12]

The project team also stated several conclusions:

- Self-help groups are worthwhile.
- The disabled can receive surgical care.
- Physical therapy equipment is needed for slum residents.

The students involved with this project had some difficulties with the language barrier because they couldn't ask their own questions during interviews, and the interviews had to be translated to English every time. The group made the following observation: "Any project conducted in a non-English speaking country not only faces language restrictions, but cultural barriers. Thailand has its own customs and mannerisms . . . ."[13]

97D253I: Training and Use of Mobile Arm Supports

This IQP was conducted in coordination with the London Project Center at the Royal Hospital for Neurodisabilities. This project dealt with the mobile arm support, which is a mechanical device that supports the hand and arm to aid the movement of the upper extremities. It allows a disabled individual to control his or her own arm movements, which makes the user more independent.[14] The design for this device was finalized in 1953 to help individuals suffering with polio in the United States. There have been several variations of this design, but the features of the original design are still prominent. The mobile arm support can be mounted to a table, a wheelchair, or a frame, and this is usually done by a trained professional such as an occupational therapist.[15] In order to use this device, the user must have at least one working muscle, a passive range of motion, and some endurance, coordination, stability, motivation, and equipment tolerance.[16]

The objective of this project was to aid Dr. Steve Cousins, the Director of Rehabilitation Engineering at the Royal Hospital for Neurodisabilities in re-introducing

the mobile arm support to the hospital by revising the training manual and producing a videotape. The students tried to assess and fit four patients with the mobile arm support for the videotape, but they were only able to completely fit one of the patients. This process is difficult because there is no formal manner for predicting successful use of the device other than by practice and experimentation. Group members hoped that the videotape and training manual would make trained professionals more aware of the potential benefits of the mobile arm support.[17] In order to create the training manual, group members reviewed material from a previous training manual that was in use at the hospital at one time.

In preparation for this project before going to London, the students involved with this project spoke with Professor Allen Hoffman about the various types of mobile arm supports that are available. They also talked with Professor Paul Davis, the London Project Center Director, to gain a better understanding of the expectations of Dr. Steve Cousins. There were some difficulties because the students thought the mobile arm support was already in use at the Royal Hospital. Group members had to reformulate the original problem statement. Through their preparation, the students also compared and contrasted the use of the mobile arm support in the United States and the United Kingdom. They found that efforts have been made in the United States to replace the mobile arm support with powered devices while interested parties in the United Kingdom have been researching improvements for the device.[18]

At the completion of this project, the students made several comments about the mobile arm support and its re-introduction to the Royal Hospital for Neurodisabilities. They claimed that the mobile arm support was the best option for the hospital, even

though they were skeptical of its potential benefits during their preparation for the project. The design is very bulky and requires the patient to be dependent on a caregiver, and this led group members to doubt its effectiveness.[19] The final observation made by the group was that the device needed to be fitted to many patients for the re-introduction to be a success.[20]

98D043I: Accessible Web Site for Dansk Blindesamfund

The Danish Association for the Blind (Dansk Blindesamfund) sponsored this project, and it was completed in conjunction with the Copenhagen Project Center. Individuals with visual impairments hold all of the positions in the organization, and individuals must have a visual impairment to become a member. The Association was founded in 1911 and has a total of 23 branches and 12,000 members. The purposes of the Association are to influence decision making to improve conditions for its members, to provide financial support to blind individuals and other associations that aid the visually impaired in third world countries, and to eliminate ignorance and prejudice related to visual impairment. Other services offered include consulting, advising, care taking, education, and recreational activities.[21]

The main goal of this project was to develop a portion of the web site that the Danish Association for the Blind was constructing while keeping accessibility and ease of use for the visually impaired in mind. The portion of the web site that the students were supposed to construct involved establishing a list of links to other relevant web sites of interest to the visually impaired so that they would have access to current information concerning their disability.[22]

In preparation for their trip to Copenhagen, members of the project group investigated how visually impaired individuals use computers and the web. They were able to do this by working with Michael Gorse, a visually impaired computer science major at WPI. He gave the students information and showed them his own computer equipment, and he also told the students about the etiquette for working with the visually impaired.[23]

Upon arriving in Copenhagen, the students working on this project interviewed Poul Luneborg, the President of the Danish Association for the Blind, to determine the desired outcome of the web site for the Association. In order to collect technical data for the project, group members had to interview people with experience with web access for the blind, and they had to search the web and evaluate the accessibility of current web sites for the blind.[24] By evaluating the accessibility of current web sites for the blind, group members created separate lists of web sites that were accessible to the blind and those that were not. At the end of the project report, the students stressed the importance of "cooperation from software and web authors to make information accessible to the equipment used by the blind."[25]

3.1.3 MQPs Completed at WPI

98D348M: Powered Arm Orthosis

This project explored the design of powered mechanical arm orthosis, focusing on helping people with DMD (Duchenne's Muscular Dystrophy). The project was sponsored by the Massachusetts Hospital School, with a goal of designing a powered arm that would enable people with DMD to grasp nearby objects and perform some rudimentary grooming and feeding activities. The background research performed for

this project focused on the physical effects of DMD and three other specific areas: the human interface, the surrounding environment, and the assistive technology that is to be designed. The human interface of the project was determined by a clinical assessment of a client with DMD, and through research on the disease itself. The information gained from this research allowed the students to have a better idea of the specific needs of the powered arm orthotic device, such as the range of motion for the client's arm, and the speed at which the client's arm can move. The environmental aspect was determined by interviews with the client, in which the students observed how the client interacted with his surrounding environment. The students also asked him questions regarding potential problems that could occur with the powered arm design. The assistive technology part of the project dealt with the device that the engineer attempted to design, and the functions that the device would be able to perform.

The research on the project was completed through an assessment of the assistive technology devices that were on the market. Research was done on mobile robots, wheelchair attachments, orthotic devices, and methods of power transmission. Research was also performed on designs that were similar to powered arm orthosis. The design of each device was analyzed, and the shortcomings of each of the designs were discussed. After the research on other devices was completed, the students followed the design process, evaluating several potential designs before arriving at their final design for the powered arm orthotic device. The project concludes with the students constructing and testing a design prototype and making recommendations for the design, citing problems with the cost of the hydraulic system, and the lack of synchronization between the motion of their device and the motion of the client's arm.

3.2 Coordination Problems with Assistive Technology Projects

Some individuals involved with assistive technology projects believe that a lack of coordination exists between students, advisors, sponsors, and center directors. New assistive technology project groups working on IQPs are not able to benefit from the lessons learned by previous project groups. Another problem with the projects program stems from the fact that only IQPs are conducted at global project centers, and MQPs are not. Project teams have worked on IQPs involving assistive technology at Project Centers in other countries throughout the history of WPI's projects program. Yet, the information and experience gained through IQP activity around the world has not been applied to MQPs that develop assistive technologies for the specific social and economic conditions of developing countries. This can be observed by looking at the projects that have been completed at WPI in the area of assistive technology. The Project Centers are now beginning to coordinate their projects by conducting projects with similar topics at different Centers.

3.3 Potential Opportunities for Assistive Technology Projects

There are numerous ideas for assistive technology projects that engineer devices for disabled individuals in countries around the world, but under the current system most of these ideas go unrealized. Very little project activity involving service delivery of assistive technology in developing countries has been conducted, but this area could provide vast amounts of useful information for students, advisors, project center directors, and project sponsors. The major controlling factor of service delivery, which is unique for each and every region of the world, is the degree of practicality that an assistive device demonstrates in its surroundings. New assistive technologies can be

developed to meet a certain need, but these technologies will be useless if disabled individuals do not understand how to use them, cannot afford them, or cannot maintain them. Once the mechanism of service delivery is determined for a specific region of the world through IQP activity, specific assistive devices can be explored through MQP activity.

3.4 Previous Work and Available Resources

There has not been any previous project activity involving the development of an assistive technology resource center at WPI that would provide information and support for project teams comprised of students, advisors, and sponsors. On a worldwide basis, there are several potential resources available to study the development of an assistive technology resource center for WPI. These resources are previously completed project reports involving assistive technology, assistive technology resource centers at other colleges and universities, and the students, advisors, Project Center coordinators, and Project Center directors that have been involved with assistive technology projects at WPI.

Another set of resources involving assistive technologies around the world is made up of worldwide web pages for disability and assistive technology organizations that are located on the Internet. A list of several web pages for organizations based in the United States appears in Appendix A4, and Appendix A5 lists several web pages for international organizations. These resources are discussed further and analyzed in chapter 5.

3.5 Interviewing Techniques for Collecting Information

Previous project reports represent the final, tangible product of a project that has been completed, but the most important information regarding the trials and tribulations that were encountered during the completion of a particular project must come directly from the students, advisors, and directors. To obtain this information, interviewing techniques were required, as well as a means to analyze the information once it was obtained. These interviewing techniques are qualitative interviewing and focus groups, and they are discussed below. These techniques were selected because they do not require a strict line of questioning, but rather they allow different questions to be posed based on the answers given by the interview subjects. The specific questions are also open-ended and allow the interview subjects to reflect on past experiences. Past experiences with the Projects Program at WPI were required for the completion of this project.

3.5.1 Qualitative Interviewing

Qualitative interviews are flexible and probing interviews in which the interviewer is able to modify later questions depending on how the interviewee answers earlier questions in order to elaborate on responses, to explore insightful lines of questioning, or to follow-up previous questions. The questions asked in qualitative interviews are open-ended and designed to produce detailed, real-life stories about the interviewee's experiences. "The purpose of such interviews is not to identify objective truth or to conclusively test hypotheses but to help the researcher understand the experiences of the participants and the conclusions the participants themselves have drawn from them."[26] Qualitative interviews cannot be planned out exactly ahead of time,

but it is necessary to generate a list of important topics that can be referred to during the interview. To conduct an effective qualitative interview, the line of questioning should be divided into three stages. The goal of the first stage is to establish the background of the interviewee with regard to the research subject. The second stage focuses on the current experience of the interviewee with regard to the research subject. In the third stage, the interviewee is asked to reflect on the meaning of his or her experience.[27]

There are several suggestions that are given to novice qualitative interviewers by social science researchers:

1. The interviewer should listen carefully so that follow up questions can be posed to elaborate on interesting comments and the progress of the interview can be monitored.
2. Open-ended questions that force the interviewee to give narrative answers should be used.
3. The interviewee should be aware of how many topics you plan to cover in the interview and how long the interview will last.
4. The questions should logically progress, taking previous questions into account.
5. The interviewer should avoid the use of leading questions.
6. The interviewee should not be interrupted unless he or she strays away from the topic at hand. Follow-up questions should be noted and asked when the interviewee has finished answering the previous question.
7. The interviewer must give the interviewees a chance to think about what they are going to say in response to questions, even though long pauses may result.
8. The interviewer should try to reach a balance between being casual and formal.

9. The interview should end on a positive note so that the interviewee will be available to answer future questions if they arise.[28]

The best way to preserve interview data is to tape record the interview and transcribe it at some point after the interview. This method produces an enormous amount of verbal data, and these data must be reduced to a level that the interviewers can handle. To reduce the verbal data, the parts of the interviews that are the most important, meaningful, and insightful need to be identified and extracted. A profile should be created for each interview to summarize the background, experiences, and opinions of each interviewee.[29] Then comparisons can easily be made between each of the interviewees without having to reread the entire transcribed interviews. The interviewees should be given a chance to review their transcribed interviews, profiles, and any other parts of the report that mention them as soon as they are completed so that they can catch any errors and make sure their views are accurately portrayed.

3.5.2 Focus Groups

The completion of this project may also require the use of focus groups. Focus groups are a type of qualitative interview in which a few people are interviewed at the same time in a flexible and insightful group discussion group. The most important interactions in the focus group are between the participants. Therefore, the organizer of the focus group takes the role of a moderator who should come to the group prepared with a well-thought, organized list of discussion topics. These discussion topics should follow the same order from background to detailed experiences as the questions for a qualitative interview. Focus groups are used to research people's ideas in a public setting where their reactions to each other and their thought processes can be observed. Because

focus groups are held in a public setting, the participants may hold back their true opinions. These opinions are less likely to be concealed in an individual interview. The emphasis on collecting opinions should be minimized so that the participants who are afraid to challenge others opinions will be willing to provide contradictory narratives of experience.[30] The moderator should reach some medium between adopting a hands-off approach and an approach involving complete control over the direction and content of the focus group.

The focus group should held at a rectangular or circular table so that all of the participants can see each other. The ground rules, such as speaking one at a time and not participating in side conversations, should be established at the beginning of the focus group. The participants should next be made aware of the role of the moderator and the importance of their participation. Each of the participants should then be encouraged to introduce themselves and explain their background to the rest of the group. Once these preliminary steps have been taken, the moderator should introduce the first topic. The moderator may have to intervene if everyone is not contributing equally to the discussion, the participants run out of things to say, or the participants stray away from the given topics. Each participant should be asked to consolidate his or her thoughts on the topic into a summary when the focus group is coming to an end.[31] The focus group should be tape recorded like the qualitative interview so that data analysis can be conducted. Each participant should identify himself when speaking so that they can be distinguished from one another in the tape recording. The data reduction and analysis is done in a similar manner as the data reduction and analysis of the qualitative interview, but in focus groups

the main unit of analysis is the group as opposed to the individual in qualitative interviewing.

4. Procedure

At the beginning of the research phase of this project, disability and assistive technology organizations in the United States and around the world were researched to determine the services and resources that they offer. Next, interviews were conducted with students who completed IQPs at foreign Project Centers involving assistive technology, advisors, project center directors, and a project center coordinator. These interviews were used in conjunction with the web research to determine the current atmosphere surrounding assistive technology projects at WPI and to find all of the relevant information for the successful development of our recommended model for an assistive technology resource center at WPI.

4.1 The Relationship between Technology and Society

The purpose of this project was to create a model for an assistive technology resource center at WPI that would ultimately provide a means of coordinating and supporting project activity in the disability fields between the Project Centers throughout the world and the WPI campus. By developing a network of information between the Project Center staff and faculty, the ATRC will enhance project activities in the field of assistive technology since the information gained from projects at one center can be applied to projects at the other centers. At the same time, disabled individuals in all reaches of the world have unique social and technological requirements for assistive technologies. The Center will hopefully be able to provide a means for developing assistive technologies that will take these requirements into account and raise the quality of life of these individuals. The Center will also strive to elevate the awareness and knowledge of students at WPI with regard to assistive technology.

4.2 The Functions of the Assistive Technology Resource Center

To accomplish this project, a set of preliminary functions that the ATRC might provide was developed. When all of these functions were assembled, the result was an assistive technology resource center that would oversee all assistive technology projects and anything else pertaining to them. The preliminary functions were as follows:

1. The assistive technology resource center will advertise opportunities in the field of assistive technology. It will inform students about available assistive technology projects, update available assistive technology projects, and make students aware of the needs for assistive technologies in developing nations. This should generate more support and interest in assistive technology projects.
2. The assistive technology resource center will provide information resources such as previously completed projects, currently available projects, and publications available in the field of assistive technologies.
3. The assistive technology resource center will work in conjunction with the global project centers to procure funding from WPI, sponsors, and other outside sources.
4. The assistive technology resource center will provide a means of communication between students, advisors, project center directors, and sponsors. Greater levels of communication will raise the quality of assistive technology project work and ensure that the expected outcomes are achieved.
5. The assistive technology project center will review IQPs conducted in developing countries to determine the state of assistive technologies in these countries, and the center will propose MQPs based on the results of these IQPs.

In the following chapters of this report, international and national assistive technology organizations with web pages will be researched to find which functions are currently in use at other centers. Also, the interviews that were conducted with individuals from the WPI community having experience with assistive technology projects will be analyzed to see where improvements can be made and what suggestions for the ATRC can be incorporated into the model. The research conducted in regard to the web organizations and the interview analysis will form the foundation for the ATRC at WPI.

4.3 The Interviewing Process

Students, project advisors, and Project Center directors and coordinators, who were previously involved with either IQP or MQP projects relating to assistive technology, were interviewed during C-term of 1999. Qualitative interviewing was the method that was employed throughout this process. Several focus groups were also conducted with students from project groups. The techniques for conducting these interviews involved asking direct questions to the interviewees, and formulating follow-up questions based on the responses that were given. A list of the questions that the interviews with students, advisors, and Center Directors were based upon appears in Appendix A6. The actual questions posed during the interviews deviated from this list depending on the specific interview subject.

The interviewing method for project advisors and Project Center directors were individual qualitative interviews of about 20 to 30 minutes in length. During these interviews, several open-ended questions were asked regarding the advisor's experiences with previous assistive technology project activity. The questions for the faculty advisors

focused on: (1) Their experience with assistive technology, (2) The resources that they were able to provide to the students, (3) The difficulties that they and the students encountered, and (4) The level of preparation that students should have before working on an assistive technology project. The project center directors and coordinators were asked similar questions, but they were also asked questions regarding: (1) The ability of their Centers to identify assistive technology projects, (2) The obstacles that exist in regard to trying to implement assistive technology projects, (3) The ways that assistive technology projects are funded, and (4) Their suggestions of functions that the Assistive Technology Resource Center at WPI should perform. The information gathered from these interviews helped to establish an overview of the current methodologies associated with assistive technology projects, and offered insights into the resources that an assistive technology resource center should provide.

The interviewing methods for students were similar to the methods used for advisors. The student interviews were somewhat shorter in length, usually ranging between 15 and 20 minutes. The IQP students were selected on the basis that they worked on assistive technology projects at Global Project Centers. The selected MQP students had completed assistive technology projects and were willing to be interviewed. The questions for the students focused on the following general areas: (1) The resources that they received from their sponsors, (2) The resources that they received from their faculty advisors, (3) The difficulties that they encountered during project work, and (4) An evaluation of the project experience as a whole.

4.4 Analyzing the Interviews

A tape recorder with a built-in microphone and tapes were required throughout the interviewing process. These pieces of equipment were used to record complete transcripts of the all of the interviews with students, faculty advisors, and project center directors. Analysis of the interview transcripts involved separating the interviews into five different categories. The categories were (1) IQP students, (2) MQP students, (3) Faculty Advisors, (4) Project Center Directors, and (5) Project Center Coordinators. The transcripts of the interviews from a particular category were compared to one another. The information that could be correlated to the other transcripts in the same category was extracted from each transcript. This was done in order to assure that the data collected from every interview would be consistent with the other interviews in the same category. The collected data was then analyzed to provide insights into possible functions of the ATRC and information on how some of those functions could perhaps be implemented. This information was used to form the basis of the model for the Center.

4.5 Materials

The development of the model for the ATRC required several forms of support from various areas. Throughout the duration of this project, the use of a computer with word-processing capabilities was necessary, especially to complete the final report for this project. Speech recognition software was also used to speed up the transcription of the interviews. During the research phase of this project, as previously discussed, a tape recorder and audio tapes were required to document and later transcribe the information that was gathered from the interviews with students, advisors, and center directors. Also, a computer with Internet access was required to complete the research of the United

States and International web resources. Finally, the completion of the project was dependent on the previous project reports that were found at the library.

5. Analysis

5.1 Web Resources

This section discusses the functions that are currently in use by international and U.S. assistive technology organizations and may be useful to an assistive technology resource center at WPI. The services that these organizations provide are also discussed in this section. The international organizations were identified through the use an internet search engine with keywords such as "international", "rehabilitation", "disability", and "assistive technology." The U.S. organizations were identified in a similar manner, but the keyword "international" was replaced by "United States" or left out entirely. The majority of the U.S. organizations produced by the search engine were based at colleges and universities, and the other types of sites did not contain very much useful information. Many organizations are just beginning to construct web pages, and this made searching for pages with appropriate content very difficult.

5.1.1 Description of International Web Resources

Rehabilitation International
http://194.191.63.42/
New York, New York

"Rehabilitation International is a federation of national and international organizations and agencies working for the prevention of disability, the rehabilitation of people with disabilities and the equalization of opportunities within society on behalf of persons with disabilities and their families throughout the world."[32] Founded in 1922, RI is made up of 200 organizations involved in disability prevention and rehabilitation service development in 90 nations around the world. Rehabilitation International holds official relations with the United Nations Economic and Social Council (UNESCO), the

World Health Organization, the International Labour Office, UNICEF, the Organization of American States, the European Union and the Council of Europe. RI is:

- an open forum for the exchange of experience and information on research and practice
- an advocate for policies and legislation recognizing the rights of people with disabilities and their families
- a deliberative body for change of public attitudes to encourage the equal participation of persons with disabilities in education, employment and the cultural and social life of their communities.[33]

Its membership includes governmental agencies and non-governmental organizations, including voluntary and private organizations, public and private non-profit rehabilitation providers, disability advocacy organizations, consumer organizations, self-help groups, and individuals.

The membership section of RI's site discusses the requirements for joining the organization. The new videos and publications section provides a listing of the most recent videos and publications produced by RI along with other organizations. There are also descriptions of each item. The description section provides a listing of all of the member organizations, which is in alphabetical order according to the country where the organization is located. The portfolio section contains information about the subjects or topics that RI has covered in recent years at conferences. A brief description of each topic is provided, and the corresponding links go to the full story. There are also three special sections that provide information about disability issues from around the world involving women and girls.

ATRC Home Page
http://www.utoronto.ca/atrc/
Toronto, Canada

"The Adaptive Technology Resource Centre (ATRC) is devoted to increasing the accessibility of information technology. The ATRC is involved in research and development to find innovative solutions to accessibility challenges. It also provides training, consultation, and information to help both educators and users to effectively use adaptive technology."[34] It is a national organization that focuses on researching assistive computer technologies, but it also offers services that help individuals with visual impairments obtain accessible computer equipment. This center is funded and sponsored by the University of Toronto and has an office located on the campus. The ATRC works with information technology manufacturers and developers during the early design stages to produce effective computer based technologies that will be available in the future. The ATRC focuses on the user during the design process "to model and create solutions that are commercially feasible, operationally effective, and universally accessible."[35]

This site is divided into the following sections that focus on adaptive technologies for computers: services, education, research and development, library, technical glossary, web resources, help, contact information, and vision technology service.

The goal of the service program at the ATRC is "to provide information, support, and training, which will allow individuals to make informed decisions and build the skills required to optimally employ technical tools."[36] The services are as follows: web design, consultation, and workshops and training dealing with web page editing.

The education section is described as follows: "The ATRC actively promotes inclusive design in information networks. The center works closely with educators,

government, industry, and organizational partners to increase accessibility and awareness of access issues. The ATRC consults decision-making bodies locally, nationally, and globally on issues related to access to information technology. The ATRC also provides information, demonstrations, and training in the use of access technology to educators, students, the media, and the general public."[37]

The research and development section provides a list of 15 past and current projects and their descriptions. One of these projects is entitled the "A-Prompt Project," and it was designed to make the Internet more accessible by encouraging web authors to write better documents. The library section provides links to the actual project reports that have been written by individuals at the ATRC. The technical glossary provides a list of current adaptive technologies for computers, and each link leads to a description of the technology.

The web resources section gives the user a means to branch off to several categories of web related resources on adaptive technology such as web access, corporate pages, vendors, disability organizations, university disability centers, and computer access. The resources are also categorized according to specific disabilities, such as blindness and deafness.

The Vision Technology Service is a sight enhancement and sight replacement clinic. The goal of the Vision Technology Service is "to bring people and technology together as a means of enhancing the work, school, and home life of persons with a visual disability."[38] The staff, which includes an occupational therapist, authorizes devices for the visually impaired and has access to a wide variety of alternative computer devices.

Disability Information for Students and Professionals
http://abilityinfo.com/index.html

Canada

This site is "the one stop resource for students from around the world studying to support and work for individuals with disabilities. This site is also intended for professionals within the field to continue to be sharp in their knowledge."[39] This site was constructed by Mike Peg, who is a graduate of the Developmental Services Worker Program at Georgian College in Orillia, Canada. During his years in college, he was inspired to construct this page.

The news section of this site provides news from various countries around the world. Each country is listed, and under each country heading there are articles from newspapers and magazines pertaining to various disability issues that are currently in the spotlight in each of these countries. The information section of this site provides a place for people to request specific information on disability issues. People can then receive responses from around the world in regard to their requested information. The resources section of this site contains links to pages dealing with disability resources, specialized areas in the field, disability issues, the online culture being created by disabled individuals, technical information, and featured sites. This section also contains:

- information for compiling reports and finding job opportunities
- listings of disability organizations and support groups
- medical and drug indexes pertaining to specific disabilities
- information about independent living and job opportunities worldwide
- chat rooms and message boards
- up-to-date electronic journals, statistics, and news

- an online resource directory to various commercial products and specific services offered to those with unique mobility and support needs.

The directory to products and services contains links to 3 directories of products and services on other web pages, and it also contains links to 4 companies such as Access Limited, which makes vehicles accessible for the disabled.

The discussion section of this site provides two discussion groups and a chat room. The site news section provides a description of changes that are taking place with the site and allows people to make suggestions about the site.

Association for the Advancement of Assistive Technology in Europe (AAATE)
http://www.fernuni-hagen.de/FTB/AAATE.html
Taastrup, Denmark

The mission of the association is "to stimulate the advancement of assistive technology for the benefit of persons with disabilities including the elderly people."[40] "The Association for the Advancement of Assistive Technology in Europe (AAATE) was constituted in October 1995. The inaugural meeting was held in Lisbon, Portugal, at the European Conference ECART 3."[41] The AAATE performs the following functions: "creating awareness of assistive technology, promoting research and development of assistive technology, contributing to knowledge exchange within the field of assistive technology by arranging conferences, and promoting information dissemination."[42] The AAATE also publishes a newsletter, which discusses assistive technology issues, meetings, and polices, and other publications on assistive technology issues, holds meetings, makes policies, and holds a conference every two years. The conference treats multidisciplinary problems and scientific progress. The AAATE is a non-profit association. The AAATE web site provides an archive of past publications by the

AAATE including past newsletters, information from conferences, and papers dealing with disability issues, 3 links to disability web pages, and a list of the members of the AAATE. The three links mentioned above are for RESNA, the Center on Disabilities Technology at California State Northridge, and a Danish technical institute.

Flintshire Disability Action
http://dspace.dial.pipex.com/town/parade/ni30/
Flintshire, North Wales

The Flintshire Disability Action provides "disability information, advice, resources, and development services focused on people with physical disabilities and sensory impairments in Flintshire, North Wales."[43] At Flintshire Disability Action, all of the staff and most of the volunteers have experience with disability and sensory impairment. This site is divided into the following sections: contents, disability forum, FDA services, who's who, links, care planning, awards, and news. The disability forum section "tells the ongoing story of the development of a forum for people with physical disabilities and sensory impairments in the county of Flintshire, North Wales."[44] The FDA services section lists the services that Flintshire Disability Action provides, and these are as follows: a disability help line, transcription services, disability benefits advice, development services, wheelchair loan service, and web design and host services. The links section contains links to web sites that Flintshire Disability Action has designed, hosted, or otherwise found useful. These sites include Welsh and international sites dealing with disability and technology. The news section contains a story dealing with an adaptive technology in Flintshire and a few want ads from the local market.

New Zealand and International Disability News and Resources
http://www.webview.co.nz/ccia/
Christchurch, New Zealand

The New Zealand Spinal Trust sponsors this web site, and this organization "has established a nationwide network to share information on the latest research initiatives as well as practical information, ideas, news, stories, etc. from spinally impaired people, their families and friends, so all can benefit from each other's experience."[45] This site is divided into three sections: general resources, disability resources, and adaptive technologies. The main page contains links to the latest news stories from around New Zealand regarding adaptive technologies and disability. The general resources section contains information such as a guide for writing essays, a guide to networking, and links to online courses at Wellington Polytechnic such as "Teaching Techniques for Adult Learning." This section also contains links to pages dealing with New Zealand and a guide to important telephone numbers in New Zealand. The disability resource section contains links to New Zealand and international sites in the following categories: accessible Internet, accessible travel, Know Your Rights, online shopping, and news and info sources. This section also contains a copy of the Spinal Network News, which is a disability magazine based in New Zealand. The adaptive technology section is divided into sections entitled computers for special needs and speech recognition. The speech recognition section provides links to speech recognition software and reviews of speech recognition software. The computers for special needs link goes to the page for an organization in New Zealand called Computers for Special Needs which promotes and supports the use of computer technology to assist people with special needs.

