



The Power of Digital Inclusion: Technology's Impact on Employment and Opportunities for People with Disabilities



National Council on Disability
October 4, 2011

National Council on Disability
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National Council on Disability

An independent federal agency making recommendations to the President and Congress to enhance the quality of life for all Americans with disabilities and their families.

Letter of Transmittal

October 4, 2011

The President
The White House
Washington, DC 20500

Dear Mr. President:

On behalf of the National Council on Disability (NCD), I am pleased to submit *The Power of Digital Inclusion: Technology's Impact on Employment and Opportunities for People with Disabilities*. This report examines the importance of social media and other information technologies in connecting people to job opportunities. Not surprisingly, digital barriers to our networked economy can reinforce rather than break down disproportionately low employment among people with disabilities. The recommendations contained in this report are therefore designed to open the doors to digital technologies that can lead to better jobs for more people with disabilities.

This report reflects your administration's recognition of the transformative power of technology and innovation and how they can improve the lives of all Americans. Delivering on your commitment to improve the performance of America's students in science, technology, engineering, and mathematics (STEM) through the "Educate to Innovate," for instance, will require that all Americans, including people with disabilities, have the necessary digital tools to pursue careers in STEM.

The ongoing transition to an economy based largely on the manipulation of information has sweeping implications for job creation for people with disabilities. New technologies create opportunities for people with disabilities to work alongside our non-disabled colleagues. However, the employment rate of people with disabilities still remains disproportionately low; we have yet to see evidence of real progress in increasing employment of people with disabilities. The research reflected in this report began with an inquiry to determine the implications of an increasingly networked economy on job opportunities for people with disabilities.

We reviewed six key digital technologies or processes that have the potential to enhance social engagement; increase opportunities for workplace participation; heighten employment prospects; and/or create new employment opportunities for people with disabilities. Encouragingly, we found that networks may well be even more critical for people with disabilities than for the general population, and that youth with disabilities are both more open to these networks and close to their non-disabled age cohort in terms of internet access.

Our report contains fourteen recommendations aimed at improving employment opportunities for people with disabilities and encouraging the type of proactive, social interaction that is essential to realize the potential of the new, networked economy. These recommendations focus on: 1) education, through the current infrastructure of community and technical colleges; 2) Internet access; 3) working with industry partnerships; 4) improvements in assistive technology; and 5) a variety of awareness campaigns. Such campaigns should be aimed at youth with disabilities; raising business recognition of the potential of the market that people with disabilities represent; and encouraging entrepreneurs with disabilities to flourish as part of the larger collaborative community.

NCD stands ready to work with you, and with the U.S. Congress, to ensure that the promises of the Americans with Disabilities Act extend to digital inclusion.

Sincerely,

A handwritten signature in black ink, appearing to read "Jonathan Young", with a long horizontal flourish extending to the right.

Jonathan Young, Ph.D., J.D.
Chairman

(The same letter of transmittal was sent to the President Pro Tempore of the U.S. Senate and the Speaker of the House of Representatives.)

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Executive Summary

The National Council on Disability (NCD) explored the utility and accessibility of six key digital technologies that can enhance social engagement, increase opportunities for workplace participation, and heighten employment prospects or create new employment opportunities for people with disabilities.

The Problem and the Opportunity

As demonstrated throughout varying statistics, employment rates for people with self-reported work-related disabilities have fallen almost continuously since the 1990s, despite the passage of the Americans with Disabilities Act (ADA) in 1990. People with disabilities have historically constituted a contingent labor force, that is, when industries retrench, they are the first to lose their jobs, and when there is industrial growth, they are the last to be hired. The active employment gap—between men and women with and without work-related disabilities—has actually increased over the past 20 years, hitting 57.4 percent by 2009, the largest gap on record. Jobs for people with disabilities have tended to be in secondary labor markets characterized by subsistence pay, low skill requirements, few opportunities for advancement, and a high number of part-time jobs.

At the same time, electronic networks and new digital media technologies are transforming the ways that people collaborate. The “new economy,” based on the networking of human knowledge, serves as the starting point for this research. The social and structural characteristics of those networks—in particular connectivity, interdependence, and communications—carry implications not only for the economy in general but also for the workplace in particular. The foundation argument of this research is that networks are likely more important for people with disabilities than for the general population. At the same time, the social capital that underpins those networks among people with disabilities is typically weaker, and the matching mechanism between employer and potential employee less effective. This situation provides the context for examining the potential of six technological pathways or vectors.

The Vectors

The technology sector in the United States is huge, including more than 140,000 companies with combined annual revenue of about \$900 billion. Inside that sector, six vectors or technological pathways to employment were identified. The areas covered by the vectors are undergoing major change, as the business models that they have long followed break down. Typically these were top-down hierarchical models, with power concentrated into only a few companies in each sector, in part due to the heavy capital investment required.

As part of that change, the nature of work is transforming. According to the *Occupational Outlook Handbook*, employment in this sector will likely be increasingly knowledge based and creative, oriented toward flexible and freelancing types of employment spanning different disciplines. The technologies represented by the six vectors are of particular interest for their potential as conduits to social capital, via networks, and hence to employment. The vectors fall into three groupings:

A. Social Networking and Tools

- Vector 1: Wireless Communication Platforms
- Vector 2: Social Networking

B. Immersive Digital Environments

- Vector 3: Virtual Worlds and Serious Gaming
- Vector 4: Tiered Digital Interactions and Electronic Games

C. Commons-based Peer Production

- Vector 5: Open Publishing
- Vector 6: Open-Source Process

The Crux of the Unemployment Problem

The extent of social or community participation is directly relevant to employment, but the social and civic participation of people with disabilities is comparatively low, and has not improved since the passage of the ADA in 1990. This report argues that networks are likely more important for people with disabilities than for the general population, while the social capital that underpins those networks is weaker, and the matching mechanism between employer and potential employee less effective. A notable and encouraging exception is among young people with disabilities. People with disabilities over the age of 30 are less likely to socialize than people without disabilities, across a range of activities, but for those between ages 18 and 29 the gap is nonexistent. Young people with disabilities also report they are much closer to their age group without disabilities in terms of Internet access, the basis of the vectors, compared with the large gap (from 21 to 33 percentage points) for older people with disabilities (Kessler Foundation and NOD, 2010).

Previous studies of technology and disability have tended toward a human-capital perspective, e.g., many types of assistive technology address perceived deficits in the skills and talents of potential employees with disabilities. Similarly, explanations for high unemployment among people with disabilities traditionally focus on a scarcity of job opportunities, or on the job seeker, assuming that people with disabilities are at a competitive disadvantage. These assumptions underemphasize the mechanism that matches job opportunity and job seekers, and its dependence on social capital. The dearth of social capital that characterizes many people with disabilities puts them at a disadvantage in job networks, actual or potential. Because knowledge is generated largely through social interaction, social capital (“know-who”) may be more significant than human capital (“know-how”).

Networks and the social capital that flows through them are at the core of the changes in economic organization and production practices that are transforming how we make

and exchange information, knowledge, and culture, and shape employment skills, marketability, and the way the world of work operates.

The new information economy can be characterized as based on a “pull” model of open, flexible production. Pull models require coordination of social and technical practices into communities of interest, creation, and production, ideally through the collaborative community model that is particularly relevant for people with disabilities, because networked social connections lead to empowerment and potentially autonomy. The vectors serve as such coordinators or conduits. However, a key point to emerge in this research is that the different types of digital connectivity represented by the vectors are all essentially latent, activated only by some sort of proactive, social interaction.

Methodology

The six vectors described above were arrived at via a rigorous review. This process included an in-depth literature review, which focused on exposing some of the underlying reasons why the figures for employment of people with disabilities remain so low, and whether there is substantial reason to believe that the vectors represent a means for new opportunities for people with disabilities (Section 2). The review was followed by an analysis of the labor and business-market environment of the vectors, looking at the vectors as both a means and potential ends to employment (Section 3). This analysis was given reference points through multiple methods, including extensive interviews with representatives of different companies and institutions chosen to represent the vectors (Section 4), and three different kinds of user studies, designed to give a general picture of the work-related utility of the vectors (Section 5).

Review of the Vectors, Findings and Recommendations

A. Summary Review of the Vectors

Vector 1

Wireless communication platforms are objects,¹ rather than channels or processes as is the case with the other five vectors. Consequently, the success or failure of aspects of different mobile platforms in facilitating people with disabilities in employment or in finding work hinges on their ability to accommodate a person's specific needs. The research revealed that two issues—"high costs and fees" and "need for wireless Internet access"—were barriers to the usefulness of the vector. However, there was a common appreciation that the platforms offered more communication options, especially for people with sensory disabilities, and that functions like electronic scheduling and the organization of personal information can be helpful for people with cognitive or information-processing disabilities.

Vector 2

Social networking emerges as a potential game changer, in the enormous potential suggested by collaborative communities, based on social networks, to supersede hierarchies and markets as a way of organizing work. Technologies are emerging that both respond to and enhance the adoption of the collaborative-community model, which in turn energizes social networks and opens up the prospects for job opportunities for people with disabilities. It was not surprising that various aspects of networking emerged as common themes, including "ability to share large amounts of information and data," "making connections," and "access to information and advice for problem resolution," as well as connecting for specific work or education functions. However, one strong negative emerged: privacy and security concerns, which may have a special force for people with disabilities.

Vectors 3 and 4

Immersive digital environments may provide employment opportunities to people with disabilities that might otherwise be unavailable to them: providing a functionally accessible work environment for people with disabilities; removing barriers of cost and distance; and allowing for more open, flexible, and satisfying relationships. The findings of the research in this area (outside the user study) were surprisingly positive.

Facilitators ranged from the predictable—“removes constraints of the physical work environment” and “choice of self-representation”—to the thought-provoking, including entrepreneurship, education and training opportunities, and space for collaboration and group meetings. Negatives again touched on privacy and security concerns, the steep learning curves that gaming and virtual worlds sometimes require, and the need to access high computing power and fast, powerful networks—again reinforcing practical concerns about access and affordability.

Vector 5

Open or peer publishing, by facilitating access to information and networks, opens doors to the most important factors of production in the networked information economy. Further, the value created in a commons-based model of peer production is not just economic, but also social and personal. It implies more open, accountable relationships and a respect for the autonomy of the people in a given commons, an important facilitator for people with disabilities. From the research, the need for high rates of literacy, education, and technical savvy were seen as potential drawbacks, as were, again, high costs and fees. There was an appreciation that commons-based publishing implies the removal or the diminishment of the professional middleman from communications, and opens up possibilities for catering to niche interests, including those of people with disabilities, and for personal communications like blogs that can aid in personal and career development.

Vector 6

Open-source processes have radically changed how people collaborate. This situation offers great promise to some sectors of the disability community by creating technology beneficial to them, at the same time allowing those with special needs to collaborate on projects that showcase their abilities for future employers. The research found one major barrier to open-source processes—the need for “substantial technical skill,” or tech savvy. But the promise of this vector was recognized as the diversity of the contribution, the creativity of the solutions, and the access to information, resources, and tools.

B. Findings and Recommendations

The transition to an economy based on the manipulation of information has had a huge impact on the employment environment. This research was designed to investigate what specific relevance the new networked economy might have on the employment prospects for people with disabilities, in the face of an employment situation that has worsened over the past 20 years.

Reports released in July 2010 indicated that people with disabilities continue to be disproportionately hurt by the recession (Diament, 2010). According to the U.S. Department of Labor, the unemployment rate of people with disabilities has increased, while the employment rate of Americans generally has stabilized and decreased over the past few months. In July 2010, the rate of unemployment for people with disabilities stood at 16.4 percent, compared with 9.5 percent for the general population, empirically supporting the view that people with disabilities are seen as a contingent labor force, first to be let go when industries retrench, and last to be hired when there is industrial growth (Braddock and Bachelder, 1994). Instead of this social exclusion, is there a prospect of digital inclusion?

Finding 1. Old realities remain: The necessity of education to increase awareness and technical skills.

A well-documented barrier to realizing the potential of the vectors is education. Lack of education was perceived as a barrier to achieving full employment potential by 20.3 percent of people with disabilities (Yeager et al., 2006). The user studies often interpreted this to mean the need to be “tech savvy,” a more specialized level of education than the norm. The Department of Labor and others also note the need for constant learning and for flexibility.

- **Recommendation 1: Develop model programs to tackle the core issues of education in conjunction with key stakeholders at the federal, state, and local level.**

We recommend that the Department of Education (Office of Special Education and Rehabilitative Services and Office of Special Education Programs) spearhead an initiative and identify funds to support this initiative in conjunction with the National Institute for Disability and Rehabilitation Research (NIDRR), the Institute of Education Sciences, the Department of Labor (Office of Disability Employment Policy) and the Interagency Committee on Disability Research, as well as other key stakeholders, including members of the business community (e.g., the U.S. Business Leadership Network, U.S. Chamber of Commerce, and Society for Human Resource Management). The aims of the model programs would be to capitalize on the collaborative community-building potential of the networked economy, commit resources, and help prepare people with disabilities to build up appropriate job skills specific to that economy. These aims are also in accord with recommendations under the National Broadband Plan (www.broadband.gov/plan/13-economic-opportunity/#r13), which state that “the Department of Labor (DOL) should accelerate and expand efforts to create a robust online platform that delivers virtual employment assistance programs and facilitates individualized job training.”

In addition this is consistent with the Social Security Administrations (SSA) efforts to build web based work incentive sites in the states.

The model programs would encourage the states and local communities to maximize the use of current infrastructure, in particular community and technical colleges (CTC). CTCs offer multiple advantages, most especially closeness, as the availability of accessible transportation remains a major obstacle for many people with disabilities (Kessler and NOD, 2010). An exemplar of such a program has been developed by the Georgia Institute of Technology, under the title of SIDE (Support and Information for People with Disabilities Employment). SIDE addresses the two core issues of education and accessibility through a program intended to change how people with disabilities seek employment and education through broadband use (see Recommendation 2). SIDE includes Broadband Learning and Support Centers for broadband education, access, equipment, and support; the SIDE Consolidator Platform, a virtual public–private network that helps people with disabilities connect with employers, as well as advance job skills and education; and a comprehensive awareness campaign to promote the program.

- **Recommendation 2: Develop an accessible online literacy curriculum aimed at people with intellectual disabilities in conjunction with family, self-advocate and service-provider groups.**

We recommend that the Center on Medicare and Medicaid Services (CMS) collaborate with the Federal Communications Commission (FCC) and relevant community organizations to develop a training on online literacy accessible for people with intellectual disabilities. This population of people with disabilities is disproportionately excluded from the economic and social mainstream of American life. Although training is currently available for persons with intellectual disabilities for such tasks as using a telephone and other instrumental activities of daily living, in today's day and age internet usage is an equally important skill set. Such a training program would enhance the ability of a particularly

underserved component of the disability community to benefit from the other recommendations of this report and broader efforts to bridge the digital divide.

Finding 2. There are significant barriers to making a dispersed workforce a reality.

The environment from which the vectors spring—the Internet and digital technology as the underpinnings of the networked economy—revealed one constant, and it was clearly a barrier: the cost of connectivity, as well as of hardware and software. This is a fundamental issue. Computer use and ownership and Internet use are significantly lower for people with disabilities compared with their counterparts without disabilities.

As social networking websites become a major mechanism for matching potential employees with employers, access to such sites, and to the right connections within them, will become increasingly important for finding work. Companies are already using a variety of approaches to incorporate mobile platforms into their work environments. One of these, known as the dispersed workforce, involves the collaboration of geographically decentralized people on a common project or job. The concept of a dispersed workforce is broader than telework, because it also includes the ability for an employee to travel from a central office to another location for temporary strategic collaboration. One survey showed there were already 34 million Americans working at least occasionally from home by 2009, a figure that is projected to grow to 63 million by 2016 (Schadler, 2009).

- **Recommendation 3: Address issues of Internet access as a critical component of the vectors.**

The Federal Communications Commission’s (FCC) National Broadband Plan includes several accessibility initiatives for people with disabilities, under the heading “Address issues of accessibility for broadband adoption and utilization.” These initiatives include the Executive Branch to convene a Broadband Accessibility Working Group (BAWG) to maximize broadband adoption by

people with disabilities; the FCC to establish an Accessibility and Innovation Forum; and Congress, the FCC, and the U.S. Department of Justice (DOJ) to consider modernizing accessibility laws, rules, and related subsidy programs. Congress appropriated substantial funds to assist industry to build out broadband. The industry should support an effort specifically targeted to increasing broadband access for people with disabilities.

We recommend that the FCC collaborate with the U.S. Access Board through a working group or committee to take an active role in identifying the barriers that people with disabilities face with regard to broadband access, and introduce policy proceedings to facilitate broadband adoption and use by the disability community. We further recommend that virtual town-hall meetings (telephone, Internet, and other technologies) be conducted to build awareness for this initiative.

- **Recommendation 4: Explore industry partnerships to address cost, for example, by providing in-kind services, devices, or partnerships to minimize cost to the end-user.**

This would be an important element implemented in support of Recommendation 3 above. Outreach should include such groups as CTIA–The Wireless Association (Cellular Telecommunications Industry Association), TechAmerica, COAT (Coalition of Organizations for Accessible Technology), and other technology industries and nongovernmental organizations (NGOs) to support the work. Create a tax credit for manufacturers of equipment that provide the latest to NGO's for distribution to persons with disabilities. Such manufacturers should also provide training to both the NGO's and clients on use and maintenance.

- **Recommendation 5: Monitor and contribute to federal and state legislative and regulatory language with regard to assistive technology (AT) and meta-design, and develop a standardized instrument to measure AT outcomes.**

We recommend that the Department of Education (Rehabilitation Services Administration, charged with administering the Assistive Technology Act of 1998 and 2004), consult with the U.S. Access Board to review pertinent federal and state legislative and regulatory language that affects policies hindering the ability to purchase off-the-shelf hardware and software and require more expensive equipment for people with disabilities (see Field and Jette, 2007).

In addition, we recommend that the Office of Special Education and Rehabilitative Services (OSERS) in the Department of Education develop a standardized instrument for measuring AT outcomes. Measures should include the quality of AT services and equipment and the effects of AT on employment and independent living, for both specialized and off-the-shelf applications, to the benefit of both caregivers and consumers. The overall goal would be to encourage migration from the realm of specialized, dedicated, and expensive equipment to the universe of meta-design. The specific aim would be wide use of this instrument in various AT settings to measure outcomes, and to achieving comparability between systems and consistency in reporting AT outcomes nationally.

Ultimately, this effort is likely to affect the Improving Access to Assistive Technology for Individuals with Disabilities Act of 2004, with the potential for amendments. Also, we recommend that this report as a whole, and the results of the work embedded in this recommendation in particular, be shared with the relevant committees in Congress: in the Senate, the Committee on Commerce, Science and Transportation, and the Subcommittee on Communications and technology; and in the House, the Committee on Science, Space and Technology, and the Subcommittee on Technology and Innovation.

Note also that this recommendation is in accord with Section 104 of the 21st Century Communications & Video Accessibility Act of 2010 (S. 3304) that requires the FCC to establish a clearinghouse of information on the availability of accessible products and services, and should be coordinated with the establishment of such a clearinghouse.

Finding 3. Through building social capital, the vectors may offer pathways to employment, enhancing proactive social interaction, led by the young.

As part of its examination of the underlying reasons for high unemployment among people with disabilities, this report has zeroed in on the mechanisms that match the two sides of the unemployment equation: job opportunities (their availability or lack) and the job seeker (i.e., human capital). In part, the unemployment experienced by people with disabilities may be attributed to a perceived inability to harness social capital in seeking or creating employment. In that sense, networks are likely more important for people with disabilities than for the general population. The implications are significant, because the effects of networking spread beyond the employer–employee nexus, to self-employment and entrepreneurship for people with disabilities. Also, social network participation is likely to heavily influence job satisfaction, job retention, and career advancement.

The new information economy of which the vectors are a part may offer a solution (provided the issues identified in Findings 1 and 2, above, are addressed). It requires coordination of social and technical practices into communities of interest, creation and production. The solution would ideally involve a collaborative-community model that is particularly relevant for people with disabilities, because networked social connections lead to collaboration, empowerment, and autonomy.

- **Recommendation 6: Develop a social-media campaign directed at people with disabilities between ages 15 and 30.**

We recommend that the Department of Labor (Office of Disability Employment Policy) develop and implement a social-media campaign aimed at younger people

with disabilities, who are more socially involved and vector aware than people with disabilities in general. This campaign will serve as a “wedge” or opening that would then diffuse back into the general community of people with disabilities.

Campaign approaches would include:

- identifying and recruiting an advisory board of the target audience (15- to 30-year-olds) to help focus messages;
- collecting and disseminating success stories of the positive effects in employment of the use of the vectors;
- collecting and disseminating case studies of companies with some direct or indirect connection with the vectors who employ people with disabilities as a resource, not as an exception; and
- collecting evidence-based best practices, intended to go toward a resource portfolio that can be used to support specific policy recommendations for government.

These stories, studies, and best practices would be combined into a strategic social-media campaign, focusing on “ability,” in a variety of vector-specific employment settings, presented in an innovative, compelling, and interesting manner. We recommend developing a subcampaign to focus on entrepreneurship, because small business offers the greatest practical opportunity for generating new employment possibilities.

- **Recommendation 7: NCD recommends that public and private organizations, such as the American Association of People with Disabilities (AAPD), explore the possibility of national awards modeled after the Malcolm Baldrige National Quality Award.**
 - The Baldrige Award, given by the National Institute of Standards and Technology, recognizes U.S. business, health-care, education, and

nonprofit organizations for performance excellence. Following this model, the awards should be given in four areas:

- An award for creative use of the vectors and other digital technology in developing new employment opportunities for people with disabilities. This would be aimed at the younger generation, but would have an additional motive of raising awareness among people with disabilities in general about the transformative potential of digital technologies like the vectors in the employment sector.
- An award, aimed at the business sector, to recognize employment creation for people with disabilities (see below).
- A “Design for Ability” award, focusing on meta-design principles (see below). To receive this award, an organization would have to demonstrate a design management system that ensures a continuous commitment to the incorporation of meta-design and universal design (UD) principles in its products and services.
- An “Entrepreneur with Disabilities” award that recognizes people with disabilities, or organizations staffed by people with disabilities, for original work in developing new types of business using networking technologies, under the theme of “computer-supported collaborative work.”

Finding 4: The disability community needs to expand efforts to enhance awareness of the presence, capacities, and potential of people with disabilities.

One of the major themes to emerge from the exemplar study was the perceived “invisibility” of people with disabilities, and that business has not focused on this community because it is perceived to be a “niche,” not substantial enough to justify development work. The most convincing rationale offered for this view was that people with disabilities tend to have little disposable income and cannot invest in expensive

software or hardware, a view that highlighted a lack of awareness of the size and scope of the community. A highly unfortunate consequence of people with disabilities not being seen as a viable market is that many of the technology companies interviewed are not considering developing specific product lines for them, and are not considering universal-design principles during the prototyping and development phase of technologies. Several of the exemplar study interviewees interpreted this observation to indicate a need for stronger advocacy and information dissemination from the disability community.

The vectors in this study all serve as coordinators or conduits. A key point to emerge in the research is that the different types of digital connectivity represented by the vectors are all essentially latent, activated only by some sort of proactive, social interaction. It is essential for people with disabilities to take on that role, to act and be seen as active participants in the networked economy.

- **Recommendation 8: Expand efforts to advocate for people with disabilities as an untapped resource and as a market, using traditional as well as social-media channels.**

In part, this awareness gap can be filled by the social-media campaign indicated above. However, there is a pressing need for business and industry to develop a greater awareness of people with disabilities as a potential market. We suggest building on Recommendation 16 from the NCD report “Design for Inclusion,” which was to develop a clearinghouse where users can obtain information about accessibility issues and the features to address them. We recommend that the Office of Special Education and Rehabilitative Services in the Department of Education serve as the base for this clearinghouse, and the remit be expanded to include involvement from the private sector. The latter might include linking with the U.S. Business Leadership Network (USBLN) and with advocacy organizations like the Arthritis Foundation and AARP, as well as identifying existing dissemination channels and developing targeted material for them.

Note also that this recommendation is in accord with Section 104 of the 21st Century Communications & Video Accessibility Act of 2010 (S. 3304) that requires the FCC to establish a clearinghouse of information on the availability of accessible products and services, and should be coordinated with the establishment of such a clearinghouse.

- **Recommendation 9: Create discussion forums focused on the potential of the market that people with disabilities represent.**

We recommend that the Department of Labor (Office of Disability Employment Policy) partner with the U.S. Business Leadership Network (USBLN), the Society for Human Resource Management (SHRM), and the U.S. Chamber of Commerce to facilitate a conference and a follow-up online community of practice. The conference would be aimed at government and industry, with panels to discuss the potential of the market that people with disabilities represent. Speakers from leading industry sectors, with a focus on those working in the areas represented by the vectors, would be invited together with government and NGOs, including OSERS, the Interagency Committee on Disability Research (ICDR), NCD, ACCESS Board, and the Office of Disability Employment (ODEP).