Australian Rehabilitation and Assistive Technology Association (ARATA)
http://www.iinet.net.au/~sharono/arata/
Shenton Park, Western Australia

"ARATA is an association whose purpose is to serve as a forum for issues in rehabilitation and assistive technology. Membership is open to anyone with an interest in the use of assistive technology for people with disabilities."[46] ARATA publishes its own newsletter that can be accessed from the site. The newsletter is released each season of the year, and it contains information about the organization and the web site. This site also provides a section for notices of events such as conferences. The section entitled "In the News" gives several columns regarding disability and assistive technology in Australia and around the world. There is a list of 43 links to disability web pages in Australia and New Zealand that is broken down into a state by state listing, and these pages fall into the following categories: web access, specific disability organizations, academic research, living centers, special education, and disability information. There is also a set of links to 9 international sites dealing with disability and assistive technology including RESNA and a set of links to 16 manufacturers and suppliers of assistive devices. Any interested individuals can obtain the latest information about ARATA by signing up for the electronic mailing list.

VICNET Disability Page
http://www.vicnet.net.au/disability/
Victoria, Australia

"This page is concerned with the many issues surrounding disability in today's world. It provides links to Victorian, Australian and world sites carrying information on a whole range of disability areas and issues."[47] This web page is sponsored by Victoria's Community Network (VICNET). The access tools and software section provides links to Australian and worldwide sites that produce hardware and software for people with disabilities which enables them to use the Internet and their own computer to its fullest.

This section also provides a list of national organizations that may be able to help with computer hardware and software for people with disabilities. The section entitled "Designing an Accessible World" provides a list of links to aid in the development of computers that are accessible for disabled individuals. This site also provides two newsgroups regarding disability that can be accessed from the site.

Disability North
http://www.nagd.org.uk/dnorth.htm
Newcastle, United Kingdom

Disability North is "a charity working with and on behalf of disabled people."[48] When it was established in 1972, it was called the Newcastle Council for the Disabled. The formation and development of Disability North was an effort in which there was a lot of teamwork between the public sector and voluntary organizations. It is based at the Dene Centre, which was built to provide a range of services for the disabled and their families, and it serves the northern region of the United Kingdom. Disability North is a charity, so it is not part of any health or local authority. Because of this, it is very independent. "However, all of its services are used, either directly or indirectly, by these statutory authorities, which at present award us grants covering 40% of the total cost of the services that we provide on their behalf, and Disability North raises money to cover the rest of the cost."[49] The mission statement of Disability North is as follows: "We offer a range of consumer led services to provide people with access to professional and independent information, advice, advocacy and education on issues relating to disability. By providing these services we will influence and change policy to further empower disabled people."[50]

The services provided by Disability North are information and advice, advocacy, display and demonstration, teaching and training, resource library, and conference and meeting rooms.

The information and advice service provides a support staff for consultation in Social Services, Health Services, disability groups, self-help groups, local advice services, and students from various educational facilities. Disability North provides information and advice on assistive equipment and other products that allow people to perform everyday activities in the presence of disabilities including specific information about items of equipment, manufacturers, suppliers, and information to help people receive equipment through the statutory and private sectors. Advice is also available on building designs that meet the requirements of disabled people at home, at work, or during times of leisure.

Disability North has a wide variety of current assistive technologies for purposes of display and demonstration that enable clients to discuss and try many different products at one location. The areas of equipment include "seating, wheelchairs, kitchen, bathroom, bedroom, toilets, stair lifts, children's equipment, equipment for people with a sensory impairment, and an outdoor mobility area."[51] The staff provides information on different options for obtaining equipment, and in certain cases they can help raise money to allow clients to buy equipment that would otherwise be impossible for them to get.

The resource library contains information on equipment and building design, self-help groups and organizations, and reference material on many disability issues. There are many databases available for people to use in the library.

Disability Scotland
http://dis_scot.gcal.ac.uk/

Edinburgh, Scotland

"Disability Scotland aims to be the national representative voice of the disability equality movement in Scotland. We undertake information exchange, policy development and joint action to achieve the full inclusion of disabled people in society."[52] The aims of this organization are:

- to advance the aims of Scotland's disability sector
- to expand the bounds of disabled people's experiences and equality of opportunity
- to be a central focus for information exchange, the development of policy and strategic intervention
- to develop and improve the scope of disability networks across Scotland
- to encourage the development of user led services which empower disabled individuals to manage the organization effectively and efficiently.[53]

Disability Scotland is also a national charity on disability and it strives to improve mobility and transportation for the disabled.

News from the Indian Medical Scene
http://www.healthlibrary.com/news/index.htm
Bombay, India

This web page is sponsored and maintained by HELP, which is a consumer health library. This site presents the reader with a "weekly news capsule of what's happening in the world of Indian medicine. Each capsule is drawn up from various Indian publications both with and without a web presence."[54] This site has also maintained an archive of previous issues for reference. The news in these capsules deals with issues such as surgery, diseases, new clinics, general health, and specific disabilities. There is a search facility that allows the user to search for a particular topic in a more convenient fashion.

5.1.2 Analysis of International Web Resources

There are three missions that the international web resources strive to fulfill: to provide services, to provide advocacy, and to provide information. Each of the international organizations falls into one or more of the mission categories. Regardless of the mission of the international organizations, each of them has featured services and resources that have been useful to individuals seeking knowledge on the subjects of disability and assistive technology. Several of the services and resources are employed by more than one of the described web pages. A summary of these services and resources appears at the end of this section in Table 5.1. Some of these features could be included in the model for the assistive technology resource center especially if a web page is designed to keep interested people and organizations updated with the latest information about the center.

Disability North and Flintshire Disability Action are service oriented web pages and organizations. Disability North offers consumer services that provide disabled individuals with information, advice, advocacy, assistive technology demonstrations, and education on disability issues. Flintshire Disability Action provides services such as the help line, transcription, advice, development services, wheelchair loans, and web design for disabled individuals.

ARATA, Disability Information for Students and Professionals, VICNET, and New Zealand and International Disability News and Resources are information oriented web pages and organizations. ARATA is a forum for rehabilitation and assistive technology issues, and its intended audience is anyone who is interested in the use of assistive technology by disabled individuals. Disability Information for Students and

Professionals is a comprehensive resource for students studying to work with disabled individuals and professionals trying to keep their knowledge up to date. VICNET provides information on a wide range of disability issues and appears to be aimed at disabled individuals and service providers of computer accessibility technology. New Zealand and International News and Resources share the latest research information, ideas, news, and stories from individuals with spinal injuries so that they can learn from one another.

ATRC is oriented toward both information and service. The goal of ATRC is to increase the accessibility of information technology through training, consultation, and information for educators and users. The services offered are web design, consultation, workshops, and training.

AAATE, Rehabilitation International, and Disability Scotland are advocacy oriented web resources and organizations. AAATE focuses on the advancement of assistive technology for the benefit of disabled individuals, and it promotes awareness, research, information exchange, and the distribution of information. The goal of Rehabilitation International is to work for the prevention of disability and the rehabilitation of disabled individuals and to give disabled people and their families equal opportunities. Rehabilitation International exchanges research experience and information, and it is an advocate for policies and legislation. Disability Scotland is the national representative of the disability equality movement in Scotland.

The most common feature that can be found in the international web resources is a list of links to other web pages related to disability and assistive technology. Six of the eleven described web pages have links to web pages in the country where the page is

based and links to international web pages. Three of the organizations have separate listings for national and international web pages. ARATA further organizes its links by breaking them down into categories for each state in Australia and New Zealand. Three other organizations have mixed listings for national and international web pages. ATRC has organized its links into categories for specific disabilities. While New Zealand and International Disability News and Resources provides links to web pages dealing with any type of assistive technology, ATRC and VICNET provide links to web pages dealing strictly with computer accessibility issues. AAATE contains links to only international web pages.

Another common feature that is found in the international web resources is a list of news columns dealing with disability and assistive technology. Two of the described web pages provide news articles from the country where the web page is based and news articles from international sources. ARATA contains a mixture of Australian and international articles on disability and assistive technology. Disability Information for Students and Professionals provides the most comprehensive list of international news articles. The articles are organized into categories by country including a category for Canada where the web page is based, and there is also an archive of past articles. Three of the other web pages provide news articles, but these articles only deal with issues and occurrences in the country where the organizations are based. News from Indian Medical Scene submits a weekly news capsule to the web page, and the index of articles is searchable including past news capsules.

A less common feature that is available from the international web resources is a newsletter that is released periodically and contains information about the organization

sponsoring the web page and the web page itself. Three of the described web resources publish a newsletter. The newsletters from ARATA and New Zealand and International Disability News and Resources can be accessed from the web pages, and the AAATE newsletter can be obtained by joining a mailing list.

Another uncommon feature is the use of archives or lists of publications and research interests that have been covered by the respective organizations that sponsor the international web pages. Three of the described web pages provide such information. AAATE provides an archive of its past publications. ATRC gives a listing of past and current projects and their descriptions. Rehabilitation International provides both a list of its publications and videos with descriptions and a list of its past research topics and their descriptions.

There are two other features that are each common to only two of the described web pages, and these are lists of member organizations and resource libraries. Both AAATE and Rehabilitation International provide a list of the organizations that support their causes. Rehabilitation International has a section containing an alphabetical list of its member organizations according to which country they are located in. ATRC and Disability North maintain resource libraries, but their libraries contain different types of information. The ATRC resource library provides links to the most recent research papers completed at ATRC while the Disability North resource library provides information on equipment and building design, organizations, and reference material on disabilities, but the Disability North resource library is not accessible from the web.

There are also several useful features in the international web resources that are common to only single web pages. ARATA offers a notice of events in which the

organization will be participating so members will stay informed of meetings and conferences that they should attend. ATRC has a technical glossary that provides descriptions and illustrations of several current adaptive technologies for computers. The New Zealand and International Disability News and Resources web page has a section containing general resources such as a guide for writing essays. This page also gives the reader the ability to read reviews of speech recognition software and download this software if desired. Disability Information for Students and Professionals allows readers to request specific information on disability issues and receive responses from around the world. This could be a useful tool for obtaining firsthand disability and assistive technology information from specific countries around the world.

Table 5.1: Services and Resources Provided by the International Organizations

Organization	Services and Resources Provided by the Organizations						
	Links to International and Regional Web Pages	International and Regional News Columns	Regional News Columns Only	Periodic Newsletter	Publication and Research Archives	Listing of Member Organizations	Resource Library
Rehabilitation International					x	x	
ATRC	x				x		x
Disability Information	x	x					
AAATE	x (international only)			x	x	x	
Flintshire Disability Action	x		x				
New Zealand News and Resources	x		x	x			
ARATA	x	x		x			
VICNET Disability	x						
Disability North							x
Indian Medical Scene			x				

5.1.3 Description of United States Web Resources

Washington Assistive Technology Alliance (WATA)
http://wata.org/wata/index.htm
Spokane, Washington

This site gives an overview of the Washington Assistive Technology Alliance (WATA). This organization is a consumer advocacy network that includes the AT Resource Center at the University of Washington (ATRC), the AT Resource Center at Easter Seals Society in Spokane (EATRC), and the Washington Protection and Advocacy System (WPAS). WATA is supported by a grant from the National Institute on Disability and Rehabilitation Research (NIDRR) and enjoys the guidance of a Consumer

Majority Advisory Board. The web site includes: the organization's information resources, resources on consultation and training related to the selection of assistive devices, legal advice and advocacy, policy development and legislative action, technical consultation, and training publications and other online resources.

Assistive Technology @ Shepherd Center
http://www.shepherd.org/SERVICE/ASTTECH/Index.htm
Atlanta, Georgia

This web site describes the Shepherd Center's Assistive Technology Center, located in Atlanta. The center is a multi-disciplinary group that provides services for disabled clients. The site gives a description of these services, which include providing rehabilitation devices, customizing rehabilitation devices, and providing information on computers and electronic devices related to assistive technology. The Center also offers an adaptive driving program that includes driver assessments, driver training, equipment recommendations, and follow-up services. The end of the site contains contact information for the Shepherd Center and the Assistive Technology Center.

Center for Assistive Technology (University of Pittsburgh)
http://pft5xx36.ft90.upmc.edu/RTP/CATHP.html
Pittsburgh, Pennsylvania

This site gives a description of the University of Pittsburgh's Center for Assistive Technology (CAT). The Center provides assistive technology services that assist individuals with disabilities and their families in obtaining appropriate interventions. The goal of the Center is to enhance the ability of people with disabilities to fulfill life goals through the coordination and provision of appropriate assistive technology services.[55] The site provides a detailed list of the services that the center provides, which include the custom designs and modifications of assistive devices. The site also includes contact

information for the Center, the rehabilitation engineer, the machinist, and the medical director.

Center for Rehabilitation Technology (Georgia Tech)
http://www.arch.gatech.edu/crt/crthome.htm
Atlanta, Georgia

This site describes the Center for Rehabilitation Technology at Georgia Tech University. The Center provides support to individuals of any age with disabilities within the State of Georgia and beyond through expert services, research, design, technological development, information dissemination, and education. The application of these resources is intended to enable maximum freedom of access to opportunities and the environment and active participation in all aspects of life.[56]

This web site offers information on the Center's various areas of expertise. These areas include: an accessibility studies group, a computer access laboratory, a design group, information technology training, a lifelong learning network, a statewide technology assistance program, and a program called *Techknowledge*, which provides information to the public on the subject of assistive technology.

The Accessibility Studies Group at the Center: identifies accessible environments for people with disabilities, provides guidance in the implementation of accessibility-related accommodations, disseminates information about the Americans with Disabilities Act, provides interpretations of ADA with reference to specific environments, and promotes accessible environments through education and training. The Center's Computer Access Laboratory provides services such as: addressing major problems of computer access through research and development, disseminating information about computer technology to service providers, establishing interdisciplinary exchanges to

transfer new technology to the rehabilitation industry, and introducing a barrier-free education program to include students with disabilities in science and math classes. The Center's design group focuses on the design and evaluation of adaptive equipment and facilities. The Information Technology Training Program seeks to develop sufficient computer literacy for its disabled students to increase accessibility to other levels of education and other avenues of life where technology is one of the principal means of participation. The Lifelong Learning Network supports the literacy objectives of the State of Georgia through the development and integration of multimedia tools and training, and through qualitative and quantitative research. The Statewide Technology Assistance Program aims to facilitate and promote the use of assistive technology to its customers.[57]

This site also contains several links to assistive technology resources. These links include CRT news (a site that provides updated information on new programs in the center), UCPA (United Cerebral Palsy Association), SE DBTAC (Southeast Disability and Business Technical Assistance center as part of the UCPA), and a listing of other related assistive technology web sites.

Comprehensive Assistive Technology Center (Mississippi State University)
http://www.msstate.edu/dept/tkmartin/
Mississippi State, Mississippi

This is the site for the Center for Technology and Disability at Mississippi State University. The Center is aimed at maintaining a clinical, research, and training facility for assistive technology in order to improve the functional capabilities of the disabled community. This web site describes the services of the Center, which include: an augmentative and alternative communication program (utilizing computer-based

technologies to assist those with communication-based disabilities), an adaptive computer access program (providing adaptive computer interfacing devices to those with physical disabilities), an adaptive driving program (evaluating the driving capabilities of physically disabled clients and recommending vehicle adaptations). The Center also recommends adaptations for the seating and mobility of wheelchairs, and adaptations for more comfortable accommodations in the home or office. The Center provides assistive devices for the visually and hearing impaired and recommends adaptations for those with learning disabilities. Other services offered by the Center involve evaluating those who have suffered brain trauma. The Center's web site also contains links to a number of its staff members' home pages.

Disability Publications
http://cosmos.ot.buffalo.edu/www_azte/publication.html
Buffalo, New York

This is a site provided by AZTech, Inc., a marketing service specializing in assistive technology. The service provides "an established network with access to over 80,000 consumers, clinicians, health care professionals, and technical and industry experts."[58] The site contains various information sources on assistive technology and provides links to several others. The site itself contains a listing of assistive technology journals and an outline of the book, Assistive Technology for Persons with Disabilities, which contains information on various services and devices that are available to disabled persons. The links contained on the site include: NARIC (The National Rehabilitation Information Center web site containing a large database of information on federally funded rehabilitation research projects and published books and journals relating to assistive technology), TeamRehab (a magazine web page containing information on

products and services), Technology and Disability (communicating knowledge about the field of assistive technology devices and services), and Elsevier Science (a web site containing journals that "communicates knowledge about the field of assistive technology devices and services"[59]). This site also has a page of links to other assistive technology resources such as: government agencies and sponsored programs in assistive technology, Assistive Technology Marketplace Resources, and links to other disability sites.

East TN Technology Access Center
http://www.korrnet.org/ettac/
Knoxville, Tennessee

This is the web site for the East Tennessee Technology Access Center whose goal is "expanding opportunities for people with disabilities through innovative uses of technology."[60] This site describes the services provided by the Center, which include: equipment and software demonstrations of assistive technologies, consultations and evaluations for individuals, families, schools, and other agencies, workshops and training, curriculum modifications, adaptations of work sites, hardware, software and toys, loans of hardware, toys and assistive devices, information on ADA, laws and community services, and advocacy and funding information. This site also contains several useful links to assistive technology sites, including The National Organization on Disability, The Alliance for Technology Access (an organization providing access to assistive technology for its clients), and Medical Equipment Exchange (a site "linking buyers and sellers of used medical equipment). This web site also provides contact information for the Center and publications from their newsletter.

Institute on Disability (University of New Hampshire)
http://iod.unh.edu/
Durham, New Hampshire

This is the site for the Institute on Disability at the University of New Hampshire. This organization attempts to: "train students, families, people with disabilities, professionals and others through coursework, seminars, workshops and conferences; develop model projects to demonstrate new ideas and approaches, providing technical assistance to assist organizations and individuals; serve as a resource to policymakers and government officials to influence policies that affect people with disabilities; conduct applied research to better understand and address the needs of individuals with severe disabilities; engage in collaborative activities and joint projects with organizations which share common goals; disseminate information to families, consumers, community personnel and professionals through books, monographs, articles, videos and newsletters."[61] The Institute is overseen by a Statewide Advisory Committee of individuals with disabilities, family members, professionals, and community members. The Center also works on projects for the disabled in the fields of education, leadership, career enhancement, and housing assistance. This web site offers links to seminars and conferences at the University, as well as publications that the Center has produced.

NEAT Assistive Technology Resources (University of Delaware)
http://www.asel.udel.edu/neat/Resources.html
Wilmington, Delaware

This is the web site for NEAT (Network for Education and Assistive Technology provided by the University of Delaware) whose goal is to "educate people with disabilities, their families, and educators about what assistive technology devices are available, and how to find these devices."[62] This site is basically a listing of different web sites that are related to assistive technology, such as NARIC (National Rehabilitation Information Center), CSUN Center on Disabilities, and AbleData. The site also contains

contact information (addresses and phone numbers) for several other organizations such as RESNA (Rehabilitation Engineering Society of North America), NIDRR (National Institute on Disability Research and Rehabilitation), and NRA (National Rehabilitation Association). This site offers access to list servers, (provided by several different universities) which people can access though email to acquire additional information on assistive technology.

Assistive Technology On-line (University of Delaware)
http://www.asel.udel.edu/at-online/organizations/
Wilmington, Delaware

This is another web site provided by the University of Delaware that is similar to the one for NEAT, but it contains links and descriptions of assistive technology organizations instead. The links are separated into the categories of general membership-based organizations, professional societies, and consumer-oriented organizations. Some of the general membership-based organizations include ATRA (Assistive Technology Resource Alliance), RESNA, Rehabilitation Technology Associates, and The Tetra Society of North America (recruits skilled volunteer engineers and technicians to create assistive devices for people with disabilities). The professional societies include APTA (American Physical Therapy Association), ASHA (American Speech-Language-Hearing Association), and AOTA (American Occupational Therapy Association). And the consumer-oriented organizations are Carolina Connection (Partnerships in Assistive Technology's (PAT) online service dedicated to providing access to "cutting edge" assistive technology information to improve independent functioning in daily living skills, employment, and leisure activities), and DREAMMS for Kids, Inc. (a non-profit

parent and professional service agency, that specializes in assistive technology related research, development, and information dissemination).

International Center for Disability Information (University of West Virginia)
http://www.icdi.wvu.edu/Others.htm
Morgantown, West Virginia

This is a web site called "Untangling the Web, Where Can I Go to Get Disability Information" provided by the University of West Virginia that contains hundreds of links to assistive technology related sites. The links are separated into several different categories, some of which include, Assistive Technology Resources, Medical Resources, General Information Resources, Information Technology Resources, Resources on Orthopedic Disabilities, Disability Legislation, Employment Resources, Visual Disability, Hearing Disability, Recently Added Sites, Other Disability Resources, Accommodation Search Systems, and Other Lists of Links.[63]

Technology and Assessment Center (University of Wisconsin-Stout)
http://www.chd.uwstout.edu/svri/atac.html
Menomonie, Wisconsin

This is the homepage for the Stout Vocational Rehabilitation Institute, a campus-based rehabilitation operation at the University of Wisconsin-Stout. "The Institute provides a wide array of continuing education training, research, informational resources, as well as direct services to people with disabilities. The mission of the Institute is two-fold: 1) to improve the quality of life for people with disabilities, and 2) to prepare students enrolled in the Vocational Rehabilitation majors at UW-Stout to become highly qualified professionals serving people with disabilities." The Center provides "service, in-service training, research and education in the fields of rehabilitation technology."[64] The Center also provides services to disabled clients that include improving work site

accommodations, providing ergonomic reviews, and performing computer assessments. The site describes the training programs and educational offerings of the center, as well as contact information for the Center's staff members.

Center for Assistive Technology (University of Buffalo)
http://wings.buffalo.edu/ot/cat/index.htm
Buffalo, New York

This is the web site for the University of Buffalo's Center for Assistive Technology. The Center provides assistance to disabled students and provides educational opportunities to students and professionals in the field of assistive technology. The Center also introduces projects involving technology transfer utilizing funds from their project sponsor, NIDRR. The link to the technology transfer project contains several other links to assistive technology information resources, such as NARIC, CODI (Cornucopia of Disability Information), RESNA, CRERO (Coalition of Rehabilitation Engineering Research Organizations), and The Assistive Technology Transfer Network.

Trace Research and Development Center (University of Wisconsin-Madison)
http://www.trace.wisc.edu/about/welcome.html
Madison, Wisconsin

This is the web site for the Trace Research and Development Center, which is an organization developed by the University of Wisconsin-Madison that improves access to computers for people with disabilities. The Center works on projects involving universal design of the World Wide Web, information transaction machines, and telecommunications. This site contains information on the recent projects completed by the Center. It also contains information about universal design, and several links to other disability groups throughout the country, such as RESNA, AbleData, WebAble, AAES

(Association of Access Engineering Specialists), CAST (Center for Applied Special Technology), Center for Universal Design, and CSUN. Another information resource on the site is a cooperative electronic library, which provides access to hyper-ABLEDATA (search engine for rehabilitation products) and various media and publications relating to assistive technology, including REHABDATA, CART (Assistive Technology for Kids), and the journal of visual impairment and blindness. This site also contains recent publications of the Center, contact information for the Center, and a search engine for the entire site.

5.1.4 Analysis of United States Web Resources

The United States assistive technology web resources described in section 5.1.3 are of two primary types. These sites are either designed to describe service-related organizations, or intended to provide information resources relating to assistive technology. The service sites primarily describe the different services of the organizations and the availability of those services to the public. These sites provide contact information for the organization, and in some cases, direct contact information for the members of its staff. Some of these service organizations also provide legal information, and information on advocacy and funding. The information resources are mainly links to different assistive technology sites, and other sites that could provide background information relating to assistive technology. One of the information web resources is a site for an advocacy group, and the site contains links to assistive technology information. Some of the web sites for service organizations also provide links to different information resources, so those sites would fall under both categories. Some of the sites contain a variety of useful information while others provide information

that is more specific to the services of a particular organization. A summary of the services and resources provided by the United States web resources appears in Table 5.2 at the end of this section.

There are three different web sites mentioned in section 5.1.3 that are service and research related. These sites also provide information resources on assistive technology. The site for Georgia Tech University's Center for Rehabilitation Technology provides services for disabled individuals such as improved computer accessibility, and the fabrication and design of customized assistive devices. The site also describes the research that takes place at the center, provides links to organizations such as (United Cerebral Palsy), and contains a page of links to other assistive technology related sites. The web site for the Trace Research and Development Center provides information on the organization's projects dealing with the improvement of computer accessibility for the disabled through web design. The site also provides information on universal design and provides links to several other disability sites, including AbleData. The site for the University of Buffalo's Center for Assistive Technology describes the center's educational service activities, and provides links to other assistive technology organizations, such as RESNA.

The other assistive technology service sites described in section 5.1.3 mainly describe the various activities of specific service organizations. The Shepherd Center's assistive technology department provides assistive devices relating to wheelchairs and computers. The center also has a driving program for the disabled, which includes the assessment of driving capabilities and supplying appropriate assistive devices. The site describes the services and provides contact information. A similar site is the

Comprehensive Assistive Technology Center for Mississippi State University. This center provides similar services to Shepherd, but also does additional clinical research. This site also describes the services of the center and provides direct contact information to members of its staff. There are three assistive technology centers that focus on enhancing career opportunities for the disabled. The East Tennessee Technology Access Center has a mission of "expanding opportunities for people with disabilities through innovative uses of technology."[65] This mainly includes new computer software and other assistive devices. The Assistive Technology and Assessment Center provides services to improve work site accommodations, provide ergonomic reviews, and perform computer assessments. This is similar to what is done at the Institute on Disability at the University of New Hampshire, except the organization also attempts to "serve as a resource to policymakers and government officials to influence policies that affect people with disabilities."[66] Another site, the University of Pittsburgh's Center for Assistive Technology (CAT) focuses mainly on designing and customizing assistive devices for disabled clients.

There are five different web sites listed in section 5.1.3, which are information resources relating to assistive technology. Disability Publications is a site that contains listings of disability journals, and provides links to NARIC, TeamRehab, Elsevier Science and several other sites. NARIC contains a large database of information on federally funded rehabilitation research projects and on published books and journals relating to assistive technology. Two other sites that contain assistive technology information resources are NEAT, and the University of Delaware's assistive technology resource site. NEAT contains contact information for RESNA, NIDRR, NRA and

NAIRC. The Delaware site is similar, but instead contains links and descriptions of assistive technology organizations, including ATRA (Assistive Technology Resource Alliance) and APTA (American Physical Therapy Association). The University of West Virginia's site for assistive technology resources contains hundreds of links to several different aspects of assistive technology. The web site for The Washington Assistive Technology Alliance (WATA) is unique compared to other information sites in that it is a consumer advocacy network. It provides information in the form of resources on consultation and training related to selection of AT devices, legal advice and advocacy, policy development and legislative action, technical consultation and training publications, as well as links to other online resources relating to Assistive Technology.

The information from these web sites can be applied to an ATRC on the WPI campus. The ATRC web site could have listings and descriptions of different web sites, similar to those described in section 5.1.3, which could be useful information resources for the students and advisors working on assistive technology projects. Another useful aspect of these web sites is that it provides an example of how an organization can promote activities in the field of assistive technology. The Center for Assistive Technology in Buffalo is a good example of how an ATRC can promote projects. The Buffalo center provides a summary of all of the projects that have been completed at the center. The other web sites, information and service-related, can be used to provide the ATRC with a means of building contacts with other disability organizations, to enhance project opportunities in the field of assistive technology.

Table 5.2: Services and Resources Provided by the U.S. Organizations

Organization	Services and Resources Provided by the Organizations						
	Links to Rehabilitation Information Resources	Links to Assistive Technology Databases	Computer Accessibility / Web Design Services	Adaptive Driving Program	Assistive Devices (Delivery or Custom Design)	Education in the Field of Rehabilitation	Others
WATA	x					x	Advocacy group provides legislative resources
Shepherd Center			x	x	x		
University of Pittsburgh			x		x	x	Provides disabled clients with necessary interventions
Georgia Tech	x	x	x		x	x	
Mississippi State			x	x	x	x	
AZTech (Disability Publications)	x	x					Marketing services for assistive technology
East TN Technology Access Center	x		x		x	x	Advocacy/ Funding information
University of New Hampshire	x					x	Career enhancement, advocacy services
NEAT (University of Delaware)	x	x					E-mail lists to disability organizations
Assistive Technology On-line (University of Delaware)	x	x					Links to general membership organizations
University of West Virginia	x	x					Information resources organized by subject
University of Wisconsin-Stout			x			x	
University of Buffalo	x	x	x		x	x	Evaluation of needs of disabled children
TRACE (University of Wisconsin-Madison)	x	x	x			x	

5.2 Analysis of the Interviews Regarding IQPs Completed at Project Centers

5.2.1 Student Interviews

Four different interviews were conducted with five different IQP students regarding their experiences with assistive technology projects. One of the interviews was conducted with David Bowler, who worked on the project entitled Internet Access for the Visually impaired at the London Project Center with the Royal National Institute for the Blind. Another interview was done with Jennifer Wright, who completed the project entitled The Klong Toey Slum Outreach Program at the Bangkok Project Center with the Duang Prateep Foundation. An interview was also conducted with Massimo Giorelli, who worked on the project entitled Preparing the Freewheeler for the European Market at the London Project Center with the Royal Hospital for Neurodisabilities. Finally, an interview was conducted with Jessica Hamel and Jason Svendsen, and they completed the project entitled Accessible Web Site for Dansk Blindesamfund at the Copenhagen Project Center with the Danish Association for the Blind. The transcripts for these interviews are shown in their entirety in Appendix A7. This section will begin by discussing the resources that helped the students complete their projects. This section will also discuss the difficulties that students encountered while completing projects. The students' comments regarding the projects program will also be mentioned. Finally, the students' suggestions regarding possible functions of the ATRC will be discussed. A summary of the information from the IQP interviews appears in Table 5.3 at the end of this section.

The topics for IQP projects are determined by the project centers, and students list their top choices for the projects that they want to complete. All five of the interviewed students were assigned to their first choice of their project. All of the students also

indicated that they chose their project because of its location, so they were indifferent to the fact that their project involved assistive technology.

The most useful resources that each of the students had while working on assistive technology IQP projects came from the organization that they were working with. The liaisons at the organizations appeared to be the most actively involved with the project activity. All five of the students identified the liaison as the person who provided them with the most assistance during their project activity. Three of the four project groups also indicated that their liaison was readily available to answer their questions about their project. Especially helpful were the liaisons in Thailand, who traveled with the students and interpreted for them.[67] The fourth group, who worked at the Danish Association for the Blind, mentioned that their liaison was very busy because he was the president of the association.[68] The organizations themselves also provided other resources for the students. Three of the four project groups, all working in Europe, had offices with state of the art facilities. The other project involved the slum community in Thailand, so office areas were not provided.[69] All five of the students mentioned transportation as an important resource provided by the project sponsor. Also, all of the project groups received help with making different contacts, to set up appointments with different people that could give them useful information for their project.

Students mentioned that the project advisors, for the most part, did not give the students as much assistance with their project. One group, working in London's Royal Institute for the Blind, mentioned that the most valuable resource that the advisor provided was names of people to contact before reaching the project site.[70] The other three groups indicated that their advisor mainly tracked the progress of their project,

through weekly meetings and mock presentations, and didn't really help the students with the project itself. All four groups mentioned that their advisor helped them with the write-up of the report, by reviewing sections and making suggestions on the format, but they also mentioned that the advisor didn't get involved with the technical aspects of the project.

In order to prepare for an IQP at a global project center, the students needed to complete a PQP, and do some research into their project topic area. All of the students mentioned the library as a place that they would start their background research, on previous IQPs and other resources, but also mentioned that it was difficult to find all of the necessary materials because the information was scattered in several different locations. Two of the project groups, both working with organizations associated with the blind, made contacts with people who were blind, through mailing lists and through blind students on the WPI campus, in order to get a better idea of what needed to be accomplished in their project. All of the project groups mentioned that travel arrangements needed to be made before going to the project site, and travel brochures were consulted to give them a better scope of the locale that they were going to be working in. All of the project groups indicated that they wrote a project proposal before arriving at the site, however, two of the groups had to change their project once they arrived at the site, because their proposal was different from what their liaison wanted to do.

There were other difficulties that the IQP students reported about their projects. Three of the project groups had difficulties with the assistive technology aspect of their respective projects. The two groups working on projects for the associations for the blind

indicated that they had difficulties relating their web designs to the needs of blind users. As one student stated, "we are not seeing the computer in the same way that they are."[71] In order to combat this problem, the students had to interview potential blind users and have them test their design and make suggestions on how to improve it. Another problem that the two groups reported was the fact that they didn't understand the scope of their project before they arrived at the site. That is, they didn't have a clear image of how widespread the use of assistive technology was for the visually impaired, so they needed to do some additional research once they arrived at the site. The student who worked on the project in Thailand reported difficulties in understanding what the government imposed barriers for the project would be. In that particular case, the disabled residents of the slum community didn't have the necessary documents to become registered as disabled persons who would be eligible to receive aid from the government. Also, the same project group had difficulties with their prenatal awareness campaign, because they were unaware of the medicines that the local women were taking during their pregnancies. These problems could not be resolved until reaching the project site, because the students were unaware that the problems existed before reaching the site.

Despite the difficulties encountered during their project activity, all five of the students indicated that their education at WPI benefited from their work on an assistive technology IQP. All five of the students reported that they benefited from making additional contacts with different people when working on their project. This was mainly because assistive technology projects require that the students deal with the human interface of their design, that is, they needed to test their design on potential users in order to make sure that the design was appropriate. As one student mentioned, [in order

to complete an assistive technology project] "You have to be very aggressive, and you have to go after people and be very friendly and very out going and often times when we are here behind our computer screens it is very easy to not be outgoing and not very friendly."[72] Another aspect of assistive technology projects is that they can have a positive impact on disabled members of different communities. In the Klong Toey Slum Outreach project, the students were able to persuade the local people to form their own organization to attempt to get government aid for disabled citizens. This may not have been done had the students not completed a project with the specific goal of helping the disabled members of the slum community.

The interviews that were done with the students provided information on ways that an Assistive Technology Resource Center could enhance project work at WPI. First, the fact that students chose their projects on the basis of the location of the project, rather than the fact that the project involved assistive technology, indicates that the ATRC should provide a better means of advertising AT projects, and the positive experiences of the students who worked on AT projects. Secondly, students who work on a PQP for an assistive technology project should have a means to communicate with their liaison before they travel to their project site. This could help avoid the problem of students having to change their project proposal after they arrive at the project site. In order for the students to gain the most information from their discussions with their liaison, they should be aware of the potential problems that they could encounter in their project work. The ATRC could help the students do this by listing the problems that were encountered in previous IQP projects involving assistive technology. This would allow the students to clear up some of these problems with their liaison before they start working on the

project. The ATRC should also maintain an archive of past Assistive Technology projects, and a listing of other AT information resources, to provide students with a more effective means of conducting background research for their project. In addition to helping students with their projects, the ATRC should provide the faculty advisors with a better means to advise the students on their projects. All five of the interviewed students reported that their advisor was unable to help them beyond correcting their project reports and offering suggestions on their presentations. The ATRC could provide the advisors with AT information resources that would allow them to get more actively involved with helping the students with their projects. Another function of the ATRC, as suggested by one of the interviewed students, would be to organize a meeting of everyone involved with AT projects, in order to brainstorm on other possible AT projects.[73] This would allow the ATRC to propose better AT projects, which would avoid some of the pitfalls of other assistive technology projects.

Table 5.3: Interview Information from IQP Students

IQP Projects	Findings					
	Assigned to the first choice of project	Had to change the project after reaching the site	Difficulty with the assistive technology aspect of the project	Liaison was readily available	Students provided with state-of-the-art facilities	Advisor was not helpful with the technical aspects of the project
Internet Access for the Visually Impaired	x	x	x	x	x	x
Klong Toey Slum Outreach Program	x	x		x		x
Accessible Web Site for Dansk Blindesamfund	x		x		x	x
Preparing the Freewheeler for the European Market	x		x	x	x	x

5.2.2 Advisor Interviews

Interviews were done with four faculty members (Professor Michael Elmes, Professor Bland Addison, Professor Dieter Klein and Professor Kent Rissmiller) who served as advisors for six assistive technology IQPs (one advisor was involved with three different projects) that were done at global sites. The interviews were performed with the focus of gathering information on the project experiences of the advisors, and recording the suggestions that the advisors had on improving project activity relating to assistive technology. The transcripts for these interviews are shown in their entirety in Appendix A8. The topics for IQP projects are determined by the project centers, and faculty advisors are assigned to the various projects. Only one of the interviewed advisors expressed a specific interest in advising a particular project. The advisor chose to advise

the project because of its location, rather than on the basis that the project involved assistive technology.

One of the issues that were discussed with the faculty advisors was the support that the students received from the sponsoring organizations. The advisors gave favorable reviews to the liaisons involved with five of the six projects, although one of the liaisons, Dr. Steven Cousins of the Royal Hospital of London, was involved with two of the projects.[74] The liaisons were attentive to the students, and also had time to work with them, even while maintaining busy schedules. The advisor, who mentioned that one of the liaisons was not very helpful, and that the students didn't have appropriate facilities to complete their project, avoided mentioning the agency involved with that particular project by name.[75] On the other hand, the five other assistive technology projects received a significant amount of support from the sponsoring agencies. The projects completed at the Royal Hospital for Neurodisabilities of London, the Danish Association for the Blind, and at Guide Dogs for the Blind, all reportedly provided state-of-the-art facilities for the students to complete their project. Those particular organizations provided students with an office and additional computer equipment. They also helped the students with transportation and provided them with contacts with whom they could conduct interviews. The Duang Prateep organization was not able to provide students with offices, but the liaisons offered essential resources to the students. As the advisor for the project stated, "You could not approach anyone in the slum community without local knowledge."[76] The liaisons traveled with the students and allowed them to interact with residents of the slum community.

The communication between advisors and students involved weekly meetings during the project. The students would send the advisor drafts of the project, and they would receive suggestions from the project advisor on how to revise the reports. The advisors also reported that they offered the students suggestions on their presentations, and met with them once a week to rehearse their presentations. These aspects of the communication between the students and advisors were common among all of the advisors that were interviewed. On the other hand, the advisors admitted that they were not able to help the students on a technical level with their projects. As one advisor noted, "The project in London, the IQP, was fairly technical, and I really did not have the technical background to be much help on the technical side."[77]

The technical dimensions of projects were mentioned among the particular difficulties that students had with their projects. All three of the advisors, who worked on projects that were technically involved, reported that the students had problems with technical aspects of their project. The technical aspect was also the only major difficulty encountered with those projects, although one of the advisors mentioned that the students had difficulty getting the attention of their liaison. The project that dealt with the Klong Toey Slum Community was not technically based, but the difficulties were encountered due to a lack of preparation heading into the project. The students were unaware of some of the government regulations that affected their project activity, so they were not able to accomplish everything that they set out to do in their project.

The amount of preparation that students should have before working on an assistive technology project at a global site, was also one of the issues that was discussed with the project advisors. Aside from the required PQP that students have to complete

prior to the project, the advisors mentioned other types of background research that students should get involved with before working on the project. One advisor suggested that students should clearly define the problem that they are dealing with, and establish a clear methodology for solving that problem.[78] Also, the students should try to determine what they could accomplish during a seven-week period, to avoid trying to take on too great a workload at the end of their project activity. Contacting the liaisons before traveling to the project site could do this.[79] Another recommendation was that students should attend a seminar on methods for conducting research, and putting together a presentation. Also, in the words of one faculty advisor, "I've said before that I think it's faculty often who have to take this class before their students because it's the faculty who are making . . . who are advising their students on how to use good methods that are appropriate for the problem. And I think a lot of faculty don't know how to do that."[80] Another recommendation that was made by a faculty advisor was that students should do specific research on the disability that they are dealing with, and have a necessary technical background to complete their project.[81] In addition, students should do research on the country that they are traveling to and the organization that they are dealing with. As the faculty advisor for the Klong Toey project noted, "you ought to have a lot of cultural awareness built up" before working on a project in a foreign country.[82] He recommended that students consult travel guides, and try to contact non-government organizations before traveling to Thailand.[83]

The faculty advisors also offered their suggestions regarding what the assistive technology resource center should provide to students and faculty members. One of the suggestions was that the ATRC should maintain an archive of all of AT projects that have

been done over the years, so students and faculty members could have immediate access to them. Also, the ATRC should provide information resources on different disabilities and on various disability organizations.[84] Another recommendation that was made by two of the faculty advisors was to find a way to maintain funding for the ATRC. Also, the ATRC staff should meet with faculty and with different AT organizations to gain insights on possible projects, and to provide the ATRC with a set of contacts that would be available to students working on AT projects.

5.3 Analysis of the Interviews Regarding MQPs Completed at WPI

5.3.1 Student Interviews

Two interviews were conducted with students that completed assistive technology MQPs at WPI. One of the interviews was with Dennis Hubbard, and his project was entitled Powered Arm Orthosis. The other interview was conducted as a focus group with Michael Malchiodi and Matthew Johnson, and their project was entitled Impact Analysis and Design of a Wheelchair Bumper System. The transcripts of these interviews can be found in Appendix A9. This section will discuss the information that was gained through the analysis of these interviews. This information can be broken down into the following categories: getting involved with assistive technology projects, resources that were used to complete the projects, problems that surfaced during the completion of the projects, and services that should be offered by an assistive technology resource center at WPI.

Dennis Hubbard and Michael Malchiodi and Matthew Johnson got involved with their respective assistive technology projects for different reasons. Hubbard wanted to get a biomedical concentration in mechanical engineering so he looked at possible

projects in that area. He also made the following statement: "One of the things that was interesting about rehab projects was that it was not just theoretical, but it was hands on."[85] Malchiodi found a description of an assistive technology project on the WPI web site while searching for a MQP topic, and he suggested the project to the other students that he wanted to work with. In preparation for the project, they took the rehabilitation course with Professor Allen Hoffman (ME3506). Hubbard wanted to work on a rehabilitation MQP, but Malchiodi and Johnson just happened to find an interesting MQP that involved rehabilitation and assistive technology.

Both of the project groups used similar resources to gain background information and complete their projects. Each of the projects was completed in conjunction with the Massachusetts Hospital School, and each project group received information from this source. Hubbard and his partners were able to interview several students at the school that could potentially use the powered arm orthosis.[86] Malchiodi, Johnson, and their partners received information and design approval from the Massachusetts Hospital School through staff contacts.[87] Also, both of these projects were follow-up MQPs intended to design second-generation prototypes so the students had access to the information that previous project groups had compiled. Professor Allen Hoffman and Professor Holly Ault were the advisors for both of these projects, and they provided students with handbooks, conference information, web addresses, catalogs and journals, and technical documents. In addition to the resources mentioned above, Malchiodi, Johnson, and their partners were able to capitalize on the knowledge that they received from the rehabilitation course by using resources such as patent searches.[88]

During the interviews, the students mentioned several problems that they encountered in the process of completing their respective projects. Hubbard mentioned the fact that his group had to look in many different places to find crucial information. He went on to say the following: "our library lacks a lot of references, manuals, and journals that would be useful."[89] Malchiodi, Johnson, and their partners had some difficulties because wheelchairs are many different sizes, and it was impossible to design a bumper that would fit on all wheelchairs. This problem is common for many accessories designed for wheelchairs. Another problem that this group encountered was finding appropriate equipment for testing purposes. Malchiodi made the following observation: "One of the major problems that we had was getting a wheelchair to run down the ramp because . . . nobody wanted to give us a new wheelchair to run down the ramp, so we were working with really old materials."[90] The last problem that they mentioned was the fact that they could not find any information on similar designs other than information on previous designs by their advisor and the Massachusetts Hospital School.

The students that completed MQPs also suggested services that an assistive technology resource center at WPI could provide. The members that were interviewed from both project teams felt that the center should house all of the information from past projects dealing with assistive technology so that project activity isn't repeated and can be used to help other project groups. Dennis Hubbard thought that the center should provide "an awareness to the campus" in regard to assistive technology projects.[91] Michael Malchiodi recommended advertising the center around campus and in funding circles to accomplish this task. The final suggestion by Dennis Hubbard was for the

center to "help pull together a lot of different departments" such as the mechanical engineering, biomedical engineering, and biology departments.[92] Matthew Johnson suggested that the center establish contacts inside WPI and outside WPI with groups, companies, and services dealing with assistive technology. While working on their project, Johnson and Malchiodi worked with a materials company to get their materials, and this relationship was quite successful. Malchiodi went on to suggest that these contacts could also be useful to students hoping to find employment opportunities in the field of assistive technology.[93] The final suggestions that they made were to create a library with a computer, catalogs, and listings of web sites and to create a web page for the assistive technology resource center.[94]

5.3.2 Advisor Interviews

An interview was conducted with Professor Holly Ault, who is the advisor for many of the MQPs completed at WPI in the area of rehabilitation engineering and assistive technology. The transcript of this interview can be found in Appendix A10. This interview described many of the aspects that are currently involved with the completion of these types of projects. The major topics that were covered in this interview are funding for MQPs, communication between students, advisors, and sponsors, resources that are used by MQP students, and student preparation for MQPs.

In the interview, Professor Ault discussed the current sponsors for MQPs dealing with assistive technology and the problems with finding other sponsors. Many of the MQPs that she advises are sponsored by the National Science Foundation. The Massachusetts Hospital School develops the topics for these MQPs and provides the students that will use the assistive technologies that are developed.[95] The National

Science Foundation was the only sponsor for these projects so Professor Ault and others tried to obtain sponsors such as Easter Seals, Liberty Mutual, Spaulding Rehabilitation Hospital, and Fairlawn Rehabilitation Hospital. In the current academic year, Liberty Mutual is sponsoring a MQP focused on the design of a prosthetic wrist mechanism. According to Professor Ault, "one of the problems that we have found in trying to find good sponsors . . . is that we need people who can be a liaison, who the students can work with, and who have a good engineering understanding of the project they're trying to do."[96] The people that she and the students work with are clinical specialists such as physical and occupational therapists, and it's difficult for the sponsors to provide the technical support that MQP students require.[97]

Professor Ault also described the frequency and types of communication between her, the students, and the Massachusetts Hospital School. She holds weekly meetings with the MQP students, and they communicate during the week through email, voice mail, or other meetings at her office. She and the students communicate with the Massachusetts Hospital School by telephone, email, and fax, and they have an initial meeting at the school at the start of the project. The students also make trips to the school whenever they are necessary.[98]

There are several resources that Professor Ault is able to offer to MQP students working on rehabilitation and assistive technology projects. The students can consult with Professor Allen Hoffman, who also advises rehabilitation projects, and Professor Ault has a collection of RESNA conference proceedings that students can access. She also has a collection of publications from the National Science Foundation that describe all of the projects from various schools that the National Science Foundation has

sponsored including the MQPs from WPI. These are "sources that would not normally be available to students on campus" unless they are working on assistive technology projects.[99] Students also use the resources of the library to find specific information on disabilities. Often the students need resources that are not in the library so they have to go to the UMass Medical School to find journals and relevant biomechanics papers.[100] As far as contacts, there are physical and occupational therapists at the school that students can consult. There is also a rehabilitation engineer at the school that serves as a project liaison, but there are no rehabilitation engineers in the Worcester area that can be used as contacts.

At the end of the interview, Professor Ault described some guidelines that should be followed by students during the preparation for rehabilitation projects. In order to avoid design problems, students and advisors "need to look at the design of the human interface separately from the design of the function of the devices and to work out a lot of the human factors and needs of the individual clilents."[101] At the beginning of the project, students need to research background information and knowledge about the specific disabilities of their clients and service delivery, among other topics, which "you would not find in a normal mechanical engineering curriculum."[102]

5.4 Analysis of the Interviews with Project Center Directors

Interviews were conducted with the following project center directors: Professor Paul Davis from the London Project Center, Dean William Grogan from the Darmstadt Project Center, Professor Peder Pedersen from the Copenhagen Project Center, and Professor Stephen Weininger from the Bangkok Project Center. The transcripts of these interviews can be found in Appendix A11. Each of the project center directors discussed

the relationships that have been established with sponsors at their respective project centers in regard to assistive technology and disability projects. They also provided some understanding of the funding requirements and issues involved with sponsoring projects at the project centers. Information was also obtained in regard to the attempts that are currently underway to coordinate the disability projects taking place at different project centers. Each of the center directors also expressed their ideas on the services and coordination efforts that an assistive technology resource center at WPI would have to provide to be successful. A summary of the comments made by the center directors appears at the end of this section in Table 5.4.

Each of the center directors discussed the current sponsors of disability projects at their centers and the projects in this area that are currently being completed or soon will be. According to Paul Davis, large national charities and non-profit organizations sponsor projects at the London Project Center, and some of these projects are related to assistive devices while others deal with the support necessary to operate these organizations. Some of the sponsors are Guide Dogs for the Blind, the Royal Hospital for Neurodisabilities, Disability Now, and the Center for Accessible Environments. Guide Dogs for the Blind trains and provides guide dogs. Students are currently working on two IQPs. One of the projects focuses on evaluating an assistive device, and the other project focuses on bringing the main office of Guide Dogs for the Blind up to date with information and computer technology. The Royal Hospital for Neurodisabilities has sponsored device-related projects and quality of care projects. Disability Now publishes a magazine for disabled individuals in England, and an IQP group developed a web page

for them. The Center for Accessible Environments is an organization that promotes the removal of architectural barriers.[103]

Professor Peder Pedersen described several of the project sponsors associated with the Copenhagen Project Center. Several projects have been completed with the Danish Association for the Blind. This is an advocacy organization for individuals with visual impairments, and it helps with employment, housing, and elderly activities for these people. Currently the Information Center for Visual Handicaps is sponsoring a project in Copenhagen. There are several Information Centers funded by the Danish government that provide services to individuals with visual, physical, speech, and hearing impairments. The current project deals with appropriate technology that would allow blind sailors to sense their compass course during races.[104]

The Duang Prateep Foundation is the only sponsor that has worked with Professor Stephen Weininger and the Bangkok Project Center on disability issues. This organization serves the residents of the largest slum in Bangkok. The coordinator of the Bangkok Project Center, the wife of a Thai WPI alumnus, suggested the Duang Prateep Foundation as a sponsor because she had been a volunteer in the Foundation. Henry Strage, a WPI alumnus, gave some funding to WPI to be used for projects involving disabled individuals. As a result, Professor Weininger suggested a project focused on the disabled residents of the slum to the Duang Prateep Foundation. Since that time, several projects involving the disabled residents of the slum have been completed. There is currently a project with the Foundation that is researching the obstacles to economic independence for disabled slum residents.[105]

The project center directors also explained issues related to funding and the process of finding sponsors. Paul Davis commented: "I think non-profits are operating at a thinner margin, and they are more willing to take on this crazy notion that 19 and 20 year olds from America are going to come over and solve a problem for them."[106] Their resources are tight so they are willing to take a risk, and they remain sponsors after seeing the work completed by students. Davis, Weininger, and Pedersen all stated that WPI provides the funding for their project centers. The London Project Center requires non-profit sponsors to pay a 1000-pound fee and others to pay a 3000-pound fee to cover costs associated with the program in London. Sponsors must also provide students with liaison staff time, equipment, and a work area, and they must pay for student travel costs.[107] The Copenhagen Project Center requires corporate sponsors to pay for the cost of the operation of the IQP, but non-profit organizations are not required to make any payments.[108] Stephen Weininger made the following observation about sponsors in Bangkok: "In the likelihood that sponsors could actually put up any money, it's just not on the radar screen, and sometimes we have to struggle even to get basic levels of support like rooms to work in and a computer . . . ."[109]

Currently the London and Darmstadt Project Centers are trying to coordinate their activities involving several disability projects. Henry Strage, the WPI alumnus who gave some funding for individual disability projects, also wanted WPI to make an effort to bring all of its activities in this area together and coordinate them.[110] This led to the attempts at coordination between London and Darmstadt. A project was completed in London that dealt with safety in train stations, and this project led to recommendations used to restore several stations with accessibility for the disabled. During B term next

year, an IQP studying disabled peoples' perceptions of train safety will be completed to begin coordinating projects with similar themes.[111] Dean William Grogan feels that the project centers have a lot to learn form one another with regard to transportation access for disabled individuals. He went on to say: "I am afraid that if we keep scattered all over the place, we will be doing some good, but we won't be doing as much good, either for our own students . . . or for . . . the recipients of the effort."[112]

Each of the center directors discussed the demands that the project centers and the projects program in general would put on an assistive technology resource center at WPI. According to Paul Davis, the "IQP is solving a problem with the interface between society and technology, and that calls for far less specialization than" a MQP.[113] Some IQPs dealing with assistive devices call for specialization that is not appropriate, and for this reason he recommends that more MQPs be completed at the project centers such as the one currently being completed in London under Professor Holly Ault. Professor Davis also suggested that students could share information and experiences if two projects were going on at different project centers at the same time. He warned that the technology at one of the sites would not be appropriate at the other site, but the students could still learn a lot from one another. If WPI could persuade funding agencies that it is doing a lot of good around the world or shared its ideas of what could be done with such an agency, the agency may agree to put some money into the program. Davis envisioned the assistive technology resource center to be some sort of structured network of people that would provide support for students, coordinators, directors, and advisors and could manifest itself perhaps as a "scheduled series of events during each preparation term" such as seminars or tutorial sessions.[114] Some support mechanisms that he suggested

were background briefings hosted by Professor Holly Ault, Professor Allen Hoffman, or students experienced with assistive technology IQPs. He also suggested that graduate students could act as junior advisors for projects. Davis also recommended "obvious necessities" including a library and research resources to point interested parties in the right direction, equipment, and lab space.[115]

Dean William Grogan discussed the benefits of a more coordinated effort that could be provided by an assistive technology resource center at WPI. Grogan stressed the following: ". . . we know that we could have stronger projects if we ran some of them with themes where we could use the experience of one project and another one, and interweave them to make our project experience for the students better and richer."[116] Better results would also be produced for the affected people. He believes that themes for projects in the areas of assistive technology and disability are necessary because those fields are so broad and everything could not possibly be covered. Grogan also claimed that big funding operations would not be interested in funding a single project, but rather they would be interested in funding a center for a substantial amount of money. He went on to suggest that WPI project teams could effectively compare conditions in different nations around the world because they would come from the outside and therefore would not be subject to political agendas or biased. At the end of the interview, Grogan recommended that the assistive technology resource center should develop IQPs and provide information on resources, problem areas, necessary background, and interview subjects.[117]

Professor Pedersen and Professor Weininger also agreed that a more coordinated effort is necessary with regard to disability projects and shared several ideas of their own

for the assistive technology resource center at WPI. Pedersen feels that the center should be a resource place where anyone interested could see the information from previous MQPs and find general information on rehabilitation, assistive technology, and disability.[118] Weininger thought it would be necessary for teams at project sites and teams at the rehabilitation lab to work together. He stressed the importance of the following: ". . . we need to be aware . . . to what extent the problems that are faced by people are universal and to what extent they are very much affected by local circumstances."[119] Professor Paul Davis from the London Project Center made a similar observation.

Table 5.4: Summary of the Comments Made by the Project Center Directors

Comments Made During the Interviews	Project Center Directors and their Project Centers			
	Paul Davis (London, England)	William Grogan (Darmstadt, Germany)	Peder Pedersen (Copenhagen, Denmark)	Stephen Weininger (Bangkok, Thailand)
WPI provides funding for the Project Center.	x		x	x
The Project Center does not require non-profit sponsors to pay a fee.			x	x
The Project Center requires corporate sponsors to pay a fee.	x		x	
The Project Center is currently coordinating IQPs with another Project Center.	x	x		
A more coordinated effort is needed in regard to assistive technology and disability projects.	x	x	x	x
If projects with similar topics are completed at different Project Centers, students will be able to share experiences and ideas.	x	x		
Big funding organizations can be convinced to fund the ATRC.	x	x		
The ATRC should provide access to research resources.	x	x		
A more coordinated effort would make it possible to determine which problems are universal and how they are influenced by local circumstances.	x			x

5.5 Analysis of the Interviews with Project Center Coordinators

A set of interview questions was sent to Jennie Hawks, the Project Center Coordinator in London, through email, and her answers to these questions helped to determine the level of involvement and establish the views of project center coordinators with respect to assistive technology projects. Her answers to these questions can be found in Appendix A12. She explained her responsibilities as project center coordinator, the current project activity regarding rehabilitation at the London Project Center, and the difficulties associated with implementing assistive technologies in Europe and developing countries. Jennie Hawks also described how she would expect an assistive technology resource center at WPI to interact and be involved with the project centers.