NCD also plans to incorporate discussions centered on the potential of the networked economy for people with disabilities into its own national forums, such as the three regional forums planned for 2011, in alignment with the theme *Living, Learning, & Earning* used at NCD's National Summit on Disability Policy 2010.

Finding 5: Social, technological, and attitudinal barriers exist to raising awareness of the potential of the new networked economy among people with disabilities.

NCD conceived of this research as examining the utility of the vectors through two lenses: how the vectors might enhance the ability to do work, and how they might help in finding or

creating work. One clear result from the focus-group discussions was the consistent emphasis on barriers to adoption in the workplace, rather than on the potential for creating new industry/vector employment. This result suggests larger social and cultural issues about the tolerance for risk and ability to engage in new types of activities.

As part of Recommendation 7 (above), an award could be given for creative use of the vectors and other digital technology in developing new employment opportunities for people with disabilities. The additional motive would be to raise awareness among people with disabilities about the transformative potential of digital technologies like the vectors in the employment sector.

- **Recommendation 10: Develop and conduct an information campaign focused on the potential of information technologies to create new job opportunities.**

We recommend that the Department of Labor (Office of Disability Employment Policy), leading an industry partnership featuring businesses involved in the vectors (such as Google, IBM, and Facebook), initiate an information campaign. The campaign could be centered on a major job fair, moving every year to a different major urban center, and focusing on the job potential of the networked economy as represented by the vectors.

Finding 6: Encourage the adoption of meta-design approaches.

One clear agreement to emerge from the Delphi study was the importance of universal design (UD) in achieving accessibility for people with disabilities. UD has evolved to meta-design, which includes communication with others who have a different perspective, integrating diversity and making all voices heard. This enables informed participation and social creativity in communities of interest. Meta-design provides a collaborative framework not only for the accessibility concerns and human-capital requirements that UD addresses, but also for social-capital and creativity requirements, in line with the needs of the new economy.

One of those needs is to harmonize standards. Another is to acknowledge the potential of HTML5, which encourages Web authors not to put information where ordinary users cannot see it, such as alt and summary attributes, but rather into the normal body text, a move that follows meta-design principles. A third need is to build on the work of the World Wide Web Consortium Web Accessibility Initiative (W3C WAI) in developing guidelines for authoring tools and user-access agents, to ensure adherence to the principles in the guidelines as we move toward Web 3.0, the semantic Web (Neville and Kelly, 2008).

While the government provides funding to support universally designed technologies, present approaches may underestimate the potential of a meta-design approach.

As part of Recommendation 7 (above), an award could be given for “Design for Ability,” focusing on meta-design principles. To receive a “Design for Ability” award, an organization would have to demonstrate a design-management system that indicates an understanding of, and ensures a continuous commitment to, the incorporation of meta-design and UD principles in its products and services.

- **Recommendation 11: Conduct hearings with business and industry representatives.**

We recommend that key stakeholders collaborate to identify and approach members of Congress about the potential to convene hearings on the role of universally designed and accessible technology to drive new job creation. The American Association of People with Disabilities (AAPD) and AARP have already demonstrated their awareness and interest in universal design. We recommend they lead in organizing hearings with industry associations (such as the Mobile Manufacturers Forum and the CTIA) and, with industry leaders, help identify what incentives would be helpful in adopting meta-design principles as a way of providing more cost-effective products for *all* users, and of reinforcing the message about the size of the market. The Department of Commerce (Small Business Administration) and FCC should also be invited. The main thrust of the

hearings should be to encourage a frank discussion. In this regard, we recommend reevaluating the recommendations given in “Design for Inclusion: Creating a New Marketplace” (NCD, 2004), to see which have been followed and which have not, and, where necessary, to turn those recommendations into a policy for action based on feedback from the listening sessions.

- **Recommendation 12: The National Institute on Disability and Rehabilitation Research (NIDRR) should solicit input on the importance of research and development of meta-design applications as part of its focus on universal design for all government-funded projects.**

Finding 7. Encourage entrepreneurs with disabilities to flourish as part of the collaborative community, and encourage development of that community.

One suggestion from the literature review is that the shift to a networked economy could be good for people with disabilities, who might have unique qualifications for the new jobs that are evolving. These are jobs in which creative, networked people transform problems into opportunities, and where networking technologies make entirely new types of business specialties possible by enabling people to express highly specific preferences that enterprising producers can meet.

This kind of collaborative work has real potential for people with disabilities. The literature shows that one of the most effective channels for disseminating institutional knowledge and expertise within an organization is informal networks of colleagues and friends (Kraut et al., 1990; Wasserman and Galaskiewicz, 1994). Social capital (“know-who”) may be more significant organizationally than human capital (“know-how”) (Downes, 2004). Heckscher and Alder (2006) point to IBM as a prime example of a corporation that has internalized these informal networks, adopting the structure, values, and character of a collaborative community, a possible model for the future.

As part of Recommendation 7 (above), an award could be given for “Entrepreneurs with Disabilities,” to recognize people with disabilities, or organizations staffed by people with disabilities, for original work in developing new types of business using networking technologies, under the theme of “computer-supported collaborative work.”

- **Recommendation 13: NCD recommends exploring a programmatic initiative to encourage enhanced interagency coordination and collaboration and to build outreach efforts.** The aim will be to increase awareness both of the potential of the collaborative community for people with disabilities in finding employment, and of the vector-related barriers to employment that affect people with disabilities, as described in this report, by conducting workshops, expanding outreach activities, and using social-media channels, with key stakeholders.
- **Recommendation 14: Create field workshops among the research, policy, and advocacy communities to expand “community-level” input into public-sector processes that affect growth of communications channels, in particular for the collaborative community and employment.**

We recommend that the Department of Commerce (NTIA—possibly the Office of Telecommunications and Information Applications) take the lead in organizing the workshops. The aim would be to go “outside the beltway,” to draw on existing and new online and social-media channels for innovative ideas, as well as support for evidence-based practices. Such efforts might include tool kits (for example, those used by the FCC) that make it straightforward for key stakeholders to provide input into the regulatory and policy processes—encouraging them to submit filings, respond to regulatory and public-sector requests for information and comments, and engage in public participation.

SECTION 1. Introduction

1.1. Origins of the Research and Description of the Problem

Our digital world continues to develop apace, opening new and original avenues for participation in society. Information itself has been democratized, offering people the transformation from content readers to publishers. “Everywhere, anytime” communications have become the norm, bridging some of the accessibility barriers posed by distance. Digital devices for command, control, and communication are with us at home and at work, on the street and in the park, during the day and while we sleep. People have become the network, reinforcing Castells’ observation that we are living through a qualitative change in the human experience (Castells, 1996). As Benkler (2006) sees it, the networked information economy is a key element of the new communications environment, changing the way we work.

For people with disabilities, the digital age represents both a tremendous opportunity and a considerable challenge. On the one hand, the Internet offers a key to a more inclusive society for people with disabilities, as it provides a way for people “to communicate, entertain, gather information, and educate themselves and others” (Wireless RERC, 2009). Benkler emphasizes the capacity-building potential. “The networked information economy improves the practical capacities of individuals...to do more for and by themselves” and “enhances their capacity to do more in loose commonality with others” (Benkler, 2006).

But it is a historical irony that 1990, the year the Web was born with the first successful communication between a Web browser and server via the Internet, also saw the passage of the Americans with Disabilities Act (ADA). Despite a clear focus on the integration of people with disabilities into society and especially the workplace, 20 years after the passage of ADA the employment picture remains stark (see Section 1.2). Little has changed during the past decade, since Hotchkiss (2003) found that workers with disabilities were older than other workers, worked fewer hours per week, were more likely to be single, and were less likely to have a college degree. Workers with

disabilities continued to be disproportionately represented in low-growth, low-wage occupations.

The National Council on Disability (NCD) commissioned this research to better understand the potential the digital age may hold for the employment of people with disabilities. The research was to include questions about the level of accessibility to new media and technologies, in particular whether new technologies are serving as facilitators or barriers to employment.

The research was designed to explore the underlying challenges facing people with disabilities in the labor market, as well as the utility and accessibility of key digital technologies that can enhance social engagement, increase opportunities for workplace participation, and heighten employment prospects for people with disabilities, in terms of both finding and creating work opportunities.

1.2. Disabilities and Employment

According to the Bureau of Labor Statistics, Department of Labor, in May 2010, 22.3 percent of people in the labor force in the United States had disabilities, compared with the 70.1 percent with no disability. The unemployment rate for those with disabilities was 14.7 percent, compared with 9.1 percent for persons with no disability (ODEP, 2010).

Even more alarming are the figures for the full-time, full-year employment rate—the percentage of working-age population in the United States who worked at least 35 hours per week, 50 weeks of the year. For people with disabilities, this figure in 2008 was just 7.2 percent, compared to 60.8 percent for people with no disability (Current Population Survey (CPS)).

Low levels of employment for one population segment negatively impact the U.S. economy, ultimately affecting everyone. In 2008, 28.2 percent of the working-age population of people with disabilities lived at or below the poverty level, compared to 9.4 percent of the working

age population without disabilities. Thus, people with disabilities were three times as likely to live in poverty (CPS). Almost two-thirds of working-age adults who experience long-term income poverty have a disability. Further, measures of income poverty likely underestimate the financial situation facing people with disabilities, who may need more income to make ends meet (e.g., for assistance, treatment, or prosthetics), so real poverty could be more intense than implied by income data (Fremstad, 2009). As Atkins and Guisti point out, “the connection between poverty and disability is complex and multi-directional”: disability and poverty form a chronic cycle (Atkins and Guisti, 1993: 6–7). The way to break the cycle is to improve employment prospects.

Employment is complex, with the employment prospects of people with disabilities involving a variety of factors: labor force participation rates, unemployment, underemployment, wages and incomes, types of employment, and how these factors fit in with structural changes in the economy. Given labor market trends, it is important to consider not only the *number* but the *types* of job opportunities for people with disabilities, so that they are not unduly relegated to low or unskilled positions. To capture these possibilities requires considering freshly conceived future work situations.

1.3. The Futures of Work

The transition to an economy based around the manipulation of information has had a huge bearing on the employment environment. Not only are people using new media and related technologies to find work, in many instances conversance with the new digital environment has become a job requirement (Knorr, 2009). In another indicator of future directions, the nation’s largest employer, the Federal Government, has begun to accept the reality of telework. In the largest-ever survey of the federal workforce, carried out at the beginning of 2010, 10 percent of respondents government-wide reported that they telework at least one day per week, and 12 percent do so less frequently, figures that are set to rise (O’Keefe and Davidson, 2010). The Telework Enhancement Act of 2010 encourages more teleworking by federal employees, providing training for teleworking and requiring the Office of Personnel Management to develop a government-wide policy for working off-site.

Demand for skills needed within specific sectors, in particular information-based and service-providing industries, results in employment opportunities. Opportunities for work in education and health services have soared with the rapid growth of those fields. The U.S. Department of Labor estimates that more than 3 out of every 10 new jobs created in the U.S. economy will be in either the health care and social assistance or the public and private educational services sector (Bureau of Labor Statistics, 2010).

The Department of Labor lists advanced manufacturing, automotive, biotechnology, construction, geospatial, health care, hospitality, and information technology as “high growth jobs and industries of the future.” The Bureau of Labor Statistics (BLS) projections for 2008 through 2018 predict that professional and related occupations will be the fastest growing major occupational group, at 17 percent, and will add the most new jobs, about 5.2 million. Employment among health care practitioners and technical occupations, a subgroup of the professional and related category, is expected to increase by 21 percent. Other subgroups of high growth and job creation include education, training, and library occupations, computer and mathematical science occupations, and arts, design, entertainment, sports, and media occupations (BLS, 2008-2018).

Entrepreneurs with Disabilities

In addition, as has long been the case, small business and entrepreneurship will play a key economic role (Small Business Association, 2009; United States Census Bureau, 2002).

Small businesses create most of the nation’s new jobs, employ half of the nation’s private-sector work force, provide half of the nation’s nonfarm, private real gross domestic product, and contribute a significant share of innovations (Small Business Association, 2009). Firms with fewer than 500 employees represent 99.7 percent of all employer firms, employ just over half of all private-sector employees, pay 44 percent of total U.S. private payroll, have generated 64 percent of net new jobs over the past 15 years, create more than half of the nonfarm private gross domestic product, hire 40 percent of high-tech workers (such as scientists, engineers, and computer programmers), are 52 percent home-based, made up 97.3 percent of all identified

exporters and produced 30.2 percent of the known export value in FY 2007, and produce 13 times more patents per employee than large patenting firms (ibid).

U.S. Census data shows that 18.4 percent of employees work for companies with fewer than 20 employees, and 89.3 percent of companies have fewer than 20 employees. Only 0.3 percent of companies have more than 500 employees; only 1.8 percent have more than 100 (United States Census Bureau, 2002). Entrepreneurship is occurring at higher rates than at any time in the last century, with 1 in 25 adults trying to start a new firm (Thornton, 1999). Further, according to one job-market index, in 2009, 8.7 percent of unemployed people got jobs by starting their own company (Wang, 2010).

A positive sign is that thousands of people with disabilities have been successful as small-business owners and entrepreneurs. The 1990 Census revealed that people with disabilities have a higher rate of self-employment and small-business experience (12.2 percent) than people without disabilities (7.8 percent). The Disabled Businessman's Association estimates that 40 percent of home-based businesses are operated by people with disabilities. Entrepreneurs with disabilities have successfully operated a wide array of businesses, including accounting, auctions, auto body repair, bakeries, bicycle shops, child care, chiropractic, counseling, farming, janitorial/maintenance, real estate, restaurants, freelance writing, and used-clothing stores (ODEP, 2010).

Despite these positive statistics, the Office of Disability Employment Policy (ODEP) also lists attitudinal barriers, restricted access to support networks, and discrimination based on misguided stereotypes about the capabilities of people with disabilities as barriers to self-employment and entrepreneurship (ibid). These observations may imply that, if attitudinal discrimination were assuaged, the numbers of people with disabilities that succeed as entrepreneurs would be even greater.

The Education Premium

Technology can be a double-edged sword. It may be more efficient—in particular, in the communications arena, which is the subject of this report—leading to an ever-rising

demand for skilled workers, pushing the college-wage premium ever higher. At the same time, in the face of the computing revolution, middle-skill, labor-intensive jobs have declined. As the *Economist* magazine concluded in a review of employment (2010), the key is a flexible, well-educated labor force—a mantra that can be applied to the situation facing people with disabilities. In this respect, a recent Harris Interactive poll conducted for the Kessler Foundation and the National Organization on Disability (NOD) is encouraging, reporting that the education gap (the share of those with less than a high-school education) has narrowed considerably between people with and without disabilities over the past two decades, from 24 percent in 1986 to 6 percent in 2010 (Kessler Foundation and NOD, 2010).

1.4. Framing the Problem: The Economic and Social Situations of People with Disabilities

1.4.1. Disability and Employment: Overview

In general, employment rates for people with and without disabilities fluctuate with the economy. The Current Population Survey (CPS) Annual Social and Economic Supplement has collected data about people with work-related disabilities every year since 1981. While employment rates for people with self-reported work limitations rose during the economic expansion of the late 1980s, they have fallen almost continuously since, even during the 1990s expansion.

The following chart, made with data from the CPS supplement (data accessed from Von Shrader et al., 2010), shows the labor market activity for men and women ages 18 to 64, with and without work-related disabilities, calculated as the percent who worked at least 52 days in the previous year. The employment gap, by this measure, has actually increased over the past 20 years.

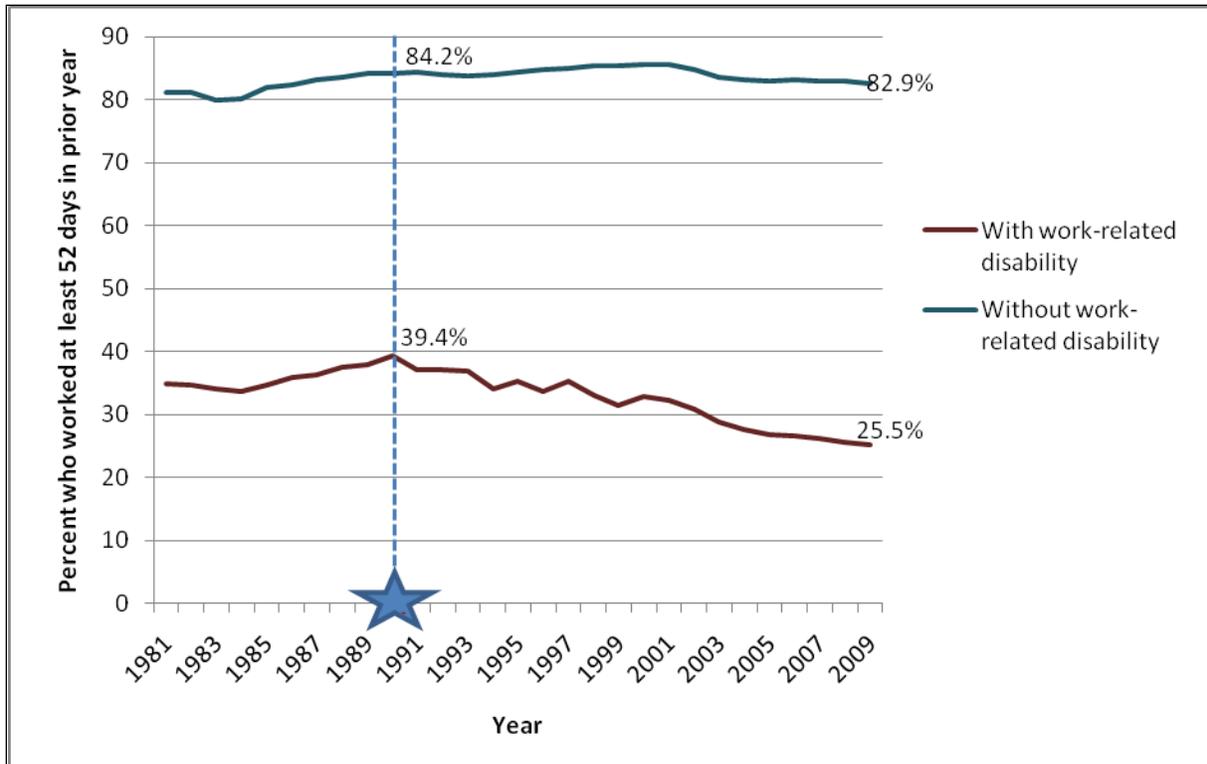


Figure 1. Labor Market Activity Rate

Figure 2 illustrates that the employment gap—the difference in labor market activity rates for people without and with disabilities—was at its lowest point (44.8 percent) in 1990, the year ADA passed, and grew to 57.4 percent by 2009, the largest gap on record.



Figure 2. The Growing Employment Gap

The following two charts also use data from the CPS supplement. Figure 3 shows the employment rates for people age 21 to 64 with and without a disability in 1989 (the year before ADA) and in 2009. Figure 4 displays the median household income (in constant 2008 dollars) of households with and without people with disabilities, before and after ADA. By both measures, the situations of people with disabilities have deteriorated, both in absolute terms and relative to people without a disability.

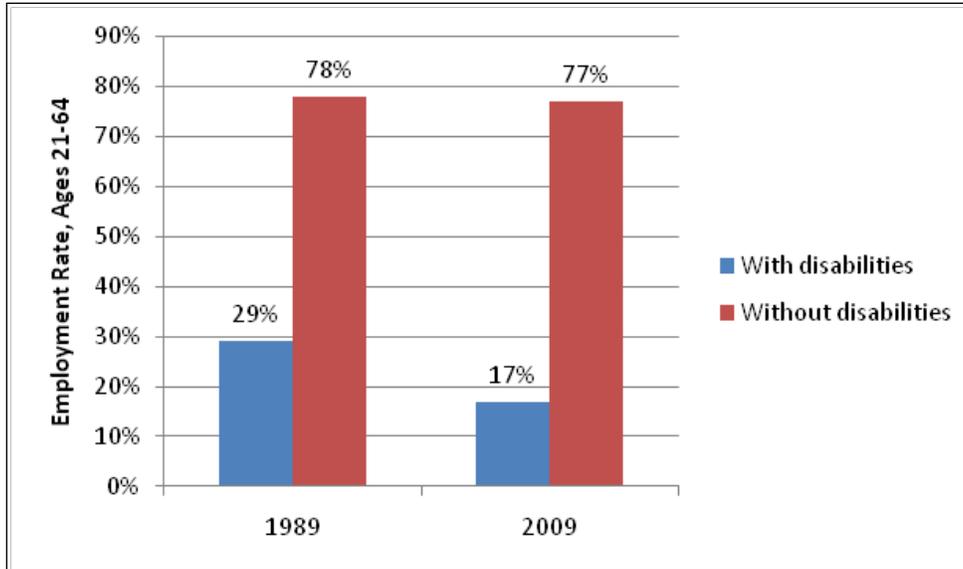


Figure 3. Comparing Employment Rates, 1989 and 2009

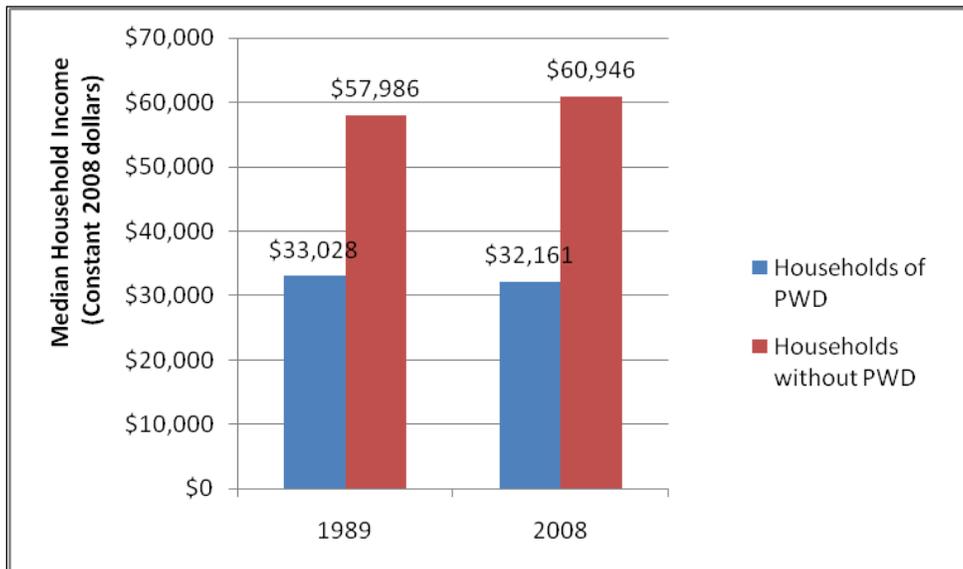


Figure 4. Comparing Median Household Income, 1989 and 2009

Gender and Race

In addition, gender and race make a difference. “Discrimination related to disability accentuates discrimination related to gender and vice versa,” so that earnings of women with disabilities with full-time jobs are around 65 percent of earnings of men with

disabilities with full-time jobs; there is a similar effect for people with disabilities in racial minority groups (Braddock and Bachelder, 1994: 15).

Employment Status

Employment status is also related to the length of time since the onset of the disability, with a severe drop in employment rates for people whose disability has lasted a year or more. The relationship between disability and employment is also strongly linked to how restrictive the disability is (Fitzgerald, 2005).

People with disabilities “must struggle to access the general labor market,” as jobs for people with disabilities have been primarily available in secondary labor markets characterized by subsistence pay, low-level skills, few opportunities for advancement, and a high number of part-time jobs (Braddock and Bachelder, 1994). People with disabilities are less likely “to be in management, management-related, or professional/technical occupations” compared with people without disabilities, and “more likely to be in service and blue-collar occupations” (Kruse et al., 2010: 5). Overall, the discrepancies are comprehensive, including “lower average pay, less job security, and reduced access to health insurance, pension plans, and training. They are also less likely than workers without disabilities to be in jobs that are classified as “economically and psychologically rewarding”” (Kruse et al., op. cit.: 2).

Even in U.S. Federal Government agencies, which are mandated to provide equal employment opportunities, the participation rate for individuals with targeted disabilities has declined in the past decade. From FY 2000 to FY 2009, the total federal work force increased by 368,634 employees (15.1 percent), while the number of federal employees with targeted disabilities (Targeted disabilities are those disabilities that the federal government, as a matter of policy, has identified for special emphasis. The targeted disabilities are: deafness; blindness; missing extremities; partial paralysis; complete paralysis; convulsive disorders; mental retardation; mental illness; and distortion of limb and/or spine) decreased from 27,231 to 24,663 in FY 2009, a net change of -9.43 percent, resulting in a 0.88 percent participation rate. Only 11 federal agencies

have achieved the federal goal of at least a 2 percent participation rate for Individuals with targeted disabilities (Equal Employment Opportunity Commission, 2009).

Such examples of employment gaps are so prevalent as to suggest that barriers other than the ability to perform a job are involved. A major task of this report is to identify and respond to such barriers.

1.5. The Potential of New Technological Pathways: The Vectors

The overarching purpose of the research was to explore the utility and accessibility of key digital technologies that can enhance social engagement, increase opportunities for workplace participation and heighten employment prospects or create new employment opportunities for people with disabilities. Some observers see electronic networks and new digital-media sources or technologies as having a transformative effect on the ways that people collaborate. In this view, most of the barriers to group action have collapsed, and we are free to explore new ways of gathering together and getting things done (Shirky, 2009).

The project was designed to investigate whether, how, and to what extent this breaching of barriers offers the opportunity to improve the ability of people with disabilities to fully participate in society, including enhanced employment opportunities. To capture this idea of barriers being breached via technological pathways, the term “vector” was developed from the work of McKenzie Wark (1994, 2009), defined as any influential force or means by which information moves. In other words, the vectors represent possible means, not ends. They are potential conduits to employment situations, not employment prospects per se.

Initial work focused on selection of potential prototypical vectors or technological pathways, taking into account the idea that optimal engagement of a user occurs when the technological features match that user’s functional capabilities. There is some indication (Appleyard, 2005) that people with disabilities strive to use technology in ways similar to everyone else: their needs and objectives are often indiscernibly

different. All information communication technologies (ICTs) are employed by users to enhance some degree and type of functioning, hence any limitation should be seen as existing on a continuum. In general, all users employ technology in order to achieve the following important goals:

1. Access to products or technologies that enable communication and enhance safety and security
2. Access to information about and ability to better manage personal finances
3. Access to entertainment, community information, and services
4. Access to products or technologies that improve the quality of life at home
5. Access to products or technologies that enhance or facilitate employment opportunities

The initial selection of vectors was based on consideration of possible relevance to goal number 5, balanced by a review of pertinent accessibility literature. For example, while wireless communication technologies continue to spread and push the limits of convergence and quality of experience for users, significant issues of accessibility persist for people with disabilities. Specific areas of concern include device compatibility, awareness by manufacturers, employment of people with disabilities, and accessibility to emergency communications (Baker and Moon, 2008). As mobile technology increasingly makes social networking ubiquitous, these problems of accessibility and inclusivity are also in danger of both spreading and becoming more complex.

1.6. Verification of the Vectors

The original candidate vectors were wireless communication technologies, social networks, virtual worlds, Web 2.0 and beyond, applications consolidators, and computational journalism. Potential exemplars included Research in Motion (RIM), manufacturer of the BlackBerry; Facebook; Second Life; Google; Apple, Red Hat; and Wikipedia. Appendix 1 describes these in detail.

The original selection of vectors underwent an extensive review. As a first step, the project arrived at a new definition of the term “vector,” aiming at clarity and also at embodying the notion of a change agent: *An influential agent or means by which information moves, and that embodies the notion of change.*

This definition was used as the basis for a review of the six vectors first proposed, and in the development of three additional new vectors described below. The initial six vectors were reviewed as follows: first, with reference to the new definition; second, to answer the practical question of whether the vector is at a sufficient state of development that it actually represents a market environment and market trends that can be researched and described; and third, with reference to three parameter-setting questions: 1) whether the vector enhances social engagement; 2) whether the vector increases opportunities for workplace participation; 3) whether the vector heightens employment prospects for people with disabilities.

Following this process of clarification, a number of new suggestions were reviewed at length. Ultimately three additional vectors were offered for consideration:

Vector 7: Online marketplace. This vector was offered in reference to the outsourced workplace and to job search and “skills-for-sale,” as well as items for sale. Potential exemplars are eBay and Craigslist.

Vector 8: Games, or Tiered Digital Interactions. This vector was suggested partly in recognition of the huge size and impact of the existing gaming industry, but also because of the potential effect on other sectors such as education, and the idea of learning by participating in a process.

Vector 9: Smart Interfaces. This vector emerged from some early findings of the literature review, in particular *The Horizon Report 2009 Edition*, that identified the personal Web, geo-location tools, semantic-aware applications, and smart objects.

1.6.1. Criteria for Final Selection and Definitions

All nine vectors described above were reviewed. Criteria to evaluate them for a final selection were based on consideration of five measures of importance and relevance. Each vector was voted on according to each measure.

1. Importance to people with disabilities and perceived product importance: market penetration among people with disabilities, evidence of marketing use, and affordability
2. Relevance to new workplace and in creating work opportunities
3. Relevance to getting a job
4. Relevance to doing a job
5. Relevance to the employer: whether it builds business, increases competitiveness, etc.

The six vectors listed, with accompanying definitions, in Section 1.6.2 were chosen and re-ordered according to the voting procedure described above. The final selection of the companies intended to illustrate each vector is described in detail in Section 4: Exemplar Studies.

Note that there were considerable challenges in defining the vectors as businesses. The challenges were partly due to the novelty of some of the technologies and the attempts to categorize them, but also because for the most part they are representative of social change, and consequently escape existing conventional economic schema. For example, available data on the market for games usually does not distinguish between “serious gaming” (e.g., training for disaster response) and the electronic games (“tiered digital environments”) popular with the young.

This lack of easy definition of individual vectors was considered inevitable, given that the rationale of the term “vector” was to capture an abstract idea (of barriers being breached via technological pathways), and that the vectors were understood to

represent possible means, not ends. As described above, they are potential conduits to employment situations, not employment prospects per se.

For categorization purposes, the decision was made to place the vectors under three overarching groupings:

- a. *social networking and tools*, encompassing both the “soft” and the “hard” side of networking communications (Vectors 1 and 2);
- b. *immersive digital environments*, encompassing both serious and nonserious sectors of the gaming world (Vectors 3 and 4); and
- c. *commons-based peer production* (after Benkler, 2006: 60), capturing the gamut of “open” input and output under both Vectors 5 and 6.

However, all of the sectors that the vectors refer to were researched, studied, and treated as separate, and, where possible, data gathered for all of them.

1.6.2. Final Vector Selection

The final selection and categorization of the vectors was as follows:

Group A. Social Networking and Tools

Vector 1: Wireless Communication Platforms

Defined by the research team as mobile telephony, computers, and gaming devices, and as “an approach to the deployment or process of the provision of communication services.”

Vector 2: Social Networking

Defined as “web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system” (Ellison et al., 2007).

Group B. Immersive Digital Environments

Vector 3: Immersive Digital Environments—Virtual Worlds and Serious Gaming

Defined by the research team as computer-simulated worlds in which the user takes on a role.

Vector 4: Immersive Digital Environments—Tiered Digital Interactions and Electronic Games

Defined as electronic systems that involve interaction with a user interface to generate feedback on a display device. These systems include “serious games,” i.e., games designed for a primary purpose other than pure entertainment, such as education, scientific exploration, health care, emergency management, city planning, engineering, religion, and politics.

Group C. Commons-based Peer Production

Vector 5: Open Publishing

Defined as information capture, sharing, and processing. This definition may be extended to cover three key elements: information processing, information authentication, and information licensing and distribution.

Vector 6: Open-Source Processes

Providing the user with tools to accomplish a task as part of an open-source process, defined as “a collaborative process in which programmers improve upon code and share changes within the community.” Open source is usually depicted as a response or alternative to proprietary software.

1.7. Research Process

Following the final choice and definition of the vectors, the report proceeds with Section 2, an in-depth literature review that focuses on discovering the underlying reasons that the employment rate for people with disabilities remains so low, and

whether there is substantial reason to believe that the vectors represent a means for new opportunities for people with disabilities. Section 3 provides a general analysis of the labor and business market environment of the vectors, looking at the vectors as both a means and potential ends to employment. Section 4 analyzes extensive interviews with representatives of different companies and institutions chosen to represent the vectors. And Section 5 summarizes three different kinds of user studies, designed to give a general picture of the work-related utility of the vectors.

SECTION 2. **Social Capital, the Networked Economy, and the Promise of the Vectors**

2.1. Introduction

This section argues that the root of the problem of unemployment among people with disabilities is deeper than the challenges that a disability may pose to doing work, or the obstacles to access that a workplace or work equipment might raise. Numerous studies show that both finding and doing work depend on social capital, in particular networks of empowering relationships. Another body of studies shows that people with disabilities often lack this important element of social capital. At the same time, digital technology and new media, represented by the vectors in this report, are changing how people access social capital, social networks, and the new employment environment.

2.2. Connecting Disabilities and Unemployment

2.2.1. The Nature of Work and Disability

Across developed countries, there is an “unambiguous and apparently universally accepted policy message that the best way to tackle poverty, social exclusion and marginalization is through jobs, jobs and more jobs” (Ronayne and Tyrell, 2005: 80). Work has many benefits beyond wages. Performing work and paying taxes can enhance an individual’s status and self-worth, especially since society tends to judge the worth of an individual by his or her productivity. Wages and fringe benefits offer increased financial security and control over personal life choices. Work offers opportunities to interact with coworkers, share common experiences, develop interpersonal relationships, and arrange social activities after work; and earning a living through work contributes to improved quality of life and personal satisfaction (Wehman, 1998). Most important, a productive and competent workplace role can decrease the stigma frequently associated with disability (Matson and Rusch, 1986).

And yet, despite that clear policy message—jobs, jobs, and more jobs—approaches to the employment of people with disabilities have had such disappointing outcomes as to suggest a fundamental misunderstanding of the dynamics of disability and employment (Ronayne and Tyrell, 2005). A comprehensive strategy for the employment of people with disabilities requires high-level political commitment and will; complements and coordinates with other policy areas (e.g., welfare, health, education, transport) that affect labor market potential; must be visible and include participation by the various stakeholders; aspires to change attitudes and behaviors; and acknowledges the heterogeneity of people with disabilities and the complexity of their intersection with the labor market (*ibid*).

Further, such a strategy requires coherency of theoretical perspective, which approaches to employment for people with disabilities have typically lacked. That is, underlying assumptions about the dynamics of disability, society, technology, and employment have not been sufficiently identified and considered, or have been treated inconsistently in policymaking (Ronayne and Tyrell, 2005). To effectively address the employment situation of people with disabilities, it is necessary to explain it. The “low-level” or “ground-view” explanations of why employment outcomes for people with disabilities are so dismal include lack of awareness among employers, perceived productivity deficits of people with disabilities, and segregation and discrimination. The “high-level” or “view-from-the-top” explanations tend to fit some variation or combination of the medical model and the social model of disability.

The medical model of disability, which has also been described as a functional-limitations paradigm, holds that impairments in the structures or functions of the body result in incapacity or reduced capacity to work. The Americans with Disabilities Act (ADA), for example, defines disability as a physical or mental impairment that substantially limits one or more major life activities such as work (42 USC 12102(2) (A)). According to the Social Security Administration, disability is “the inability to engage in any substantial gainful activity (SGA) by reason of any medically determinable physical or mental impairment” (Social Security online).

The social model of disability takes a different tack. This model holds that physical, sensory, intellectual, or psychological variations, which may sometimes cause individual functional limitation or impairments, do not necessarily lead to disability, unless society fails to include people regardless of individual differences (Oliver, 1983). In other words, preconceptions about people with disabilities in society, much like racism or sexism, oppress people with disabilities (Ronayne and Tyrrell, 2005). Overall, “concepts of citizenship, the economy, and the body are embedded in understandings...that generally exclude or marginalize the forms or realities of disability” (Breckenridge and Vogler, 2001: 351). Our social environment is molded by public policies that themselves reflect pervasive attitudes and values. If that environment was designed to meet the needs of individuals with disabilities, “traditional assumptions about their capacities and productivity embedded in the ‘functional-limitations’ model of disability probably could no longer be sustained” (Hahn, 1997: 175).

Although no universally accepted model of disability yet exists, there is acknowledgment of the complexity of the medical, social, economic, and policy interactions. The World Health Organization (WHO) asserts that the social organization of society and economy do not take into account diversity and calls for removing the barriers to participation resulting from impairments. The WHO definition combines elements of both the medical and the social model, calling disability “a complex phenomenon, reflecting an interaction between features of a person’s body and features of the society in which he or she lives” (WHO, 2001).

That interaction is inescapably mediated by technology. Technology and media influence what the body can do and is required to do, affecting actual and perceived productivity (Stone and Colella, 1996). But just as the relationship between technology and the social organization of society and economy is never unidirectional (DiMaggio et al., 2001), productivity is dynamic and changeable. Considerations of the employment of people with disabilities should not view the productivity as static and collapsed unidimensionally into impairment.

More specifically at the individual level, productivity is a function of the organization of work (management effectiveness), the technical resources deployed, the skills and experience of the worker, and the worker's motivation (Ronayne and Tyrell, 2005: 79).

Motivation is most often the one element overlooked. Any consideration of the roles that digital technology and new media could play in the employment of people with disabilities must address why that motivation might be low, before looking at the opportunities offered by the changing socio-technical employment environment.

2.2.2. Disability and Social Participation

People with disabilities may be “unable to participate in society in ways that others take for granted” (Atkins and Guisti, 2003). A study of the social and civic participation of people with disabilities showed that 36.8 percent regularly attended group meetings, compared to 53.7 percent of people without disabilities. They also had lower weekly religious attendance, union membership, political participation, and self-rated civic skills (Schur et al., 2005).

In another study, 35 percent of Americans with disabilities say they are completely uninvolved in their communities, compared to 21 percent of those without disabilities (VABoard 2010 (a)). Approximately half of people with disabilities report that the absence of a full social life is a concern, citing attitudinal barriers, lack of transportation, lack of awareness, lack of income, and lack of encouragement from community organizations as barriers (Leitman et al., 1994; VABoard 2010).

A 2010 Harris Interactive poll of people with disabilities conducted for the Kessler Foundation and the National Organization on Disability (NOD) revealed that people with disabilities are less likely than those without disabilities to report that they socialize with friends, relatives, or neighbors (79 percent versus 90 percent). The gap of 11 percentage points has remained basically constant since surveys in 2004 (10 percentage points) and 2000 (11 percentage points). People with disabilities are also less likely to go to a restaurant or to attend religious services. However, the same

survey spotted one encouraging trend: young people with disabilities (ages 18 to 29) report that they socialize more with friends, relatives, or neighbors than their counterparts without disabilities (Kessler Foundation and NOD, 2010). Generally, younger generations of people with disabilities are more socially and politically active than older generations.

The same survey (national cross-sections of 1,001 people with disabilities, including proxies, and 788 people without a disability) provides some insight into a major cause of the lack of social participation. Over one-third of people with disabilities reported the availability of accessible transportation as an obstacle. Of those, half (18 percent overall) claimed the unavailability of accessible transportation as a major problem. The transportation gap between people with and without disabilities had widened by five percentage points since 1998. Transportation was identified as a much larger obstacle for people with severe disabilities, who were twice as likely to consider it a major problem compared with those with “somewhat severe” disabilities, and over three times more likely than those with a slight or moderate disability (Kessler Foundation and NOD, 2010).

Additional studies have focused specifically on people with intellectual disabilities. Bray and Gates note that community participation in a variety of valued roles is a goal through which other goals are achieved. However, “adults with an intellectual disability may play few roles, and these may be roles which imply dependency and lack of community contribution” (Bray and Gates, 2003: 3). Many adults with an intellectual disability rely primarily on paid staff or on other adults with disabilities as sources of social support, which reinforces the likelihood of limited opportunities for community participation and the development of other sources of social support (Newton et al., 1994). In residential settings, social participation is drastically limited. A study of 500 adults with intellectual disabilities living in residential settings shows that, excluding staff, the median size of participants’ social networks was only two people. The authors note that people with intellectual disabilities are marginalized and socially excluded in western countries (Robertson et al., 2001).

2.2.3. The Relevance of Social Participation

The extent of social or community participation is relevant because, to possess social capital, a person must be related to others, usually in a group or community, with those others serving as the source of his or her social capital. Social capital is described by Fukuyama as important to the “efficient functioning of modern economies” and essential for stable liberal democracy (Fukuyama, 1999). Social capital is “a resource that actors derive from specific social structures and then use to pursue their interests; it is created by changes in the relationship among actors” (Baker, 1990: 619), and it requires “deliberate investment of both economic and cultural resources” (Portes, 1998: 4). Social capital can arise from embedding in a common social structure (Portes, 1998) and is a positive effect of interaction among participants in a social network (Ellison et al., 2007). Obtaining social capital also depends on communication, which may create or reinforce a sense of group identity (Dawes, 1991), especially with frequent or durable interactions (Axelrod, 1984). Social capital is distinguished from material capital in that time is not delimited. Any exchange continues a relationship into the future and leaves open the possibility of the next transaction. Social capital is based upon connections and reciprocity (Putnam, 2000; Malaby, 2006).

Social capital exists where people gain advantages because of their location in a social structure (Burt, 2004). By far, “the most common function attributed to social capital is as a source of network-mediated benefits beyond the immediate family” (Portes, 1998: 12). The many benefits of social capital are what lead to claims that community participation is a goal by which other goals are achieved (Bray and Gates, 2003).

Importantly, social capital plays a role in obtaining other types of capital. By the start of the 21st century, 80 percent of a company’s market value was determined not by cash, buildings, or equipment, but by intangible factors such as human and intellectual capital (Weatherly, 2003). As intellectual and human capital grow in value, it becomes clear that “workplaces are complex social communities, in which social capital plays no small part” (Baker et al., 2006: 421).

Through social capital, people can gain direct access to economic resources (subsidized loans, investment tips, protected markets). People can increase their cultural capital through contacts with experts or individuals of education (i.e., embodied cultural capital); or they can affiliate with institutions that confer valued credentials (i.e., institutionalized cultural capital) (Portes, 1998: 4).

Social capital is also seen as a predictor of school attrition rates and academic performance, intellectual development, sources of employment and occupational attainment, juvenile delinquency, and immigrant and ethnic enterprise (ibid: 9). Because knowledge is generated largely through social interaction (Anderson and Kanuka, 1998), social capital (“know-who”) may be a more significant organizational aspect than human capital (“know-how”) (Downes, 2004). “From the perspective of the employee, getting a desirable job may be viewed as a return accruing to the person based on their human, cultural, and social capital. All three types are important to the employment process” (Potts, 2005: 21).

Although human and social capital enhance each other, they are distinct and offer different insights into society’s inequalities. Society is marked by inequalities, in the sense that the interests of some people are better served than the interests of others.

The human-capital explanation of the inequality is that the people who do better are more intelligent, more attractive, more articulate, and more skilled. Social capital is the contextual complement to human capital. The social-capital metaphor is that the people who do better are somehow better connected (Burt, 2001: 202).

The explanation strikes at the heart of the employment dilemma facing people with disabilities. “Lack of human capital is likely to be the first explanation we consider when we encounter a person who has been repeatedly unsuccessful finding a job....There is a tradition of identifying family, friends, and coworkers as potential sources of ‘natural’ social support for workers with a disability, or less often as potential employment contacts, but the concept of social capital as a key to employment has been largely ignored by those assisting persons with disabilities to find employment” (Potts, 2005: 22).

Studies of technology and disability have leaned toward a human-capital perspective. Many types of assistive technology address perceived disparities in the skills and talents of potential employees with disabilities (Potts, 2005). New types of digital technology can certainly affect the *human* capital of people with and without disabilities. But the types of technology selected for focused study here (the six vectors) are of particular interest for their potential to serve as conduits to *social* capital, the connections among individuals. The role of social networks and their intersection with employment is at the core of this study.

2.2.4. Matching Employment Opportunities with Job Seekers Through Networks

When employment does not occur, the root of the problem may lie with the job opportunities, with the job seeker (i.e., human capital), or with the mechanisms that match the two sides. High unemployment among people with disabilities is traditionally explained by a scarcity of job opportunities, or by the assumption that people with disabilities are at a competitive disadvantage. A variety of legal initiatives, programs, and accessibility requirements aim to improve the first area, the job opportunities available to people with disabilities. Other initiatives, such as vocational programs, job training, and technological assistance, address the second areas, the perceived disparities in the talents and skills of potential employees with disabilities, based on the assumption that stronger marketable skills will lead to employment. In view of the worsening employment picture for people with disabilities, it is apparent that these initiatives are not working or are in some ways inadequate.

The largely missing or underemphasized factor is a focus on the matching mechanism and its dependence on social capital (Potts, 2005). As Potts points out, the process of matching employees and job opportunities is not trivial or automatic.

There is another possible explanation for unemployment: employees may fail to fill job opportunities for which they are qualified because they are unaware of the job opportunity or the employer is unaware of these people as prospective employees. This

situation leads to the question, “How do we connect accessible jobs to qualified people?” (Potts, 2005: 23).

The matching mechanism between potential employees and potential job opportunities has been a major focus of sociologists studying social networks, which are a way to describe structures of interpersonal relationships. In 1973, Granovetter suggested analysis of social networks as a tool for linking micro and macro levels of sociology theory. He noted that the sociological theory of his day could not convincingly relate micro-level, small-group social interactions to macro phenomena such as social mobility, community organization, and political structure. His solution was found in social networks.

The analysis of processes in interpersonal networks provides the most fruitful micro–macro bridge. In one way or another, it is through these networks that small-scale interaction becomes translated into large-scale patterns, and that these patterns, in turn, feed back into small groups (Granovetter, 1974: 1360).

Granovetter defined the strength of an interpersonal tie as a “combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie” (Granovetter, 1974: 1362). For ease of discussion, he categorized relationships roughly as strong ties (close friends) and weak ties (acquaintances). When he applied this idea to work situations, he found that white-collar workers frequently locate jobs through weak ties, which relay useful job information more frequently than strong ties. Weak ties tend to be less redundant and to reach people more geographically and socially far away, thus offering access to more job opportunities. A successful job seeker typically receives information about the opportunity through a short chain of one or two contacts. Often people who obtained work through a network were not actively seeking work at the time; the weak ties initiated contact when they heard of the suitable opportunity (ibid).

Calvó-Armengol and Jackson have modeled the role of networks in employment status, and show that in the long run, any interconnected workers’ employment status is

positively correlated: employed workers tend to be connected to employed workers. If people are employed, other people in their network are more likely to hear about and obtain employment opportunities. Network density, structure, symmetries, and path lengths between people are all relevant to employment status (Calvó-Armengol and Jackson, 2004). The growing body of findings about the role of social networks in obtaining employment has direct implications for the ability of people with disabilities to find or create work.

If persons with certain types of disability are at a disadvantage with respect to their job networks, and if networks affect employment for persons with these disabilities as they do the general population, then it is likely that a nontrivial portion of the unemployment experienced by persons with those disabilities is due to this lack of social capital (Potts, 2005: 23).

That many people with disabilities are at a disadvantage with respect to their job networks is likely the case. Social networks of job contacts can be built through participation in clubs, civic and religious groups, and other social activities (ibid), and as discussed, people with disabilities report less social and civic participation than people without disabilities (Kessler Foundation and NOD, 2010; Schur et al., 2005; Atkins and Guisti, 2003; Leitman et al., 1994).

The suggestion here is that networks are likely more important for people with disabilities than for the general population. “If disability narrows the set of jobs one is qualified to fill, then having the right channels of job contacts to get access to that smaller set of job opportunities may be even more crucial to employment success” (Potts, 2005: 22). But at the same time, the social capital that underpins those networks is likely weaker, and the matching mechanism between employer and potential employee less effective. This provides the context for examining the potential of the six vectors that is the focus of this research.

The implications are significant, because the effects of networking spread beyond the employer–employee nexus. The Office of Disability Employment Policy (ODEP) notes

that restricted access to support networks is one barrier to self-employment and entrepreneurship for people with disabilities. Studies of immigrant and ethnic communities identify networks and the social capital that flows through them as a key for successful small businesses. Community networks provide a vital source of tips about business opportunities, start-up capital, access to markets, and a pliant labor force (Portes, 1998).

Social networks affect the likelihood of having a good idea in the first place, because people connected across groups are more familiar with alternative ways of thinking and behaving, and new ideas emerge when they select and synthesize across groups. People with varied weak ties connecting them across many groups are in a better position to innovate than people who are strongly connected but in fewer groups (Burt, 2004). There is also a feedback loop whereby benefits beget more benefits, as people's early access to diverse information makes them more attractive to other people as contacts in their own networks (Burt, 2001: 209–10).

Having a social network of many weak ties that bridge different social groups increases the likelihood both of having a novel idea and of successfully spreading the novel idea. In combination, these factors partially explain why entrepreneurial success depends on social networks (Burt, 1992). Network entrepreneurs are “people who build interpersonal bridges across structural holes,” or who “add value by brokering connections between others” (Burt, 2001: 210).