The responsibilities of Jennie Hawks at the London Project Center include finding accommodations for students and advisors, finding IQP topics, and providing students with help for projects or anything else that they may need help with.[120] Her connections with many organizations and disabled individuals have made her involvement with the project center very beneficial. Over the last two years, many of the projects have been sponsored by the wheelchair center at the Royal Hospital for Neurodisabilities. These projects include IQPs in wheelchair design, mobile arm supports, expert systems and an MQP involving wheelchair stress testing.[121] This is the only MQP that has been conducted at a WPI project center overseas.

When asked about the difficulties involved with implementing assistive technologies in Europe, Jennie Hawks described a catalog program that was attempted in Europe. This program was supposed to allow disabled Europeans to order assistive devices from any country in Europe, but the program failed after the investment of

considerable money. According to her, "The main problems are cost, time it takes to get equipment, time it takes to repair broken equipment."[122] She went on to say the following: "Also disabled people are never seen as partners but always as recipients-disabled people know exactly what they want and should be asked far more frequently than they are."[123] In regard to difficulties involved with implementing assistive technologies in developing countries, Jennie Hawks talked about the fact that it is impossible to design an inexpensive wheelchair that could be manufactured in a developing country or bought by the citizens of such countries.[124] She also stressed the need for assistive technologies in war ravaged countries.

Jennie Hawks made several suggestions in regard to the role that an assistive technology resource center at WPI would play in relation to the WPI project centers. She stated that "it would be useful to have a center whose expertise we could use as required."[125] She also recommended that the center develop project ideas, and the project centers could fit these ideas into their collection of projects and find sponsors for them. Her final suggestion was that the center "could also be an information center and . . . a one-stop shop for anyone wanting information from any of our centers."[126]

6. Model for the Assistive Technology Resource Center at WPI

In this chapter, the model for the ATRC at WPI will be explained and suggestions will be made for its implementation. The aspects of the Center discussed include: the Center's involvement in the Projects Program, information resources offered by the Center, the web page for the Center, advertising the Center, preparing students for projects, the staff for the Center, and obtaining funding for the Center. The development of this model depended heavily on the analysis of the web resources and the analysis of the interviews with members of the WPI community. In order for this Center to be successful, the WPI community must be aware of its existence and make use of its services. Further research into the funding aspect needs to be conducted before the actual development of the Center can begin.

6.1 The Center's Involvement in the Projects Program at WPI

The Assistive Technology Resource Center needs to be completely integrated into the Projects Program at WPI in order to be successful. In regard to IQPs completed at Project Centers, several changes will have to be made to create a more coordinated effort involving assistive technology, disability, and rehabilitation projects. To enable the technical aspects of these types of projects to be explored, MQPs will have to be proposed and conducted at Project Centers overseas. In order for these changes to occur, all of the individuals involved in the Projects Program including the coordinators and directors of the Project Centers must be willing to accept and facilitate them.

The changes that need to be made to create a more coordinated effort between the IQPs completed at Project Centers must be focused on determining a few categories of projects in the fields of assistive technology and disability. Due to the breadth of the

disability field, the Assistive Technology Resource Center needs to focus proposed projects on a few areas. Currently, the London and Darmstadt Project Centers are conducting IQPs in the category of accessibility to transportation. Jennie Hawks, the coordinator of the London Project Center, suggested that the Resource Center should simply propose projects, but it would be necessary to have input from each of the Project Centers to create a more coordinated effort. Project Center Directors and Coordinators would have to research the areas of concern in the fields of assistive technology and disability in the respective countries where the Project Centers are located. Once all of this information was received by the Resource Center, it could be analyzed to find recurring areas of concern that fall into similar categories in these fields. The categories that contain the most areas of concern would be selected as the categories that the Center would concentrate on, and projects could be proposed for the various Project Centers from these categories. Project Center Coordinators could then search for sponsors who are interested in the projects. If these attempts at coordination are successful, students will be able to learn from one another and see how similar projects are conducted in completely different societies.

The technical aspects of assistive technology and disability issues can be considered more effectively through several changes in the usage of MQPs at WPI that could be facilitated by the Assistive Technology Resource Center. The first change that should be considered is the use of MQPs at Project Centers. This has already been attempted by a MQP at the London Project Center involving the finite element analysis of a wheelchair in preparation for destructive testing, but it should be expanded to other project centers. Some IQPs completed at Project Centers cover technical aspects of

assistive technology such as web design for the visually impaired that really should be covered by computer science MQPs, and the use of MQPs at the project centers would hopefully discourage this practice. Advisors familiar with the technical aspects of assistive technology would have to be approached to advise these projects. It is obvious that all of the Project Centers will not be able to facilitate MQPs. For example, it would probably be impossible to find a sponsor that could provide the facilities necessary for a technical MQP in Bangkok. In this case, an MQP team could go to the Project Center to do any necessary research surrounding their specific assistive technology, and they could return to the Rehabilitation Lab at WPI to develop their design taking into account the resources and conditions that are available at the project site. IQP teams could also complete the research involving background and societal aspects for projects and provide this information to MQP teams, and the MQP teams could go on and carry out the technical aspects of the projects.

6.2 Information Resources Offered by the Center

The ATRC should maintain information resources in the center itself. This will allow students to have easier access to assistive technology information, since the information would be contained in a centralized location. The center should maintain an archive of all previous projects completed in this area at WPI. This means that the center should obtain a copy of all previous projects, and the projects should be accessible to students and faculty members who request them. This could be done by requiring students to submit their IQP and MQP projects electronically, where the ATRC could have access to them. The ATRC should also provide instructions on how to search through the previous projects using the web site. Another resource the ATRC could also

offer would be up-to-date rehabilitation and disability journals at the center itself, and a listing of books and other reference material that students could obtain from other locations. The reference material that is included on this list would be determined by the members of the ATRC staff who are familiar with existing assistive technology information that can be obtained by the center. The staff members could also work with the IGSD to create a guide for students on how to conduct background research, and how to obtain information resources from other locations. Another information resource that the ATRC could provide would be contacts with different members of global project sites and organizations that sponsor rehabilitation and disability projects. Students who work on one of these projects at a global site should be given information on how to contact their liaison prior to working on the project, and a guide on the types of questions that they could ask their liaison to provide the students with the most information on how to prepare for their project. Also, the students who will be working at a global site should have access to travel information, or travel guides, and the ATRC could help them find these resources. These functions could also be done through a coordinated effort with the IGSD.

6.3 Web Page for the Center

The ATRC should maintain a web page to provide information on the services that the center provides, and provide updates on the activities that the center is involved with. One of the features at the beginning of the web page should be a general mission statement of the center, and a listing of all of the services that the center provides. Another important feature should be a listing of rehabilitation and disability projects that are available to students, including a description of each of the projects. Also, the web

site should describe the projects in these fields that are in progress, and the projects that have been done in the past. This archive of past projects should be categorized using the following criteria: (1) the type of project was done (IQP or MQP), (2) the project site (local or global), (3) the disability that the project dealt with, (4) the organization that sponsored the project. The archive should include information for each project including the title of the project, the students and advisors involved, the sponsoring organization, and the abstract for the project.

One of the other features that the ATRC web page should include is a page of links to the web resources that are available for rehabilitation and disability projects, and a description of each web site. These web resources should be organized in a similar fashion as the description of web sites in sections 5.1.1 and 5.1.3. Another information resource that the ATRC page could offer could be a listing of the books and journals that are available at the ATRC, and recommendations on searching for specific information. The ATRC web site should also have a listing of all of the staff members, and provide contact information for each member. This could include links to the homepages of faculty members, or listings of the e-mail addresses of the ATRC staff. A final feature of the ATRC home page could be a news and events section, in which the current activities of the center are discussed. This information could include a description of upcoming seminars and presentations conducted by the center and a discussion of the projects that the center is trying to implement. Also, this portion of the web site could allow students and faculty members to post any information that they wish to contribute to the ATRC.

6.4 Advertising the Center

One of the functions that the ATRC should perform would be to advertise its activities to students and faculty members, who may be interested in working on rehabilitation and disability projects. The center should also advertise itself to both local and global organizations that may be willing to sponsor projects. This could be done primarily through the web page, and through the contacts that the ATRC could build. For example, the ATRC could establish contacts with the organizations that currently sponsor projects. From these organizations, they could establish contacts to other organizations, and so on, to build a larger network of contacts. This would give the ATRC an opportunity to offer a broader range of project opportunities, and to offer more information resources to students and faculty advisors. As far as advertising the center to students on campus, the ATRC, working with the projects office could send out e-mail to all students and professors, and post fliers in the academic buildings on campus when IQP and MQP project opportunities arise. Another way that the ATRC could advertise itself is through presentations, once to introduce the center when it opens, and once or twice a year to provide a summary of what the ATRC has accomplished, and what project opportunities could arise in the future. This presentation could also be used to encourage students to work on rehabilitation and disability projects. Students who had positive experiences with these types of projects could share those experiences with other students, to explain the benefits of working on these projects.

6.5 Preparing Students for Projects

Another way that the ATRC could provide students and faculty members with background information is through the use of seminars. The ATRC staff could develop a

set of seminars that they could offer, that would incorporate the past experiences of students and faculty advisors who worked on rehabilitation and disability projects. One possibility is to have two separate seminars to prepare students: one dealing with IQP and MQP projects at global sites involving assistive technology, and one dealing specifically with MQP projects. The IQP and MQP seminars for students traveling abroad could discuss the factors surrounding the specific disability that they will face at the project site. The other MQP seminar could discuss the process of designing assistive devices. Each of these seminars would be presented by a member of the ATRC staff, a faculty member who worked on a project in one of the three specified areas, and a few students who completed projects in the specified areas. The students could discuss the difficulties that they encountered in their projects, particularly on the technical side, and discuss ways that students could prepare to avoid such problems. They could also discuss how to get sufficient information from their liaison, and from the disabled clients that they are aiming to help. This is important because these two aspects of assistive technology projects have caused students difficulties in the past. The seminars could direct students to other project resources on campus, such as the IGSD, where they could improve their methods on conducting background research, and show them ways to make presentations.

6.6 Staff for the Center

The Assistive Technology Resource Center will need a staff to handle the day to day operations and to make any decisions affecting the Center. The most important position in the Center would be the director. The director would make decisions involving the direction that the Center will follow in terms of proposing projects and developing concentrated categories, the funding received by the Center, and the

information resources that the Center will maintain. The director would also be in close contact with all of the advisors of rehabilitation and disability projects and the Project Center Directors and Coordinators. Some experience with assistive technology and rehabilitation would be required of anyone holding this position. A professor could possibly hold this position in a manner similar to the directors of the Project Centers. The director would need an administrative assistant to handle all of the requirements of the position since a professor would have teaching responsibilities as well.

There are several other positions that would be necessary to keep the Center going and to make it a success. The Center would need staff members to keep the Center's information resources in order and to perform any advertising tasks. Work-study students interested in the types of projects dealt with by the Center could be hired to fill this role. Staff members would also be necessary to answer students' questions and to help in any way possible. Graduate students that completed rehabilitation or disability projects, undergraduate students that completed these types of IQPs, or professors that commonly advise these types of projects could take turns providing this kind of support.

6.7 Obtaining Funding for the Center

Funding is another important factor of the Assistive Technology Resource Center that needs to be addressed before any actual implementation can be considered. The Center would require funding to procure information resources such as manuals, catalogs, books, and computers with databases, to pay staffing costs, to maintain a web page, to purchase any necessary laboratory equipment, and to set up an office area on campus. Dean William Grogan and London Center Director Paul Davis suggested that the information and model developed by this project could be used to convince large funding

agencies to fund an entire coordinated center instead of single projects. WPI could provide funding for the Center as it does for all of the Project Centers since IQPs and MQPs are important to each student's education and must be completed in order to meet the degree requirements. Funding from large funding agencies could be used to set up the Center initially, but funding from WPI would ultimately be necessary to keep the Center operating. IQP projects dealing with assistive technology and disability at the Project Centers currently receive funding from WPI like any projects conducted at the Project Centers. MQPs conducted abroad may require additional funding because this is currently not a common occurrence that WPI has budgeted for.

7. Conclusions

There are several conclusions that were revealed during the completion of this project regarding the current involvement of the WPI Projects Program with assistive technology projects and how the ATRC could enhance this involvement. The previous projects that have been completed in this area have been very successful and provided students with many unique experiences, but these students have not been able to learn as much from one another as they potentially could. The interviews conducted with members of the WPI community made it obvious that many individuals would be willing to participate in the development of the Center and make use of its resources and services. The potential benefits that the Center could provide for WPI and its students far outweigh the financial requirements and determination that would be necessary to implement the Center. These benefits include the ability to conduct technical projects at Global Project Centers, generate more recognition for WPI, compare different societies, and provide students with information from previous projects with similar topics. These are just a few of the potential benefits. If no further consideration is given to the model for the ATRC, WPI will lose a great opportunity to make a difference in the fields of assistive technology, disability, and rehabilitation.

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Appendix A1: Assistive Technology IQPs Completed at Project Centers

PROJECT 1 (96A005I): Internet Access for the Visually Impaired
Students: Bowler, David Brian; Okamoto, Tetsuro; Pothier, Brian D.
Advisor: DAVIS, P. W. (MA)
This project determined which screen access programs best allow visually impaired individuals to access and utilize the Internet and the World Wide Web. In addition, this project has developed criteria for judging screen access programs and provides a means for testing future programs. The outcomes of this project address Internet access for the visually impaired in both the present and the future. This project was completed for the Royal National Institute for the Blind, London, UK.

PROJECT 2 (96D006I): Studying the Handicapped Residents of Klong Toey
Students: Lau, Capitola Stewart; Moniz, Matthew Justin; Scheurer, Karen Marie
Advisor: WEININGER, S. J. (CH)
During a seven-week period a project team, in cooperation with the Duang Prateep Foundation, investigated for the first time, the quality of life of handicapped individuals in an urban slum community in Bangkok, Thailand. Based on background research, a survey of slum residents, and interviews with local organizations, a series of recommendations were made to improve the lives of the handicapped residents of the slum community as well as to reduce the incidence of handicaps in the future.

PROJECT 3 (97D013I): Klong Toey Slum Outreach Program
Students: Andrade, Alfred; Fong, Stephen Sai-Loong; Sinyei, Amy M.; Wright, Jennifer Marie
Advisor: KLEIN, D. (MG)
This report, prepared for the Duang Prateep Foundation, is comprised of two components. The first is to increase awareness of pregnant women in Khlong Toey by designing posters and pamphlets containing guidelines on proper prenatal care. The second is to increase handicapped individual's awareness of services available to them by holding a forum. The forum covered benefits and requirements of registration, while encouraging the handicapped to establish a committee within the community.

PROJECT 4 (97D250I): Assessment of Housing for Disabled People
Students: Costa, Stacey Marie; Hudson, Stuart Carter; Rush, Johnathan Michael
Advisor: RISSMILLER, K. J. (SS)
This project provided the Design and Plans Section of Merton Council with recommendations regarding accessibility in housing. Interviews were conducted with housing developers and interest groups to gather their contrasting opinions. Surveys were conducted on residents to evaluate the presence of certain adaptations and assess the satisfaction of the occupants. The majority of the adapted units surveyed were built to mobility standards. This was found to be useful by disabled residents, and generally not an inconvenience to the non-disabled population.

PROJECT 5 (97D253I): Training and Use of Mobile Arm Supports
Students: Block, Jeannine Marie; Gaudreau, Jade Alyssa; Sheehan, Kathleen Ann
Advisor: RISSMILLER, K. J. (SS)
This project, prepared for Dr. Steven J. Cousins and the Royal Hospital for Neuro-disability in London, England, re-introduced the modular assistive Mobile Arm Support (MAS) to the staff of the hospital. This re-introduction process was accomplished via a written training manual and a complementary videotape. By assessing the needs of occupational therapists, physiotherapists and the patients, we strived to improve the training and use of Mobile Arm Supports.

PROJECT 6 (97E006I): Access to Special Needs Housing
Students: Claux Hermosa, Christian Paul; Galadi-Navajas, Alberto; Perea, Nicolas R.
Advisor: HANLAN, J. P. (HU)
This project provided the Design and Plans Section of the Merton Council with a database containing detailed information about disabled adapted housing units in the London Borough of Merton. This project also provided recommendations by which the availability of adapted units can be noted and disseminated to people interested in such accommodations. Surveys of residents were conducted to compile the database. We interviewed interest groups and estate agencies in order to recommend to the Council how to develop a system by which the availability of the database can be disseminated. Four hundred and nine adapted units were introduced in the database. Eight percent of the total adapted units surveyed are wheelchair adapted and eighty six percent are mobility adapted.

PROJECT 7 (97E010I): Technology for the Deaf-Costa Rica
Students: Chevalier, Jaime Rodrigo; Martinez, Jose Luis; McIlhenny, Julia Frances
Advisor: CHRISTOPHER, P. R. (MA)
This report was prepared for the Costa Rican Institute of Electricity (I.C.E.) to help establish a relay service for the deaf in Costa Rica. Included is an assessment of the telecommunication systems and services for the deaf in the United States and in Costa Rica. The final recommendations to I.C.E. include a design of a relay service, and details of a pilot program for its implementation.

PROJECT 8 (97E005I): Access for the Visually Impaired at the White Tower
Students: Billa, MariLisa; Enright, Gabriel William; Ramapriya, Jeevanadhar Vrittam
Advisor: HANLAN, J. P. (HU)
Sponsor: ROYAL ARMOURIES
This project, prepared for the Royal Armouries at HM Tower of London, will describe the techniques and the processes used by museums to accommodate the visually impaired. Working from literature and interviews, we will: define visual impairment; describe what is currently being done by selected museums in the United States and the United Kingdom to accommodate the visually impaired; and devise a plan for the Royal Armouries at HM Tower of London to accommodate its visually imparied guests.

PROJECT 9 (98D043I): Accessible Web Site for Dansk Blindesamfund

Students: Anderson, Charles R.; Hamel, Jessica Lynn; Svendsen, Jason Neil
Advisor: ADDISON, W. L. (HU)
This project contributes to the development of a web site for the Dansk Blindesamfund (the Danish Association of the Blind) in Copenhagen, Denmark, by identifying links to blind accessible sites containing information of use to the all blind membership of DAB. The importance of having accessible resources for the disabled should be understood in the context of the political-social philosophy of Denmark and how this philosophy differs from that of the U.S.

PROJECT 10 (98E005I): Preparing the Freewheeler for the European Market
Students: Giorelli, Massimo; Russomanno, Mauricio Pardlin; Samant, Govind S.
Advisor: ELMES, M. B. (MG)
Sponsor: THE ROYAL HOSPITAL OF LONDON
The Freewheeler, a modern wheelchair for patients with neuro-disabilities, has been in development process during the past years. Starting from June 1998 it is mandatory for medical devices commercialized in Europe to carry the CE Mark. The objective of this project was to conduct the risk analysis and to prepare a user's and technical manual. Both tasks were carried out in compliance with the British Standards and are part of the Technical File, essential to obtain the CE Mark.

PROJECT 11 (98E004I): Disablility Now's On-line Archive
Students: Greenlaw, Brian Arthur; Kataya, Nathalie Chafic; Tei, Alida
Advisor: ELMES, M. B. (MG)
Our project was to create an on-line library of articles for the monthly newspaper Disability Now, the leading publication in the United Kingdom, which deals with disability issues. This archive provides information to disabled people and serves as a marketing tool for the newspaper. We considered best practices in web page design and access technology. We conducted surveys to determine classification categories, and installed a search engine to allow an easier and faster search. Finally, we designed a site maintenance manual.

Appendix A2: Assistive Technology IQPs Completed at WPI

PROJECT 1 (89B022I): A Spinal Cord Injury and Rehabilitation Manual
Students: Barrucci, Donald D.; Luttig, Keith H.
Advisor: HALSEY, M. D.

PROJECT 2 (92C043I): Powered Mobility for Young Children with Cerebral Palsy
Students: Garceau, Matthew E.; Musiak, William L.
Advisor: HOFFMAN, A. H.; AULT, H. K.

PROJECT 3 (95B001I): Outset Evaluation: Real Jobs for Disabled People
Students: Kelly, Jennifer Ruth; Laher, Sahal Shafique; Thurston, Deborah Stephanie
Advisor: DUCKWORTH, R. J. (EE)
This report, prepared for the Lewisham Centre of OUTSET describes the results of an in depth evaluation of OUTSET and the job preparation training it provides. The many

problems that disabled people face when they are preparing for and seeking employment are explored, as well as how these problems can be overcome with the assistance of OUTSET and its services. This report concludes with our recommendations on how OUTSET can improve their services and ultimately place more graduates in jobs.

PROJECT 4 (95D045I): Handicapped Accessibility at WPI
Students: Clouart, Jeralyn D.; Marcoux, Michael Walter; Truong, Dan Vi
Advisor: KASOUF, C. J. (MG)
The purpose of this project was to determine the level of disabled accessibility on the WPI campus. Through a literature review, access was found to consist of two components: architectural access and emotional support. These components were measured by three methods: a physical inventory of campus buildings, survey of WPI community members, and administrative interviews. Deficiencies were identified through the results obtained and recommendations were subsequently proposed to remedy them.

PROJECT 5 (96D089I): Assistive Technologies and Their Implementation
Students: Kowalchik, Michael Paul; Odegard, Brian Thomas; Swanson, Brian Andrew
Advisor: HOU, Z. (ME)
Sponsor: PAXTON CENTER SCHOOL
Due to changes in federal law, some students who have special needs are being moved from schools dealing in specialized education into the regular schools to attend "normal" school sessions. We investigated for the Paxton Center School assistive technologies to aid in their need with one individual student with special needs. We collected resources and developed research guidelines for future similar situations. Although our suggestions were not yet implemented we hope this project will aid in future endeavors.

PROJECT 6 (97D005I): Assistive Technology in Public Schools
Students: Bogdanov, Yevgeniy; Zelfond, Grigoriy
Advisor: HOFFMAN, A. H. (ME)
This project examines the delivery of assistive technology to the disabled students of Worcester County school districts. Seventeen school districts of Worcester County were questioned on the use of assistive technology through surveys and interviews. The data were analyzed and compared to the standards established by government regulations. Improvements to the existing system and connections between collaborative programs and the Rehabilitation Engineering Laboratory of Worcester Polytechnic Institute (WPI) were proposed.

PROJECT 7 (98E001I): GDBA Software Modifications and Introductions
Students: Barber, Justin Gregory; Nacy, Jennifer-Lynn; Shah, Kamran H.
Advisor: ELMES, M. B. (MG)
The objective of this project was to create a toolbox of modifications for the Guide Dogs for the Blind Association's (GDBA) new PC software and to introduce it into the overall PC implementation. Utilizing a User-Centered design process, it was our goal to develop systems and tools that maximize the PC's usability and functionality, assure that the toolbox would become an integral component of the complete PC system, and position the organization to take further advantage of emerging PC technology.

Appendix A3: Assistive Technology MQPs Completed at WPI

PROJECT 1 (94A004M): LEG-POWERED MOBILITY AID SUSPENSION SYSTEM
Student: Provencher, Kevin Matthew
Advisor: ZENGER, D. C. (ME)
A caster mounted suspension system was developed to minimize vibration and wheel wobble for a personal mobility aid for an individual with osteogenesi imperfecta. Various systems were proposed and evaluated. A torsional spring design was selected for detailed design, prototyped, and evaluated. This report summarizes and reports the results of this design project.

PROJECT 2 (94S144M): Secondary Joystick Adapter for Force Reduction
Student: Suszko, Michele Sart
Advisor: AULT, H. K. (ME)
Commercial wheelchair joysticks are constructed to withstand a limited amount of force. Current designs are at a high risk of failure for users with excessive muscle tone and spasticity, such as those with cerebral palsy. The joystick must be sent out for repair, which is not costly but frustrating for the client who then becomes dependent on others for mobility. The purpose of this project, in cooperation with the Massachusetts Hospital School and funded by the National Science Foundation, is to design a customized secondary joystick linkage retrofitted to interface with an Invacare proportional joystick currently used by a student with cerebral palsy. The apparatus limits the force applied to the current joystick.

PROJECT 3 (95D185M): Design and Prototype of a Walker for the Handicap
Student: Adamo, Steven Christopher
Advisor: ZENGER, D. C. (ME)
Sponsor: SHERRY FROST
The purpose of this Major Qualifying Project was to design and prototype two functioning walkers for use by Sherry Frost, an individual with a physical handicap. Ms. Frost sponsored this project and currently uses a walker that served as a design model. The basic goals were to minimize weight and increase comfort and safety so the walker can function properly as a rehabilitative aid. One walker model was designed to collapse into a small suitcase for easy storage during travel.

PROJECT 4 (95E015M): Custom Vehicle Control for a Handicapped Individual
Students: Domit, Edward J.; Rosiello, Lisa
Advisor: ZENGER, D. C. (ME)

PROJECT 5 (96D123M): Wheelchair Design
Students: Bruno, Christopher James; Davis, Todd Anthony
Advisor: NORTON, R. L. (ME)
The wheelchairs that are currently used in the healthcare environment for patient transport are oftentimes under-qualified for their function utilizing features that are both unnecessary and uncomfortable for the users. By analyzing surveys obtained from healthcare workers, the transport chair was redesigned. Complete structural analysis was

performed on this design to ensure stability for its intended use. A prototype was built to show how the chair was redesigned along with providing insight into how the chair could be improved further.

PROJECT 6 (97D037M): Adaptive Feeding Device
Students: Cronin, Tracey Ann; Puchovsky, Sylvia Bessie; Thurston, Deborah Stephanie
Advisor: HOFFMAN, A. H. (ME)
Sponsor: MASSACHUSETTS HOSPITAL SCHOOL
This project was completed in conjunction with the Massachusetts Hospital School (HMS) in Canton, MA. The goal of this project was to design and manufacture a manually operated device, which will enable a young woman with Arthrogryposis to independently feed herself. Two prototypes were built, analyzed, and tested at WPI and MHS. The first device utilizes a gearbox to amplify her motions, combined with a linear slider, providing two degrees of freedom. The second device uses a joint similar to a gyroscope, providing three degrees of freedom. The gear device proved to be very successful for this particular client. In addition to these two devices, eating strategies were developed along with adaptive utensils and plates.

PROJECT 7 (97D185M): Powered Arm Orthosis
Students: Moynihan, Shawn Timothy; Pousland, Michael R.; Prince, Rebecca Ann
Advisor: HOFFMAN, A. H. (ME)
Currently, there is a need for powered arm devices to aid the mobility of those who suffer from Muscular Dystrophy. The goal of this project was to design and manufacture a device that would effectively increase the mobility of the user to enable daily functioning such as grooming and feeding. The final device furnishes the user with powered flexion/extension about the elbow, powered flexion/extension about the shoulder, and passive rotation about the shoulder allowing for the desired mobility functions.

PROJECT 8 (97D121M): Swing Away Joystick
Students: Gadbois, Erica Lyn; Kohm, Andrew C.; Provencher, Michele Darlene
Advisor: HOFFMAN, A. H. (ME)
A Major Qualifying Project (MQP), The Swing Away Joystick, was completed in conjunction with Massachusetts Hospital School (MHS) in Canton, Massachusetts. This joystick was designed for John Burns a wheelchair bound student at MHS afflicted with Cerebral Palsy. This joystick can be suited to any individual who desires more than one driving position. The positions include first and second locked driving locations, as well as a third back position. The joystick arm relocates to the second position keeping the control box oriented correctly.

PROJECT 9 (98D347M): Automated Wheelchair Tray Design
Students: Lee, Jackson; Wang, Shu Quan
Advisor: AULT, H. K. (ME)
Sponsor: MASSACHUSETTS HOSPITAL SCHOOL
Massachusetts Hospital School (MHS) is a school for disabled children and young adults, many of whom require the use of wheelchairs. The limited variety of commercially available wheelchair trays requires that engineers at MHS design custom wheelchair

trays. The objective of this project is to develop a computer program that will automate the design of a wheelchair tray. Visual Basic is the development tool used to design a user interface program that accepts user input and generates an AutoCAD script file. The script file automatically creates a fully dimensioned engineering drawing of a wheelchair tray. This program makes the design of custom wheelchair trays more efficient and less time consuming. In addition, this program will also reduce errors in the design and manufacturing of the trays and facilitate modifications for children with changing needs.