Finally, the nature of the social network is likely to heavily influence job satisfaction, job retention, and career advancement. The work environment and relationships with coworkers may be the most important factors contributing to job success and satisfaction, and studies show that work performance and job retention are related to an employee's participation in social relationships with coworkers and supervisors (Wehman, 2003). Coworker relationships play an important role in completing work responsibilities, handling personal problems, dealing with other coworkers, learning new job tasks, understanding the unwritten rules of the workplace, and responding to emergency situations (ibid).

Physical integration in the workplace does not necessarily ensure social inclusion, and studies of workplace interactions of people with disabilities with their coworkers suggest that employees with a disability participate in the same frequency of social interactions at work as their coworkers, but the type, content, and settings of the interactions differ. Employees with disabilities are less likely to be involved in nonwork-related interactions, involving joking and laughing, break-time conversations, and informational exchanges (ibid).

Studies of the relationships between employees with disabilities and their supervisors suggest that “nondisabled supervisors are likely to perceive subordinates with disabilities as dissimilar to themselves and so experience less positive affect. Also, supervisors may expect less contribution from subordinates with disabilities” (Colella and Varma, 2001: 305). As a result of stereotypes, workers with disabilities may face additional challenges and problems when they first join an organization (Braddock and Bachelder, 1994). People with disabilities may experience fewer treatment problems as they gain status in organizations but may be given few opportunities to do so, because they are often targeted for low-level positions, which in turn perpetuates “biases and treatment-related problems experienced by the disabled” (Stone and Colella, 1996: 369).

2.3. The Networked Economy and the Collaborative Community

2.3.1. What Is New About the New Economy?

In 1998, Kevin Kelly predicted that “the great benefits reaped by the new economy in the coming decades will be due in large part to exploring and exploiting the power of decentralized and autonomous networks....This new economy...favors intangible things—ideas, information, and relationships. And it is intensely interlinked” (Kelly, 1998). The social and structural characteristics of networks—in particular connectivity, interdependence, and communications—carry implications for workplaces and the economy as a whole. The model of a collaborative community originates in sociology,

but finds a natural embedding in the combination of social, cultural, technological, and economic co-developments that comprise the networked information economy.

In *The Wealth of Networks*, Benkler claims that changes in economic organization and social practices of production have changed how we make and exchange information, knowledge, and culture. He describes new patterns of production in terms of cooperative, coordinated, decentralized individual action in a pervasive network (Benkler, 2006). What has been called the “new economy based on the networking of human knowledge” (Gadman and Cooper, 2005: 57) serves as the starting point for this research, in particular the role of social networks in obtaining or creating employment, and the implications for people with disabilities.

Social networks increasingly characterize both inter- and intra-corporation structures and interactions (Heckscher and Alder, 2006; Wellman et al., 1996) and facilitate commerce (Rauch, 2001). More broadly, the social networked information economy is challenging fundamental economic assumptions about utility, incentives, production, consumption, and markets (Akerlof, 1997; Benkler, 2006; Bollier, 2006).

Employers have indicated that the most important factors ensuring the employment of people both with and without disabilities are their skills and aptitudes. “One of the biggest hurdles to the career advancement of persons with disabilities has been their lack of marketable skills and orientation to the business world” (Braddock and Bachelder, 1994: 24). But in the networked information economy, both the business world and the marketable skills are changing and being shaped by networked digital technologies, represented in this report by the vectors. Fundamentally, “the networked information economy improves the practical capacities of individuals...to do more for and by themselves” and “enhances their capacity to do more in loose commonality with others,” while “the removal of the physical constraints on effective information production has made human creativity and the economics of information itself the core structuring facts in the new networked information economy” (Benkler, 2006: 4).²

The transition to a new economy has been described as a transformation from push economies (geared toward mass production) to pull economies (geared toward open, flexible production). The pull model is not just about IT capability, but also touches on rich networks of various types of social relationships. Pull models develop products through socially driven, iterative processes, and require coordination of social and technical practices.

In this way, communities of interest are becoming communities of creation and production; social communities play a large role in creating value (Bollier, 2006). “The most powerful leaders in this [pull] environment will be those who have cultivated shared moral ideals and social relationships over time within distinct communities” (ibid: 19). Pull models “seek to provide people on the periphery with the tools and resources (including connections to other people) required to take initiative and creatively address opportunities as they arise....Pull models treat people as networked creators (even when they are customers purchasing goods and services) who are uniquely positioned to transform uncertainty from a problem into an opportunity” (Hagel and Brown, 2005: 4).

Coleman predicts that the shift toward pull economies will benefit the United States, because of its tradition of entrepreneurship, and its propensity to let creative destruction work, and thereby let new jobs evolve (quoted in Bollier, 2006: 26–27). The shift could also be good for people with disabilities, who could have unique qualifications for the new jobs that are evolving. It is in those new jobs that creative, networked people transform problems into opportunities, and where networking technologies are making entirely new types of business specialties possible by enabling people to express highly specific preferences that enterprising producers can meet.

2.3.2. Cultural Limits on the Economic and Social Roles of People with Disabilities

The idea that communities of interest are becoming communities of creation and production marks a potential watershed in how social communities are perceived, by

moving away from a simplistic contrast between the primacy of the individual and the primacy of the group or community—a contrast that also plays a large role in how people with disabilities are perceived in society.

Individualism and collectivism represent two extremes of a cultural spectrum. Individualist culture focuses on the separateness and unique strengths of a person, whereas collectivist culture focuses on contributions to the good of a group (Rothstein-Fisch et al., 1999). These different cultural viewpoints imply different conceptualizations of disability. Individualistic societies view disability as a physical, individual phenomenon, and a condition to be remediated. Collectivist societies, on the other hand, view disability as a spiritual, group phenomenon, and a condition to be resigned to (Kalyanpur and Harry, 1999).

The individualistic viewpoint has characterized American society in general and the American attitude toward disability. Linton points out that America's glorification of independence has not served people with disabilities well, because individual worth came to be judged in terms of financial and social independence, historically a goal few people with disabilities could reach (Linton, 1998: 48). Before the 1960s, a child with a disability, deemed incapable of an individual independent life, would have been put into an institution and segregated from the community. After the 1975 passage of the Education for All Handicapped Children Act, institutionalization was less common, but children with disabilities were often placed in special-education programs separate from other students (Schur, 2005).

Today, integrated education is more common, but self-reliance, competitive employment, and independent living are considered top priorities of American special-education programs (Black et al., 2003), and the Individuals with Disabilities Education Act explicitly cites preparation for “employment and independent living” as the primary purpose of special education (P.L. 105-17, Section 601d). While professionals tend to define independence in terms of self-care activities, people with disabilities tend to define independence as being in control of and making decisions about one's life (Reindal, 1999).

The American cultural glorification of independence has neglected that “the experience of disability is clearly in conflict with conceptions of autonomy that assume a self capable of isolated independence” (Ells, 2001). People with disabilities who are considered incapable of achieving isolated independence are eligible for transfer programs such as Social Security Disability Insurance and Supplemental Security Income. Historically, American disability policy has been dominated by transfer programs, and the benefit rolls have increased continuously since eligibility expansion in 1984 (Burkhauser and Daly, 2002). Paradoxically, government and private programs that address barriers to independence have actually fostered dependence in many program participants, who learn to rely heavily on agency personnel or transfer programs (Leake and Black, 2005; Burkhauser and Daly, 2002).

At the same time, the collectivist view does not represent an ideal alternative. In collectivist societies, children with disabilities are commonly conferred “disabled” status and are not expected to work or live outside the family home. The focus is on protecting, indulging, and collectively caring for the child (Black et al., 2003). In these arrangements, because the nature of the group is to care for group members in need, people with disabilities are placed in a highly dependent role.

In fact, both the individualistic and collectivistic social views have resulted in dependency for people with disabilities. Dependency is satisfactory to no one—it implies a cost of time and resources to some parts of society, and a lack of autonomy and opportunities for others. Dependency is not suitable for the development of social capital and social networks. Network ties involve reciprocity (Granovetter, 1973), which is counter to dependency. People seek to include in their network individuals who have access to information and control, which a highly dependent person is unlikely to have (Burt, 2002).

However, the glorification of individualistic, isolated independence and its association with autonomy may be fading, with corresponding effects on community participation and values. The next sections describe these changes and what they could mean for

people with disabilities in the community and the workplace, and examine how digital technology fits into the picture.

2.3.3. *The Promise of the Collaborative Community*

The last few decades have seen the emergence of the collaborative community, an alternative to the dichotomy between individualism and collectivism (Quan-Haase and Adler, 2005). The collaborative community preserves the importance of both individual identity and interdependent relationships. In collaborative communities there is an “and” and not ‘versus’ relationship between individual and social creativity” (Fischer, 2005: 2). Authority and power relations are more flexible and horizontal (Adler and Heckscher, 2004). A collaborative community is distinguished by its structure (networked, interdependent process management), its values (the ethic of interdependent contribution), and its character (relational self finds both individual identity and sense of community through interdependence in social networks) (ibid: 42).

The difference between collaborative communities and collectivist societies is that in the former, the crucial structure is not groups but networks, and that community does not imply conformity (Thomson, 1997). Collaborative communities are composed of “collections of individuals who are bound together by natural will and a set of shared ideas and ideals” depending on “autonomous, independent individuals engaged by influencing each other” (Kowch and Schwier, 1997: 1). Social networks in collaborative communities, like groups in collectivist societies, may work toward a collective goal, but the key difference is that network members maintain autonomy. In Burt’s work on the social topology of autonomy, he notes that strong integration into a group of similar others serves to limit the autonomy of an individual, but a network of diversified relationships enhances the autonomy of an individual (Burt, 1980).

The collaborative-community model is particularly relevant for people with disabilities, as “the extent of interconnectedness and interdependencies emerges more distinctly in experience that includes disability” (Ells, 2001). The collaborative conception of autonomy, focusing on an interdependent relational self, contrasts with the individualist

conception of autonomy through isolated independence. According to the Ethics and Chronic Illness project at the Hastings Center, “Autonomy is not some a priori property of persons abstractly conceived. It is an achievement of selves who are socially embedded and physically embodied. This is perhaps the single greatest lesson to be learned from chronic illness” (Jennings et al., 1988). For people with disabilities, the ideal of autonomy often struggles with the realities of challenges posed in housing, transportation, employment, rehabilitation, technology, education, and the physical environment that interfere with acting independently. “An analysis of these sorts of barriers to independence makes clear that the possibility and condition of independence depends not on separation from others but on particular and extensive sorts of interconnections with others and with the social and political fabric of one’s community.... Access to social spaces and services and empowering relationships makes autonomy possible” (Ells, 2001).

2.3.4. How Can the Culture of Collaborative Communities Change the Workplace for People with Disabilities?

Collaborative corporate communities are emerging just as the “goal-driven, superego-based, relatively inflexible form of individualism” of the industrial economy is no longer seen as suitable for business (Thomson, 1997). Corporations such as IBM have found success in applying the collaborative-community model to the workplace, and other corporations are catching on (Heckscher and Adler, 2006). A high degree of interdependence is a distinguishing characteristic of collaborative corporate communities (Adler and Heckscher, 2006).

In collaborative corporate communities, because there is less need for conformity as a basis of trust, there is more openness to diversity (Heckscher, 2007). Whereas perceived dissimilarities negatively affect people with disabilities in traditional workplaces (Colella and Varma, 2001), perceived dissimilarities need not be viewed so negatively in the collaborative community. Trust depends not on homogeneity, but “on organized processes of contribution to a shared task,” best achieved through “diversity

of skills and competencies” (Heckscher, 2007: 123). Disability is of course a form of diversity, and may be “a forum for the development of sensibilities and skills theretofore unrealized” (Ells, 2001). The flexibility of the collaborative corporate community offers hope that a wider variety of competencies and contributions can be recognized and valued.

A case in point is Autistic adults, for whom online technologies have allowed the development of an independent autistic community and culture, in part because the challenges associated with interpreting nonverbal and social cues are less significant online (Ne’eman, 2009). As one example, the Danish company Specialisterne “turned ‘disability’ into an asset” by realizing that “as long as someone with autism could feel comfortable in a workplace and have the social confidence to perform a job then they would have skills that made them more capable than others to perform certain tasks which required large degrees of precision, focus and memory recall” (Milmo, 2009). The company employs more than 40 Autistic people as software consultants, paid competitive wages.

2.4. Overall Effect of the Internet

2.4.1. The Effect of the Internet on the Social Capital and Employment Opportunities of People with Disabilities

The Internet is associated with the networked information economy as the chief enabler of the information revolution, encouraging transparency and lower transaction costs. It has been predicted that the Internet will allow productivity gains of more than 1000 percent in the 21st century (Bollier, 2006). Though some researchers initially argued that by detracting from face-to-face interactions, the Internet would decrease social capital, some studies have challenged this view by demonstrating positive effects on community interaction and social capital (Ellison et al., 2007). In particular, the Internet makes it easier to form and support weak ties through features like distribution lists, photo directories, and search capabilities. The Internet facilitates new connections

by providing people with an alternative way to connect with others who share their interests or relational goals (ibid), and provides the basis for the collaborative-community model and the promise it holds for people with disabilities.

The Internet has contributed to the shift to a network-based society by decoupling community and geographic propinquity (DiMaggio, 2001). Relatively early developments in the Internet's history, such as RSS feeds and blogging, highlight the Internet's inherent usefulness for sharing content quickly and efficiently and for social networking (Downes, 2004). Internet-supported social networks may provide social support, companionship, a sense of belonging, emotional aid, and information about medical treatment and other matters without requiring major investments of time, money, or energy (Wellman et al., 1996). By lowering the cost of information, the Internet can enhance the ability of low-income people to gain human capital and find and compete for good jobs (Anderson et al., 1995).

There is "much anecdotal evidence that the Internet provides significant benefits to people with unusual identities or concerns (e.g. rare medical conditions)" (DiMaggio, 2001). "People have always given each other advice about their bodies, psyches, families. The Net has just made the process more accessible and more visible to others" (Wellman et al., 1996: 219). The use of advanced telecommunications, Internet access, and broadband services can contribute to the creation of more flexibility in the workplace, increasing the potential for people with disabilities to enjoy more job opportunities as well as independent living (Wireless RERC). All of these claims point to the Internet's advantages in terms of functional accessibility, social/cultural accessibility, and affordability.

2.4.2. Accessibility of the Internet and Digital Technology

However, there are still concerns regarding the Internet's accessibility. Computer use and ownership and Internet use are significantly lower for people with disabilities compared with their counterparts without disabilities. More than four in five (85 percent) people without disabilities use a computer or other device to access the Internet

compared to just over half (54 percent) of people with disabilities (Kessler and NOD, 2010).

The Convention on the Rights of Persons with Disabilities, which the United States signed in July 2009, “recognizes the importance of accessibility...to information and communication in enabling persons with disabilities to fully enjoy all human rights and fundamental freedoms” (Department of Justice). This is not simply a question of being able to use the Internet: access, like disability itself, is a complex and multidimensional construct. “A sociological perspective calls attention to the need to go beyond the conventional focus on access per se to explore inequality in the combination of technical and social resources required for effective participation” (DiMaggio, 2001). The dimensions of accessibility include:

- **Functional accessibility:** Availability of options suitable for physical, sensory, intellectual, or psychological variations.
- **Awareness:** Awareness of options, opportunities, and legal rights.
- **Social/cultural accessibility:** Stigmas, policies, or social norms may limit access. May be internal or external, formal or informal.
- **Affordability:** High costs of money, time, or other resources may limit access.

The vectors in this research are by definition high-technology devices or services, requiring computers, electronics, or microchips to perform some function, which in turn often need assistive technology “to increase, maintain, or improve functional capabilities of individuals with disabilities,” in the words of the Technology-Related Assistance for Individuals with Disabilities Act of 1998. Assistive technology (AT) is a basic tool to ensure accessibility for people with disabilities, but both its cost and the need for training before its use may have negative consequences.

About half of adults with disabilities use some form of AT specific to their disability, but many lack some form of AT that they need (VABoard, 2010); Braddock and Bachelder,

1994). In particular, AT devices and services are not readily available to “culturally diverse populations, families in rural areas, older Americans, and individuals in long-term care facilities” (Braddock and Bachelder, 1994: 23). To promote functional accessibility, a number of collaborative efforts, such as the Accessibility Interoperability Alliance and a working group of the International Organization of Standards (ISO) called ISO/International Electrotechnical Commission (IEC) JTC1/SC35/WG6, promote interoperability between AT and information technology (Lyle, 2010). In addition, there are national and international standards and guidelines, including the Web Content Accessibility Guidelines and International Committee for Information Technology Standards (INCITS)/V2, as well as organizations such as the Human Factors and Ergonomics Society (HFES) and Institute of Electrical and Electronics Engineers (IEEE) voting accessibility standards (Trace Center).

Studies have shown that although numerous people with disabilities are dissatisfied with their AT and discontinue its use, certain factors greatly increase the likelihood of satisfaction and continued use (Riemer-Reiss and Wacker, 2000). Trialability, or the degree to which a user can experiment with a technology before acquisition, is an effective means to promote ongoing use. However, people with disabilities often lack the option of trying AT before purchasing it. For instance, in one study only about half of people with visual disabilities reported that they were able to test their AT before purchase (Rogers, 1995).

A challenge to functional accessibility is keeping up with the rapid pace of technological change. Even when technology has been adapted to meet the functional accessibility needs of people with disabilities, the adaptations have historically been slow to come, leaving people with disabilities years behind in accessing the newest technologies. As examples, it took more than 100 years for the telephone to become accessible for people with speech and hearing disabilities, 50 years for television to become accessible for people who are deaf or hard of hearing, and 10 years for people who used hearing aids to use digital wireless phones (Lyle, 2010). New, more interactive,

dynamic, visual, and rapidly changing technologies add accessibility challenges (Gibson, 2007).

In terms of awareness, “accessing current and appropriate information on assistive technology is a problem for consumers and their families. Many assistive devices must be used differently in different settings. In an employment setting, assistive technology must always be matched to an individual’s needs, preferences, capabilities, and comfort” (Braddock and Bachelder, 1994: 22). In reality, there is little awareness of the potential benefits of technology in facilitating the performance of job tasks, including greater productivity and self-esteem (Yeager et al., 2006: 342). Many people with disabilities who need work-related AT fail to request it as a job accommodation from their employer, perhaps because they are unaware of employer obligations (Yeager et al., 2006; Williams et al., 2006). There is also a need to raise employers’ knowledge and awareness of AT (Baker et al.). They assume that AT and other accommodations will be expensive, but a large study by the Job Accommodations Network reported that a high percentage (56 percent) of accommodations cost nothing to make, while the rest typically cost only \$600.

There may also be lack of awareness that certain new technologies are available and accessible. According to a report commissioned by the FCC, “Lack of exposure to broadband...contributes to a general perception among people with disabilities that broadband and broadband-enabled technologies are inaccessible” (Advanced Communications Law and Policy Institute, 2009: 25).

In terms of social-cultural accessibility, fear of being perceived as receiving special treatment may constitute a social barrier to requesting AT (Yeager et al., 2006). Many workers are reluctant to disclose mental limitations to others (Williams et al., 2006), perhaps due to cultural stigmas. Social and professional stigmatization, marginalization, and isolation are concerns for employees with disabilities, particularly those separated from the physical workplace through the use of information communication technologies (Baker et al., 2006).

Some “non-disabled workers may interpret disabled counterparts as either ‘problem workers’ who do not meet organizational standards or individuals receiving accommodation as ‘special treatment.’ Neither characterization lends itself to the fostering of solidarity or to an understanding of how employment relationships and labour processes might be disabling” (Wilton, 2004: 423).

Affordability is a large factor. An estimated 59 percent of people who need AT are unable to afford it (Braddock and Bachelder, 1994). Of people with disabilities who have not adopted broadband, 37 percent cite cost as a barrier (Lyle, 2010). AT may add a layer of expense to technology that people without disabilities do not face. As examples, Lyle notes that screen-access technology (which reads text on the screen for people who are blind or have low vision) ranges from between \$800 and \$1,000 for computers and costs about \$400 for cell phones. Displays that produce the on-screen content in Braille cost in the range of \$3,500 to \$15,000, with an average cost of about \$5,000. Augmentative and Alternative Communication (AAC) devices for people with severe motor or other communication disabilities can cost \$8,000 or more. “While government programs pay for AT under certain circumstances, the European Commission (EC) recently estimated that people with disabilities in the United States pay for AT out of pocket about 56 percent of the time” (Lyle, 2010: 6–7).

An accelerated depreciation schedule is one strategy for funding expensive technology. For example, American Security Bank in Washington, DC, wanted to employ a computer programmer who was blind and needed AT costing about \$3,000. The company depreciated the AT over a two-year period and told the programmer he could take the equipment with him to future jobs if he remained with the bank at least two years. “The bank recouped its investment in the terminal by retaining a skilled employee; and the employee obtained a valuable tool that he could take with him to other jobs, and which also increased his bargaining power with future employers” (Braddock and Bachelder, 1994: 33).

2.4.3. What Aspects of Technology Design Are Important for People with Disabilities?

Section 508 of the Rehabilitation Act Amendments of 1988 mandates the purchase of accessibly designed electronic and information technology (E&IT). Accessible design is a step forward when developing E&IT products, but it leads to technologies that will be used separately, or in addition to, the main E&IT product, which diminishes the effectiveness of designing for all (NCD, 2004).³ In reality, designers of equipment, services, and networks “often fail to consider accessibility issues in the design and development stage—and retrofit solutions are expensive” (Lyle, 2010: 4).

Universal design (UD), or design for inclusion, is “a process to ensure that E&IT is inclusive, accessible, and usable by everyone, including people with disabilities.... Incorporating UD processes when developing E&IT is one solution to accommodating people with disabilities that also improves the usability of the products for the rest of the population” (NCD, 2004). A 2004 report of the National Council on Disability, “Design for Inclusion: Creating a New Marketplace,” provided an extensive guide to UD.

The government provides funding to support universally designed technologies. For example, the U.S. Department of Education’s National Institute for Disability and Rehabilitation Research funds a Rehabilitation Engineering Research Center (RERC) on Universal Interface and Information Technology, which focuses on the accessibility and usability of current and emerging IT. The desired outcome of this research center is “seamless integration of the various technologies used by individuals with disabilities in the home, the community, and the workplace” (Trace Center).

One area of interest is the integration of UD and AT (NCD, 2004). Another focus is the lag time that often occurs between new technological development and accessibility. If adaptations to facilitate the incorporation of AT and toolkits were universally incorporated into newly developed Web elements, that would reduce the lag between such development’s appearance and the point at which it becomes accessible to all users (Gibson, 2007). Adaptability is related to accessibility. An adaptable system must

be capable of being flexible, parameterized, integrated, and tailored. Being flexible means that generic objects and behaviors that can be interpreted and used differently are provided. Being parameterized means the system allows the user to choose between alternative behaviors. Being integrated means the system can be integrated with other components, internal or external. Being tailored means that users are allowed to change the system itself by specializing behavior or adding new functionality (Morch, 1995).

Media design has traditionally followed a professionally dominated approach, in which one can distinguish between design time (when the media are being designed by experts) and use time (when the media are being used by people other than the designers). A fault of this approach is that “most of the design intelligence is forced to the earliest part of the design process, when everyone knows the least about what is really needed” (Fischer, 2005). As Brown and Duguid point out, successful design should draw on “social resources, even while helping them change” (Brown and Duguid, 2000: 87).

Participatory design approaches “seek to involve users more deeply in the process as co-designers by empowering them to propose and generate design alternatives themselves. Participatory design supports diverse ways of thinking, planning, and acting, thus making work, technologies, and social institutions more responsive to human needs. It requires the social inclusion and active participation of the users” (Fischer and Ostwald, 2003).

2.4.4. Possibilities for Meta-design

One step beyond participatory design is meta-design, which shares and transcends the characteristics of participatory design. Meta-design empowers the users not only at design time, but also throughout use time (ibid). To foster creative production and enable diversity of access, socio-technical environments must “not only build new technologies but seed new practices, new genres, new communities” (Fischer, 2005: 24) and put the tools rather than the object of design in the users’ hands, defining

conditions for the process of interaction rather than the process itself (De Kerckhove, 1995).

“The development of the notion of meta-design can be categorized as critical and reflexive thinking about the boundaries and scope of design, aimed at coping with the complexity of natural human interaction made tangible by technology. Meta-design seeks to transform this complexity into an opportunity for new forms of creativity and sociability” (Giaccardi, 2005: 2). Central to meta-design is learning to communicate with others who have a different perspective, integrating diversity and making all voices heard. This enables informed participation and social creativity in communities of interest. The ultimate goal is media-augmented social creativity to make all voices heard and integrate diversity (Fischer, 2005).