PROJECT 10 (98D044M): Impact Analysis and Design of a Wheelchair Bumper System
Students: Becker, Mark; Hoover, April; Johnson, Matthew; Malchiodi, Michael
Advisor: HOFFMAN, A. H. (ME)
Sponsor: MASSACHUSETTS HOSPITAL SCHOOL
The project goal was to design a bumper system, which reduces damage caused to power wheelchair leg rests during impact. Experiments were performed to determine force vs. time curves for frontal impacts using a 315-lb wheelchair system at 4-7mph. The curve was determined to be a triangular wave with peak forces of 470-lb. Preliminary designs were developed and analyzed. Creep compliance tests and hereditary integrals were used to determine the effective- ness of these materials in the proposed design.

PROJECT 11 (98D348M): Powered Arm Orthosis
Students: Guy, Victor Achilles; Hubbard, Dennis Brian; Murphy, Gregory Raymond
Advisor: AULT, H. K. (ME)
The objective of this project was to design and manufacture a powered arm orthosis to improve the quality of life for individuals suffering from Duchenne's Muscular Dystrophy (DMD). The orthosis supports the user's left arm and is controlled by the fingers of the right hand. Two degrees of freedom, shoulder and forearm flexion and extension, are powered with hydraulic cylinders. Two passive degrees of freedom, shoulder and forearm abduction and adduction, are lockable by the user in variable positions.

Appendix A4: International Assistive Technology Web Resources

Australian Rehabilitation and Assistive Technology Association (ARATA)
http://www.iinet.net.au/~sharono/arata/

Association for the Advancement of Assistive Technology in Europe (AAATE)
http://www.fernuni-hagen.de/FTB/AAATE.html

ATRC Home Page
http://www.utoronto.ca/atrc/

Disability North
http://www.nagd.org.uk/dnorth/disnorth.htm

Flintshire Disability Action
http://dspace.dial.pipex.com/town/parade/ni30/

New Zealand and International Disability News and Resources
http://www.webview.co.nz/ccia/

News from the Indian Medical Scene
http://www.healthlibrary.com/news/index.htm

Disability Information for Students and Professionals
http://abilityinfo.com/index.html

Rehabilitation International
http://194.191.63.42/

VICNET Disability Page
http://www.vicnet.net.au/disability/

Disability Scotland
http://dis_scot.gcal.ac.uk/

Appendix A5: United States Assistive Technology Web Resources

Washington Assistive Technology Alliance (WATA)
http://wata.org/wata/index.htm

Assistive Technology @ Shepherd Center
http://www.shepherd.org/SERVICE/ASTTECH/Index.htm

Center for Assistive Technology (University of Pittsburgh)
http://pft5xx36.ft90.upmc.edu/RTP/CATHP.html

Center for Rehabilitation Technology (Georgia Tech)
http://www.arch.gatech.edu/crt/crthome.htm

Comprehensive Assistive Technology Center (Mississippi State University)
http://www.msstate.edu/dept/tkmartin/

Disability Publications
http://cosmos.ot.buffalo.edu/www_azte/publication.html

East TN Technology Access Center
http://www.korrnet.org/ettac/

Institute on Disability (University of New Hampshire)
http://iod.unh.edu/

NEAT Assistive Technology Resources (University of Delaware)

http://www.asel.udel.edu/neat/Resources.html

Assistive Technology On-line (University of Delaware)
http://www.asel.udel.edu/at-online/organizations/

International Center for Disability Information (University of West Virginia)
http://www.icdi.wvu.edu/Others.htm

Technology and Assessment Center (University of Wisconsin-Stout)
http://www.chd.uwstout.edu/svri/atac.html

Center for Assistive Technology (University of Buffalo)
http://wings.buffalo.edu/ot/cat/index.htm

Trace Research and Development Center (University of Wisconsin-Madison)
http://www.trace.wisc.edu/about/welcome.html

Appendix A6: Interview Questions for Students, Advisors, and Center Directors

FOR STUDENTS:

1. What experience did you have with assistive technology before completing the project?

2. Did you propose your own project?

IF SO: -How did you get the idea for your project topic?

IF NOT: -How did you find out about the project?
-What stimulated your interest in the project?
-What types of things would have made you more interested in the project?

3. By what means were you able to communicate with your project advisor?
-What information did your advisor provide on assistive technology?

4. Describe the support such as information, facilities or funding that the project received.

5. Which resources helped you the most to complete the project?
-What information did you obtain from these resources?
-What resources did the Global Project Center provide?

6. What difficulties did you encounter while trying to complete your project?

7. How did your work on the project change your opinion of assistive technology?
-Did the project have a positive impact on your education at WPI?

-Do you think that your project had a positive impact on those who it was designed to help?

8. What other assistive technology resources would have been helpful while you were completing your project?

FOR ADVISORS:

1. What experience did you have in the field of assistive technology before advising this project?

2. How did you become the advisor for this assistive technology project?

3. Did you ever propose an assistive technology project for which you could not find any students?
   -What was the reasons for this?
   -What types of Assistive Technology projects are the easiest to find students for?

4. Did you ever have to seek additional funding for an assistive technology project?
   -What types of assistive technology projects are the most difficult to obtain funding for?

5. How did you communicate with the students and the sponsors while advising this assistive technology project?

6. What resources were you able to offer students to help them complete their assistive technology project?

7. What difficulties did the students encounter while trying to complete their assistive technology project?

8. What assistive technology resources, which were not available when the project was completed, would have been helpful to you and the students?

9. What are the major problems surrounding the implementation of assistive technologies in different countries?
   -Is service delivery a major problem?

10. What is the general level of preparation that students should have working on an assistive technology project?
    -What are some of the ways that students could improve their preparation?

11. Are there any other comments about assistive technology projects that you would like to add?

FOR CENTER DIRECTORS:

1. What experience have you had in the field of assistive technology projects?

2. What resources does your project center provide to students and advisors for completing assistive technology projects?

3. Did you have any contact with project advisors while assistive technology projects were being completed at your project center?

4. How do you find assistive technology project sponsors and what difficulties have you encountered in trying to find them?
   -Do they ever come to you?
   -If so, what types of assistive technology projects do they most often express interest in?
   -What support or resources do sponsors typically provide for assistive technology projects?

5. What level of funding does your Project Center provide for assistive technology projects?

6. What are the major problems with implementing assistive technology at your site?
   -Is service delivery one of the major problems and why?

7. Are there any types of assistive technology projects that you would like to see completed at your Project Center?
   -Would you like to have more projects involving assistive technology completed at your Project Center?

8. What level of preparation should a student have before completing an assistive technology project at your site?
   -What are some of the ways that students can improve their preparation?

9. If we were to have an ATRC at WPI that would provide assistance to students working on assistive technology projects, what functions do you think this center should provide?

Appendix A7: Interviews with Students that Completed IQPs at Project Centers

David Bowler

Sundaram: How did you get involved in this project?

Bowler: Yes, I wanted to go to London so I ended up signing up for the London Project Center, and then once we were in the ID2050 setup getting our choice of projects, I wrote down as my first choice working at the RNIB. So they picked out four different projects,

but they were all very vague, so I decided to work at the RNIB with some sort of accessibility with computers and things like that and ended up getting into that project, which was my first choice.

Trevor: Could you tell us a little bit about the Royal National Institute for the Blind, who was your liaison there?

Bowler: We were working with a guy called Peter Boucher, who was excellent . . . the guy was extremely good. There were a lot of other contacts down there whose names that I don't really remember in particular. They are all over, I think, in the report, I don't remember their names off hand, and the Royal National Institute for the Blind is located in London. They are government funded so they are non-profit, except for the fact that the people who work there do get paid so that they can give up having other jobs in there lives so to be able to meet their bills and everything. And it is basically geared towards trying to get visually impaired people access to everything that would allow them to lead lives that bases . . . so that their handicap didn't get in their way and they can do everything that everyone else can do. That is the whole point of it, and so that is where the project fit in, to try and provide some kind of access to the internet and the world wide web, which if you are blind can be kind of difficult because most of the information is given through the screen. So, it is a rough situation to be in.

Sundaram: What kind of resources did you receive from the project center or from the advisor?

Bowler: The main resources we received from him were people, so names of people that we could talk to and write to and survey. And what we actually did was to build up a series of, in essence . . . just made up different combinations of screen readers and stuff for packages for reading their screens and navigating around and modify the device slightly and different pieces of hardware that went along with it and other packages so that you could have a totally autonomous world wide web on this one computer and brought the whole computer on the trains to all these different peoples' houses, set it up in their living rooms, had them sit down, and they would try each set up, go through and navigate our kind of pseudo world wide web and tell us everything they thought about it, what they thought was good, what they thought was bad. We had a whole set of predetermined questions that they would use as kind of a guide of judging. We needed some kind of basis for comparison so we had our own questions. At the same time, because there are a lot of things that we are not going to think of because we are not seeing the computer the same way they are. And even if I turn off the monitor and try and use the computer, I still don't have the same situation that they have because I already knew what was on there. I understand what it means to be using a desktop and what it means to be opening up windows and closing windows. And so, a lot of it was also coming up with some kind of unique description of what windows was that a blind person could use to be able to know what to do and be able to find their way around it. To basically answer your question is that he was giving us the resource of people, contacts to talk to.

Trevor: What resources did the Royal National Institute provide?

Bowler: They gave us funding. Someone associated with the RNIB actually donated the hardware, which we used which was at the time, I think, it was an early model Pentium which was really, really fast back then, way back when they got a whopping 16 meg of ram or something. We had such a fast machine and a 15 inch monitor which was huge. So, they donated that, which was like a $3000.00 computer back in that time. They paid for our taxi back and forth because some people worked on the tube lines, and so we had to get to these peoples' houses. And when you are carrying around this huge monitor and huge computer that can be a rather daunting task. They paid for a lot of that stuff.

Trevor: Did you have office area?

Bowler: Yes, we had our own office up on the top floor with an excellent view of London, and there were two computers in the office, tons of work area, access to the phones so we could use their phones at will to call up people and interview over the phone. We had full internet access there which was all set up for us, and we could use their cafeteria. And it was really good, too, because it added structure to the work day by going down there and working in an office. And that helps when you are doing an IQP to actually get things done.

Sundaram: What kind of difficulties did you have?

Bowler: There were two different sets of difficulties. The first set of difficulties, which are related to the project itself, is that it was very difficult for me to understand what kind of problems a visually impaired person would find in trying to access the internet because it is obvious that they can't see the screen, but it is actually subtle what the real problems are and subsequently how to solve them. It is really something, which I realized early on that I didn't understand, and so I had to use interviews and talking to people who did experience these problems and try and solve them. The other problems were the group problems. There was a little bit of a personality conflict within the group. I don't know if you would like me to discuss that or not, I have no problem with it.

Trevor: What did you have to do to get prepared to go to London?

Bowler: I had to get a passport. I had to get airplane tickets. I had to get a London A to Z, which is your guide to all the streets in London. And other than that, I had written up basically the entire proposal going to London and then went down there and the project changed totally from what I thought it was going to be. So, I had to trash the entire proposal and all the literature review and everything, about 50 pages written going down there, and had to start from scratch again upon showing up. We had very little contact with our liaison before going down there, and once we talked to him we realized that the project that he really wanted to do was very very different than what WPI wanted us to do. And I made an executive decision to opt for the project that the RNIB wanted us to do, and that is what we did, which involved trashing our entire report. Otherwise, the preparation was monitoring newsgroups that related to this sort of material and mailing

lists for people who were blind and were using the Internet. And just monitored those and towards the end before going out, sent out a survey and asked them to respond to us personally, answering all these questions. We probably got close to 100 responses off of the mailing list and that was a really good way to get started in order to know what kinds of questions to ask when we were doing our real hardcore interviewing and to know what kind of a really broad spectrum of people are using the internet.

Sundaram: What impact did this project have on your education at WPI?

Bowler: Let's see, it was the most involved project that I had done up to that point, and it is also the first time I had to deal with a group member who had flatly refused to do any work whatsoever and told us and the advisor that he refused to do any work whatsoever. And so that was an interesting experience because in real life you do have to deal with people like that eventually. So other than that, it was also good for learning how to be very forward. You have to be very aggressive, and you have to go after people and be very friendly and very out going and often times when we are here behind our computer screens it is very easy to not be outgoing and not very friendly. But in order to get results when you are dealing with people, you need to go and say hi, my name is David, it's nice to meet you, I am working for WPI, and I really want to talk to you. And so, that's a really, really good skill to learn, and that is probably the number one skill that I gathered from doing that, more than anything else.

Trevor: What we are proposing is a resource center for assistive technology projects that would have resources and propose projects and things like that? What do you think a center like that should provide?

Bowler: So you're proposing projects for students to do? Through the RNIB or is this also through other organizations? Okay now, is it just for people with disabilities or all projects in all of London or all IQPs? Obviously there is a huge market for people with disabilities. There is all of the blind software and everything that has to with that. Different kind of things for people who are deaf, such as alarm clocks that vibrate the bed to help you wake up because you are not going to hear an alarm clock and interfaces for phones so that it will print out what is coming out of the phone. But in addition to all of the obvious ones to do with disabilities, there are lots of types of assistive technology, such as cars that have some kind of automatic recognition system on them that help them avoid getting as close to the car ahead of them. So that, maybe a little help on the break that you can turn on if you know that your reaction time isn't as quick or if you are getting older and are not as good at judging distances. It will send out a pulse, and it will know that the car in front of you is really, really close. And you need to go a little slower and maybe apply a little bit of break there. That is another kind of assistive technology. So, I think there is a lot of brainstorming that could be done there. I could go on if you like. I think one of the main things that your center should do is try and find projects that are good IQPs because there are good projects that will try and save the world, it doesn't mean that they are IQPs. It's important to realize that it's better to have something that is 100% done than have something that is really cool that is only 70% done because no one can use it. You got most of the way there but you don't actually have any product, and

one of the things in an IQP is that it is really nice . . . it is very satisfying to have a whole product done. I think one of the main things is making sure that the projects are within the scope of an IQP.

Massimo Giorelli

Sundaram: What experience have you had with Assistive Technology before working on this project?

Giorelli: Well, to tell you the truth, my experience with Assistive Technology was practically zero.

Trevor: How did you decide that you wanted to get involved with the freewheeler project?

Giorelli: It was not the Assistive Technology part that I liked the most. Probably the project was the most close to my major. It involved a wheelchair and designing a wheelchair can be the task of a mechanical engineer and my major is ME. Between the options that I had, this was the closest one to my major so I decided to go with that one. Besides that, I was looking to do the IQP with the most serious company or association that I could and the Royal Hospital looked like the best association or company to do an IQP with. That was my first option, when you go abroad, they give a number of options for which you can choose, but you don't really get to choose but you can give them your options and I was lucky because that was my first option.

Sundaram: How did you communicate with your project advisor and also the project center director when you were in London?

Giorelli: We met with the project advisors at the hospital once a week. We used to meet for an hour or so and show them how far we got and listen to suggestions and that was a good time to see where we were. The project advisor just came once through the term and we had a presentation and the director for the IQP, Professor Davis, flew over and he attended one of the mid-term presentations that we had to prepare. We also used to meet once a week outside our job site, where we used to give presentations. Actually, it was kind of a rehearsal for the final presentation and we used to do that each week. To summarize, we had two meetings with our project advisor per week, once at the job site and once outside our job site to give our presentation.

Sundaram: Did you meet with any of the sponsors or with people from the hospital itself?

Giorelli: We didn't use to meet every day with our liaison at the hospital but at least once a week we had a meeting with him. Also, it depends on the task that we were working on. Sometimes I would go into his office every hour to ask him questions. He was a really nice guy, Dr. Steven Cousins. I heard from people who worked on other IQPs that their liaison didn't really care what they did, but we were lucky that our liaison was a really nice person and he was really interested in what we were doing.

Trevor: What resources were most helpful in helping you complete the project?

Giorelli: We did research from books in the library because we had to write this manual so we had to research technical writing. We did that just by taking books, but in order to become familiar with wheelchairs and the technology of wheelchairs and the standards that wheelchairs have to comply, we asked help for that. When we were here, we asked Professor Ault. When we were there, we got to ask our liaison because he is pretty involved in that. Also, we had a meeting once with the manufacturer of the wheelchair, because that area hospital was the designer of that wheelchair, but the manufacturer was outside the hospital, was actually a small company. So the head of that company once flew over to the hospital in London so we had a meeting with him. An external source that we had was an expert on risk analysis of biomedical equipment, because we also had to write a risk analysis on that wheelchair.

Sundaram: Were there any difficulties that you encountered while you were trying to complete the project?

Giorelli: Actually, I think the task was well defined and sometimes in an IQP you don't have a well-defined task. We also had a good liaison who cared for our project so that was good. So everything was fine. The only thing that didn't go that well was that I didn't get along that much with one of my IQP partners actually. That was kind of hard, but anyway, when some person doesn't do that much but thinks that he knows everything, so it's really hard to work with someone like that. That was the only problem I had, but other than that it was a really good IQP.

Trevor: Did your project experience change your view of assistive technology and did it have a positive effect on your education at WPI?

Giorelli: I think it is a good background to have done that IQP, especially it was a big job of organizing things. You know when there are so many things that you have to take care of and you are not so familiar with everything. For example, in the risk analysis, you have to consider thousands of things, so it was really a good job of organizing things that you don't know, so that was really a good experience. Also, the methods on how to conduct risk analysis was a good experience to know. Other than that, from the point of view of the assistive technology, I think that a really good experience was to work in that hospital. It's kind of a sad place to work in, because it was full of sick people, and in that hospital, all of the sick people are in a serious state. The impact with that environment was the most interesting part of that IQP. Other than that, the tasks that we had to do were kind of easy, other than the task of organizing things. But writing the manual was not that bad. It was good to live for two months in a hospital and that was really good.

Sundaram: Are there any other comments that you would like to add about the project?

Giorelli: No. I don't think that there is anything else that I need to add.

Jessica Hamel and Jason Svendsen

Sundaram: First of all, what made you decide to do this project?

Svendsen: We wanted to go to Denmark. We all signed up for that, and then we just signed up for . . . there were four available projects, and we signed up for the one that we happened to get. It was kind of by choice. It was the one that was most interesting to me, but we kind of didn't have a choice either.

Hamel: They put us in projects.

Trevor: Do you remember who the liaison was at the site you worked at?

Hamel: He was the president of the association that we worked for. He was blind.

Trevor: What types of resources did he offer?

Hamel: We used resources such as . . . we interviewed him, and we had a person that we worked for right there. He was very busy so we worked more with this other person who showed us his special keyboard that he used. They set up interviews at another blind association in Denmark.

Svendsen: Materials . . . they had information about blindness, just information, basically pamphlets . . . anything they could find.

Trevor: Did you have an actual office that you worked out of?

Hamel: Yes. There was a computer that had a speech synthesizer on it so we could see how it worked.

Sundaram: How about your advisor, what types of resources did he provide?

Svendsen: Mostly he critiqued our paper . . . gave us ideas if we were heading in the right direction or if we should do something else.

Hamel: He was more with our grammar, how our paper . . . what it needed in it and stuff like that. He is a history professor here so he really didn't know much about web site design.

Trevor: Could you describe a little bit about how you prepared to go to Denmark?

Svendsen: We had a PQP before to kind of give us a background of Denmark, and one of the girls that went before came and talked to us and said this is what you should expect there. What you should bring and what you shouldn't bring. She really helped us and gave us information.

Hamel: We looked at a lot of the different IQPs that had already been done here through the library, and some of them were already done regarding the blind and using the computer. And then, there were some different computer magazines and journals that we used that had different technologies that are useful for blind people with the computer. It was kind of like the PQP . . . we researched what was available out there for blind people to use.

Sundaram: What were the major difficulties that you encountered while you were working on the project?

Hamel: The paper itself? The research itself? We had problems, but I don't think with the paper. I don't think we really encountered much difficulty because everything is very . . . the information we found was very descriptive, this type of device does this, and on the web we researched often and tried some of it, like the speech synthesizer. There is even a program over the web that we used to evaluate the web sites to see how useful they were to blind people. Like if there was things in it that there are even other technologies could handle that they use for the computer.

Trevor: Would it have been helpful to have all the information that you looked up to get prepared . . . would it have been helpful if all of that was in one centralized location?

Hamel: Yes, because kind of the way that we divided it up, our other IQP partner was a computer science major, and he did a lot of the background research into just the technology, I think.

Svendsen: He did a lot of the writing too because our advisor liked his writing.

Hamel: He looked at a lot of the computer journals and stuff like that because he was used to dealing with all that information. Where for me, I am a civil engineering major so I don't deal with computer and computer technology all that much. So, it would have been helpful for me, I know . . . for people who don't have a background in it.

Sundaram: Did your work on this project change your opinion on assistive technology?

Hamel: I didn't know there was that much out there, just looking at what we did for just certain web sites. Like all of the technology that is out there for a blind person to use the computer, and considering it's always being updated, and new things are always being invented. I was surprised. I thought, actually, I had no clue how blind people would use the computer or anything so it was very helpful.

Svendsen: I didn't realize there was so much. Certain important things you should follow when you are creating web pages and stuff like that, so, in order to make it readable to them. I didn't realize there were so many . . . it just makes it really hard to read if you have a picture in there if you don't have a description of the picture. I never really thought about that before until we did this.

Sundaram: Is there anything else that you want to add?

Hamel: What you're doing . . . did we answer enough on what you had questions on, like what you're doing your IQP on per se? Or is there stuff along that line that we need to answer?

Trevor: Are there any other resources, that would have helped you prepare better, that you would have liked to have had?

Svendsen: The thing we forgot to mention was that we talked to some students that are blind on campus. They gave us a lot of information.

Hamel: That was very helpful to have a firsthand experience of actually . . . he actually showed us a lot of his equipment and stuff like that. So, we kind of learned a lot of stuff through him also. But we might not always have that resource on campus.

Jennifer Wright

Sundaram: What experiences have you had that got you interested in this project?

Wright: Basically, I knew I wanted to get the biggest cultural experience that I could get. And reviewing all the projects I knew that this project would allow me to get the most contact with the people. I mean the real people and not just the business people. So that's what made me want to go for that kind of project.

Trevor: Was there someone at the Duang Prateep Foundation that you talked to while you were working on the project?

Wright: We had our liaisons, their names were Go and Tuang, those were their short names, and they were with us the whole time, they actually interpreted, and brought us to everywhere to help us make appointments and he had appointments with many different people like government officials, doctors, and they also got us around. Over there it's called a slum, but over here they would call it an economically depressed area to be politically correct, they brought us around the slums, and it was huge. There were five parts and a total of about 100,000 people there. They were the people that we would contact the most, and there was also an American man working over there and there was an American doctor and Duang Prateep herself, who founded the foundation. We ate lunch with her and on occasion we got a chance to interview her too.

Trevor: How often did you meet with your advisor on this project?

Wright: Individually, our group met with him once a week during the project, and we also met with him again to do the presentation once a week.

Sundaram: Did you have any problems communicating with any of the people that you wanted to?

Wright: Sometimes we did just because of the language barrier. Sometimes our interpreters didn't understand what we were saying and they couldn't relay what they were saying directly to us so we had to use hand motions or pictures. Also, we developed prenatal care awareness campaigns. We developed little booklets and we didn't know how to relay the information that we wanted to come across in Thai language, so that was hard. And the pictures, we didn't know what pictures represented certain things. Like, in our country, there's a certain symbol for pharmacy but it's different over there, so we had to make alterations because of that type of thing.

Trevor: Were there any specific resources that the foundation offered to you that helped you complete the project?

Wright: The largest resources that we had were maps of the area. We needed to know where a lot of the handicapped individuals resided because one of the other parts of our project was to get handicapped people registered with the government as being disabled so that they could receive benefits from the government. In order to do that, we needed to know where they lived, so we needed addresses. We wanted to focus, we wanted to gather them around for one big forum so that they could learn about the benefits from the government and things like that. So that was one part, the maps. And then basically the people who worked at the foundation like the liaisons as I said before were a large part of a resource for us.

Sundaram: Were there any resources that you didn't have that you wished that you had?

Wright: I think we basically had everything that we needed. Maybe more background before we got there, because we had to switch our project a little bit once we got there. We did more research on drugs that they might be taking, but we didn't know that most of the stuff that was going on was that they weren't, like for the pregnant woman part, we thought that they would be taking drugs because they'd have access to it because over there, prescriptions aren't required. But we found when we got there that the major problem was the women got morning sickness and they would take an ancient Thai medicine to get rid of it, and Thai medicine contains alcohol in it. So every time they took it, they would be ingesting alcohol and a lot of their children had symptoms of fetal alcohol syndrome, and I wish we had known that before.

Trevor: Do you think that your project had a positive impact on those individuals it was designed to help?

Wright: Definitely. We got a report about a year later that said that the people of the community started their own organization to get everyone who was disabled registered with the government, so they had to get them certification of housing and they had to get them an identification card, so they founded their own organization. I'm not so sure

about the prenatal awareness campaign but I know that the pamphlets got distributed to the young women in the area.

Sundaram: Is there anything else you want to add about your project?

Wright: I loved my project because I really got right into the culture of the Thai people and we got to experience all different types of people so we got to deal with the lower class income people. Also, unrelated to the project, we met with people from the upper class bracket so we got a whole cultural experience out of it, so I really liked it, I had a good time.

Appendix A8: Interviews with Advisors that Advised IQPs at Project Centers

Bland Addison

Addison: We did a project that surveyed web sites with information that would be of use to the blind, and we did two things. The students did two things. One is that they did an evaluation of them . . . their criteria for making web sites user friendly for the blind and we see how closely they follow that. And, they, in addition, set up guidelines. We created a handbook that someone who wanted to consult these web sites would be able to pursue it in a simple fashion. That's essentially what that project was all about. Is that the type of project that you want to pursue? Give me an example of some other assistive IQPs.

Trevor: I think they did a few for the deaf in Costa Rica.

Sundaram: I think they did a lot in the Royal Hospital of London.

Addison: In our particular case, there was not much that we needed to do as far as technological development because there are various types of readers that the blind use to audiblize things. The problem is that the sites are laid out in such a manner that it is difficult for someone who is blind to scan the site and effectively find what they want. And, the way to overcome that is to establish standards that sites should observe. The simple one, obviously, is graphics don't necessarily help the blind. There's a text-only format that you can switch to such as the WPI library page. So, that's user-friendly for the blind. Then after that, the way it's laid out is following a certain format and specifications so it's easy to pursue and gather the information that they need.

Trevor: Could you just tell us how you got involved with that project?

Addison: The project was actually identified by the directors of the Denmark Project Center. They go every year and survey a host of different people who are prospective sponsors of projects, so they actually went and located them. Tom Thompson, who is actually one of the directors of the Copenhagen Project Center, knew the director for the Danish Association for the Blind. And, they are, this year with Rick Sisson, on site

working on yet another project so you may want to talk to them. Not actually with the same blind association but someone who works with them so it has a related feature. So the answer is simple. The project was identified by the project directors, and that's sort of a routine process when you open a project center. You look for sponsors that might be able to provide useful IQP projects.

Sundaram: What kind of communication did you have with the sponsors while the project was being done?

Addison: It was very good. They had very close contact with the students who worked there. The students had an office in the Association's building. They had someone who oversaw the project on a daily basis, and I would come there every other day to talk with the sponsors. So, it was very close, and they were very hospitable. They were one of the most attentive sponsors that we had of any of the projects that we worked with. Eventually, at the end of it, they sponsored a presentation of the project for interested parties in Copenhagen that came to it. They took the kids out to a local amusement park known as Bakken in Copenhagen. So, we had very close contact. They were very agreeable. They could be reached by e-mail and by phone before we went over so we initially had a lot of contact. They had never done an IQP so they weren't quite sure what an IQP was, and we sort of had to work that out. I had the impression that they were anxious to sponsor projects because they wanted other organizations to see the type of work that they did and be able to publicize that work so that they could provide better services to their clients.

Trevor: Were there any particular difficulties that the students had while they were working on the project?