Meta-design is a conceptual framework that both encompasses and surpasses universal design. It acknowledges economic, social, and technical complexity, and offers an environment that can accommodate the diverse and unpredictable needs of a heterogeneous population in a changing work environment. Meta-design addresses what Fisher and Scarff (2000) see as three necessities for socio-technical environments:

1. They must be flexible and evolve because they cannot be completely designed before use.
2. They must evolve to some extent at the hands of the users.
3. They must be designed for evolution.

The person with a disability becomes a co-developer, an intrinsic part of an interactive feedback process (Fischer and Giaccardi, 2004) rather than a reluctantly included contributor to ever-lengthening lists of accessibility guidelines that always run a step behind the rapid pace of technological change. Meta-designed technology encompasses not only accessibility concerns and human-capital needs, but also social-capital and creativity needs, in line with the needs of the new economy.

2.5. Summary

This section argues that the root of the problem of the employment of people with disabilities is deeper than the challenges to do work that a disability may pose, or the obstacles to access that a workplace or work equipment might raise. One key element of both the ability to find work and of productivity in the workplace is motivation. Any consideration of the roles that digital technology and new media could play in the employment of people with disabilities must address why that motivation might be weak or lacking, before looking at the opportunities offered by the changing socio-technical environment of employment.

Work takes place on a socially complex stage, where social capital plays a significant role. Because knowledge is generated largely through social interaction, social capital (“know-who”) may be more significant organizationally than human capital (“know-how”). However, human capital is likely to be the first explanation we turn to when considering why a person cannot get a job. The human-capital explanation is that people who do better are more able, more intelligent, more attractive, more articulate, and more skilled. Social capital provides the context to human capital. The social-capital metaphor is that the people who do better are somehow better connected. To possess social capital, a person must be related to others, usually in a group or a community, and it is those others who are the source of his or her social capital.

When employment does not occur, the root of the problem may lie with the job opportunities, with the job seeker (i.e., human capital), or with the mechanisms that match the two sides. Explanations for high unemployment among people with disabilities traditionally focus on the first two elements. The largely missing or underemphasized factor is the matching mechanism and its dependence on social capital.

In part, the unemployment experienced by people with disabilities can be attributed to this weakness of social capital. In that sense, networks are more important for people

with a disability than for the general population. The implications are significant, as the effects of networking spread beyond the employer–employee nexus, to self-employment and entrepreneurship for people with disabilities. Also, the nature of the social network heavily influences job satisfaction, job retention, and career advancement.

The new economy based on the networking of human knowledge serves as the starting point for this research. In the networked information economy, the business world and marketable skills are changing, shaped by networked digital technologies, represented in this report by the vectors.

The new economy has been characterized as a “pull model,” based on rich networks of social relationships. Social communities are playing a large role in creating value. Communities of interest are becoming communities of creation and production. This suggests a transformation in the way social communities are perceived, and has opened the door to an alternative to individualism and collectivism, called the collaborative community. Where both the individualistic and collectivistic social views have resulted in dependency for people with disabilities, collaborative communities stress the embracing of diversity of skills and competencies and have networks, not groups, as the crucial structure, offering the opportunity to recognize and value a wider variety of competencies and contributions.

The Internet underpins the shift to a network-based society, sharing information quickly and efficiently, supporting social networking, and in a real sense leveling the playing field. The effect of the Internet on the social capital and employment opportunities of people with disabilities, and on practical questions of accessibility and technology design, is undeniable, and insofar as it underpins collaborative communities, the effect is positive. However, a pivotal point to emerge from a study of the different types of digital connectivity that the vectors represent is that the positive potential is essentially latent, activated only by social interaction. Other key points follow:

For Vector 1, wireless communication platforms are objects, rather than channels or processes as with the other five vectors. The success or failure that different mobile

platforms will have in facilitating people with disabilities in an employment setting or in searches for work hinges on devices' ability to accommodate people's specific needs.

For Vector 2, social networking emerges as a potential game changer in collaborative communities, superseding hierarchies and markets as a way of organizing work. Technologies are emerging that both respond to and enhance the adoption of the collaborative-community model, which in turn energizes social networks and opens up the prospects for job opportunities for people with disabilities.

For Vectors 3 and 4, immersive digital environments may provide people with disabilities with employment opportunities otherwise unavailable to them, by providing a functionally accessible work environment for people with physical, sensory, or mobility disabilities, by removing barriers of cost and distance, and allowing for more open, flexible, and satisfying relationships.

For Vector 5, open or peer publishing facilitates access to the most important factors of production in today's economy, namely information and networks. Further, the value created in a commons-based peer production model is not just economic, but also social and personal. It implies more open, accountable relationships and a respect for the autonomy of the people in a given commons, an important facilitator for people with disabilities.

For Vector 6, open source processes have radically changed the ways in which people collaborate. This situation offers great promise to some sectors of the disability community by creating technology beneficial to them, at the same time allowing those people with special needs to collaborate on projects that showcase their abilities for future employers.

Table 1 summarizes the facilitators and barriers identified in this section.

Table 1. Facilitators and Barriers—Section 2

Vector	Facilitators	Barriers
<p>The Internet and digital technology in general</p>	<ul style="list-style-type: none"> • Making connections • Finding information • More options for interaction and community participation • Workplace flexibility enables greater diversity of opportunities 	<ul style="list-style-type: none"> • Cost • Unavailability or awareness of AT • Rapid pace of technology causes time lag for accessible options • Lack of broadband, computer ownership, and Internet access • Lack of digital literacy (particularly for people aging into disability) • Fear that special accommodations will cause social and professional stigmatization or isolation
<p>Social-networking</p>	<ul style="list-style-type: none"> • Promotion of solidarity, shared identity, activism, pride, and self-esteem • Formation of weak ties, professional networks • Matching employers and employees 	<ul style="list-style-type: none"> • Privacy and security concerns

Table 1: Facilitators and Barriers—Section 2 (continued)

Vector	Facilitators	Barriers
Immersive Digital Environments	<ul style="list-style-type: none"> • Removes constraints of the physical work environment • Education and training opportunities • Community building • Space for collaboration and group meetings • Choice of self-representation • Entrepreneurship opportunities 	<ul style="list-style-type: none"> • Steep learning curve • Need access to high computing power and powerful network • Dynamic multimedia features often incompatible with AT • Privacy and security concerns • Sometimes not taken seriously • Not relevant to manual labor

SECTION 3. Labor and Business Market Environment and Trends for the Vectors

3.1. Employment in the Networked Economy

3.1.1. Introduction, Sources, and Methods

3.1.1.1. The Information Economy

In the 1950s, researchers began using the term “post-industrial” to describe the gradual expansion of nonagricultural, nonindustrial sections of advanced industrial economies. Early studies of the post-industrial economy referred to it as a service economy (Verzola, 2005), a reflection of the rapidly increasing share of economic activity taken by services from the early 1970s.

However, the shift to services was only a characteristic, and not the key one, of the post-industrial economy (ibid). One of the first authors to recognize the main feature of the new emerging economy was Machlup (1962), who used the term “knowledge-based industry” to describe it. In 1977, Porat measured and estimated the size of this emerging sector and described it as the “information economy,” recognized as the first major use of the term (Verzola, 2005).

Porat’s definition of the information economy remains the most commonly cited. He distinguishes between two economic domains: the domain of matter and energy (including the agricultural and industrial sectors), and the domain of information, which he called the information sector.

3.1.1.2. The Networked Economy and the Vectors

The digitization and networking of information have increased both the types of patterns information can take and the methods and speed of transformation, leading Kelly to propose the term “network economy” (1997, 1998), which Benkler modified to

“networked information economy” (2006). In short, the ways information can be codified, communicated, and transmitted are constantly expanding. The technologies that facilitate a greater variety of information transformations between greater varieties of information patterns are referred to as vectors in this report.

Wireless communication platforms add flexibility and mobility to information processes, including social networks. Immersive digital environments affect the way information is embodied and experienced, and largely remove geographic constraints to information transfer. Commons-based peer production gives more people the capability to find, access, use, and transform information. All of these vectors, then, have increased the scope and magnitude of the information sector. Of course, the transformative nature of the vectors also makes them challenging to measure, as many new uses defy traditional classification.

This section analyzes the employment and business potential of the information sector, as seen through the prism of the vectors. The section includes an analysis of industry and occupation data sources; the identification of selected “occupations of interest,” chosen as vector-relevant areas of job growth; and overviews of each of the vectors, including a conventional business analysis combined. Overall the vectors are regarded as avenues or conduits to work, rather than targets of potential work areas. However, this section also examines the vectors as potential “employment destinations,” i.e., areas where people with disabilities may “do” work, in addition to find or create work.

3.1.1.3. Two Sides of the Information Sector

The networked information economy is both growing and changing fast. The International Data Corporation (IDC), a research and consulting firm, estimates that one million new technology-related jobs will be created over the next four or five years—an increase of about 10 percent.

The rapid pace of change has a direct impact on workers: a flexible, well-educated labor force is most likely to do well in the information economy (OECD, 1996). The U.S.

Department of Labor’s Bureau of Labor Statistics (BLS) publishes the *Occupational Outlook Handbook* (OOH) every other year. The OOH 2010 provides qualitative explanations for projected job prospects in many occupational categories. Information technology and digital media can be associated with two competing tendencies. On one hand, the BLS has high expectations for employment in certain parts of the information sector, which map well with the vectors chosen for this research, in particular Vectors 1 (wireless communication platforms), 2 (social networking), and 5 (open/peer publishing).

In particular, the OOH frequently notes the growing prospects for self-employment, freelancing, and flexible work opportunities facilitated by digital media. Table 2 summarizes the two sides of the information industry: characteristics of jobs in decline and jobs on the increase.

Table 2. The Information Industry: Characteristics of Jobs in Decline and on the Increase

Declining	Increasing
Data oriented	Knowledge oriented
Automated	Creative
Off-shore	Cultural
Routine	Flexible, freelancing
Operating	Designing
Processing	Interpreting
Traditional media	Multimedia

Table 2 also reminds us that prospects for manufacturing and “hard” industries are poor, as they are part of an apparently inexorable decline, based on the OOH analysis that information technology can replace existing manufacturing employment opportunities through, for example, automation and off-shoring.

3.1.1.4. Industry and Occupational Data Sources

Four major sources of data were identified for use in assembling vector-relevant industrial and occupational data, in order to give a factual basis for estimating employment prospects for the near future. Those sources were the North American Industry Classification System (NAICS); the U.S. Census Bureau’s Economic Census; the Bureau of Labor Statistics in the U.S. Department of Labor; and nongovernment sources.⁴ The latter included First Research, a division of Hoover’s Inc. and a provider of market-analysis tools. First Research industry specialists study a wide range of primary and secondary sources, including trade publications, company annual reports, and SEC filings such as 10Ks, in addition to government sources. This allows for a more general overview of the information sector (see Appendix 3). Another nonfederal resource used in this report is the research and consulting firm International Data Corporation (IDC).

3.1.2. Occupations of Interest

Based on the Office of Management and Budget (OMB) Standard Occupational Classification (SOC) system, the occupational groups and occupations most related to digital media were selected for cross-industry analysis, focusing on occupational categories expected to grow at or above average. For each selected occupational group and occupation, the National Employment Matrix 2008–18 was used to obtain data on the number of jobs held in 2008 and the projected growth or decline in employment from 2008 to 2018. Self-employment figures and projections were also obtained, as these may be of interest to people with disabilities or others seeking flexible or nontraditional employment.

Employment growth of 7 to 13 percent from 2008 to 2018 is considered “about as fast as average” according to economists in the BLS Office of Occupational Statistics and Employment Projections, indicating that anything above 13 percent is above average, and therefore “of interest.” The following selections are ranked in order of extent the projection exceeds the average.

3.1.2.1. Computer Specialists

Network systems and data communications analysts held 292,000 jobs in 2008. This occupation is **expected to grow 53 percent** by 2018, for a gain of 155,800 jobs, placing it among the fastest growing occupations. The occupation is expected to grow in every NAICS sector of the economy. There were 56,600 self-employed network systems and data communications analysts in 2008, **expected to increase 55 percent** by 2018, for a gain of 31,100 jobs.

Computer software engineers held 909,600 jobs in 2008. This occupation is **expected to grow 32 percent** by 2018, for a gain of 295,200 jobs. There were 24,600 self-employed computer software engineers in 2008, **expected to increase 27 percent** by 2018, for a gain of 6,800 jobs. “Software engineers design and develop many types of software, including computer games, business applications, operating systems, network control systems, and middleware.... Demand for computer software engineers will increase as computer networking continues to grow.... The increasing uses of the Internet, the proliferation of Web sites, and mobile technology such as the wireless Internet have created a demand for a wide variety of new products. As more software is offered over the Internet, and as businesses demand customized software to meet their specific needs, applications and systems software engineers will be needed in greater numbers. In addition, the growing use of handheld computers will create demand for new mobile applications and software systems” (OOH, 2010).

Computer and information scientists, research held 909,600 jobs in 2008. This occupation is **expected to grow 24 percent** by 2018, for a gain of 7,000 jobs. There were 1,300 self-employed computer scientists in 2008, **expected to increase**

17 percent by 2018, for a gain of 200 jobs. “Employment of these computer specialists is expected to grow as individuals and organizations continue to demand increasingly sophisticated technologies. Job increases will be driven, in part, by very rapid growth in computer systems design and related services industry, as well as the software publishing industry, which are projected to be among the fastest growing industries in the U.S. economy. Computer scientists develop the theories that allow many new technologies to be developed. The demand for increasing efficiency in areas such as networking technology, computing speeds, software performance, and embedded systems will lead to employment growth. In addition, the growing emphasis on information security will lead to new jobs” (OOH, 2010).

Network and computer systems administrators held 339,500 jobs in 2008. This occupation is **expected to grow 23 percent** by 2018, for a gain of 78,900 jobs. There were 2,600 self-employed network and computer systems administrators in 2008, expected to increase 5 percent by 2018, for a gain of 100 jobs.

The *computer specialists* occupational group represented 2.27 percent of all employment in the U.S. economy, or 3,424,300 jobs, in 2008. By 2018 this occupational group is expected to represent 2.52 percent of all employment, or 4,187,000 jobs. This is **employment growth of 22.3 percent**, for a gain of 762,700 jobs. Self-employment in this occupational group will increase even more, from 154,600 self-employed workers in 2008 to 198,500 in 2018, which represents **28.4 percent growth**, a gain of 43,900 new jobs.

The occupations in the computer specialists occupational group include computer and information scientists, research; computer programmers; computer software engineers; computer support specialists; computer systems analysts; database administrators; network and computer systems administrators; network systems and data communications analysts; and all other computer specialists.

Database administrators held 120,400 jobs in 2008. This occupation is expected **to grow 20 percent** by 2018, for a gain of 24,400 jobs. Self-employment is rare for this

occupation, with only 700 self-employed database administrators in 2008, a figure that is not expected to change by 2018.

Computer support specialists held 565,700 jobs in 2008. This occupation is **expected to grow 14 percent** by 2018, for a gain of 78,000 jobs. There were 6,700 self-employed computer support specialists in 2008, expected to increase 12 percent by 2018, for a gain of 800 jobs.

It is noteworthy that the category of *computer programmer* is projected to decline, both as an employed and as a self-employed category. “Advances in programming languages and tools, the growing ability of users to write and implement their own programs, and the offshore outsourcing of programming jobs will contribute to this decline” (OOH, 2010).

3.1.2.2. Computer Hardware and Electrical Engineers/Engineering Technicians

Within the engineering occupational group, computer hardware engineers and electrical engineers are the occupations directly related to digital media. Within the engineering technician occupational group, electrical and electronic engineering technicians were the selected occupation.

Computer hardware engineers held 74,700 jobs in 2008. This occupation is expected to grow by only 4 percent by 2018, for a gain of 2,800 jobs. “Although the use of information technology continues to expand rapidly, the manufacture of computer hardware is expected to be adversely affected by intense foreign competition” (OOH, 2010). The occupation categories of *electrical engineers* and *electrical and electronic engineering technicians* are both expected to decline.

3.1.2.3. Media and Communication Occupations

Again, following the BLS Office of Occupational Statistics and Employment Projections, anything above 13 percent growth is above average, and therefore “of interest.”

Overall, the *media and communications* occupational group represented 827,200 jobs in 2008. This occupational group is **expected to increase 12.7 percent** by 2018, for a gain of 310,700 jobs, effectively putting it in the “of interest” category. While this entire occupational group depends on digital media to one degree or another, several occupations within the group are most directly related to digital media: editors; technical writers; writers and authors; and news analysts, reporters, and correspondents. The following selections are ranked in order of extent the projection exceeds the average.

Editors held 129,600 jobs in 2008. This is expected to decline 0.3 percent by 2018, for a loss of 400 jobs. The decline is more drastic in non-Internet publishing industries, where employment is expected to shrink 16 percent. However, prospects are much better for editors in data processing, hosting, related services, and other information services (**42 percent increase**) and in software publishing (**29 percent increase**). There were 15,700 self-employed editors in 2008, expected to increase 5 percent by 2018, for a gain of 800 jobs.

Technical writers held 48,900 jobs in 2008. This occupation is **expected to grow 18 percent** by 2018, for a gain of 8,900 jobs. There were 1,000 self-employed technical writers in 2008, **expected to increase 15 percent** by 2018, for a gain of 200 jobs.

Writers and authors held 151,700 jobs in 2008. This occupation is **expected to grow 15 percent** by 2018, for a gain of 22,500 jobs. There were 105,200 self-employed writers and authors in 2008, **expected to increase 16 percent** by 2018, for a gain of 16,700 jobs.

Employment of *news analysts, reporters, and correspondents* is expected to decline overall. However, improving technology may eventually lead to employment growth in

this occupation by opening up new areas of work, such as online or mobile news divisions (OOH, 2010). Again, though general job prospects are declining, technology is facilitating self-employment. In 2008, there were 11,900 self-employed reporters and correspondents, which is **expected to increase 14 percent** by 2018, for a gain of 1,700 new jobs (BLS).

3.1.2.4. Artists and Animators

Multimedia artists and animators held 79,000 jobs in 2008. This occupation is **expected to grow 14.2 percent** by 2018, for a gain of 11,200 jobs. In 2008, there were 47,400 self-employed multimedia artists and animators (60 percent of this occupation), expected to grow 6 percent by 2018, for a gain of 3,000 jobs.

Note that nearly all of the fastest growing occupations described above are from the computer-specialist occupation group. Also note that the 12 fastest growing occupations identified require a bachelor's degree or higher, while the nine fastest declining occupations require postsecondary vocational awards or on-the-job training only.

3.2. The Business Market Environment for the Vectors

All the vectors are located in the technology sector, as described by the Department of Labor. The technology sector in the United States (according to First Research definition—see Appendix 3) includes more than 140,000 companies with combined annual revenue of about \$900 billion. Average annual revenue per worker is about \$300,000 (First Research, 2009). Hence, the technology sector overall represents approximately three million jobs.

3.2.1. Vector 1: Wireless Communication Platforms

3.2.1.1. V1: Business Background

Since the 1975 introduction of the world's first personal computer, the MITS Altair 8080, technology related to personal computing has revolutionized the way people in modern society function. In particular, personal computers have changed the world of work, facilitating data assembly, analysis, storage, and retrieval; document production; publishing and presentations; teleworking and geographically dispersed project teams; and communications in general. As the tangible beginning and end-point of social networking, virtual worlds, serious gaming, peer publishing, open-source processes, and personal and tablet computers, along with smart phones and gaming consoles, underpin the digital communications that the vectors represent.

The relative newness of mobile platforms, coupled with their extraordinary growth, makes it difficult to identify trends in pricing and business models for the mobile platform industry, but one newly established reality is clear: the mobile Web, referring to browser-based access to the Internet or Web applications using a mobile device connected to a wireless network. The advent of mobile services and content gives unprecedented access to information (such as news, weather, and contacts), communications (such as email and SMS), and services. In 2009, for the first time in the United States, the amount of data in text, email messages, streaming video, music, and other services on mobile devices surpassed the amount of voice data in cell-phone calls (Wortham, 2010).

By 2011, more than 85 percent of new handsets will be able to access the mobile Web, many with 3G.⁵ In order of importance, the key drivers for mobile use are predicted to be money transfer, location-based services, mobile search, mobile browsing, mobile health monitoring, mobile payment, near-field-communication services, mobile advertising, instant messaging, and mobile music (MobiThinking, 2010). Mobile applications, which consist of software running on mobile devices and performing a large number of functions, are witness to explosive growth. In 2010, the top 10 mobile

application channels by revenue ranking were gaming (accounting for 58 percent of revenue) followed by social networking, weather, entertainment, news, sports, education and employment, utilities, music, and shopping (Millennial Media, 2010).

Social networking growth is extraordinary. Twitter use via mobile browsers rose 347 percent from January 2009 to January 2010, while Facebook mobile browser use rose 112 percent, making social networking one of the most popular and fastest-growing behaviors on the mobile Web (comScore, 2010). In January 2010, more than 30 percent of smart phone owners accessed a social networking site via smart phone (ibid). Social networks inherently reflect connections from person to person, rather than from computer station to computer station, and are well suited to mobile devices that are essentially personal.

A Fast-Growing Market

IDC forecasts that the U.S. mobile broadband market will grow from 6.5 million subscribers in 2009 to 30.2 million in 2014, for a compound annual growth rate of 36.1 percent. IDC notes that the market for mobile broadband connectivity for portable computers has been slow to gain momentum, but in the past 18 months the U.S. market has taken significant steps toward broader adoption beyond the traditional mobile worker.

3.2.1.2. V1: Business and Social Trends

Wireless communication platforms—also called mobile platforms, mobile operating systems, or wireless platforms—are identified for the purposes of this research as mobile telephony, computers, and gaming devices. These categories are not fixed, as the technological developments represented by devices like the iPad or the Kindle or the latest generations of smart phones quickly blur functional distinctions. The focus is on the applicability and potential of these platforms to aid in the employment of people with disabilities.

The Dispersed Workforce

Several of the participants in the user study carried out for this report were enthusiastic about the unrealized potential of telework, for which mobile communication platforms play a vital supporting role. As information and communication technology progresses, encouraging growth in the number of people who participate in teleworking and other forms of mobile collaboration, companies have taken a variety of approaches to incorporating mobile platforms into their work environments. One of these, known as the dispersed workforce, involves the collaboration of geographically decentralized people on a common project or job. The concept of a dispersed workforce is broader than telework, as it also encompasses the ability for an employee to travel from a central office to another location for temporary strategic collaboration. According to one survey, there were already 34 million Americans working at least occasionally from home by 2009, a figure projected to grow to 63 million by 2016 (Schadler, 2009).

This growth in a dispersed workforce not only provides employment opportunities for people regardless of location, but also provides job opportunities for previously inaccessible populations. Examples could include those people with disabilities for whom finding transportation to an office is a major obstacle, working parents who want to remain with their children, and students tied down by an inflexible academic schedule (Paradise, 2008).

The dispersed-workforce approach seems to omit or downplay the optional nature of mobile working, leading Venzia et al. to propose an alternate approach based on *value network analysis*, and to define the mobile worker as “an employee who has choices concerning how, when and why they work” (Venzia et al., 2008: 61). Distancing itself from other, organization-centric methods, value-network analysis focuses on “attempts to determine the value generating interactions between people in a network” (ibid: 64). This includes both tangible value (the direct contracted or mandated value of the assigned tasks) and intangible value (the value generated from the interaction of players within the network, but not necessarily the formal outputs of the company or

organization). Examples of intangible value include deepening business relationships or increased efficiency.

Venzia et al. note that any “one size fits all” method of mobile working leads to inefficiency and employee dissatisfaction (ibid). Many companies started with the assumption that their mobile employees were constantly traveling and needed technology to accommodate that reality; however, Venzia’s study found that most mobile workers saw themselves as more productive working from home, and that these home offices closely resembled traditional office workspaces. At the same time, a significant number of workers expressed a strong desire for a physical, collaborative workspace at their office headquarters. The study dismissed many misconceptions about mobile teleworkers. While the assumption was that the average mobile user was young and female, the research indicated that 65 percent were male and over the age of 40. The technology needs of the mobile worker were found to vary according to their role, but all the mobile workers required a laptop, cell phone, and method of interpersonal communication (ibid). While the research did not directly address the needs of the disability community, there seems no reason why people with disabilities could not take on the corporate roles that authors found were most common among participants in mobile working—consultants, problem solvers, and managerial or leadership roles (ibid)—provided appropriate assistive technology was in place to allow this kind of remote collaboration.

Questions remain about how suitable teleworking and other forms of mobile collaboration are to different organizations. A fit-viability study of firms to discover the effectiveness of mobile technology in the workplace recommended caution before an organization introduced such a change. The study found that the vast majority of businesses studied had high fit, where fit is the extent to which the new network applications are consistent with the core structure, value, and culture of an organization. However, the study found low viability for the introduction of mobile technology, where viability measures the extent to which the infrastructure of an organization is ready for the technological change (Liang et al., 2007: 1159).