Addison: I would say no. Nothing in particular. We thought initially that working in an environment with the blind might create come things that we need to learn about social etiquette and what not. But as it turned out, the actual building where they worked was probably half blind people and half who could see. They quickly learned that the blind interacted every day with the seeing people so there was no real tangible difference when all was said and done in the actual conducting of the project. They had someone who helped them in the organization who could see, and they had a more immediate supervisor who could not see. And, both came to the meetings and collaborated together. So, there was no particular problem presented by working with the blind organization. There was probably some learning curve . . . a small learning curve and just some basic social etiquette, walking down the hall with someone who's blind or opening doors or announcing your presence. But, that was overcome in about ten minutes. It was a non-issue. I had thought it would be much more significant but not at all. It was easy. It was very easy to deal with them . . . to work with them.

Sundaram: What do you think is a general level of preparation that you think the students should have before working on a project involving assistive technology or in this case the blind?

Addison: Well that's a complex question because there were other issues involved other than the matter of our clients simply being blind. There was the issue of it being in a foreign country, Denmark that required other types of preparation. This particular project . . . what we were asked to do . . . the technical dimension of it was something that the students who I advised . . . they had a very steep learning curve. I had two computer science majors, and the one thing they needed to know about is the type of technology that translated the web or any sort of computer program to audiblize it to a verbal form. And, that they mastered quite quickly. And, they learned more once they started working on the project because there at the association they had all kinds of examples of these translators and Braille printers and things of that sort. So, I'm not quite sure I can provide a useful answer to your question. I could say simply that for this particular project . . . for a WPI computer science major . . . I had two on this particular team . . . this project was highly oriented to solving a computer problem for the blind. And, the skills that they already had were very appropriate. There was a matter of let's say one-sixth learning that they needed to acquire during the PQP, but only a portion of that, let's say one-twelfth, dealt specifically with learning the type of technology that the blind used. And, they mastered that very quickly. And, they spent the other portion of time learning what an IQP is . . . learning how to research, learning about Copenhagen, learning about the organization and what they did for their clients in Copenhagen. But, that would be the sort of thing that they would do for any IQP. So in my case, it wasn't terribly demanding. I can imagine projects in which they involve a lot more.

Trevor: Was there a liaison at the site? Could you tell us a little bit about that?

Addison: We had two liaisons. One who could see and one who could not see, and I've forgotten what their positions were. The person who could see was the secretary for the person who could not see, and he had an executive administrative type position in the Danish Association for the Blind. He wasn't in the very top echelon, but he was a young fellow who was in the second echelons. So, he was obviously an important, crucial organizer for the Association, but he had plenty of time to help us organize the project and to work with the students.

Trevor: Was there a liaison at the project site as well?

Addison: Well, the project center in Copenhagen is wherever the advisor who ends up there is housed. So, since it was a beginning type project, I had only 12 students, 4 projects, and I did all the connecting, the liaison work, between myself and Poul Luneborg . . . was the fellow's name . . . who was at the Danish Association of the Blind, and his secretary did the connecting. But, the students eventually assumed most of the coordinating responsibilities after the initial contact was made. They expected us on our room floors, and we met them, and they put us right to work.

Trevor: If we were to have an ATRC here at WPI, what resources do you think it should provide?

Addison: I'm still not quite clear on what assistive technology would include . . . things like wheelchairs. What else would be involved? And, the effort would be comprehensive, not only to work with the physically disabled, but the people who couldn't hear or things of that sort as well. I think that the fact that it would be comprehensive would be very useful. And there must be over the years an accumulation of IQPs and projects. One of the problems that they have now is that they're done in a disparate way. They're scattered in various professors' offices so I don't know what we have, and I think other people do not know as well. It could well be that if you centralize those, and people can actually see the types of things that have been done in the past. And, that would create an initiative to do other types of projects and also give some ideas of what might be accomplished. I don't know what areas would be covered, but if you're comprehensive of the various types of handicaps that people face, then I think that would be a good start and would begin to tell you exactly what areas need to be developed. One of the things that I learned, I suppose, is a philosophical attitude in working with the blind, is that the handicapped should not be cheated of the benefits of technology. So, that for the blind particularly . . . the web is a vast source of information. In Denmark, they took a very aggressive, a very political attitude that no citizen should be deprived of that information. It's important for their careers. It's important to the body politic, voting or whatever you want, so every effort should be made to give those citizens access to that type of technology. A service that we could provide is to ask ourselves when something technologically comes through that gives ordinary citizens an advantage. The question is how can we share that with all of our citizens. And, I don't know where that falls, but clearly in access to the Internet you had a very clear example. One of the issues is to do some sort of survey . . . some sort of study on what are the needs of the handicapped community. It's probably already out there. They themselves are probably well aware of options that are not available to them and what needs to be done to correct that. And, then that center would be able to create an agenda arising out of those types of needs.

Michael Elmes

Sundaram: What experience did you have with assistive technology before you started advising projects?

Elmes: None. I had no experience. Really the London project, which was last summer E-term of 1998, was the first project . . . are you talking about just projects, or any experience with assistive technology?

Trevor: Yes.

Elmes: Any experience . . . any personal experience. I can't say that I've had any experience with assistive technology, even in my personal life, in my family. My wife worked . . . She was the director of a program for kids, infants, and toddlers with certain kinds of conditions, and I think wheelchairs were fairly common in that workplace. So, at least I've been around certainly and talking to her, but that was ten years ago. But other than that, I've had very little experience.

Sundaram: Did that pose any problems when trying to advise projects?

Elmes: Let me ask you this. Assistive technology, does this mean, anything, any device or is there a certain range of devices? For instance, is a hearing aid an assistive technology?

Trevor: Yes.

Elmes: Okay. Yeah, I have a niece that wears a hearing aid . . . my grandfather wore a hearing aid. That's really the extent of it. So, your second question is what impact that has had on my ability to advise? I don't know, that's a good question. The project in London, the IQP, was fairly technical, and I really did not have the technical background to be much help on the technical side. Fortunately, the students were able to get the resources they needed from the liaison that was Steve Cousins, who was great. Plus, the students were able to sort of dig it up on their own with their own initiative. So, it wasn't a problem. In terms of my own reaction and so forth, I think whenever you go into a place like the Royal Hospital, which is a hospital for people with neurological problems, some of them are very severe. You know, it's a challenge . . . I think it's a challenge for the students too. It didn't get in the way. I didn't find myself in any particular aversion to anything if that's what you're asking. We didn't work . . . actually the students did, I think, work . . . they talked a lot with the staff, but I'm not sure how many patients they actually worked with. And my role as advisor, I more or less met with the students and their on site advisor, their liaison. And so, to answer your question, I didn't experience it as a particular problem.

Trevor: Could you just give us a brief description of your background.

Elmes: Sure. I had a bachelor's degree in biology and psychology in 1975. I worked for a while. I went and got a master's in counseling. I worked as a counselor. I did lots of different kinds of counseling. I worked in a mental health department in a rural county in upstate New York. I did career counseling, and I did career planning at Syracuse University. I got my Ph.D. in 1989 from Syracuse University in the area of organizational behavior, and I did research in the area of organizational change and learning. And so, I've had a lot of different kinds of work experiences, but, mostly, prior to going into academia, it was mostly in the so-called health care professions . . . counseling. I spent a summer in 1976, when there were a great number of Vietnamese refugee families . . . I spent a summer working with Vietnamese refugee families. I spent a time, as I mentioned, in career planning with adults, college age kids, and so on. So it's sort of a human services background . . . going into academia and business . . . and now doing research and teaching classes in organizational behavior. I'm married with a wife and two children, two daughters . . . almost fourteen and almost nine. And I live in Holden, which isn't far from here. Is that enough background?

Trevor: Yeah.

Elmes: Okay.

Sundaram: In general, how did you become the advisor for assistive technology projects?

Elmes: The people in London said we have a project at the Royal Hospital, here it is, you're the advisor. It wasn't a project that I solicited . . . it wasn't a project that I went out and sought. It was a project that was developed through the liaison in London, Jennie Hawks, who has a very good community service connection, and with the Royal Hospital. It was there, and I advised it . . . it was assigned to me, you could say.

Trevor: What about the other projects? The Disability Now Online project?

Elmes: The same thing. There was . . . I'm trying to remember all of the projects . . . there was the Disability Now project, and there was the Guide Dogs for the blind project. So there were three projects . . . all three of them the same thing. The way . . . a lot of times, the way the projects in London and Venice . . . each of those sites has a liaison at WPI . . . a WPI liaison, and part of their job is to go out and solicit projects, and our liaison in London happens to be very well-commended. She's in a community that works with Guide Dogs for the blind is one . . . lots of different community service type agencies. So, basically the way it works is . . . these are the projects we have. It might work differently in some other . . . maybe the faculty get involved in helping to set them up, but that wasn't my experience. They were good projects too . . . they were interesting.

Trevor: Are there any specific difficulties that the students had while working these projects?

Elmes: One of the projects, I think for what they wanted to do, the technology that the organization had was inadequate for what they wanted to do, which was . . . I'm not sure I want to get into what agency it was. I don't want to be critical of the agency. They basically didn't have the resources to provide them with the equipment they needed, so the students ended up doing a lot of, what I would call, menial and manual labor that anyone could have done. And I think in some ways it was kind of a waste of their services, but it came down to money. By contrast, an organization like Guide Dogs for the blind, is a very wealthy organization, and they had great resources . . . great computer equipment . . . they had travel . . . they had a place they could stay in Reading, which is, well, its outside of Reading . . . about an hour away from London. So there were real differences in the resources that people had and agencies had, and that made a difference. That was the main problem that I saw. I think the other one, and I think this is true for projects in general, it has to do with the liaisons. I've used liaison in two different ways . . . there's a liaison, sort of a coordinator, that would be Jennie Hawks, and she works for WPI, and she's done some projects. But at each project site there's usually a liaison at the agency, and the liaison at the agency, the quality of that person . . . the time they have available makes a huge difference. Because if they don't have the time, then often the students . . . to at least meet with the students periodically and meet with me, or if they are not helpful or if they're not forthcoming, that's a real problem. But fortunately in every case, the liaisons were really quite good . . . with Guide Dogs the liaison was

exceptional. At the Royal Hospital, the liaison was exceptional . . . very conscientious . . . very smart . . . thoughtful with good ideas and so on. That I think is very important. So it's really resources and the quality of the liaison . . . their commitment . . . their willingness to meet with students and so forth.

Sundaram: How were you able to communicate with students who were doing projects in London?

Elmes: How was I able to communicate with them?

Sundaram: In general, how did you communicate with them?

Elmes: In every way conceivable . . . I met with them at least once a week at their site. I met with them at their flat sometimes. They would hand in drafts of their work, and I would need to get it back to them quickly. We met at my flat . . . we talked about how things were going. Sometimes we did it via email. Many of them we got in the habit of sending in drafts electronically. Then I would make revisions using the revise feature on Word . . . that worked pretty well . . . saved a little paper, paper was precious. Paper's a lot more expensive in London I think . . . maybe its just we're spoiled, or the faculty are used to having an unlimited supply. So I communicated via email, in person, over the phone . . . usually several times a week . . . always once a week for at least an hour. I would say usually an hour and forty-five minutes to an hour where we would have a formal meeting with the on-site liaison, the students, myself where we would talk about progress. And then in addition to that there were usually these more informal meetings, and if there was a problem in the team, then I would generally try to meet with them in addition to this on-site meeting. I would invite them to the flat, or I would go to their flat. There were problems sometimes and especially towards the end. There's one group that was really struggling at the end. They made it through . . . I was worried they weren't going to. So it's probably a lot like here . . . although I think the contact is more frequent at the project centers . . . just because you're living afar . . . you're the go-to person if anything happens . . . you have a lot more reason to be in touch with them.

Trevor: Were there any major problems you saw with implementing the assistive technologies you were doing the projects on . . . were there any difficulties in implementing them in the London area?

Elmes: In the London area . . . well, there was if you want to say . . . implementation . . . well, you know, the Royal Hospital project was really kind of a . . . how do you describe it? It was a precursor to further development. It was a process they had to go through. They had to do a risk analysis of the wheelchair in order to have it certified in the European community. So, it was . . . and they also had to design a manual . . . so it really wasn't going to go on the market right away. But it was a prototype, and so I think future editions will go on, and the idea was that the manual and the risk analysis would serve as prototypes for the product that eventually does go on the market. So in terms of implementation, I'm not sure if this question is applicable to that project. In terms of implementation in the Disability Now web site project, there were some problems with a

search engine that was put into that site. And we actually, thanks to one student who was not on that team . . . he was able to, from here in the fall . . . he was able to fix their web site and their search engine. So, I think technically there were some problems with making it all work. Some of it is I think . . . again the technology . . . they're not quite as far along as we are, and I don't think they have the resources or the expertise. Guide Dogs . . . I think the . . . you know what they were doing is developing tools for . . . essentially they were developing ways in which people in various sites. They were trying to standardize the kinds of tools that were available to people and trying to get them using the tools . . . the computer tools consistently . . . this is staff that I'm talking about . . . consistently. I think that many people were somewhat consistent. Initially, the feeling was that people would be resistant to using these tools. But in fact, I think they were very open to using them . . . great, very helpful in working with the students' development tools, that were user friendly and that would be useful to the people. So, again in terms of implementation, I didn't see any real problems there. But some of that's due to the students having spent a lot of time with users and making sure they got input. So I don't know if that answers your question . . . but that's my answer.

Trevor: That's fine.

Sundaram: What do you think the general level of preparation should be for students before working on assistive technology projects or if it's not an assistive technology project, I guess for going abroad to work on projects?

Elmes: We're talking about overseas . . . I mean . . . I think if we're talking about an overseas project where it's being done in one term, I think they have to go through the proposal process. I mean they have to write the proposal, define the problem, do the background research, find out what other people have written about the problem, and have a very clear, explicit methodology for how they're going to go about solving the problem and dealing with the problem. Because there is no time really when you get there to figure it out. So that means that they need to spend time in the library, they need to talk with . . . I found that some students just didn't talk to the site coordinator, the liaison. And I think that that's important, when there's any confusion in order to . . . but I think the advisor needs to be there if there's confusion in terms of what's the problem . . . what is it that they're trying to do here. I think that's very important. That's the biggest lesson that I got out of it as an advisor is just the importance of defining the problem clearly. They have to be very clear about what the deliverable is going to be because if you don't do that seven weeks goes by like that and by the time you figure out what you're supposed to be doing, you're almost out of time. You don't have time to collect data, and do the analysis and so on. So, it's a very intense process. So, I would say at the very least doing the proposal. I don't know . . . I know there's somewhat of a controversy around . . . I forget the number of the course . . . the social science course . . . the course in social science methods, I don't know if you want to call it that . . . I have mixed feelings about that. My students and I find that it varies tremendously by who teaches that course. Do you know what class I'm talking about? It's a class . . . it's a preparation class, for London, students are required to take it. Methodologies and issues, although whoever teaches it ends up being slightly different. But with the person who

taught it to my students, it really focused on methodological issues. The students really didn't like it, and I'm not sure what they got from it. But, I think there are some things that would be useful. How to make a presentation . . . a seminar on making a presentation. I think it is useful to give students a sense of what is a research methodology . . . why do people think about these things? I'm not someone who thinks that IQPs are great social science research. I think we're fooling ourselves if we think that taking ID2050 . . . that's what it was . . . if we think that students who take ID2050 are going to go off and do social science research that's great, I think it's delusional. But, I think that it does make sense for people to have some general sense of what is a research methodology. Why are there differences in methodologies? What kind of approach is more effective? How do you design a questionnaire that's reasonably valid? I think these are things that make sense. And how to do it in a short period of time I'm not sure. I've said before that I think it's faculty often who have to take this class before their students because it's the faculty who are making . . . who are advising their students on how to use good methods that are appropriate for the problem. And I think a lot of faculty don't know how to do that. So I would . . . I think that something like that seminar, like ID2050, that has some sort of focus on presentation skills, maybe even writing skills as well, but also something around methodology would be useful. And I know that they're playing with that portion of advising. But I think the proposal is absolutely essential, and I think establishing contacts with the liaison is absolutely fundamental. Students need to have had some contact . . . they need to have shown a draft of their proposal to their liaison there so that the liaison knows where they are and whether they're on track because when they get to London they're going to be presenting their proposal, the first week. Right after that . . . and if it's a surprise to the liaison, it could be a problem. So that's what I think.

Trevor: Do you have any other comments you would like to add?

Elmes: I think it's a great idea, what you're proposing. And I suspect that there will be lots of people interested in sponsoring such projects. I think London's a great place for it and I think a lot of it has to do with Jennie Hawks, the project coordinator there. I wonder whether other places would be as . . . I don't know how projects are identified . . . I think to some extent it's a function of who the coordinator is in Australia or in Venice. And I wonder whether . . . what's going to have to happen is that your group is going to have to work with whoever the coordinators are to get them thinking about projects such as these in other sites because right now I don't know of other projects other than in London. Maybe there are some in Puerto Rico.

Trevor: There's quite a wide variety

Elmes: Are there others?

Trevor: Yes.

Elmes: Are there? Okay. That's great . . . I just know . . . I know London, but I didn't know there were a lot of other places. It seems to me that Venice, looking at the canals, can't have any . . . maybe they do.

Trevor: We're trying to talk to people at all of the sites.

Elmes: Okay. That I think would be important, and I think also it's an easy sell. I think it's a perfect IQP if were talking about the relationship between technology and society. It's full of potential as a project, and I think in lots of places the fear is that . . . my concern is that some of these agencies don't have the resources to really support a project in the way they should and that's a concern. That's it . . . that's all I have to say.

Deiter Klein

Sundaram: Could you start by stating your background?

Klein: I deal with information systems, primarily statistical information systems. I sense that there are two interest areas. One is that I did one project that had to do with handicapped people in Bangkok. And, the other thing is that I have worked with NGO's, non-government organizations, in Africa, but that was in no way concentrated or related to handicaps.

Trevor: How did you become the advisor for the Klong Toey Outreach project?

Klein: I wanted to go there. I've been interested in the IQP centers for a long time, and I've done a lot of them. I managed the San Francisco one when that came along. That came because it was one of the topics that was on the list of projects, which were derived by other people. The project center directors . . . and they create the projects. The Klong Toey Duang Prateep Foundation has been on the project list. I think for every time that they do a project.

Sundaram: How did you communicate with members of the Duang Prateep Foundation and others that you needed to communicate with while you were in Thailand?

Klein: The students associated with someone from the Foundation who helped them with talking to people. They couldn't do anything by themselves.

Trevor: Was there a particular person in the foundation who they talked with, like a liaison?

Klein: There were two or three people with which they interacted, but there was one who actually went out with the students.

Sundaram: What were the most valuable resources that the project site provided for the students?

Klein: It was just being available in that environment. You could not approach anyone in the slum community without local knowledge. It's what the foundation wanted the students to do which was to increase the visibility and access to resources for the handicapped. I think an interesting part of that process is that our students simply feel no cultural boundaries and were not really cognizant of them. In that case, that helped a lot because they just went to everyone and talked which local people might not necessarily dare to do or think appropriate to do. In that project, the real issue was . . . the government does provide services to the handicapped people, officially. But, the licensing process, which recognizes those that are handicapped, was a real barrier. The people in the slum community really had no access. In order to be licensed, you needed to get a card from the government. In order to get that card, you had to have certain documents that people in the slum community didn't have. That short-circuited the availability of those services they needed, and no one made an attempt, particularly on the government side, to make that process easier. It really took some self-action by the slum community to find ways. There were ways. It was possible but not by the normal procedures to get that card. The students were probably influential in facilitating other mechanisms which people had not thought about. They were recognizable, but people weren't aware of them.

Trevor: What preparations do you think students need to make before going to project centers abroad?

Klein: Well there's a whole range. There's a huge diversity of project centers. And, I would say that preparation for a project in Europe would be very different from a project in Thailand. Within that perspective, there are projects that deal with organizations that have a lot of similarity to our organizations. I would assume that the Duang Prateep Foundation is really at one extreme of projects that deal with issues which people are really not prepared for at all. As far as the Duang Prateep Foundation, when you go to a country like Thailand, you ought to have a lot of cultural awareness built up. And, that can be done in several ways. You can learn a little bit about customs. This is a Buddhist country so it's very different cultural traditions, and students need to be directed to that. They can't get that by themselves. I think they can get that from travel guides. I think it takes a little bit more reading, and there's a lot of material available. I think you can direct them so its important that they have some guidance, and I would assume that the people who direct the project would have a lot more ideas and experience with it. It's the same thing I had to do to learn about it. Maybe, because of my own experience, I am a little more aware that there are real differences and that you need to know things. So, that's one part . . . that's Thailand. Then comes the other issue, that they are dealing with slum issues and slum problems, which are much more difficult to know anything about. I think a lot of the learning about how to deal with those things happens in the local context. There are resources available. You could talk potentially with non-governmental organizations that deal with such issues, but it would be much more difficult to give a particular guideline on how to learn about that. I think a lot of it is being sensitive to other people's problems. Becoming aware and increasing your sensibility and to learn and just being open. Don't form quick judgments.

Sundaram: What types of resources should an ATRC provide?

Klein: Have you had any conversations with Professor Grogan? I think that's an important thing because I know that there is some other background. When we got some funding from a WPI alumnus . . . I had never met . . . Professor Strage in London. He has either a foundation or he has certainly contributed money to WPI to be thrown in that direction. We had received from Strage in London some funds that we used in our project in Bangkok so he might be interested in what you are doing. If you wanted to support efforts to increase accessibility to handicapped people in Thailand, a lot of the stuff that we do here could be applicable but could not be necessarily. The major issue is cost, particularly in Klong Toey. Is it going to be an organization that is charitable, or will it provide services for profit? Is it going to provide better mechanisms to go to classes or whatever handicaps that people have . . . support their learning capabilities, which most people obviously would be willing to pay for? Or we would have services that would pay for those, which is a very different approach from trying to produce simple devices that could improve conditions for those in the Duang Prateep Foundation in the Klong Toey environment.

Kent Rissmiller

Sundaram: Could you first state your background?

Rissmiller: My background is in Law and American Government. I worked in energy fields for some years, so I have degrees in both sciences.

Trevor: What about your projects in London, did you have any experience with assistive technology before advising them?

Rissmiller: No, I have worked for a year with emotionally disturbed children, relying on some assistive technologies . . . in the research sense, no.

Sundaram: How did you communicate with the students in London?

Rissmiller: I met with the students at their project location weekly, and I met with the students at their apartment more than weekly, probably 15 times . . . which amounted to about twice a week over the term. And we had telephone access . . . so occasionally I made calls to them.

Trevor: Are there any particular resources you remember that the students had while they were working on the project?

Rissmiller: Cousins is the best. This is a person with a lot of energy, interested in what he is doing, enthusiastic in what he is doing. He is very committed to the work. He knows a lot of people perhaps that worked in the same field, and he is also very busy. That makes it a little harder to sort of get his attention, and the students in fact had trouble getting his attention. But he is absolutely working . . . working very hard. I have

a lot of respect for him. I thought he was a great resource. I might think that Jennie Hawks knows a little more about this than I would. I would certainly ask because she seems to have a wide type of experience and knowledge of people who work at serving or work with people with disability . . . work with people in service that effect change through political fundraising, housing, and social services.

Sundaram: Are there any specific difficulties that the students had during the project, other than getting Steve Cousin's attention?

Rissmiller: What I mentioned early, for the benefit of your tape recording, is that the students didn't come with . . . although they had some interests . . . they had interests in the area but they were not coming prepared to do an MQP. And there were some issues . . . especially in the mobile arm support . . . issues here that you needed students to be more well prepared in the engineering aspects, prepared to work on the engineering aspects. As I said to you, Cousins is a busy guy, it's hard to get his attention . . . not because of any ill way. We found that particularly with the mobile arm support that it is a technology that while apparently useful in some set of persons or small set of persons isn't widely used. There is not much training done on it. People don't know how to fit it and therefore is not a widely used technology. Although it is a low cost technology that is appropriate. So part of the problem there is that we had trouble finding stuff that we could use and needed in the United States, and when we got there we had trouble finding enough working mobile arm supports. The students would fit people who would be potential users. The process you might note, the process of fitting somebody, includes the training and the working of the device, which seems to take a lot longer. It will be working for awhile, and then it needs to be adjusted. The one patient that they really . . . there was one patient that however really was successful, and they started for this reason to think it would be really useful.

Trevor: Do you have any other comments?

Rissmiller: If I understand your overall goal, I would just repeat for you especially the need to refer you to the resources we have had in terms of students . . . graduate students who might work in this area and what resources might be available in terms of financial support. And financial support would be for people who would be getting something out of the center. But the other idea that I have got is really sitting down with your advisors and saying if we were to make an invitation list of people who work within this field locally, bring them all together, and pick their minds about the possibility of developing and making available assistive technologies . . . Who would we invite? What would we learn? Would we find interest in the medical community?

Appendix A9: Interviews with Students that Completed MQPs at WPI

Dennis Hubbard

Sundaram: What made you decide to do the project that you did?

Hubbard: I was looking to get a bio-medical concentration so I started looking at possible bio-medical related projects. One of the things that was interesting about rehab projects was that it was not just theoretical, but it was hands on. It was an actual design project.

Trevor: Was the project proposed by someone else?

Hubbard: It was with the Massachusetts Hospital School so it was a rehab project with them. They had a list of several projects, and that was actually a project that was worked on the year before. So, we already had some groundwork of it already done. It was more of a follow-up trying to build a second-generation prototype from a first-generation prototype.

Sundaram: What resources did the sponsor provide for you?

Hubbard: The sponsor itself didn't provide that much for actual resources. We did get a tour of the plant. We got to meet a couple of students . . . do a couple of interviews with students who would be potential users for it. So, they were able to provide us with that sort of information, but, other than that, all of the other research we got on our own, mostly by the net.

Trevor: What difficulties did you encounter while working on the project?

Hubbard: The lack of information out there is one thing. Especially with our project, we had a problem with hydraulics . . . low-pressure hydraulics. There was lots of information scattered out there . . . lots of places that you had to look to get what you have to find. Also, our library lacks a lot of references, manuals, and journals that would be useful. Biomedical in general and especially with rehab for the most part it's just mechanical engineering. You start getting into the medical journals and they have nothing.

Sundaram: Did your advisor provide any resources?

Hubbard: Professor Hoffman provided us with handbooks, conferences, some background literature, especially information from the previous groups. He was really useful, especially in pointing us in directions for web sites and stuff to check out.

Trevor: Do you think that the proposed center . . . other than the resources, what things do you think it should provide?

Hubbard: Definitely an awareness to the campus that we're doing these things. A lot of people don't know about it, even that we do rehab projects. I think you would find a lot more students doing them because it's rewarding. It's just a matter of the information being out there . . . that we're actually doing it. A place like that . . . a place to share ideas. Also, it will be easy to find what's been done before so we're not reinventing the wheel a lot, which happens.

Sundaram: Is there anything else you want to add?

Hubbard: The idea of a center will help pull together a lot of different departments because right now there's the biomedical engineering, the bio department, and the mechanical engineering department. And, for the most part, none know what the others are doing. You often talk to people who say, "Oh yeah, they're doing a similar project over there," and nobody had any idea about it. So I think a center, especially for rehab, would be good for helping pool together all of that sort of stuff.

Matthew Johnson and Michael Malchiodi

Sundaram: First of all, how did you get involved with that particular project?

Matt: Actually, you and Mark found the project for us.

Mike: Yeah, we . . . the two of us as well as our third partner, Mark Becker . . . we were hoping to a do a project together, and so we just started doing web searches, talking to different Professors, and we came across the outline of an assistive technology project on the web. And it wasn't a specific project at all. The idea that I found, I mentioned it to Matt and Mark, and they both seemed excited about it. So we went and spoke to Professor Hoffman, and he talked us into joining his rehab class. It was offered D term during our junior year. We all took it and really enjoyed the course and the work that went with it. So, we decided to stay on for the MQP. Which when we started that, that is when we got our fourth partner, April Hoover. So, that is our story.

Trevor: Did you have any other experience with assistive technology before that?

Matt: No. None that I can think of anyway . . . not in particular.

Mike: I have had very limited . . . done projects at home. I have never run any or designed any. I just tagged along. So, very limited, if any.

Sundaram: What were some of the resources that your advisor provided for you while you worked on the project?

Matt: I am trying to think of what resources we specifically used.

Mike: They gave us technical documents . . . knowledge.

Matt: We had an idea of individual resources that we had used for the class that we took, the rehab class. The class gave us data, all sorts of stuff like that . . .

Mike: Patent searches we used quite a bit.