Collaboration-Centric Analysis

Because technology makes collaboration more easily accessible does not necessarily translate into improved communications. Kakihara and Sorensen examine how the increased accessibility and flexibility provided by mobile platforms aid or disrupt a person's ability to complete "fluid mobile work" (Kakihara et al., 2002). Asynchronous communications allow the recipient of a message to delay replying, at the expense of the sender. This leads to contrasting "interactive" and "interpassive" communications, with interactive implying communication and collaboration between two or more people around a shared object, while interpassive indicates a situation in which an individual is passive in interactions with others. In other words, the nature of the communication may affect the efficiency of the collaboration.

Collaboration may become an end in itself. In the current business and technological environment, it is virtually impossible to avoid being part of a team, especially since the geographic barriers that often prevented collaboration have been overcome by technological advance (Beurer-Zuelig and Meckel, 2008; Belov et al., 2005). In their empirical study of wireless communications among employees from 16 German companies, Beurer-Zullig and Mechel found that the workers who were most open to the introduction of mobile technology perceive themselves as more productive than their less technologically inclined counterparts (op. cit.).

Mazmanian et al. discuss how the advent of wireless email devices (WEDs) affect social, spatial, and temporal interactions by professionals and their organizations, and professionals and their spouses. Preliminary results indicate that WEDs have changed workplace interaction by making professionals constantly available, regardless of time or location. While the study also suggested that WEDs allow for monitoring as well as being monitored, there is an increased expectation of responsiveness by all parties involved, regardless of gender, hierarchy, or family life (Mazmanian et al., 2005). The preeminence of work was also identified by Beurer-Zuellig and Mickel (2008), who found that the use of mobile email positively affected mobile business because of "extended reachability and timely provision of information."

Ultimately, the success or failure that many aspects of mobile platforms will have with regard to their ability to accommodate people with disabilities in an employment setting or in endeavors to find work hinges on their ability to accommodate a person's specific needs.

Wireless Communication Platforms and People with Disabilities

The phrase mobile accessibility is often used not in the context of disability, but of making the Web as accessible on mobile platforms as on desktop platforms. But interestingly, users of mobile devices and people with disabilities experience similar barriers when interacting with Web content. For example, mobile phone users and people with mobility or dexterity disabilities can have a hard time if a Web site's navigation requires the use of a mouse (Web Accessibility Initiative). The Web Content Accessibility Guidelines (WCAG), a guide for making Web sites accessible to people with disabilities, has a number of overlaps with the Mobile Web Best Practices (MWBP), a guide for making Web sites usable from a mobile device. For instance, the MWBP best practice "Label all form controls appropriately and explicitly associate labels with form controls" corresponds with the WCAG technique of "Using label elements to associate text labels with form controls" (Web Accessibility Initiative). Following both sets of guidelines makes Web content more accessible for a wider variety of people on a wider range of devices.

Wireless Internet access is of course a critical component of mobile platforms. The FCC's National Broadband Plan includes several accessibility initiatives for people with disabilities. In a statement regarding these initiatives, CTIA President Steve Largent claimed that "mobile Internet to the person significantly improves the quality of life for individuals with disabilities through new opportunities in employment, education, health care, and public safety. CTIA and our member companies agree with the FCC that all Americans should have equal access to wireless communications.... As wireless carriers compete with each other on service plans and mobile devices for individuals with disabilities, they are providing this community with innovative offerings—such as built-in accessibility features, compatibility with Assistive Technology ('AT') or

downloadable applications to replace expensive, immobile assistive communication devices at significantly lower prices. Most importantly, due to the wireless industry's commitment to key accessibility issues, a recent survey showed that the barriers for people with disabilities to adopt wireless have been lowered, and their satisfaction with wireless services and products increase" (Largent, 2010).

Technology

Over the past few years, smart phones "have opened up a new world of communication and convenience to consumers with disabilities worldwide" (Axistive, 2007). The rise of mobile telephony has opened new opportunities for seniors with different levels of physical restrictions due to aging. Mobile technology allows not only ubiquitous communications, but also anytime access to some services vital for seniors' security and autonomy (Abascal and Civit, 2001). A system called MUSEpad could be used to help people with disabilities in informal learning environments such as museums (Waite et al., 2005). Voice activation on mobile devices is an option for people with low vision or dexterity (Bennett, 2010).

Electronic schedulers and personal digital assistants can be helpful for people with intellectual or information-processing disabilities like dyslexia, who have difficulty with reading, writing, short-term memory, or time management. Mobile note-taking, reminders, and spellchecking features are particularly useful to these individuals (Bennett, 2010).

A prototype interface system for a mobile phone and accompanying speech-generating device enable users who cannot speak to independently initiate, answer, conduct, and terminate voice calls, as well as send text messages. Trials show that the system gives users a sense of independence, safety, and security, and also contributed to improving their communication skills, leading to the self-confidence to engage in conversation and social activities (Nguyen et al., 2008).

T-mobile's Sidekick has traditionally been adopted by the deaf for its text-friendly keyboard, email accessibility, and text-only plan options, which allow deaf users to

communicate more readily with those around them. When T-mobile had a system outage disconnecting deaf users from their communication lifeline, the deaf community's outcry indicated the extent to which the device had become an important part of their everyday lives (Fried, 2009). Lately, T-mobile's deaf user base is migrating to more advanced smart phones, such as Blackberry and iPhone, to make use of their increasingly advanced capabilities (Fried, 2009).

Mobility, Telework, and People with Disabilities

In the contemporary business environment it is virtually impossible to avoid being part of a team, especially since geographic barriers that once prevented collaboration have been overcome by technological advance (Beurer-Zuelig and Meckel, 2008). The absence of borders of these collaborations necessitates asynchronous communication to compensate for differences in culture and time between collaborators. Therefore, it stands to reason that this expectation of dispersed and asynchronous communication will make it easier to accommodate those people who have a limited ability to move around. An advantage of modern synchronous communication is that mobile collaborative systems allow "improvised synchronous intellectual teamwork among geographically diverse participants" on mobile computing devices (Belov et al., 2005).

Much of the literature on mobile platforms has focused on the concepts related to telework: hot desking, the dispersed workforce, and mobile workers. Hot desking is the strategy of abandoning fixed desks and providing laptops, cell phones, and Internet connections so employees can work where they choose (Brown and Duguid, 2000). A dispersed workforce involves the collaboration of geographically decentralized people on a common project or job, and may provide employment opportunities for previously unreachable populations including people with disabilities for whom finding transportation to an office is an often insurmountable obstacle (Paradise, 2008). A mobile worker is "an employee who has choices concerning how, when and why they work" (Venizia et al., 2008).

A noted problem with telework is "a misunderstanding of office work, which is too easily painted as information handling....The idea of managers working remotely with

information inevitably ignores the much more difficult, intangible, but inevitably face-to-face side of management, the management not of things or of information, but of people” (Brown and Duguid, 2000). Further, “the facts of office life reveal a combination of technological frailty and social resourcefulness. Infoenthusiasts, however, tend to think of these the other way around, missing the role of the social fabric and assuming that individuals in isolation can do it all” (ibid). A “one size fits all” method of mobile working can lead to inefficiency and employee dissatisfaction in the workplace (Venzia et al., 2008). Concerns emerge regarding increased marginalization and stigmatization that may occur due to the lack of direct interaction with managers, or discrimination that may occur among these workers, particularly with regard to promotions (Baker and Fairchild, 2005).

Other studies paint a favorable picture of telework, claiming that teleworkers often perform more and better work, meet deadlines better, and are better able to juggle multiple priorities and deadlines than their counterparts working in the office (Stanley and Messinger, 2007). A study of the relationship between telework and social participation concluded that teleworking could be considered as a community-friendly form of work (Kamerade and Burchell, 2003). The National Telecommuting Institute believes that over the next two years it will be able to double the number of people with disabilities it places in in-home jobs (from 400 to 800 annually), and that broadband will be key to its success (Lyle, 2010). “Overall, telecommuting is an increasingly useful and requested way to work. Not only does it help employers and employees in general, but it is likely the workforce will include more people with disabilities if telework reaches the mainstream” (Stanley and Messinger, 2007: 3).

3.2.2. Vector 2: Social Networking

3.2.2.1. V2: Business Background

Social networking is defined as Web-based services where individuals construct a public or semipublic profile within a bounded system; articulate a list of other users with whom they share a connection; and view and traverse their list of connections and

those made by others within the system (Ellison et al., 2007). FireFly, Friendster, and Orkut were precursors to today's major social-network sites such as Facebook and LinkedIn. Social-networking sites are gaining a major share of the Web's content, communications, and commerce (Rayport, 2010). Social networks can be described as platforms that encourage the discovery of relationships between individuals, links that emerge through family, friends, school, work, location, hobbies, interests and much more. Creating a profile on a social-networking site adds the individual to an increasingly global social-networking map.

Before 1997, dating Web sites were the only sites to allow users to construct a public profile within a bounded system. These sites allowed users to search other user profiles to find potential romantic interests. Little security or privacy was afforded to early users, and no traverse connections were possible. Classmates.com allowed users to connect with high-school or college classmates. Users could search for other users with similar backgrounds, and were given contact information with which they could connect with former classmates. Once found, any communication was made through email, telephone, or postal mail. Again, security and privacy prevented widespread early adoption.

In 1997, SixDegrees.com merged aspects of dating sites and Classmates.com, allowing users to create profiles, search for users, find friends of friends (traverse connections), and connect by sending messages on the Web site, becoming the first site to meet the three characteristics of a social-networking site as described by Ellison. Users were able to search profiles of previously connected contacts, allowing for a more viral and widespread network. This marked the beginning of the social-networking phenomenon. By 2000, low revenues pushed SixDegrees.com out of business. Many users complained about the lack of other users on the network, as well as the site's limited functionality—once a connection was made, most people did not know what else to do (Ellison, 2007).

Other social-networking sites were established in the late 1990's, focused mostly on special topics or minority populations, as were blogs that offered features similar to

social-networking sites, such as Xanga (1998) and LiveJournal (1999). AsianAvenue, BlackPlanet, and Migente were all targeted to minority populations within regional boundaries (connecting people of Asian descent in New York, for example). Ryze (2001), LinkedIn (2003), and XING (2003) were established specifically for the development of business networks (Ellison, 2007). Habbo (2000), Skyrock (2002), and Friendster (2002) served as forerunners to MySpace and Facebook, currently the two most popular and financially successful social-networking services, begun in 2003 and 2004, respectively.

Now, with hundreds of millions of users worldwide, social-networking sites enable users to connect or reconnect to other individuals at speed and with ease. This network facilitation is responsible for hundreds of thousands of new connections each year—for friendship, romance, and professional relationships. Online social networking sites support the maintenance of existing social ties and the formation of new connections (Ellison et al., 2007). The most common uses and gratifications in Facebook, for instance, include social connection, shared identities, content, social investigation, social-network surfing, and status updating (Joinson, 2008). A study of college students demonstrates a robust connection between Facebook use and indicators of social capital (Ellison, op. cit.).

Several explanations are offered for the popularity of social-networking sites to maintain existing social ties in the United States. First, by the end of the last century, the increasing tendency for families to move for job-related reasons was a cause of social-capital deterioration (Putnam, 2000). Second, students often move a greater distance to attend college, and again upon graduating from college become geographically separated from established social networks. Social-networking sites help with the maintenance of contacts (Ellison et al., 2007).

Within the business and workplace domain, several corporate services like Ryze, Visible Path, and openBC are gaining traction, but the clear leader is LinkedIn (Salz, 2006). This platform currently has over 55 million members in over 200 countries with executives from all Fortune 500 companies as members with profiles (LinkedIn). As

social-networking sites become a major mechanism for matching potential employees with potential employers, access to such sites, and to the right connections within them, will be important for finding work.

Social-Networking Sites and People with Disabilities

By lowering barriers to interaction and encouraging more self-disclosure, online-network tools may be particularly useful for individuals who otherwise have difficulties forming and maintaining both strong and weak ties (Ellison et al., 2007). As discussed earlier, this can be the case for people with disabilities (Potts, 2005; Schur et al., 2005; Atkins and Guisti, 2003; Leitman et al., 1994).

Within Facebook, disability-related groups are easily found, including the Coalition of Texans with Disabilities, Disability Rights Education and Defense Fund, Disability Policy Consortium, Campaign for Disability Employment, Deaf Equal Access Foundation (DEAF), and the Arc of the United States. It is common for users to post questions, advice, and words of encouragement related to topics such as parenting, education, work, relationships, and health. People with disabilities report problems with self-esteem and fear as barriers to workplace accessibility (Yeager et al., 2006), and many of the communications on these groups address these issues positively. The groups generally promote solidarity, shared identity, activism, and pride, and thus have a positive effect on social and cultural accessibility. There is also a large awareness component to the groups. Group members post and discuss relevant news items, events, policies, and opportunities. For example, the DEAF group page has a posting about the chance to win a free Amplified Telephone, and the Job Accommodation Network page (a service of the Office of Disability Employment Policy of the U.S. Department of Labor) posts legislative updates and resources to help workers with disabilities understand their rights.

Along with well-known broad-based social and professional networking sites, there are niche social-networking sites relevant to people with disabilities. For instance, Blueverse (www.blueredefined.org) is a community committed to creating social and creative opportunities for people who have disabilities, hospitalized, or in an assisted-living environment. The site includes BlueVerse.net, a social-networking site aimed at

developing an online community specifically for the people with disabilities and their friends, and facilitating the donation of devices and video games that can be used for physical therapy, encourage physical and social activity, and inject relief and entertainment into an environment that is otherwise extraordinarily challenging.

The Current Social-Networking Industry

Today social-networking sites are the fourth most visited sites on the Web, trailing only search sites, general-interest portals and communities, and software manufacturers. It is estimated that more than 66 percent of worldwide Internet users belong to a social-networking site (Nielsen, 2009). More noteworthy, though, is the growth in the time spent on these sites. In 2010, nine out of every 10 Internet users visited a social-networking site each month. Social-networking sites accounted for 12 percent of all time spent online in 2010, with the average Internet user spending more than 4.5 hours on these sites each month. Globally, social networking accounts for 15.6 percent of online time among those ages 15 and older (comScore, 2011).

3.2.2.2. V2: Business and Social Trends

The Idea of the Collaborative Community

Following the Industrial Revolution, some social analysts were concerned that urbanization and bureaucratization would lead to a mass society typified by segmented, impersonal relations, and that individualism would take the place of community ties and sociability. The argument about a mass society was challenged by ethnographers and survey analysts, who documented the persistence of supportive community relations. Since the 1970s, with the additional tool of social-network analysis, community theorists have suggested a new community model, called the collaborative community.

Corporations, computers, and communities are characterized by networks, and these networks are inherently social (Wellman, 2001). Adler and Heckscher (2006) apply community theory to the corporate world. They suggest that the collaborative corporate community, based on social networks, can replace hierarchies and markets as a way of organizing work. Technologies are emerging that both respond to and enhance the

adoption of the collaborative-community model, casting an interesting light both on social networks and on the potential for job opportunities.

Networks and Work

Social networks pervade the world of business and work. For example, networks are key to understanding commerce, as they characterize trade relations, consumer–producer interactions, the labor market, and both inter- and intra-corporation structures. Networks may function as a deterrent to economic opportunism, as a purveyor of commercial and labor opportunities, and as a viable alternative to hierarchical bureaucratic structure in corporations (Rauch, 2001).

Networks also play a “characteristics knowledge” role—that is, networks transmit information about current opportunities for profitable interactions by enabling agents’ characteristics to be matched to opportunities. Networks provide a matching and referral service that has been studied in international trade.

Network inclusion or exclusion may largely govern resource distribution, a point directly relevant to the situation of people with disabilities who may feel or create a sense of exclusion from social networks.

The role of networks in matching characteristics with opportunities is important not only in trade but also in the labor market, where social networks mediate employment opportunities and match employer needs with employee characteristics. Empirical studies reveal that typically around 50 percent of individuals obtain or hear about jobs through friends and family (Corcoran et al., 1980; Holzer, 1988; Montgomery, 1991; Addison and Portugal, 2002).

Such methods have the advantage that they are relatively less costly and may provide more reliable information about jobs compared to other methods. Networks of personal contacts mediate employment opportunities, which flow through word-of-mouth and, in many cases, constitute a valid alternative source of employment information to more formal methods (Patacchini and Zenou, 2008).

Calvó-Armengol and Jackson (2004) model the role of networks in employment status, and show that in the long run, any interconnected workers' employment status is positively correlated: employed workers tend to be connected to employed workers. If a set of people is employed, other people in their network are more likely to hear about and obtain employment opportunities. Network density, structure, symmetries, and path lengths between people are all relevant to employment status. It is in the interest of employment-seekers to position themselves strategically in social and professional networks.

The interest in networks as purveyors of opportunities comes from the employer side as well. Recruiters at Microsoft and Starbucks, for instance, troll online networks such as LinkedIn for potential job candidates. Goldman Sachs and Deloitte run their own online alumni networks for hiring back former workers and strengthening bonds with alumni-cum-possible clients. Boston Consulting Group and law firm Duane Morris deploy enterprise software that tracks employee communications to uncover useful connections in other companies (King, 2006).

Corporations as Collaborative Communities

Corporations are not only a component of external trade and employment networks; they are themselves becoming networks. Although social networks have always pervaded organizations, it is only recently that some analysts have proclaimed the proliferation of organizations structured around such networks (Quan-Haase and Wellman, 2005). By the 1990s, technologists, economists, and corporate strategists foresaw a changing environment for value creation. The term "organizational learning," first coined in Senge's *The Fifth Discipline* in 1990, refers to knowledge acquisition, information distribution, information interpretation, and organizational memory (Huber, 1991). By the start of the 21st century, 80 percent of a company's market value was determined not by cash, buildings, or equipment, but by intangible factors such as intellectual and human capital (Weatherly, 2003). This new business environment was accompanied by a shift in the structure of work relations.

Throughout human history, people have cooperated as members of shared long-term communities where personal reputations were well known. The most effective

organizations in previous decades fostered this type of community, using loyalty as the base for both bureaucratic structure and market relations with key suppliers and customers. Now these arrangements are seriously compromised. Within organizations, people are asked constantly to cross boundaries—to work with people “outside the community” and who are different from themselves. Increasingly, work requires flexible cooperation across functions, divisions, and levels within organizations, leading to the development of “norms and processes for a goal-oriented type of cooperation which we call a collaborative community” (Heckscher and Alder, 2006).

Studies show that one of the most effective channels for disseminating institutional knowledge and expertise within an organization is informal networks of colleagues and friends (Kraut et al., 1990; Wasserman and Galaskiewicz, 1994). Social capital (“know-who”) may be a more significant organizational aspect than human capital (“know-how”) (Downes, 2004). Heckscher and Alder (2006) point to IBM as a prime example of a corporation that has internalized this, adopting the structure, values, and character of a collaborative community. While a traditional bureaucratic structure seeks to create clarity by ensuring that each person has a defined role that matches accountability, the new IBM breaks this traditional rule: people are expected to take responsibility for things they cannot fully control and that they will move outside the zone of their formal accountability. While in a traditional bureaucracy, power and influence flow downward, the collaborative approach includes high levels of participation, as processes are defined and refined over time by input from all levels. In terms of its value system, IBM has shifted toward a focus on contribution to collective company goals. Variable pay is now based largely on assessments of the individual’s contribution to IBM.

Latent Social Networks

Computer-mediated communication (CMC) facilitates the interdependent process management that characterizes the structure of collaborative communities. CMC makes communications fast, accessible, cheap, and convenient, and allows for leaping over workgroup and organizational boundaries, regardless of distance or the number involved (Quan-Haase and Wellman, 2005).

CMC may enable or enhance the structure of collaborative communities, but it is the values and character of a collaborative community that motivates interactions and activates a network. For instance, the uses and gratifications in Facebook that make it an active network include social connection, shared identities, content, social investigation, social network surfing, and status updating (Joinson, 2008). In other words, the technical infrastructure for connectivity—the Internet, intranets, wireless connectivity, grid computing, telephone lines, cellular service, community networking initiatives, or neighborhood networks, and the devices that access them (phones, cell phones, computers, gaming consoles)—is essentially latent, and is activated only by some sort of social interaction, a phone call, an email message, a visit to a Web site, and so on (Haythornthwaite, 2005).

The motivations for the activation of latent networks are not necessarily social. Research on the use of social software in corporate environments (Jackson et al., 2007; Hasan and Pfaff, 2006) indicates that users focus on providing and gathering information, not socializing (Dimicco et al., 2008). In relation to the workplace and employment, there are several key areas of debate, including the strengthening of communities of interest, the ability to increase institutional knowledge, privacy concerns, and questions of how an entity is represented or the “brand” managed.

People with Disabilities and the Collaborative Community

People with disabilities report problems of self-esteem and social fears as barriers to workplace accessibility and accomplishment (Yeager et al., 2006). Internet-supported social networks may provide social support, companionship, a sense of belonging, emotional aid, and all kinds of information without requiring major investments of time, money, or energy (Wellman et al., 1996). By lowering the cost of information, the Internet can enhance the ability of low-income people to gain human capital and find and compete for good jobs (Anderson et al., 1995). DiMaggio (2001) mentions “much anecdotal evidence” that the Internet provides significant benefits to people with unusual identities or concerns, such as rare medical conditions.

The emergence of specialized social-networking sites, focused on specific niche groups like professionals with disabilities, demonstrates the flexibility and adaptability of these platforms (Vascellaro, 2007; Haynie, 2007). CMC has already become a major component of various activism movements (Haythornthwaite, 2005), and could play a particularly important role in disabilities activism.

The kind of support potentially available is indicated by the array of disability-related groups on Facebook, including Coalition of Texans with Disabilities, Where Do People with Disabilities Fit into God's Kingdom?, YAI/National Institute for People with Disabilities Network, DEAF, and the Arc of the United States. Users commonly post questions, advice, and words of encouragement related to topics such as parenting, education, work, relationships, and health, and the communications on these groups tend to positively address these issues. The groups promote solidarity, shared identity, activism, and pride, and thus have a positive effect on social and cultural accessibility. There is also a large awareness component to the groups. Group members post and discuss relevant news items, events, policies, and opportunities. For example, at the time of carrying out this research, the DEAF group page had a posting about the chance to win a free Amplified Telephone, while the Facebook page of the Job Accommodation Network, a service of the Office of Disability Employment Policy of the U.S. Department of Labor, posted legislative updates and resources to help workers with disabilities understand their rights.

3.2.3. Vectors 3 and 4: Immersive Digital Environments

3.2.3.1. V 3 & 4: Business Background

Social factors, including participation, communication, and interaction, are at the heart of immersive digital environments (IDEs) (Garber, 2004). IDEs usually require users to adopt persona or create 3-D representations, or avatars, through which they interact with a simulated environment (Taylor, 2002; Jones, 2006). The three categories of IDEs under review are virtual worlds, serious games, and casual gaming. As the market data for serious games, virtual worlds, and video games are, for the most part, collected together, it proved necessary to look at these two vectors as one group.

Virtual worlds are computer-simulated 3-D environments or realities where users create content and interact with one another (Steuer, 1992; Biocca and Levy, 1995). Examples include Second Life, OLIVE, Active Worlds, and Club Penguin. Serious games are mental contests, played with a computer or other people, with specific rules, that use entertainment mediums as the main platform (Zyda, 2005). America's Army is one example. Entertainment and casual gaming consists of traditional video games that can connect to others via the Internet connection, the XBox 360, the Play Station 3, or the Wii (Messinger et al., 2008). A well-known example is World of Warcraft, the massively multiplayer online role-playing game (MMORPG) that claims to have the most subscribers worldwide (11.5 million in 2009).

Serious games are widely accepted as practical teaching and training tools in many professions, including the medical field (Rosser et al., 2007), government, education, and public policy (Cone et al., 2007; Zyda, 2005). Serious games allow learners to experience situations that are impossible in the real world for reasons of safety, cost, time, etc., and are also claimed to have positive effects on the players' development of different skills (Susi et al., 2007), including collaborative practices, technical proficiency, and strategic processes (Brozik and Zapalska, 2002). IBM, for instance, has documented its use of gaming-enhanced team building, mentoring, knowledge exchange, and multipurpose global events with complex social interactions (Cherbakov et al., 2009). Other companies using digital game-based learning include IBM, Ameritrade, GE, Nortel, SAS, and think3, which use games to teach options trading, customer service, CAD software, and engineering concepts (Dziorny, 2005).

Studies of casual or entertainment gaming are challenging the "axiomatic assumption that games are by definition 'unproductive'" (Pearce, 2006: 18). Many employers find the skills acquired through "accidental learning" even in casual games—the "learning to be" that is a natural byproduct of adjusting to new cultures inside the game—as advantageous as traditionally acquired skills. This process is described as bringing about a profound shift in perceptions and reactions to the "real" world, with users becoming "more flexible in their thinking and more sensitive to social cues" (Brown and

Thomas, 2006: 1). Leadership and business-oriented skills can be developed through collaborative casual gaming, which prepares people for “computer supported collaborative work” (Nardi and Harris, 2006: 149).

Others assert that the effect of casual gaming is deeper, that “the boundaries between play and production, between work and leisure, and between media consumption and media production are increasingly blurring” (Pearce, 2006: 18). In productive play, “creative production for its own sake (as opposed to production for hire) is an active and integral part of play activities, particularly those enabled by networks” (ibid: 17).

The IDE industry already offers a good living for writers, designers, programmers, and producers in work “involving the most positive possibilities of ‘immaterial labour’ scientific know-how, hi-tech proficiency, cultural creativity, and workplace cooperation” (Dyer-Witthford and Peuter, 2009).

Business Environment

The market data for serious games, virtual worlds, and video games are, for the most part, collected together. In this broader “game” industry, NPD Consulting (NPD) is the most trusted and widely cited source of market data. Note, however, the NPD numbers do not fully represent this vector.

One reason for the lack of accurate representation is the secretive nature of a large portion of the client base of serious games and virtual worlds—namely, those clients who work in sensitive areas of the government. As these two sectors—especially virtual worlds—do a great deal of work for the government, health care, and the Department of Defense (DOD), it is uncertain how much of the industry revenue is recorded and analyzed by traditional market analysts. There is likely to be a great deal of overlap, and yet a great deal of unrecorded revenue.

If, for example, the DOD were to contract with Blizzard Entertainment to create an urban-warfare simulation to train soldiers pre-combat, Blizzard would be forced to sign a nondisclosure agreement (NDA), keeping all activities and resulting revenues secretive.

The associated revenues will likely appear on Blizzard's annual income statement but will not be itemized and traced to the government. These revenues, therefore, will be included in NPD's report on video-game revenue, even though the nature of the revenue was not generated by entertainment games.

An example of the unrecorded revenue can be seen in the case of a private company that works solely for the DOD. This company does not make commercial video games, and therefore its sales are not recognized by NPD as game sales. The revenues are instead factored into the broader DOD-related expenses. With the necessary secrecy of DOD actions, these revenues are not possible to "strip out" of the overall DOD expenditures. Therefore, they will not be included in any market report accessed for this report.

Virtual Economies

However, the size of the market is remarkable. According to NPD, more than 60 percent of the U.S. population plays video games (NPD Group, 2007). The financial statistics that are available indicate there is a huge untapped potential within the economies of the virtual-world platforms, made all the more striking by the apparent ease that the leading platform, Second Life, has weathered the recent recession. According to Linden Labs, the developers of Second Life, user-to-user transactions in 2009 totaled \$567 million in 2009, representing growth of 65 percent over 2008.

Contrary to the image in the popular imagination of the typical player being an antisocial teenage boy, a long-running survey of MMORPG players indicates that half of them work full-time, 36 percent are married, and 22 percent have children. Players spend on average 22 hours a week inside environments, and there is no correlation between time spent "immersed" and age—older players are spending just as much time as younger players. One finding is directly relevant to the theme of this research: 80 percent of players play with someone they know in real life, highlighting a highly social environment "where new relationships are forged and existing relationships are reinforced" (Daedalus Project, 2009).

3.2.3.2. V 3 & 4: Business and Social Trends

Introduction

The last decade has seen a rapid rise in the popularity of immersive digital environments (IDEs). IDEs usually require users to create 3-D representations, or avatars, through which they interact with the simulated environment (Taylor, T. L., 2002; Jones, 2006). While IDEs may vary greatly in application and in motivation, there are several common characteristics of these platforms that include having a shared space, a specific graphical user interface, interactivity, immediacy, persistence, and socialization or community building (virtual worlds review). For the purposes of this study, the categories of IDEs that we investigate are virtual worlds, serious games, and casual gaming: *Virtual worlds* are computer-simulated 3-D environments or realities where users create content and interact with one another (Steuer, 1995). These environments can also be called synthetic worlds (Castronova, 2002). Examples of this classification are Second Life, OLIVE, Active Worlds, and Club Penguin. One major point of clarification is that virtual worlds, in this context, do not have specific rules or a set purpose within the environment—this is something that is organically developed by the individual avatar.

Serious games are mental contests, played with a computer or other individuals, with specific rules, which use entertainment mediums as the main platform (Zyda, 2005). Serious games are used for training, learning, and business activities within the domains of government, education, health, public policy, and strategic communication objectives (Cone et al., 2007; Zyda, 2005). An exemplar of a serious game is America's Army. Most of the functionalities associated with serious games are similar to those of virtual worlds, yet the main difference is the issue of rules and set objectives within the platform. Serious games are widely accepted as practical and teaching tools in many professions, including the medical field (Rosser et al., 2007). One of the most compelling components of using gaming for training is the ability for participants to be deeply engaged (Ben-Zvi and Carton, 2007). Serious games allow learners to experience situations that are impossible in the real world for reasons of safety, cost, time, etc., but they are also claimed to have positive effects on the players' development

of different skills (Susi et al., 2007). In addition to engagement leading to greater learning, collaborative practices, and technical refinement and proficiency, it is highly effective in exercising and cultivating strategic processes (Brozik and Zapalska, 2002).

Entertainment and casual gaming are traditional video games that have the ability to connect to others via the Internet, for example, Xbox 360, Play Station 3, and the Wii. To complicate matters, a number of virtual worlds fall into this category. These virtual worlds are represented by massively multiplayer online role-playing games (MMORPGs) like World of Warcraft (Messinger et al., 2008). A common characteristic of these games is they are typically fantasy focused. The games might not seem to have implications within the business and corporate world, but research is showing that many leadership and business skills can be developed and nurtured through this kind of collaborative game play (Nardi and Harris, 2006; Brown and Bell, 2004).

In reference to the workplace and business sectors, several issues cut across all three of these sub categories: market opportunities and viability of in-world or inter-platform interactions, the benefits of 3-D experiences, and greater immersion or the context of computer-mediated communication and exchanges. The current literature on immersive digital environments fits within the broad framework provided by Media Richness Theory and Social Presence Theory, explained briefly below, and providing the context for a three-pronged model of human exchange focusing on material, social, and cultural capital.

Media-Richness Theory

More than two decades after its initial development, Media Richness Theory (MRT) still proves useful to media researchers, particularly in the study of immersive digital environments (IDEs). MRT grew out of managerial research in information systems. The richness of communication media is based on the ability of a medium to carry information (Trevino et al., 1987). A medium's ability to carry information has two major components. First, data-carrying capacity refers to the medium's ability to transmit information. Second, symbol-carrying capacity refers to the medium's ability to carry information about the information, or about the individuals who are communicating

(Sitkin et al., 1992). Media richness may be ranked based on ability to relay immediate feedback, provide feedback cues such as body language, allow the message to be created or altered specifically for an intended recipient, and transmit the feelings or emotions of the communicators (Daft and Lengel, 1984).

Social-Presence Theory

More recently, a social-presence component has been added to the analysis of media richness, referring to the degree to which a person is perceived as real in a mediated environment (Russo, 2000). The degree of social presence in a communications activity affects the participant's perception, appreciation, participation, and level of satisfaction. "Environments where participants do not feel they are recognized as individuals, or in which their input does not seem to be valued may result in a reduced motivation to participate. Because of this it is important to use richer communications media in situations where it is desirable to have the participants more strongly identify with each other" (Newberry, 2001).

Human-Exchange Model

A three-pronged model of human exchange as market, social, and cultural capital lends an organizational framework to the analysis of immersive digital environments. "Market capital includes *commodities* and *currency*, social capital includes *connections*, and cultural capital includes *competencies*, *credentials*, and *artifacts*" (Malaby, 2006: 148).

1) Market Capital

Malaby notes that "synthetic worlds have surprised many with the degree to which they generate tradable goods that can now be found easily through online markets" (Malaby, 2006: 149). Virtual property is persistent, prone to rivalry, and has interconnectivity, opening up a plethora of ownership-rights issues (Fairfield, 2005). And because digital goods can be created and destroyed without cost, traditional economic models of supply and demand and price controls may need to be reconsidered (Castronova, 2002). Virtual markets also include services, such as notary, design, and writing (Malaby, op. cit). Castronova finds evidence of "real economic activity, both within online virtual worlds, and between virtual worlds and earth" that includes a liquid-currency market. As current national income and product accounts do not place value

on online assets, the growing effects of virtual-currency markets will raise interesting questions for economic analysis and accounting (Castronova, 2002), as well as for tax policy (Barfield, 2009).

2) Social Capital

Just as many forms of communication go beyond information exchange, human exchange exceeds material transactions. Social capital is distinguished from material capital in that time is not delimited. Any exchange continues a relationship into the future and leaves open the possibility of the next transaction. Social capital is based upon connections and reciprocity, and involves, but is not limited to, the networks and social groups within and between virtual worlds (Malaby, 2006).

IDEs have also garnered interest for their marketing potential, “because of their ability to generate sustained consumer engagement with a brand” (Hemp, 2006: 51). In the context of MRT, virtual branded events and other immersive business applications have high potential for media richness because they can relay immediate feedback, provide feedback cues, allow messages to be created or altered specifically for an intended recipient, and transmit the feelings or emotions of the communicators.

3) Cultural Capital

Typical demands of the new networked economy include personalized training schemes, flexible access to lifelong learning, just-in-time training delivery, and cost-effective means for meeting training needs of a globally distributed workforce (Sampson et al., 2002). Cultural capital refers to the competencies and credentials that IDE users may acquire. Competencies may include language, etiquette, criticism, and many other culturally specific skills.

Malaby argues that human-capital competencies for real-world users cannot be distinguished from avatar competencies, as all competencies are “inescapably embodied” (Malaby, 2006: 156). Many employers find the skills acquired through accidental learning in IDEs—the “learning to be” that is a natural byproduct of adjusting to new cultures inside a game—as advantageous as traditionally acquired skills (Brown and Thomas, 2006).

Serious-game development could potentially eclipse the entertainment game world in size. Serious games are used for training, learning, and business activities within government, education, health, public policy, and strategic communication objectives (Cone et al., 2007; Zyda, 2005). Serious games use entertainment principles, creativity, and technology to build games that carry out government or corporate objectives.

IDEs and People with Disabilities

Virtual reality reflects internal, rather than external, environments and replaces the sensory inputs and outputs of the material world with those of the computer (Jones, 2006). Avatars allow people to take on an alternative appearance and persona, so that a muscular, spiky-haired Second Life avatar named Wilde Cunningham represents a group of people who have severe physical disabilities in real life (Hemp, 2006).

IDEs can be attractive to people with disabilities: a survey conducted by the Information Solutions Group found that 20.5 percent of players of casual video games have a physical, mental, or developmental disability. The same survey found that people with disabilities play more frequently, for more hours per week, and for longer periods of time per gaming session, when compared to the casual gamer population as a whole (which rough industry estimates put at 300 million to 400 million players worldwide). People with disabilities also report that they experience more significant benefits from playing and view their game-playing activity as more important in their lives than do consumers without disabilities (Information Solutions Group, 2008).

Working within virtual spaces may also provide people with disabilities with employment opportunities otherwise unavailable or inaccessible to them (Baker et al., 2006). With IDEs, “an interaction can be reasonably rich without requiring common physical presence” (Lyons, 2008), offering potential for a more functionally accessible work environment for people with physical, sensory, or mobility disabilities. Virtual worlds also mitigate cost and location barriers by offering a relatively inexpensive form of business communications (Cherbakov et al., 2009). Media experiences that are interactive and take place in a commons are more flexible, personally satisfying, and culturally

authentic than traditional media and imply more open, accountable relationships (Bollier, 2006).

IDEs designed to support an open range of flexible, playful, unspecified activities can be a mechanism for developing new values and goals, learning new things, and achieving new understandings (Brown and Bell, 2004). By overcoming geographic barriers that once prevented collaboration (Beurer-Zuelig and Meckel, 2008), IDEs afford the possibility of “improvised synchronous intellectual teamwork among geographically diverse participants” (Belov et al., 2005). Virtual reality “blurs and fragments boundaries and senses of self and place and functions as a virtual microcosm for cultural, economic and identity recombination” (Jones, 2006: 4). Virtual worlds offer possibilities for experiential learning, in which students are engaged in problem-solving activities within a flexible environment that facilitates collaborative learning (Cremorne, 2009).

Lack of education was cited as a perceived barrier to achieving full employment potential by 20.3 percent of people with disabilities (Yeager et al., 2006). Serious games may make education and training more appealing to those who consider traditional classroom training beyond endurance or otherwise unmanageable (Horton, 2003), which could be helpful for people with intellectual or learning disabilities. However, such systems often create challenges for people who are blind or have low vision who may want to use them.

3.2.4. Vector 5: Open/Peer Publishing

3.2.4.1. V 5: Business Background

The history of the media reveals that periods of radical innovation have caused major shifts not only in the methods, but also in the business of collecting, producing, and distributing information: we are living through such a period now.

Historically the publishing and news industries have been highly professional, centralized businesses responsible for controlling what gets published or distributed to the public. The Internet and digital technologies are changing this. Researchers at the

Center for Public Media describe the emergence of “people-centric public media,” a shift from the traditional top-down method of journalistic reporting to one that is more citizen-centric, allowing for greater user participation in the media. Instead of relying on major news broadcasters, people now have the ability to seek and compare news from a variety of sources (Clark and Aufderheide, 2009). The same paradigm applies to the worlds of music, films, and television programming.

Peer publication has been described as “a process not a product” (Beckett, 2008). Under this process, news, for example, is collaboratively created, gaining importance according to its status as a part of an electronic conversation (Clark and Aufderheide, 2009). Users can congregate around an issue and share ideas and media to contribute to that conversation (ibid). The advent of comment and discussion boards allow for users’ opinions to be expressed and debated. In short, people can now create a variety of media (video, text, audio) either as a unique expression or combined with traditional media, and have access to platforms on which the media can be shared and critiqued.

With the emergence of peer publishing, traditional media have had to adapt to the changing socio-technical environment to stay viable. Open and peer publishing, and changing roles in media production and consumption, have not replaced the traditional media, but they have posed challenges to traditional business models.

The democratization of media creation, distribution, and access does not necessarily foretell that traditional media are dinosaurs of a new variety. “If we are fortunate, we’ll end up with a more diverse media ecosystem in which many forms—including the traditional organizations—can thrive. It’s fair to say, though, that the challenges to existing businesses will be enormous” (Gillmoor, 2006).

Peer publishing challenges the viability of the traditional role of media companies as intermediaries. “The fundamental disintermediation caused by peer-to-peer pull models is that people are actually communicating with each other without intermediaries” (Bollier, 2006: 29). The disintermediation of services that garnered much attention in the dot-com era is just beginning in the world of media production and publishing. While

intermediaries will still be needed, their functions will change: they will become aggregators, advisers, and consultants (ibid). This fits well with the intriguing possibility suggested by Goldhaber (1997), that the amount of time we spend on the Web and the Net is such that there is the beginning of a market in what is most scarce, what he calls the “attention economy.” Hagel has extrapolated this notion to identifying a new kind of brand, the “trusted agent” or adviser, who helps you get more value out of your limited attention (quoted in Bollier, 2006: 25).

3.2.4.2. V 5: Business and Social Trends

What Is New About New Media?

In 1984, David Andrews criticized the communications technology of his day, particularly what he called “central media,” because of its incompatibility with the emerging complexities of the information economy and social interdependence. His suggested replacement was “lateral media,” whose description largely predicts both the Internet and social-networking sites as we know them today: “a dynamic, two-way medium in which the ‘audience’ has just as much power to create content as the ‘producer’ threatens to upend this power structure” (cited in Pearce, 2006: 19).

The publishing, broadcasting, and news industries developed historically as highly professional, centralized, reasonably stable businesses responsible for control of content production and distribution to a mass audience. The Internet has changed all that. Suddenly, the audience is on the stage, the reader is the writer and the publisher, and the couch potato is using a “controller” or making films or television, with an audience that may be one or many, and that changes by the minute. Traditional media outlets have had mixed success in adapting to this new reality, and face an uphill struggle to develop new financial models that can accommodate it. These changes represent a fundamental shift in the structure of the media and in the ways information, news, and entertainment are produced, collected, and shared. This section examines different approaches to peer publication and the associated employment opportunities.

Gatekeepers No Longer

A gatekeeping metaphor is commonly used to describe which stories (or television programs, or music selections) get published and how they are shaped, timed for distribution, and handled (Shoemaker et al., 2001). The defense of the practice of gatekeeping range from the desire for fairness—to maintain accuracy and balance—to the need to protect against potential legal issues, to the inherent strictures of column space, air time, storage capacity, or transmission frequencies (Open News Room). In other words, gatekeeping selects “all the news that’s fit to print and that can be made to fit into the available channel space” (Bruns, 2005).

The Internet and new media have largely removed such space restrictions, and digital technologies have made high concentrations of capital less necessary for participation (Bruns, 2005; Bollier, 2006). The result is a multitude of channels through which news, information, and entertainment emerge into the public arena. According to Pew’s Project for Excellence in Journalism, the overwhelming majority of Americans (92 percent) use multiple platforms to get news on a typical day, including national TV, local TV, the Internet, local newspapers, radio, and national newspapers; and six in 10 Americans (59 percent) get news from a combination of online and offline sources on a typical day. Pew characterizes people’s relationship to news in this new multiplatform media environment as “portable, personalized, and participatory” (Pew Research Center, 2010). There is a corresponding diversity in the criteria for evaluating content value for specific audiences (Bruns, 2005).

Less stringent rules and requirements for contribution of content mean fewer barriers for participation, potentially turning what were once passive media consumers into tech-savvy users with the capability of doing in theory what only journalists or broadcast professionals or record producers could do. This means that concern about access to information has given way to concern about coping with the amounts to which we abruptly have wide-ranging access (Brown and Duguid, 2000).

The introduction of new technology and the accessibility of new media have dramatically changed both the roles and the relationship of the gatekeeper and the

gated (Bruns, 2005). For example, a number of sites have taken to “gate-watching,” helping audiences navigate the vastness of news channels. Gate-watchers publicize, rather than publish, news, by providing headlines, summaries, and links to stories they deem relevant or noteworthy. They constantly survey what information becomes available in a variety of media and serve as guides to the most relevant sources when approached by information seekers: they require online research skills rather than significant journalism skills (ibid). Bruns (2005) describes this as a move away from a mass-media “information-push” news model to an individualized “information-pull” approach. Instead of the gates controlling the news that comes to us, they allow us open access to the information, both raw and processed, contained within.

The demand-side pull of content is made possible by the drastic reduction in transaction costs that the networked information economy is father to. One result is the growth of niche communities of interest. In the era of the Internet, creative products that once were dismissed as “too marginal or idiosyncratic to make money can be the foundation for a robust pull market” (Bollier, 2006: 32). Four converging developments are credited for this blossoming of niche content: the development of low-cost and easily accessible content-creation tools, the spread of the Internet as an infrastructure for content distribution, the growth of new forms of access devices, and the emergence of new types of distribution businesses (Hagel and Brown, 2005: 5). One unexpected consequence is that disabilities-related news and issues that may have not received coverage by the mass media may now find their way into publication.

People-Centric Media

Clark and Aufderheide have described ways in which the traditional top-down method of journalistic reporting is changing to what they call “people-centric public media.” These different approaches also suggest how employment opportunities may be changing. For example, the idea of choice, where people now have the ability to seek and compare news on important issues from a variety of sources, necessitates converting the content to make it accessible on different platforms and devices, and formatting and tagging the stories to aid in their discovery. Increasingly, news is collaboratively created, allowing

users to leverage conversation tools to share interests and mobilize around issues. Users are creating a range of multimedia content as well as remixing existing content, all of which is increasingly a target for use by professional media makers, and is representative of a “variety of new roles along the chain of media creation and distribution” that users are adopting (Clark and Aufderheide, 2009: 7).

One example of open/peer publishing, adopted by individuals, companies, and many large newspapers, is blogging. Access to an audience is still hard to come by; bloggers are many, but widely read bloggers are few. New media make it easier to voice an opinion, but not necessarily to make it heard. In that respect, the barriers to entry are high. Internet traffic is highly concentrated, with 80 percent of site visits to just 0.5 percent of sites (DiMaggio, 2001). But on the flip side, for those with something truly interesting to say, the social-networked diffusion of ideas described by Granovetter (1973) is enhanced by the digitization of social networks. Often, “those who are at the cutting edge of inquiry where journals either don’t exist or are too slow in getting ideas out find blogs a powerful way to engage in discussions to test and refine their ideas” (Hagel and Brown, 2005: 7).

Even if a blogger cannot generate enough revenue to blog as a career, purposeful and intelligent blogging can be a career booster, primarily by engendering social capital. A dedicated blogger has the opportunity to develop and demonstrate industry knowledge, build a reputation, enhance a personal brand, and make contacts (Tahmincioglu, 2010). A personal blog can function as a promotional platform for people in any profession, and the community that it engenders can lead directly or indirectly to career opportunities, to the extent that the corporate world increasingly turns to the blogosphere as a talent pool (Taylor, 2006). Peer publishing, by facilitating access to information and networks, in fact facilitates access to the most important factors of production in the networked information economy.

The value created in a commons-based peer-production model is not just economic, but also social and personal. Many online commons are outcompeting conventional markets by being more flexible, personally satisfying, and culturally authentic than

central media (Bollier, 2006). Leveraging the commons for business gain “implies a different sort of social relationship with the customer base. It implies a more open, accountable relationship and a genuine respect for the autonomy of the people in a given commons” (ibid: 38).

Networked Journalism

Traditional media outlets have tried to accommodate and control the influx of information from these communities of contributors, in which news publication is a process, not a product (Beckett, 2008). As both traditional news media shift to an online format and citizen journalism becomes increasingly active and vocal, Beckett sees the future of journalism in this interaction between traditional media outlets, technological advance, and citizen journalists (ibid).

However, some caveats are in order, because while the changes in the media are real, they are not necessarily as revolutionary as sometimes depicted. The “legacy” or traditional media (described here as newspapers, television, radio, print publishing, music, and movies) coexist with “myriad” names for social media in the news world (Cohn, 2007). Similarly the job categories may be permeable, with the professional journalist who uses new media technology to produce news and information products working in parallel with the “citizen journalist” who contributes to an overall journalistic discourse by commenting on blog posts and submitting cell phone photos to relevant media outlets (ibid).

Computer-aided information collection, filtration, and presentation may help improve journalism and publication, but does not necessarily represent a break with the past. What technology has done is speed up the rate of production and distribution immeasurably, and also brought diverse methods of presentation together. Hence, internally, a news story package on a Web site may use both the spoken and written word, as well as music, moving and still images, graphic animations, including interactive and hypertextual elements; and, externally, the same package may be distributed or linked through a Web site, a Usenet group, email, SMS, MMS, radio, television, and print newspapers and magazines (Deuze, 2004). This fast, multifaceted

approach to publishing is highly dynamic, requiring reevaluation of the roles of traditional journalists and editors and the environment in which they publish, as well as providing increased employment opportunities for the technically savvy.

As the old order changes, some key questions remain the same, in particular about the control and verification of the validity of published information. The argument is not wholly academic. Wikis in general, and Wikipedia in particular, stand as the most popular examples of open-access peer publishing on the Internet, providing people alternatives to more professional forms of scholarship or current events. But even for this exemplar of peer publication, control is still exerted, especially on the most controversial articles, in an attempt to maintain the integrity of the information and prevent page defacement, a practice that contradicts the ideals the organization espouses (Angwin and Fowler, 2009) but provides a strong argument for the value of the editorial role.

3.2.5. Vector 6: Open-Source Processes

3.2.5.1. V 6: Business Background

The open-source movement is commonly associated with the fields of software and information technology. Made popular by Red Hat, Novell, and other Linux kernel innovators, open-source software (OSS) development has become a multibillion-dollar industry, encouraging the spread of the open-business model to many other industries. OSS complies with criteria regarding freely accessible source code, redistribution, and nonrestrictive licensing and involves tight feedback loops between production and consumption, with interesting dynamics of social-capital formation and skill development through remixing and sharing (Bollier, 2006).

The open-source movement epitomizes the collaborative community discussed elsewhere (see Section 2.3), and covers a much wider spectrum than OSS. The Open Source Initiative, a nonprofit corporation that educates about and advocates for the

benefits of open source, frequently uses the language of community, collaboration, and networks when discussing its goals and values.

Supporters of the open-source movement argue that the creation of new knowledge requires the free exchange of ideas, and that intellectual-property laws and digital methods of controlling or locking information are a threat to cultural and social creativity (Berry et al., 2008). Innovation is improved due to access to a steadily richer innovation commons (Hippel, 2005). Some researchers propose an incentive related to career concerns, in which open-source programmers are motivated to produce open-source works because future employers may see their work, or an ego-gratification incentive in which programmers desire recognition for their individual contribution (Lerner and Tirole, 2002). However, others argue that such an individualistic or profit-driven incentive is not the typical or primary motivation for open-source collaboration (Goetz, 2003; Benkler, 2006).