Matt: . . . patent searches . . .

Mike: . . . RESNA, catalogs and journals. There are some other journals out there that they had mentioned that we had looked in and didn't do any kind of extensive research.

Matt: Actually, I think April knew a few other resources because she had worked in the lab so she had been working on designs in the lab for a while so she knew of a few resources that she used on her own. If she knew any others that we didn't.

Mike: Other than that, the Massachusetts Hospital School, obviously, we did our project with them. So, Gary Rabideau was the contact there, and he helped us out a lot, as well as his staff. George, I think the man's name was, the machinist, he approved our proposed design. They helped us get a lot of the equipment that we used. A lot of our building resources and testing resources . . . our third partner Mark, he helped . . . he did most of the design work on them and most of the construction on them. Have you seen the things that we used for our testing down there? Have you taken a look at what we used, I don't know how much you know about the project? So basically, we ran a wheelchair down a ramp, and we ran it into this instrumented impact barrier which was up against a wall. So, Mark's family has a lot welders, they own their own welding business, so we took the materials down there. And we actually welded this thing together down there, actually Mark did that, and I helped Mark put together the ramp. Background information, is that what you meant by resources?

Trevor: That was good.

Matt: So that was too much information for you anyway.

Trevor: How often did you guys meet with Professor Hoffman?

Matt: We met once a week at least. Occasionally, if we had individual . . . we kind of split up the tasks . . . if we had individual questions or problems we would go in and actually ask the questions. I know that towards the end of the project, I was in asking a lot of questions about a particular integral that I was trying to do. I had no idea what I was doing. He gave me a lot of help with that. We did have a weekly meeting with both of the advisors.

Sundaram: What were some of the difficulties in trying to do a project involving assistive technology?

Mike: Well one of the big problems that we had is that we are trying to design a bumper system for powered wheelchairs, and powered wheelchairs . . . obviously they are various sizes. And we didn't really have . . . we tried to design it for two particular types of models. One of the major problems that we had was getting a wheelchair to actually run down the ramp because we didn't . . . obviously nobody wanted to give us a new wheelchair to run down the ramp, so we were working with really old materials. So that was one of the bigger problems that we had. We were trying to find actually some information on designs that were similar to what we were trying to design, and the only ones that we could find were projects that were performed here already. Professor

Hoffman designed a bumper . . . that was a MQP group a couple years before us that had designed a bumper system, and Gary Rabideau had already designed a system, as well, based off of Professor Hoffman's design. So those were the only designs that we could find that were done for this purpose, and they all failed for one reason or another. So, we did a lot of searches to try to find other types of bumper systems that could be applicable in this kind of area, and we didn't really find anything.

Mike: The wheelchair due to size, center gravity, weight constraints . . . there really isn't much out there that could be slightly modified to fit. As close as we could come are bumper cars, which there your weight constraint isn't as important. Your size constraint isn't even close. The only other . . . we did come across this one page, actually somebody found it for us, on bumpers for wheelchairs to be used for rugby, but the more we looked into it, the bumpers were not optimal for day to day use at all. The background, doing any kind of research, was a large problem. Finding things similar.

Matt: Our project kind of took a turn because we were trying to design this bumper system to start off with . . . like he just mentioned something about forces, or either I was imagining things. We couldn't find information on what kinds of forces were involved in wheelchair impact, and we did a lot of research into impact testing. We finally decided, you know, we have to determine these forces and that became basically the main focus of our project. So, information such as that we couldn't find, background information. So, that is something you might want to think about. Incorporating old materials because now like the main information that we had, will be used for future groups, such as a group right now that is trying to design a bumper and I think they are using some of our data.

Trevor: If we were to developed this resource center that I described, other than having information available from past projects, what other services or resources should it provide?

Matt: Different contacts, both inside and outside of WPI, groups, companies that are in the same field. Past projects that have been worked with. I know that we gave Professor Hoffman a lot of our materials that we used, and we had a contact that we were dealing with at a particular company that was a materials company that I think this group that's working again on our project, the same project that we worked on last year, I think they are using the same company to get their materials. So, things such as that might establish a relationship with some outside company or service.

Mike: Another vendor or a builder or any kind of . . . just a list of people that would know when you call them up and say we are from WPI, we are from the assistive technology center, somebody there should know or have in their memory that know they exist . . . we know what they are. That is one thing that we didn't have, and we established one with this materials company. And we were lucky enough to have the welders, our partner's cousin being a welder, now we would of had to outsource to a welding company or do it ourselves, here. So, that saved us a lot. I know our other partner April was looking for a job in assistive technology, a full time position after

graduation, and she had to do a lot of the research on her own because the lab didn't have that many companies that they had dealt with or that they knew of. Professor Hoffman and Professor Ault both know of some companies, and I believe she went to them just for help, you know, do you know of any in the area in certain areas . . . but trying to keep like an updated list. It is an interesting field, and people have been known to do an MQP in it and are somewhat interested in it and probably wouldn't mind a career in it. I know we graduate a couple of people every year who look into going into the field.

Matt: We need to just get a computer in some sort of library of catalogs or something, there are some catalogs for assistive technologies and that kind of thing. That might even be useful. A listing of web sites or something.

Mike: A web page is always good. Somehow get . . . the other nice thing is advertising the assistive technology center. There are a few places on campus that are advertised large, and that is not one of them. You know researching around a little we probably have one of the best ones in the area. I would say probably one of the best ones on the east coast, possibly in the country, but we don't know that. So, maybe do a little research, and if it is that good let people know that it is. And you get people calling you up and saying hey we have money, and we want somebody to do a project that really helps out. It is a good name for the school, too.

Matt: How do you . . . I don't know what your plans are for this project, are you actually going to establish this resource center, or are you going to write it up?

Trevor: We are just going to write it up.

Matt: Write it up and say this is what should be done. Maybe even just having a web page for the assistive technology center. More people will come across it then. That would have actually been useful with a lot of these things we gathered together. I know Professor Hoffman and Professor Ault did their best to give us good information without having one central place where you could go to and see what kind of information there was.

Appendix A10: Interviews with Advisors that Advised MQPs at WPI

Holly Ault

Sundaram: The first question is, did you ever propose an assistive technology project for which you could not find any students?

Ault: I have a couple posted on the web so I guess, theoretically, you could say yes. I haven't had any students respond to those postings, but they're still available projects. Does that answer your question?

Sundaram: Why do you think that students pick certain projects over others?

Ault: I don't have much of an idea of why students pick projects. Why did you pick this project?

Trevor: Did you ever seek funding for an assistive technology project?

Ault: We have a NSF grant for the MQP projects that we do. I have not looked at the funding for IQP projects. We do have funding to take care of expenses for construction of materials and things like that.

Trevor: Have you searched for any sponsors before?

Ault: We have the NSF projects that we do for MQPs are funded. So, you could say in theory that the National Science Foundation is the sponsor, but as far as the project topics, we work with the Massachusetts Hospital School. They provide us with clients. In that case, the funding is separate from the client base or the sponsors or the people that we actually work with. So, I guess you would call those people the sponsors. We tried to get other sponsors for similar types of projects, like Easter Seals. We also talked to people at Liberty Mutual, and Spaulding Rehabilitation Hospital, the rehabilitation hospital in Worcester, Fairlawn, and a variety of other agencies, even some who have done work in the school systems. And, one of the difficulties that we found in trying to find good sponsors for MQPs in assistive technology is that we need people who can be a liaison, who the students can work with, and who have a good engineering understanding of the project that they're trying to do. And, when you talk about projects in assistive technology typically the people at these other agencies that we work with don't have any engineering expertise. They're clinical people, physical therapists, occupational therapists, special-ed teachers and those sorts of people, and it's difficult to provide the type of technical support that we'd like the students to get from the project sponsors for an MQP type project. They haven't been very good at getting other sponsors besides the Massachusetts Hospital School for those kinds of projects. I haven't had any sponsored IQP projects with the exception of the project that I did in London, and I was not responsible for finding the sponsor for that project.

Sundaram: What experience have you had with assistive technology before advising IQP projects?

Ault: I've been working with rehabilitation MQPs since 1989. Before that I did my Post-Doc in Rehabilitation at MIT so I started investigating the design of assistive devices which I've been doing for almost ten years.

Trevor: How did you become an advisor for assistive technology projects?

Ault: For the MQPs, it's because of my interest in the design of assistive devices. In the case of the project that was done in London, that came as part of the assignment to become the advisor of the project at the London Project Center. That had nothing to do with my own personal or professional interests in rehabilitation engineering.

Sundaram: How did you communicate with the students as well as the sponsors while you were advising projects?

Ault: The MQPs are done on campus so we have regular weekly meetings with the students and communicate by e-mail and voice mail during the week between meetings, if necessary, or meetings in my office. When I was the project advisor in London, then I again would have regular weekly meetings with the students and with their sponsors and also other weekly meetings with the students if they needed help with different aspects of the project. As far as the MQPs, our sponsor for those projects, the Massachusetts Hospital School, it's in Canton that's an hour's drive from here so we communicate by telephone. This year for the first time they have e-mail so we can communicate by e-mail. And fax, we can send them drawings if necessary by fax, and we also usually have an initial meeting with them or visit to the school at the beginning of the term. And, then the students will go down there and meet with the sponsor on an as needed basis. So, there might end up being one or two trips during A term, one or two trips during B term, and then more frequently during C and D term as they begin to develop prototypes that need testing with the clients. So, depending on the project, they may make between 5 and 10 trips a year to the Hospital School for design consultation and meetings with the client and testing.

Sundaram: How about for projects that are in other countries?

Ault: Well the only one I've done is the one in London, and I was on-site so I don't have any experience with remotely advising a project that is being done at an off-campus site, but I am about to do that. I'm sending a bunch of students to the Royal Hospital for Neurodisabilities during this coming C term. Our plans are to use e-mail primarily. I will be visiting them in the middle of the term for a progress report. Other than that we're just going to play it by ear. This is the first time I've done it. Hopefully the e-mail will be adequate when supplemented by faxes and occasional telephone calls.

Trevor: Have you been able to offer any information resources on assistive technology in general?

Ault: All of the MQPs that we do in the design of assistive devices have access to Professor Hoffman, and I have a collection of conference proceedings from RESNA. And, we also have some publications from the National Science Foundation that describe past projects, student projects, not only the projects that we have done, but all of the schools that are sponsored by this program that provides funding for our MQPs. So, those publications are also available . . . sources that would not normally be available to students on campus, but because Professor Hoffman and I are advisors and have these publications. We also send the students to do a literature search at the beginning of the project to find out specific information on the disability that their client may have. So, they use the normal resources of our library, and we also have suggestions for web sites that they can access, one is called Able Data. But, those are the kinds of resources that we can share with them.

Trevor: Were there any professionals that students could talk to in order to get more information on assistive technology?

Ault: Well, we've taken advantage of our professional contacts with the Massachusetts Hospital School. There are physical therapists and occupational therapists and occasionally others besides those. There's a colleague at Spaulding Rehabilitation Hospital who's a physical therapist, who has helped on a couple of projects. So, it's through our personal contacts from working in this area for the past ten years or so. There are people available that we can consult with. Again, most of the faculty would not have those contacts, but as far as rehabilitation engineering, we really don't have anyone locally as a trained rehabilitation engineer.

Sundaram: What difficulties did you and the students encounter while trying to complete assistive technology projects?

Ault: In terms of doing student design projects, maybe the question is: are assistive technology projects different from other ME MQPs that are design projects in terms of the resources that students need or what is the point? What are you driving at? Is that what you want to know? Are assistive technology projects different in what way from other MQPs?

Sundaram: What resources were not available that would have been helpful to the students for an IQP?

Ault: As I said, the only IQP that I've done was in London. And in that IQP, we were working for the Royal National Institute for the Blind so our sponsoring agency was an agency that works with people with disabilities. The project itself was not really focusing on assistive technology, it was more of a management project. So, the students really didn't need any resources that were specific to assistive technology. The sponsoring agency was an assistive technology agency, but it just as well could have been some other kind of business. So, we had the kind of resources that any of the other IQPs in London had. One of the things that I think often happens with our MQPs is that they do need to use resources that are not in our library. They need to go to the Medical School to get some references to papers from journals that we don't have, that come from outside, or papers on biomechanics that might be relevant to the design. Another thing that we do with the MQPs that is very important to the way that the whole design is developed, is that when working with assistive technology, as opposed to working with other kinds of design projects, is that you really need to be concerned about the HAAT model. I know that Trevor is familiar with that. There is a need to look at the design of the human interface separately from the design of the function of the devices and to work out a lot of the human factors and the needs of the individual clients. And, I think that it's valuable to at least have that knowledge when you get into an MQP. I can see how if you had an MQP that had an advisor that wasn't aware of that problem in the design process, and conducted that MQP just like any other MQP, then that is a potential pitfall for those kinds of projects. So, it's just sort of experience from doing projects like this that I really think benefits the students.

Trevor: In your experience, are there any major problems with implementing assistive technologies in other countries that you've seen?

Ault: As I said, the one IQP that I did in London really wasn't focused in that direction in implementing assistive technology. So, I'm going to let you ask that question of the other advisors who have done so, because what I would tell you would be second-hand information.

Sundaram: What do you think is a general level of preparation that students should have before doing an assistive technology project?

Ault: Before they work on the project, they should have the normal academic requirements. At the beginning of the project, I think there's some important knowledge and background information that I think they need to get up to speed on right away. And, some of that would be specific to the disability or the client that they're working with. Some information about service delivery in assistive technology because in the long run I think that impacts how devices are. You know, some of the problems that people with disabilities have with "the system" is useful background information. The HAAT model and those specific design considerations for assistive devices that we talked about for MQPs, I think they need to understand before they can do a good job of designing an assistive device. That's not stuff you would find in a normal mechanical engineering curriculum. IQPs . . . I think that has to vary with the project. But again, I really haven't done very many IQPs, so I think I'll let you ask the people that have.

Appendix A11: Interviews with Project Center Directors

Paul Davis

Sundaram: First, could you describe what goes on at the London Project Center?

Davis: At the London Project Center, currently we operate three terms C, D, and E, and this year will have 75 students completing 25 different projects. And those projects include: solving problems in the environment, the use of information technology by non-profits, a whole range of activities related to assisting individuals with disabilities . . . a lot of work with city government and loosely what you could call city planning kinds of activities. Specifically in the area supporting individuals with disabilities, we work with a number of large national charities and also a number of small non-profits, and in some cases we are involved with device related activities. And in other cases we are involved with activities that support the operation of an organization.

Trevor: Could you describe a few of your major sponsors?

Davis: Sure. In the disability area, two of the biggest organizations are the Royal National Institute for the Blind and the Guide Dogs for the Blind Association. RNIB is the main lobby group for individuals with visual impairments, and Guide Dogs does what

its name says. They invented the whole concept of the guide dog, and they train and provide guide dogs. Our liaisons at Guide Dogs . . . we have two projects going there in term D. One is related to evaluating an assistive device, and the other is related to the use of information technology. The information technology liaison is a consultant that they brought into the main office to bring them up to date as far as using computers to do things like tracking the three million pounds of dog food that they go through every year. And on the device side, the liaison there is an individual who has been involved with the internal use of this guiding device. At the Royal National Institute for the Blind, we have had several different liaisons. One, who was the liaison for several projects that involved access to the web and the use of windows by the visually impaired, was himself totally blind and an expert computer user. More recently we worked with an individual named Gordon Dryden who manages a group whose main charge is clients who are older than 16 and who are seeking further education or employment needs. He is essentially a manager. At the Royal Hospital for Neurodisabilities, we work with several different people. One of them is Steve Cousins, a biomedical engineer, who is involved . . . is literally responsible for all of the devices in the hospital. He's got an innovative wheelchair design that several different IQP teams have been involved with. Holly Ault is the contact there on the faculty. We have also worked with several individuals in the patient care side, assessing the quality of patient care and so on. Some of the smaller organizations, Disability Now, publishes a newspaper for individuals with disabilities, and some student teams worked to put that on the web. One of our long time supporters is the head of a very small agency called the Center for Accessible Environments. They maintain a library and otherwise conduct activities that promote the removal of architectural barriers. So that's not the whole story, but that is a range of the people that we work with.

Sundaram: What are some of the obstacles to implementing more assistive technology projects at the London Project Center?

Davis: One obstacle to having more device-focused projects is that we are operating IQPs primarily, and for an IQP, you are dealing with a different set of issues than you are for an MQP. The IQP is solving a problem with the interface between society and technology, and that calls basically for less specialization than you might have in a narrow device project. A good example of the range are the projects that Holly Ault has advised, and some others have advised, related to the wheelchair. She has a project team, an MQP team, right now that is doing a finite element analysis of the chair design in preparation for destructive testing. And that is obviously highly specialized, and strictly speaking they could just as well be analyzing an oil derrick as a wheelchair. In fact, they are interested in rehabilitation engineering so this is a very good project for them from a purely technical point of view. The technical challenge is to some extent device blind. On the other hand, there have been some groups in there, and some of them advised by Holly, that worked on developing the user's manual for this same wheelchair. And that required some expertise in the mechanical engineering side to understand some of the safety issues with respect not only to the collapse of the chair but things like could you fingers get pinched in the brake? But it also clearly required a more social concerned side because you were writing a document that had to be useful to non-experts, and you

had to really understand both the patient and the support people who would be using the chair. That was a device-related project. It is not clear to me in the scope of the project you are doing whether that user's manual object would count as a device project. I think it made an important contribution to help get that device, that wheelchair, out into the market where people could use it, but if that's an issue. Going back to a real extreme, we've also done some very good projects at that hospital that have been concerned with the care that the patients receive, and there is no device relationship there at all. Given the choice between one of those quality care projects and a device related project like the user's manual, I don't think any of us would say that one is better than the other. They were both very good projects. If I had a choice between a good project at the Royal Hospital on patient care and a lousy one related to access to the computer for visually impaired, and we had a lousy such one, I would choose the better quality of care one at the expense of the more device oriented one. But you could turn the tables too. I really haven't answered your question about the barriers, other than the fact that some device projects require specialization that is inappropriate for an IQP. But I would say that if there were more MQP teams, like the one that Holly has over there at the moment, that we could put in place, then lets go for it. There is no reason to stick with just IQPs in London, and I would think that that would apply to other project centers as well. In fact, I could go on at great length. I hope your project is going to begin to open the doors for those possibilities.

Trevor: How do you find sponsors and what difficulties do you have finding them?

Davis: The main route to finding sponsors is through contacts that our local coordinator, Jennie Hawks has. Once we've found a new coordinator, if we do a good job for them, which, I think, we usually do, we find that word of mouth advertising helps us. Jennie Hawks has long been involved through a job she had a few years ago and other connections with access for the disabled to employment. So, she has good relationships with a lot of the agencies that have become our sponsors, and then from those satisfied customers we have gotten more. We have also joined some organizations that are specifically focused on the volunteer sector in order to meet more prospective sponsors. So, essentially it is networking. Starting with her contacts and working out from there. I would say in general we have found alumni and commercial contacts to be significantly less productive than the contacts with the non-profit sector. I think non-profits are operating at a thinner margin, and they are more willing to take on this crazy notion that 19 or 20 year olds from America are going to come over and solve a problem for them. They are willing to take that risk because their resources are so tight, and then once they see that you folks can really do good things for them, they are ready for more.

Sundaram: How does funding work for the project center?

Davis: We depend ultimately on funds from WPI, which means in some sense that the project center operation is competing with mechanical engineering and mathematics and all the other teaching activities that we've got and research activities. We do ask that non-profit sponsors pay a fee of 1000 pounds and the for-profit sponsors pay a fee of 3000 pounds per project. In addition, we ask that they pay for the student travel costs

while the students are in London and that they provide us with some liaison staff time and a place for students to work, desks, telephone, computer access, etc. The actual fee money that we get doesn't go directly into the budget, but it helps to support some of the other kinds of things that go on. For example, it provided some of the seed money to make it possible for Holly to make an extra trip over to London if that were necessary to get that MQP set up. This is really round numbers, but the 1000-pound project fee is about 15 or 16 hundred dollars. It costs the college roughly 5 to 6 thousand dollars to put a project team in place. That is counting the faculty costs and the substitute teaching and so on while the faculty member is away. And that is some of the cost that goes to just run the program.

Trevor: We interviewed Bill Grogan the other day, and he mentioned that there were some parallel-type projects between London and Germany?

Davis: That's something that is just getting started. We are trying to link project activity at several different project centers, and I think that is one of the important roles down the line if we are able to set up some sort of disability project center, the kind of thing you are doing the ground work for. There have been some projects in London about safety in train stations. This is not specifically a disabled question, but our students did a very nice project to assess what it is that makes a person think that a train station is safe or what drives your perception. And recommendations from that project were instrumental in how about 6 million pounds was spent on a program of station restoration. We actually have a team working right now to assess how well all of those changes work. There is going to be as similar project in Darmstadt in term B looking at perceptions of station safety. On the disability side, what I think would be a really powerful connection is to be able to take some of the overall expertise. For instance, a problem constructing a wheelchair in Bangkok faces a different set of issues than it does in London. The politics are different, the economics are different, the sources of supply are different, and there really is a question of appropriate technology in both places. So to say that the students who work with Holly could do a clone project in Bangkok on wheelchairs, is probably not appropriate. But to think in terms of having some wheelchair related projects in Bangkok and drawing on the experience that we have had in London when those Bangkok students have prepared and maybe to have things happen simultaneously in London Royal Hospital and in Bangkok in one of the slum service area projects, would be very attractive where the students could trade information. We could have people like Holly Ault and Al Hoffman, who are rehab experts, brief the students on the major issues. We could have students who have done the projects in London or Bangkok, return and provide some background briefing and support on the main issues. So, I think those kind of transnational connections could be very powerful and lead to projects that are that much better. And I say that with my fingers crossed . . . persuade some funding agencies perhaps UNESCO or other places to say these folks are doing great things all across the globe, lets put some money into it. So there is a long-term payoff. If you guys do a great project, it could really pay off literally all around the world, but you need to do a good job.

Sundaram: If you were to have an assistive technology resource center on campus to help students who are doing projects, what types of resources do you think the center should provide, other than what you already mentioned?

Davis: I think there are some obvious functions like library and research resources. I don't know that you would necessarily need to have hard copies of everything here, but it would be very useful to have some expertise on where to start looking and maybe some fundamental references available. But, I think the real power of that kind of resource center would be in the network of people that it could develop. I would think that it would be appropriate, for example, for anybody who is going off to a global center to do a project, which is related to supporting disabled individuals. What are the basic issues related to devices . . . related to service? What are the fundamental dos and don'ts that folks have discovered? What are the standard mistakes, and what are the real successes? Not that all of that would be directly applicable, but I call it almost a cultural orientation if you are going to work in this general area. So you need to know what the basic ideas are. You can take the same engineering concepts and move them into different areas, and the vocabulary changes, so you need to know that. And in the same way, the same kind of cultural concepts as you move into different areas . . . you need to change the vocabulary that you use. That would be one part. I could imagine that, say with a specialized device oriented MQP, if you had some graduate students working in the rehabilitation lab, that they could be part of the project team, either collaborating scientifically or functioning on a junior advisor level. It would be good experience for the graduate students and provide real day to day contact for the undergraduates. And very often because of the lack of an age barrier, graduate students would be more effective in communicating than faculty members. I think that you could set up a system with undergraduate peer learning assistance using folks who come back to project centers to do some of the support work. Even help with things like reading drafts of problem statements and background research. You guys are going to know a lot about the literature when you are done with this project. If you were to just to read through a background research for any project with a disability connection, you could say yeah, you guys have pretty much got it. You've covered all the bases, or whoops here is this great big area that you need to go to, or you really ought to check the center at Wisconsin or wherever because they have some important resources there. I would envision it more as a support network than as a room with some books in it. And, you would need a structure for the support network, and you would need to identify the ways in which people could contribute. Maybe its primary manifestation would be a scheduled series of events during each preparation term. Two or three talks or seminars. Maybe it would be a scheduled source of tutorial sessions where students with experience, like what you are developing, interact with students who are new to the project area. I hope that out of some of the work that you are doing . . . these interviews and so on . . . is how you will get a whole range of suggestions, and then we could begin to coalesce those. And again, I've got this notion that if we had a good set of ideas we might be able to go to an outside foundation and say look, here are the things that we could do. We've got these individual bits of expertise, and if we could put them all together, we would end up with something more powerful than the sum of the parts. So, please give us ten million dollars, and we will do it for you. That's not a very concrete description . . . it's really a set of possible

ways to set up such a center. I think I am more narrowly defined on the engineering device side of the technology. There are a lot of things that you could do. You need laboratory space, you need certain kinds of equipment, you need to know about certain kinds of testing protocols, and you could have all that in place. I am really trying to look beyond what I regard as sort of obvious necessities on the device side. Not so obvious to everyone, but obvious to people like Holly Ault. She could make up a wish list pretty fast. What else can I tell you?

William Grogan

Grogan: I was involved in starting a number of the project centers, including the one in London. And, one of the things that we talked about with our various project centers and the kinds of projects that we have been doing, is the fact that the projects are here, there and, everywhere. And, we know that we could have stronger projects if we ran some of them with themes where we could use the experience of one project center and another one, and interweave them to make our project experience for the students better and richer. But also, we would be able to produce better results for our sponsors and the people who would be effected by the projects. As we talked about this, we realized that we can get some funding for some projects beyond the tune of $5000.00 - $10,000.00 dollars for individual projects, and we have. The Strage Foundation has given us now $20,000.00 to help with projects which we have done in London which have to do with the Royal Society for the Blind and some with the sight impaired projects. We also have done projects over in Bangkok, which was what Steve Weininger has been doing, that had to do with disabled people and access to jobs in Bangkok. There are a number of cottage industries, small jobs and people with a wide range of disabilities, and the question is how can we match the people with the various disabilities with various employment opportunities. So that we can bring them together. There are apparently national, international, and municipal registers that classify many of these kinds of things. The whole thing amounts to the fact that rather than do individual projects which may be meritorious, we could raise the effectiveness of the entire enterprise by working together and creating an overall center as it were. In the case of disabilities, we have the center that Al Hoffman and Holly Ault run here . . . assistive technologies of all kinds of types. And the thought occurred to us, Henry Strange and myself, . . . when we met in London several times and he's been over here . . . is if WPI could pull together everything that it has been doing in terms of assistive technology. Whether it is access to transportation in London or all kinds of access problems as you could well imagine. Also, design new buildings, new facilities, and then we have mobility issues. The areas such as Afghanistan or Cambodia where there are enormous number people, as a result primarily of land mines, who have lost limbs, and they don't have wheelchairs. They don't have anything, and the situation is really awful. Is it possible to have the indigenous people have a basic design that they could make out of local products because the poverty is just unbelievable? So it can't be something made in American or Sweden or someplace with high labor costs. What could be designed that would be safe and practical that people on the scene could possibly make? Can we design something like that that would increase the mobility? Maybe it's a kind of wheelchair that looks totally different than anything that we currently make. Are there better ways of doing it? And people don't think of it

because in the advanced countries there are lots of resources available that are not available in some of these very poor developing countries. But there is a whole range of things that we could be doing, but we are doing it bang, bang, bang . . . you know a project in London. Now we have linked some of the projects in London with our project center in Darmstadt, Germany so that we are sharing some of the information about access to transportation between the two. Some of the projects that we will be doing in Darmstadt this year are going to be parallel projects to those that we will be doing in London. So we are starting to network this. Bangkok . . . we've got a little feedback, but we haven't really systematically developed it. And then on top of the whole thing, we have our laboratory and the work we are doing here in the Biomedical Division. So, the concept, which seems to make a great deal of sense to us, is can we find some themes, because we can't cover everything . . . it's such a huge broad field. Can we identify some elements of this huge monumental problem that we could concentrate on? And then by pulling together our research and teaching facilities here on the campus at WPI and matching them with the kinds of problems that exist in the fields, it would seem that WPI would be in a position to establish a reputation as a resource so people would come and projects would come to WPI. Funding to carry out the projects would be able to come, as you point out, from the big funding operations such as UNESCO out of Geneva where they have a big group that's doing exactly this, but they won't . . . can't be bothered to fund an individual project for $10,000.00. But they would fund a center for half a million. They want to talk great big money, and to do great big money you have to have a significant operation. And therefore, if WPI were to establish an overall center for assistive technology, and they could identify a spectrum within the broad field that we could really specialize in and combine what seems to be a great resource in terms of the research and academic work going on on campus with the field work being carried on by smart, technically oriented students, all over the world. What a powerful combination we could make both for the good of society, the education, and the ability to contribute on the part of the students! And everyone would benefit from it by raising this to a more specialized and coherent program, than simply having the laboratory doing some work here. Some very interesting and useful projects in London, in Darmstadt, in Venice, in Bangkok, and all over . . . if we could find a theme and build up something so that the projects that we did do would be more useful and could develop a longitudinal base, which is what we've done with many of our projects. The other thing along with this would be environmental projects, which we are doing in Costa Rica and Venice and also Bangkok and Puerto Rico and all over. So the two themes, if WPI were to take this enormous energy that is available in our IQP projects and in our academic work here and link them in a more effective way, everybody would benefit all over the place. And, we would be able to attract funding so we could do better work on these projects. We would be able to elevate it to more important and significant operations by having them longitudinal projects, and so there is some work going on in environments. But the one that's really taking hold is in assistive technologies about to work primarily for access problems. And as you can well appreciate if it's bad here in a somewhat modern environment like this, you can imagine what it's like in the medieval environments of the old European cities where it is awfully hard to retrofit some of these essentially castles and dungeons and all of these other things that they have. Very hard, but yet it has got to be done, and so there are enormous challenges. I am delighted that you are on this

project because it's one that we've talked about. I called a meeting back in November, during the winter, and Al Hoffman and Holly Ault were there along with Paul Davis, who is head of London, I'm there and I'm connected with Darmstadt, Steve Weininger, who is connected with Bangkok, and Lance Schachterle, who is the Associate Provost. We got together and said okay how can we start this, what is there, what would be the best topic to start with. And she said she was going to have an IQP coming up, and I guess that's you guys, to kind of take it from here. So that's my story and that's what we hope to do, and I would be interested to know what you feel is the theme of your IQP as it's evolved. I know that it was pretty broad when you got into it so it took some courage and faith in a sense to get started and see where you are going. So, I would be delighted to help you in any way that I can. That's my background. I don't know whether this matches what you are doing now or not.

Trevor: Yes it does. Would you just describe a little more about the projects that you are going to be doing in Germany?

Grogan: The projects there have to do with . . . there are two or three of them that are comparing public transit access for disabled people in London, how they approach access to tram cars and busses and so forth. With what we are doing in Germany, which is almost nothing, but of what can be done and how can it be improved? What should be the first steps that they are going to take? Part of it is a survey of where are there any measures being taken to make places or particularly transportation more accessible. London, for example, a big way of getting around is the tubes, and most of those are very hard because of all of the big escalators going up and down. Also, they are starting to put in elevators in some of the stations. So to the extent that they have elevators and those platforms can become accessible and all the platforms are level, but sometimes they are not very close to the trains. They have these signs all over, and they keep announcing it, "mind the gap" when the subway train comes in. They will say "mind the gap". They have t-shirts in London that say "mind the gap". You hear it a thousand times. Well if someone is in a wheelchair like that, the front wheel would go into the gap. So they've got to think about that problem, and that's a tough one, but it's not unsolvable. They can have a flap of some kind that would come down, and you could ride over it. They have to be aware that it's not. You say, well, they can't bring the platform closer, of course not, but they can have mechanisms so when the door opens that some kind of flap would come down. And, people with a wheelchair could ride right into the car, and they have access spaces where you could put a wheelchair near the door. It's reserved, but I've never seen them used because I don't know how you would get in. They haven't addressed the whole problem as a system and the same thing in Germany. They are going to have to have lifts or some kind of accommodation on the electric tramcars. I've never seen one in Germany. I have seen them here but not in Germany, and the British are very sensitive to it, and the Germans are becoming more sensitive to it. They haven't been. They are much more interested in the speed of the trams than they are with access to the trams. In fact, it's a cultural thing. They are now becoming much more concerned. We are doing comparative studies about . . . the Germans asked for it . . . what we were already doing with London, but the Germans heard about it. And we had a meeting in London between our coordinator in Darmstadt and our coordinator in London to see how

we could coordinate these because they both have a lot to learn from each other, and they are just really starting to get going, especially the Germans. So, we are kind of the intermediary. So, that is exactly the kind of thing we are in a position to do because we can send teams to both places and since we are coming at it from a third country. We are not even German or British, and we don't have that. We are coming with a neutral viewpoint, and with that we can do a fair comparison or at least one that is not suspect of being biased. Those are the kind of things. Bangkok has all kinds of problems. The whole world does, and this is something we can do. We can do some good work, and we have the same thing with visual impairments. The people who, back when we had the Dos environment on computers, blind people or people who are severely visually impaired could work it. The Braille became very good. And then, the Windows environment came, and it blew them away because you had to rethink the entire approach to computer operation because everything was now visual on the screen and the mouse and the icons and the whole thing. There had to be a whole new approach for people who had sight difficulty, who were blind, because they had to come and have different ways of approaching Windows. It is being worked out, and we have done some work. And, we have done some work with the Royal Society in evaluating this, and that again is transferable all over. There are ways of learning how to accommodate it. There are talking machines with tone machines, and it is coming along. But it's tough, and I don't think people ever thought of that. But, what about the people who could not see the icons? People became very good at the Dos line by line program environment, and now you had to go to a different one. So, as technology improves things for some people, it creates problems for other people. That's one of the things that is international. It's one of the things that we can study and do evaluations. We could send teams to do international comparisons. Almost like no one else can because we are not suspect of being a government organization or having a big political agenda. We are coming as engineers and scientists and people like that to do an objective evaluation and make recommendations that are not political but were based upon sound technical approaches. That is what we are doing . . . that is our main thing now . . . is in transportation access. That is what we are doing this year.

Sundaram: What sort of resources does the German Project Center provide for students doing projects there?

Grogan: In Germany, we began the project center really as an exchange program with . . . it was called in those days . . . which sounds like technical high school which is exactly what it says. But, in Germany that's a technical university, so they just changed the name to the Universitad Darmstadt. We started an exchange program, and we started doing projects. So, the University provides us with an office, computers, computer access, libraries, residential facilities, and access to professors. The students who go there now almost always have to be able to speak German. You can get away with it in the University because all the German University people speak English, but if you go out and do a survey in the town or something, you better speak German. But, we have had this relationship now about ten years. It has been a very good one. Of course you have to do an exchange, and so we have German students over here for a full year exchange program. So, I think we have three or four German students here right now who are here

for a full year studying, and we send about 16 students to Germany for a ¼ of a year to do projects plus some studies. So, we vary in relationships. That is the kind of arrangement that we have. It is like they have sort of a center for the interdisciplinary studies at the University with a mission very similar to our IQPs, and that is the group that we work with. Dr. Gearhardt Stearch is the coordinator in Darmstadt. He has been over here, he has been to London, and he is working with our London coordinator whose name is Jennie Hawks. And, these are people we have sort of hired and made affiliates that help us as needed on the scene, and we have faculty coordinators, like Paul Davis in London and Professor Weininger in Bangkok. But if we had a theme, we could focus on and give resources to build the center where we could not lose the data that we are gathering that goes into a report. Could we provide greater focus to our projects, could we elevate them by providing the students with greater financial resources so that they could accomplish more and have a center here, which would be the repository of all this information and help guide the program so we would accomplish more . . . reach higher levels of value for everybody involved? So, that is what we're trying to do. So, one of the two questions really, or one big question, is how do we do it. More specifically which as I understood it was the one that you are working on, is can we identify a more narrow subject area so that we can get more depth. Not be flying all over the field but concentrating on a given topic or two topics so that we can start building greater depth and a more longitudinal dimension to our projects. So, what have you found?

Trevor: There is a pretty wide array of projects.

Grogan: Don't you feel we could accomplish more if we tried to bring them into more focus or what do you think?

Trevor: Yes that would be effective. If you could cover a single topic in different environments, that would be a lot more useful.

Grogan: We have to figure out from the enormous menu that is out there, what are the ones that we're best suited to concentrate on? It doesn't have to be one area but maybe three or maybe four but not twenty. It's that kind of thing.

Trevor: You answered most of our questions. Is there anything else that you think the center should do other than hold all of the information at the end of a project?

Grogan: I think it should be very proactive in being a source of recommended IQPs. People come . . . I am sure you did . . . you would like to do something in this general area but didn't know what. And, people are doing that all the time, and I think a center where people like our project center directors and our coordinators, people who are coordinating in London, Darmstadt, Bangkok, and Puerto Rico, who want to have projects in this area, can come and look through what is available or have some people to talk to. In fact an IQP . . . say you are doing this two years from now, you might be doing as your IQP the advising of the people who want to do IQPs. Pointing out where the resources are, where the problems are, what kind of background people should have, what kind of reading they should do, who they should interview. So the people don't

have to rediscover the wheel every time they start. Where can they be directed to start? So, I think it's a resource of material but not just dead material but being a place where people can come to. We would like to do projects, and it would be nice to relate it to what's going on in Venice or what's going on anywhere. We would like to suggest, this is a project that finished last year, a very nice follow on project would be one like this. And, help the advisors and the interested students to find their projects up front and then follow through and bring that information back into the system. Now it goes to the library or goes on the Internet. There is no way when you start a project you can go back and look through it, but I think we would pick up so much more momentum if we had a systematic way of doing that. So, I look upon the center as being a place to say look there's a real opportunity of putting up on a video screen or of sending information to advisors or students. Saying this is a project . . . if you are going to go to London, this is a project that we would like to have you consider, that kind of thing. But be active in it not just be a passive thing but be very active and a director to help make this thing go. Mainly your job now is to find what we should be doing. I would think it would be interesting to set up a big matrix listing all of the kinds of projects that have been done in this area. Keyword them so when you want to look them up in the library or something, you know what the keywords are so those projects would fall out. And, linking them in some kind of Internet would be very useful. But then getting the matrix and then classifying into different kinds of projects like the ones we have been talking about. Access problems . . . there are access problems to buildings. There are building projects when they put together apartments. I know we have done some on that and new developments in transportation access. And, that can be city transportation, such as trams, undergrounds, and aircraft transportation. There are all kinds of things, and then we could look into what other kinds of problems, such as the problems of visual impaired people, how does their world and their problems relate to technology, whether it be computers or whether it be transportation. We need some kind of a matrix. I guess my engineering background . . . we need some kind of matrix to help classify these and then out of that classification select one or two or three that are going to be the primary recipients of attention. And, that will then go back to the faculty, to potential donors, to the administration. Say okay, WPI is going to become known as a world leader in this type of projects and solutions, and I think we could make some progress. But I am afraid that if we keep scattered all over the place, we will be doing some good, but we won't be doing as much good, either for our own students doing the projects or for certainly the recipients of the effort. That is my theory.

Peder Pedersen

Sundaram: Can you explain what the primary activities of the Denmark Project Center are?

Pedersen: The primary activity is to provide IQP opportunities, and this is over a broad range. This year we have IQP projects at the National Museum. Demcovis is a subsidiary of our underwriter's laboratory. We are doing lifecycle analysis. We are doing a project with the English bicycle innovation, and we have an interesting project at the Information Center for Visual Handicaps and that sort of falls into your category.

Next year's projects will probably be different at least to some extent. It is likely that we will be back at the Danish Society for the Blind. They are interested in sponsoring another project.

Trevor: Could you give us a little more background on the Danish Association for the Blind? Who you worked with there?

Pedersen: I was, of course, not over there to advise the project. The Danish Society for the Blind works as an advocacy organization for the blind people. They help with employment opportunities, housing, and activities for the elderly. And that particular IQP project, which took place last year in 1998, dealt with appropriate web design and web-based information. It was basically an investigation into appropriate web tools, appropriate web design, appropriate guidelines for designing web pages for the blind, and how the web could be used as a source of information for people who had visual handicaps. The group worked, at least to some extent, with the director, Poul Luneborg, and he is an active person in Denmark, involved in many organizations that help handicapped people.

Sundaram: How does funding for the project center occur?

Pedersen: At this point, we have not received any funding from anyone. Our corporate sponsors will pay an amount of money equal to the cost of the IQP operation. For non-profit organizations, we have not found it appropriate to ask for money.

Trevor: What was the other blind advocacy group that you mentioned?

Pedersen: Denmark has a whole series of Information Centers, for visual handicaps, physical handicaps, speech handicaps, hearing handicaps. There are five or six or seven Information Centers that are funded by the Danish government, but I guess are run independently. It is basically a source that anyone in Denmark or outside of Denmark can draw on if they want to do something. The case in point is a project this year: there is a sailing club in Denmark, consisting of blind sailors. They like to go sailing and not only go sailing but compete in races. The IQP project that is currently ongoing looks into appropriate technology so you can see what compass course you are sailing in. You can have a sense of the depth. You have an idea of the position of the sails and the wind speed and everything else. And they're looking into technology that will help visually impaired and blind sailors to go into competitive sailing. That's maybe not a typical example of what an information center would do. We may well in the future have projects with some of the other Information Centers for x handicaps, be it hearing handicaps or walking handicaps or whatever else.

Sundaram: What types of things do you think need to be done in order for more assistive technology projects to take place in Denmark?

Pedersen: It is between Tom Thompson and myself to decide which projects will take place. There are constraints by which organizations are willing to offer serious projects

that they are interested in. So, there is no sort of formula. We feel that assistive technology IQPs are good IQPs because they embody what IQPs are about, if you look at societal aspects with needs together with technology. But, we are not going to run all IQPs to aid people with one handicap or another. We will hopefully continue to have a number of them. We also want to continue to have environmentally oriented IQPs.

Sundaram: How did assistive technology projects begin at the Denmark Project Center and how could that possibly be expanded?

Pedersen: It started with a contact at the Danish Society from the Blind, and then a couple of people from this Information Center for Visual Handicaps came to the final presentation a year ago, where I was. I talked to them, and I went to Denmark last summer and had a meeting with someone from the Information Center and one thing led to another. We hope that this will continue to the extent that there will be a more coordinated effort that is. A project in England or Venice or Puerto Rico or Boston or wherever can draw from projects in Denmark and vice-versa.

Trevor: What do students have to do to prepare to go to the Denmark Project Center?

Pedersen: They have to do a PQP that, as of next year, will have two consecutive parts. This year it had two concurrent parts. It is sort of a cultural, societal preparation where you talk about the Danish society's norms, values, expectations, lifestyles and many other aspects of Danish society. And, these are reading assignments and presentations and short essays. So, that is one preparation to have a sense of the things that you're going to do. The second part is the actual project preparation where the students will work in the teams that they will be working with in Denmark. They set up goals. They do literature searches. Sometimes they do trial projects. There was a project where they did a passive solar heating study here for a project. So, they do a pretty thorough investigation and write a project proposal and do a project presentation. It is for the future going to be two one-sixth units preparation with one sixth in C-term and one sixth in D-term for a project that is to be done in E-term.

Sundaram: If we were to have an ATRC on campus that would assist students who were doing an IQP in another country relating to assistive technology, what types of functions do you think that center should provide?

Pedersen: I would think that one thing it should do is be a resource place. If you want to learn about museums that would be useful to the blind or about handicapped access to trains or skiing for people who are paraplegic or whatever, I am just inventing something. You could go there and see what exists, not just what exists in previous IQPs, but what exists in general . . . have databases that could be useful.

Stephen Weininger

Weininger: Let me just ask you to start out with if you have some set, a fixed set of questions that you want me to answer or do you want a kind of freeform answer. How do you want this conducted?

Sundaram: Could you start by stating your background?

Weininger: I am a Professor of Chemistry. I have been at WPI since 1965. I have been involved in the off campus IQP program since about 1986. In 1993, I went to Bangkok for the first time . . . as site director in Bangkok . . . back in 96 and then in 97 I became . . . the two previous times I was the on site advisor and then I became the director of the program so I didn't see it. I could go on and tell you a bit about how we got involved with the assistive technology. I was informed by Bill Grogan, who is the former dean of undergraduate studies, that one of our alumni, Henry Strage, who is now in London and who himself has taken a great interest in organizations that are aimed at making a better life for handicapped people. He had given some money to WPI, which he wanted to be used for projects that affected the handicapped. Now since 1991 when the Bangkok Project Center got underway, we have been doing projects with an organization that serves residents of the largest slum in Bangkok, this foundation is called the Duang Prateep Foundation. And this has been ongoing every year and that year there was a, preparing for projects, there was a question of what we might do, what project we could possibly do with them that year, and I thought that this was a very good opportunity to do something worthwhile, continue to do something worthwhile for the Foundation in the Bangkok slum and also to respond to Henry Strage's offer. So, I proposed to them that we do a project specifically aimed at the handicapped residents of the slum. First I wrote a little . . . and I think they didn't quite know what we had in mind, but we eventually convinced them that this was a worthwhile thing to do. And in fact as it turned out, nobody knew how many handicapped people there were living in this slum area and what sorts of handicaps they suffered from and so on. So our first project was precisely to do a survey and find out how many people were handicapped, what were the criteria, what sorts of handicaps they suffered from, what was the official position of the Thai government in terms of legislation and so forth. What kind of yield and practical problems did they face and so forth, this was a good background study. That was C term of 1996, and C term of 1997, by then I was the director, so I wasn't resident in Bangkok except in the beginning, but that year there were two projects in the Foundation, and the handicapped people that was under Professor Klein. In 1998, we did a project that didn't involve handicapped people, but in fact now in 1999 a project that is in fact focusing on promoting more economic independence of handicapped people. So that is sort of the history of my involvement and how the Bangkok Project Center got its involvement. Grogan had told us that in addition to assisting in specific projects, Mr. Strage, who had a lot of experience in international organizations, really wanted to see us really make a more coherent effort here at the college to bring all of these efforts together and coordinate them. And if he was here I am sure he would say a lot of things to this effect. He was here in December last year, and he spoke at length about this.

Trevor: Do you have any other experiences with assistive technology, or just the project you advised?

Weininger: Not directly with the technology. My first cousin who just recently in the last several years passed away . . . to whom I was very close . . . contracted severe polio as a young teenager a few years before vaccination . . . was severely afflicted and was wheelchair bound for the remainder of her life. So I have some sense on a first hand basis of the kind of problems that she had. Perhaps not assistive technology in the sense that you mean, but at least in some sense of various everyday problems, like someone who depended on assistive technology.

Sundaram: What types of resources does the project center provide at the site for students and project advisors?

Weininger: Do you mean in the way of preparation or do you mean what goes on at the site or both?

Sundaram: Mainly what goes on at the site.

Weininger: The projects that we have done there have been to some degree scattered. What makes them hang together is the fact that the people who work or for whom we work are not only handicapped but are quite poor. So as I mentioned, the first project was simply to find out how many people there were with handicaps and also to familiarize ourselves with attitudes for handicapped people . . . are very important . . . as well as what the legal status of things were and also the degree to which any legislation was actually being enforced. So in 1996 was the survey. In 1997 there were two projects. One of the factors that our survey had uncovered was that some sizeable fraction of the people who suffered various kinds of handicaps, had congenital types that seemed to be related to the fact that in Thailand, as in many other countries, it is possible to get any medication that you want, pretty much over the counter. And so, a lot of people would treat themselves, and this turned out in many cases to be a problem particularly for pregnant woman because they would take some medication for some sort of condition that they had, some problem and they were unaware of the extent to which some of these medications might in fact cause fetal damage. And so, many children were born with drug induced handicaps. One was an education program that was aimed at indicating what could be safe medications for certain kinds of conditions and which ones to stay away from. Another important factor that the 1996 team had uncovered was that there were in fact government services for handicapped people but necessary to having access to this service was registering for this program. And many of these people being poor and in some cases illiterate, were utterly unaware, so they instituted a big campaign to get people in the slum community that were handicapped to qualify under the government program to register. That was actually quite successful, and they had a big public registration during which the prime minister came down. So that's 1997. In 1998 we didn't have a project there involving the handicapped. 1999, now, there is one focusing on economic independence, and so they are actually talking to handicapped people in general . . . to other people not handicap and activists, to ask them about their view of what the biggest obstacles are to economic independence. We rely a great deal on onsite interviews and research methodology. None of us are sufficiently fluent in Thai

ourselves so we depend on having translators and so forth. But in terms of legal information and stuff like that, we get the United States regulations. We find out whatever we can here about applicable laws in the United States, and the ties are very interesting and allow us to contrast Americans by the legal approaches. But in order to find out what is actually happening on the ground, we have two major resources over there. One is newspaper articles. In the last few years, I would say from the time that we first started to do this, the problems and issues connected to handicapped people have become much more prominent in the Thai press particularly in the English Language. There are two very big English-speaking newspapers in Bangkok. So we got a lot of information through that and some of the hope of the newspaper stories and interviews with local people.

Trevor: Do you have like a liaison or something that works with the students?

Weininger: Yes. We always do. Now at the Foundation, there are two people who are quite, woman actually, whose English is quite good and serve as our principal liaisons. The woman who is the head of all of this, the general secretary, is the one who approves our project and with whom we negotiate. And sometimes we propose to her as in the initial project about doing the survey. And sometimes she makes a proposal to us, such as what we are doing this year about the economic independence. She is not involved in the day to day activity but we do have two people who have been our liaisons, for some time and who work with us and enable us to complete our projects. Neither of them is handicapped.

Sundaram: What kind of contact do you have with the project advisors before they work out on the project and at the site?

Weininger: Well we do have a preparation program. All of the students have to do a PQP for the projects and of course the advisors supervise them so they get engaged with the issue. When people ask me, students or faculty members, about what the likely projects will be in the future, because often we don't know until it is about D term, I give them a general run down. Like I tell them for instance that every year we do projects with this Foundation and that in the last three or four years many of the projects have involved the handicapped. So they are aware of that, and we also tell them that there is this background information contained in the project reports. So usually the students, and certainly the faculty advisors, have read those.

Trevor: In general, at your site, in regard to any projects, how do you find sponsors? Do they come to you?

Weininger: No. We really do have to sort of have to dig them out. We have two coordinators in Bangkok. One of them is a university professor who got her Ph.D. here in the chemistry program. We have a long-standing relationship with her and the other, also a woman, is the wife of one of our alumni who was born in Thailand and so forth. She married him, and so she has been with us for a long time. The two of them actually have connections in sort of different parts of the whole Thai community so it turns out to

be very helpful to us. The second woman, the wife of the alumnus, had herself been an actor in volunteer activities in the Foundation, which relies very heavily in volunteer contributions in terms of work, money or pertinent stuff. She was the one who suggested to us, even before I came on the scene, that the Foundation would be a good place. In fact, we would probably take more over, but they have a limited small number of staff, and a minority of them are English speaking. We rely very much on our coordinators.

Sundaram: As far as proposing projects, does the site propose the projects?

Weininger: As I sort of indicated there is a give and take. In the case of the Foundation, which is a principal place where we have projects that are focused on the handicapped, it gives back and forth. Sometimes we propose and sometimes they propose. Usually it comes from them, more often than it comes from us. Our first handicapped project was unusual in that it did come from us. But in general the projects come from the potential sponsors.

Trevor: Does the project center have to procure funding from WPI or are there other sources?

Weininger: The project center gets essentially all of its funding from WPI. Thailand is not a third world country, lets call it a second world country, and right now of course, along with many other countries in Southeast Asia are having a lot of economic trouble. In the likelihood that sponsors could actually put up any money, it's just not on the radar screen, and sometimes we have to struggle even to get basic levels of support, like rooms to work in and a computer and some places the computer paper is hard to come by. So the funding comes from us, and frankly I think for the foreseeable future probably will.

Sundaram: Are there any other comments that you would like to add about assistive technology projects?

Weininger: Well, I certainly would, I think, like to follow through on Henry Strage's idea to coordinate our efforts. We have projects for the handicapped going on in London as well as in Bangkok. I don't know are there other sites by the way? I would certainly like to see better coordination. For instance, one of the problems that a lot of people have particularly in the slums, many of them can't afford assistive technologies, and even if they could, they couldn't make use of them because they live in very small places. Often they have these concrete walkways, just about wide enough for a person to walk, probably not wide enough for a chair. Tackling some of those problems, through some sort of coordinated effort, people who are out there and maybe some teams here working with Professors Hoffman and Ault could be a possibility. I don't think it would be trivial for the coordination, but I think it could be valuable. I also think that probably we need to be aware, when I say we I mean all of us involved in these projects, to what extent the problems that are faced by people are universal and to what extent they are very much affected by the local circumstances. We really haven't just sat down to exchange information on that. That would be an awfully good idea. So we could certainly use more coordination. We could also use more talk, but that's always in short supply around

here. That's my major . . . I think this is a really worthwhile, focused project. I am just glad that they have provided us with some projects that are extremely worthwhile.

Appendix A12: Interviews with Project Center Coordinators

Jennie Hawks (email questionnaire)

1) Could you please describe your professional background?

School teacher for 20 years in UK secondary school system teaching English, English as a second language and special needs. Gap in work to bring up children. During gap involved in nonprofits and campaigning organizations to improve health and social services locally and regionally. Served on board of large teaching hospital for 8 years with special interest in services for disabled people amongst other things. Chairperson for 10 years of an organization providing assessment and training for work for disabled people. Back in work early 1990's, joined a major UK bank as Equal Opportunities Manager for Disability. In 1995 became self employed. Have been working for WPI since 1996 as well as project managing a European network for disabled university students and graduates in six countries.

2) Could you describe the responsibilities that you must fulfill as the on-site coordinator at the London Project Center?

As on site coordinator for WPI I have to find suitable accommodation for students and faculty, find IQPs, provide students with any other help on projects or anything else.

3) Please give a brief description of any affiliations that you may have with organizations concerned with assistive technology or disability issues in Great Britain or Europe as a whole.

Through my work in the disability field which began in the mid-1970's, I have got to know a large number of organizations as well as disabled people. Whilst on the Hospital Board I became aware of the appalling service that disabled people get from the health services in relation to wheelchair provision and prosthetics. I am aware of assistive technology centers in the UK and in the rest of Europe.

4) In your opinion, what issues regarding assistive technology are a source of debate today amongst members of the assistive technology and disability community in Great Britain and Europe? What are some of the obstacles involved with implementing assistive technology in Great Britain and the other countries of Europe?

I can't really comment too much on this one as I have been out of campaigning for some time. The European Commission tried to set up a catalogue on line or something similar so that people could order wheelchairs etc. from all round Europe not just from within their own country. This was called Handynet and cost millions of ecus and was a failure. The main problems are cost, time it takes to get equipment, time it takes to repair broken equipment. Also disabled people are never seen as partners but always as recipients - disabled people know exactly what they want and should be asked far more frequently than they are.

5) How do you typically find sponsors and convince them to provide funding for assistive technology projects?

I don't usually find assistive technology organizations - the only one, by chance, is the Royal Hospital.

6) Could you describe a few of the sponsors that are currently funding assistive technology projects at the London Project Center and their participation during the completion of these projects?

We have worked closely with the Royal Hospital Wheelchair Centre over the last two years. IQPs have been in wheelchair design, mobile arm support, expert systems and an MQP in stress testing a new wheelchair.

7) Are there any other areas of assistive technology that you would like to see explored through project work at the London Project Center?

Don't think so - I am very interested in what colleagues are doing in assistive technology with computers and software development for visually impaired and hearing-impaired people.

8) If an Assistive Technology Resource Center were developed on the WPI campus, what role would it have to fill in order to improve the projects program at the London Project Center?

I don't think it would, but it would be useful to have a center whose expertise we could use as required. Any links between WPI expertise and disability projects is useful both here and at our other centers.

9) What needs to be done in order to complete more projects involving disability and assistive technology at the London Project Center and the others located in Europe?

I think that WPI might need to come up with the ideas and then colleagues and I could fit those projects into project areas and find sponsors.

10) What tasks would you expect such a center to complete, and what resources would you expect it to provide for students, project advisors, and center directors?

I would like a center to become a sort of center of excellence in AT drawing on skills in EE, computing, and ME. It could also be an information center and be a one-stop shop for anyone wanting information from any of our centers, perhaps being hot linked into other organizations like MIUSA in the US. WPI needs to perhaps find out what others are doing and see where the gaps are. However, one thing that is very important and at present impossible is to design a cheap wheelchair that can either be manufactured in the developing world or designed and made in the developed world that is not expensive to buy. There is other AT that will be desperately needed in the developing world particularly where there is war going on. Perhaps 'satellite' AT centers could be considered in our centers in Costa Rica, Zimbabwe and Thailand?