Commons-based open-peer production, which relies on decentralized information gathering and exchange, is a new model of production that often results in more efficient allocation of human creativity than in traditional firms (Benkler, 2004). This can result in a balancing act, as online communities and business explore each other, “trying to find effective ways to balance profit imperatives with the social and psychic needs of the commons” (Bollier, 2006: 40).

Gadman and Cooper describe open-source processes in utopian terms, equivalent to complex ecosystems of interactive relationships among people, institutions, and supporting structures, which require the cultivation of positive effects in the lives of those involved. They describe the facility enabled by open source as having the following components: making it easier for people to have equal access to information, resources, and tools; enabling rich interconnections of shared interests and capabilities; and creating a sense of ownership over outcomes and a sense of identity as people who improve their own lives and those of others (Gadman and Cooper, 2009). The first component is essentially human capital, the second is social capital, and the third is empowered autonomy.

An integral ingredient to the success of open-source collaborations is that technology has allowed for the convergence of a greater diversity of perspectives because traditional barriers to collaboration such as time and geography have been overcome. Even the less-traditional barriers of conceptual distances are also overcome when specialists are taken out of their homogeneous communities and put into a group with a diverse skill set collaborating on a common goal to produce the most valuable output (Fischer, 2005).

Open-source processes epitomize the “pull” economy (Bollier, 2006). A challenge to the pull model is achieving coordination among the many contributors to the process: “If there is a suitable focal object—a dynamic shared resource like open-source software code, or a shared set of goals or discourse—a stable community can form. The resulting ‘swarms’ of previously atomized individuals can self-organize to create new mechanisms and types of knowledge that never could have occurred through the top-down design of a push system” (Bollier 2006: 14).

In the corporate world, innovative strategies call for the optimal mix of open-source processes and agreements, acquisition, alliance, and internal R&D (Rothaermel and Boeker, 2008), as companies in many industries find it increasingly difficult to justify the investments necessary to spur internal innovation. “Open innovation” offers a solution, referring as it does to the “purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation” (Chesbrough, 2006).

Open innovation presents several opportunities for positive economic growth. First, when companies embrace the open innovation model, they can begin to unlock some of their unused patents, allowing other firms to capitalize on those developments and offering the potential for the creation of new developments. A second benefit is the creation of employment opportunities for individuals and small enterprises. From the innovator’s perspective (the creator of the patent), a large and growing market exists for small R&D organizations and individuals. These small companies work to generate innovations in hopes of being acquired, or having their patents licensed or purchased by a larger organization. This effect is common in the pharmaceutical or computer-

technology industries, but also can be found in video gaming, information technology, consumer products, biotechnology, and other life sciences.

3.2.5.2. V 6: The Business and Labor Environment

Open-Source Software

With the relative novelty of open-source software development, there are few statistics that accurately depict the size and trends of the overall marketplace. Companies that engage in OSS development and sales are, with few exceptions, small privately held companies that do not report revenues or volume of deliveries. There are exceptions, including Red Hat and Novell, both of which are public. But overall this leaves market analysts in the position of simply estimating the numbers of users of open-source products, and estimating the potential revenue generated by such users. This is not an exercise in precision. For example, the Open Source Initiative—the open-source community-recognized body that advocates and governs open-source development activity—has estimated the number of Linux users to be anywhere between 4 million and 27 million (Open Source Initiative, 2007). For this reason, this section does not try to estimate the market size or revenues for open-source processes, in particular as the term is so loosely defined. Instead it focuses on the business model for software development, the large OSS companies, and the prospect of job creation in the OSS marketplace.

Open-Source Software—The Business Model

The unique dynamics of OSS development allow for different market strategies. Since the software is, by definition, open to modify, use, or sell, the cost at which a company or individual acquires an open-source program will typically be minimal, or even free (Open Source Initiative, 2007). This situation is largely due to the microeconomic laws of zero economic profit: in a perfectly competitive market, a product will sell only for as much as its lowest-priced identical competitor (Allen et al., 2009). The limited, or nonexistent, barriers to entry in the OSS market create this perfectly competitive landscape. Open-source vendors, therefore, typically generate revenue from the goods and services that accompany the software. These include service packages and subscriptions, and enterprise consulting (McGovern, 2009).

Software development itself occurs differently among the OSS vendors. Red Hat, for example, relies heavily on developers outside of the company, who are not paid by the company (Seavey, 2010). The company pays a small team of in-house developers, while thousands of outside developers code programs as a hobby, a private business, an educational opportunity, or a resume builder. Few of them will ever be brought in-house (McGovern, 2009).

JBoss, on the other hand, performs a much larger share of its development in-house (Seavey, 2010). When a promising developer from the community shows talent, there is a much better chance of being hired by JBoss than by Red Hat⁶: MySQL fits somewhere between these two extremes (Seavey, 2010).

As mentioned above, revenue for OSS vendors comes primarily from residual activities that accompany the downloaded software. Red Hat, for example, generates revenue by selling several different tiers of service packages, as well as consulting services to those who download and use their product. As Red Hat relies heavily on community development, the ratio of paid developers to service and consulting personnel is much lower than that of the industry as a whole (McGovern, 2009).

3.2.5.3. V 6: Business and Social Trends

This section examines how open-source processes affect people's ability to find and do work, with a specific focus on applications for people with disabilities.

A concept most often associated with well-known names like the Firefox Web browser, the Linux operating system, and the Android operating system for mobile devices, the open-source movement has revolutionized the computer world. However, this research follows the general concept of "open-source processes," in recognition of a method of collaboration that extends beyond the field of computer science into many other areas and disciplines. The core ideals—of the open collaboration of a group of skilled individuals without regard for proprietary ownership—encompasses a plethora of projects emerging from various disciplines. Biologists have used the spirit of open

source to compile databases mapping the genetics of organisms, and thousands of workers answered NASA's call for help in mapping the surface of Mars during the Mars mission (Goetz, 2003), just as thousands of programmers responded to Linus Torvalds' original call for collaborative programming in his development of the Linux operating system.

The Social Implications of Open Source

The open-source movement has also had a major effect on how people collaborate in the workplace, referring to a method for loose connections among decentralized workers who unite for the duration of a common goal or project. The influences of open-source approaches on traditional business models and collaboration techniques has led some to suggest a new economy based on the networking of human knowledge, crossing "functional, organizational, and national boundaries, allowing people to share data and information to generate new knowledge" (Gadman and Cooper, 2005).

Gadman and Cooper's study of collaboration-friendly businesses in the United States, Europe, and the Middle East found varied motivations driving people to collaborate. Some companies sought partners to obtain the knowledge and strategies necessary to gain knowledge about their existing markets, while others were drawn to collaboration to spread their products or services to new markets. Motivation was also influenced by potential risk and the level of complexity of the project: the more complex the project, the more likely collaboration inspired by open source was to occur (ibid).

As corporations become more global, expanding their markets and engaging in increasingly complex projects, they will not be able to hire sufficient staff to keep up with demand, especially in less developed countries. Employing open-source methods remedies that potential problem, demonstrating that open-source collaborations have the potential to revolutionize how both employers and employees accomplish work. An example is the Open Medical Records Systems (OpenMRS), an open-source eHealth collaboration that has spread to remote regions throughout Africa and South America. This system allows for contributions and improvements from the entire health-care community, from both developing and industrial nations.

Albors examines open-source processes as a method of community collaboration, an approach to problem solving that revolutionizes traditional ideas about collaboration, innovation, creativity and intellectual property (op. cit.). Similarly, Fischer (2005) sees the emergence of “socio-technical environments” to ensure that each individual’s voice gets heard amid the cacophony of collaboration. Technology has allowed for the convergence of a greater diversity of perspectives because traditional barriers to collaboration such as time and geography have been overcome. Businesses that use open-source collaboration codify the de facto standards that emerge from these communities (Albors et al., 2008).

This adoption of ideals from the community that created it has interesting implications for traditional ideas of copyright and intellectual property. Coleman notes how the code that comprises free and open-source software qualifies as speech under the First Amendment, and is thus afforded the associated intellectual-property rights; at the same time, the systematic abdication and inversion of one’s intellectual-property rights by the open-source community has devalued intellectual property, demanding a rethink of such rights (Coleman, 2004).

Encompassing the idea of open-source processes is a concept called Web 2.0, which no longer sees the Internet as a static source of information, but as a dynamic, evolving work reliant on the contributions of users to provide and improve content through the use of Wikis, blogs, and social networks. As part of that dynamic evolution, the components that allow users with special needs to access the Internet need to adjust accordingly. The Accessible Rich Internet Applications (ARIA) standards are being developed to interface effectively with assistive technology through the Application Programming Interface (API) of the platform (Gibson, 2007). Different measures are required to accommodate different aspects of the Web 2.0 experience (e.g., adjustments to the markup language of the Web site so that each component can properly interface with a dynamic Web site). If adaptations to the APIs to facilitate the incorporation of assistive technology and toolkits are made more user friendly for all users, eventually all new Web 2.0 elements will include these features, eliminating the

lag between cutting-edge development and its being made accessible to all users. As the Internet becomes more sophisticated, it will create greater opportunity for collaboration, accessibility, and employment (ibid).

The dynamic potential of Web 2.0 should not be underestimated. MIT's Media Lab has already developed a prototype "wearable, gestural interface" that gives a taste of the future. When users wear the SixthSense device around their necks, they can capture photographs by using their fingers to frame the desired image, look up reviews for a book by simply holding the desired title in their hands, or check their email by tracing an @ symbol in the air. An extrapolation of the capabilities of such a device into the realm of assistive technologies suggests great possibilities for helping people with disabilities not only to do work but also to create work.

The Economics of Open Source

At first glance, open-source processes, in all their iterations, are a collective economic anomaly, as the production of large and complex projects rarely occurs without monetary compensation, as is the case for most open-source development. In fact, economic motivations behind open-source software production exist, but in a subtle way.

Economic theory asserts that for people to engage in a task such as software development, they must reap both immediate and delayed rewards (Lerner and Tirole, 2000). Immediate rewards include, for example, monetary compensation or the use of customized software to complete a task. Delayed rewards, called the "signaling incentive," are further divided into two distinct categories. The first category is "career concern incentive," in which collaborators are motivated to produce open-source works because future employers may recognize their work. This category is important for people with disabilities because the source code produced is the sole component leaving an impression on employers, providing people with disabilities with an even playing ground for displaying their capabilities to potential employers. This situation applies not only to software-based work: because there is such a low barrier to entry on open-source collaborations, people with disabilities can put their talents and capabilities on display for potential jobs in the future.

The second “signaling incentive” or motivation is called the “ego-gratification incentive,” where programmers desire recognition for their individual contribution (Lerner and Tirole, 2000). In addition, Lerner and Tirole find a third motivation, the “alumni effect,” where students use open-source code while learning to program and continue to do so once their skills have developed (ibid).

Krishnamurthy (2003) found the open-source community to be largely indifferent to profitability but nevertheless suggested methods for monetizing open-source projects. He pointed out that distributors of open-source software will generate profits from selling add-ons to their software or charging for tech support, while other companies offer third-party support for a wide range of open-source products. Krishnamurthy uses customer applicability and relative product importance to analyze a product’s profitability. He labels as “stars” those products, such as the various Linux operating systems, that excel in both of these categories. At the other extreme, “low profile nichers” have low potential for profit and low customer applicability, but must fulfill a small need somewhere to exist.

This latter category is exemplified by Steve Kitchin, who has paraplegia and who designed an accessible pickup truck after he acquired his disability in an accident, as he was not content driving a modified minivan. This initiative soon led to a new career adapting vehicles for people with disabilities (Celeste, 2010). Kitchin’s project thus changed to a “high-profile niche” category: products vital to the community they serve, but with low universal applicability. In Krishnamurthy’s final category, “mainstream utilities” have low relative importance but high customer applicability, as with many Firefox add-ons. The product developed is not essential to the computer’s functionality, as an operating system would be, but is universally useful.

Ultimately the open-source processes have radically changed how people collaborate, offering great promise to some sectors of the disability community by creating technology beneficial to them, at the same time allowing those with special needs to collaborate on projects that showcase their abilities for future employers.

Open Source and People with Disabilities

Open-source communities have been noted as a successful model of inclusive interaction (Fischer, 2005). In open-source communities, shared concerns rather than shared location becomes the prominent defining feature of a group of people interacting. This allows more people to be included, exploiting local knowledge. Transcending spatial-distribution barriers is especially important for locally sparse populations (ibid.). Many categories of disability fit the characteristic of locally sparse populations, as there may be few people with a specific disability-related concern in a given geographic area.

Some open-source developments contribute to the availability of affordable assistive technology for people with disabilities. For example, Orca is a free, open-source scriptable screen reader developed by the Accessibility Program Office of Sun Microsystems, Inc. with contributions from many community members (About Orca, 2010). As other examples, “companies, consortia, and individuals are also developing open-source software applications that consumers can download for free. One allows a user to write up to 30 words per minute (‘wpm’) by pointing or gazing at zooming letters on a screen; another is a screen reader using speech, Braille, and magnification; and a third is a program that has both text-to-speech and automatic speech recognition capabilities” (Lyle, 2010).

3.3. Summary

The technology sector in America is huge, including more than 140,000 companies with combined annual revenue of about \$900 billion. The areas covered by the vectors are undergoing major change, as the business models that they have long followed break down. Typically these models have followed a top-down hierarchy, with power heavily concentrated into only a few companies in each sector, in part due to the heavy capital investment required. According to the *Occupational Outlook Handbook*, employment in this sector is likely to be increasingly knowledge oriented, and creative, with an orientation toward flexible and freelancing types of employment spanning different disciplines.

Although this report was not intended to identify specific job opportunities for the future, there are “occupations of interest” relevant to the vectors, which help identify categories of potential work opportunities. They include:

- **Computer Specialists:** *Network systems and data communications analysts, computer software engineers, computer and information scientists, researchers, network and computer systems administrators, computer specialists, database administrators, and computer support specialists.*
- **Media and Communications:** These occupations are expected to increase overall, but especially in certain categories: *editors* (for data processing, hosting, and related services, as well as other information services in software publishing); *technical writers and authors*; and *self-employed reporters and correspondents*.
- **Artists and Animators:** *Multimedia artists and animators.*

Similarly a review of the areas of business represented by the vectors points to relevant “areas of growth.” They include:

- IDC forecasts that the U.S. mobile broadband market will grow from 6.5 million subscribers in 2009 to 30.2 million in 2014.
- For Vector 1, wireless communication platforms, employment prospects are heaviest in the software and Internet service-provider sectors.
- For Vector 2, social networking, the story is one of extraordinary growth. Social-networking sites are already the fourth-most visited sites on the Web, with more than 66 percent of worldwide Internet users belonging to such a site. The average user spent 63 percent more time on a social-networking site in 2008 than in 2007.
- For Vectors 3 and 4, the U.S. entertainment and games software industry includes about 220 companies with combined annual revenue of \$28 billion. While Second Life already represents a robust economy, residents spent

21 percent more time on Second Life in 2009 compared with 2008, and user-to-user transactions in the first quarter 2010 increased 30 percent year-to-year, an all-time high for the economy.

- Growth in the market means video-game jobs are also growing. Game Developer Research says there are about 45,000 total employees in the U.S. video-game industry, with an average salary of close to \$80,000. The Bureau of Labor Statistics projects that employment for computer-software engineers, some of whom develop video games, will grow by nearly a third in the next decade.
- For Vector 5, open/peer publishing, online video viewing has become mainstream. The industry leader Google attracted 144.6 million unique viewers during May 2010. The same applies to the online news sites of newspapers—current estimates are that 53 percent of American adults get their news online—and to the sale of e-books: by 2009, sales of books available for the Kindle were 35 percent as high as sales of the same books in print.

SECTION 4. Exemplar Studies

4.1. Selection of Industry Partners: The Process

The selection of industry partners was multifaceted. The aim was to conduct three interviews for each vector—one each to represent a senior-management perspective, a marketing perspective, and a technical/engineering or design perspective. A list of projected “target” companies was drawn up, emphasizing diversity, and based on awareness of accessibility, willingness of management to participate in the research, and familiarity with Georgia Tech researchers (based on an inventory of contacts known or assumed by each team member). As discussed below, the interview process was expanded when difficulties in obtaining cooperation from the companies on the target list became apparent.

In parallel with the identification of potential companies for interviews, interview questions were developed, based on the preliminary literature reviews and business case analyses. The final decision was to break the list into two: questions that were universal and covering all technology vectors, together with a subgroup of questions specific to each vector. Along with the questions, an introductory text was created that explained the aims of the research and how the data would be used. Once a company agreed to participate, the research team scheduled either an initial meeting or a preliminary telephone briefing with the company representative, in which the research objectives were reviewed and the use of the responses and data explained (see Appendix 1 for a list of companies targeted and of those actually interviewed, the interview protocol, and the interview questions).

Lining up interviews was considerably more difficult than initially anticipated. Companies identified as potentially the easiest to approach often proved the most challenging. When this process began, the economic downturn was in full effect, and some companies were restructuring, making it difficult to identify the most suitable person for interview. Several of the primary contacts at companies were no longer employed there,

which added an unanticipated level of complexity to the process. Another unforeseen issue with the companies willing to be interviewed was the inordinate amount of time it took for the questions to be validated by management.

The success of the industry study depended on the willingness of the interviewees to engage in a frank and open discussion of the successes and failures of the accessibility practices and employment attitudes held by the company, and by the industrial sector it represented. Experience has shown that companies are willing to share sensitive information as long as they feel confident the information will not be used against them or disclosed to a competitor. Accordingly, we assured the potential interviewees that the research was not designed to focus on an individual company but was rather a method of identifying problems and potential solutions to issues faced by the industry/vector as a whole. Therefore, the following statements (positive or negative) about the industry/vector associated with the product line under evaluation are not attributed to a specific company. Instead, the research focuses on identifying opportunities and lessons learned that are typical of the vector represented by the individual company participating in the research protocol.

One interesting and unexpected outcome was that the most fruitful avenue to identify potential companies and appropriate individuals within those companies proved to be the LinkedIn platform (ironically, we were unable to interview someone from LinkedIn). An illustrative example of social media's potential, in this case being more effective than traditional networks in arranging interviews, arose from the experience of arranging interviews for Vector 4 (immersive digital environments—electronic games). We performed simple group searches within LinkedIn for entertainment and gaming groups within Georgia, which identified the Georgia Film, Music & Digital Entertainment group. By our using LinkedIn to contact an individual with this group (which does not traditionally facilitate or brokerage introductions), the group was made aware of the project and our need for contacts in the industry, leading to its eventually providing them. This group was not part of the initial research team network, yet in the end it was responsible for securing several interviews for this project.

By contrast, the least productive method of lining up interviews was having interviewees refer or link us to other individuals whom they thought would be appropriate and interested in cooperating. This is ironic because the focus of this part of the study was to analyze new technologies and their effects on business operations and labor prospects, and the new modes such as Facebook, LinkedIn, and Twitter were much more effective in making productive contacts than the traditional model of personal networking and identifying potential participants.

4.2. Interviews with Industry Partners

Interviews were conducted to gain “on-the-ground” information about how the different technology vectors affected both the ability to do work as well as the ability to create or find work for the general population, and for people with disabilities. These interviews were conducted over three months at the beginning of 2010. To ensure anonymity, interviewees are identified in the text by general position and by industry sector only. For each vector, three individuals were interviewed, each representing a managerial, a technical, and a marketing position.

The following text summarizes those discussions and the issues brought to light. General facilitators and barriers are discussed first. The analysis then shifts to specific effects found for people with disabilities. Following this, the important characteristics on both the individual level and the employer are discussed. Finally, the analysis examines issues addressed by the interviewees that were of significant importance in terms of the potential for immediate change.

4.2.1. Facilitators: General Observations

The interviews led to identifying both potential facilitators to work, or to finding or creating new opportunities for work, as well as barriers or potential pitfalls threatening their successful realization. The great majority of the interview subjects noted how the potential and power of these technologies increase as they are integrated into one

another—but so do the challenges. The following are general trends identified through the interviews as having potential in terms of employment.

Crowd-Sourced Project Work

One interviewee within the social-networking vector pointed out the need for a fundamental shift in how one finds and is rewarded for work.

If we are going to thrive and find novel ways for technology to assist in the evolution of finding and creating work that is accessible to most, we must find unique ways to ‘mash-up’ these social technologies with more familiar avenues for the public at large.⁷

Social-networking tools like LinkedIn have demonstrated that online social sites can be important facilitators for individuals marketing their abilities to potential employers, but other online employment environments reverse this idea—instead of interviewing to work for the company, you just work (Rosedale, 2010).

One such new endeavor is called Love Machine, developed by Second Life creator Phillip Rosedale. The concept is for employers to market their needs to broad audiences and allow individuals to bid on work on a project-by-project basis. Available projects are posted to a worklist, and work bids are solicited. Successful bids are expected to join a virtual work environment known as the live workroom. This is a social interface that allows the participants to harness the institutional knowledge of the group, as they search and discuss together, all from their own remote locations. As of August 2010, there were 42 jobs being bid on and 36 active jobs. Though there are similarities between this undertaking and other online job fairs or bulletin board spaces like Craigslist, there is a key difference: an individual’s account is tracked and performance audited, based on quality of work and timeliness of deliverables. This introduces not only a measure of quality control but also of recognition, as the work community can see who is doing well in any particular field of work.

Virtual Economies

While the current economic downturn has resulted in an increase in unemployment, all the interviewees within Vector 3 pointed out that immersive digital environments, and more specifically the virtual world, have been thriving. As pointed out in Section 3.2.3, there is a huge untapped potential within the economies of these platforms, in particular for business development.

All the interviewees in this domain noted that social categories, such as gender, race, and disability, need not act as barriers to doing business in virtual worlds. Currently there are 127 specific groups in Second Life focused on employment opportunities, with career fairs regularly being held “in-world.”⁸ Second Life is just one of many virtual spaces with robust internal economies. Other platforms that are part of this trend include World of Warcraft, IMVU, and There.

Stability of Electronic Games

The electronic gaming industry (Vector 4) has been a growth leader historically: from 2003 to 2006, the entertainment software industry’s annual growth rate exceeded 16 percent, compared with a U.S. economy growth rate of less than 4 percent (Grabstats, 2010). The industry also has shown remarkable resiliency during the recent economically unstable period.

In terms of employment, the scope is broad, ranging from traditional areas like software programming, graphical design, and hardware manufacturing to writers, producer/production personnel, audio artists and engineers, and educators (Marcucci, 2010). Other forms of employment in this sector include audio development and production, marketing, and story boarding. Several interviewees pointed out how flexible this market is, as mostly this is based on contract work instead of full-time employment, typically for small to mid-sized companies, allowing for greater mobility within the workforce.

Low Barriers to Entry

Several interviewees in the open-publishing vector (Vector 5) identified the role of “citizen journalist” as a niche with the lowest barriers to entry and potentially the greatest opportunity. Citizen journalism is defined as when people, not necessarily with any professional training, “collect, report, analyze and disseminate news and information” (Bowman and Willis, 2003). Lasica’s typology of citizen journalism includes participation at mainstream news outlets (staff blogs, discussion forums, content sent in by readers and articles written by readers); independent news and information sites (individual blogs for niche-news publications geared to community or city news, consumer news, politics, among others); full-fledged participatory news sites (citizen first-person reporting); collaborative and contributory media sites (mash-up interfaces of blogs, discussion boards, and other social sites where individuals can contribute and link to others); and “thin media” (including mailing lists and email newsletters). The possibilities of YouTube could also be mentioned, as could personal broadcasting sites like Daytonabeachlive.com and KenRadio.com, where individuals create their own brand of local news broadcasting.

4.2.2. Facilitators: People with Disabilities

During the interviews, opportunities were identified specifically for people with disabilities. Below is a summary of two of these potential benefits.

Free Advertising

It is well understood that social networks can be used to connect disparate people to groups and inspire a sense of belonging. Yet social networks like Facebook, which are traditionally seen as strictly social, are increasingly being used in employment hunts. As a technical director in this domain pointed out:

The power of social networks in finding employment, especially for those with disabilities, is that the platforms are agile enough to allow for almost

*anything. Because these services are free, it is almost like setting up your own free and highly engaged Web presence. The only barrier to entry is having access to the Web.*⁹

While there are close to 800 advocacy groups on Facebook for people with disabilities, a more specific search of disability and employment returned 435 groups that focused on specifically creating or supporting networks of employment for people with disabilities.¹⁰ More traditional employment or career-focused sites such as LinkedIn did not compare to the power and scope of the Facebook community, only returning 24 groups focused on employment for people with disabilities.¹¹ The largest LinkedIn group is Aspiritech, which has 136 members as compared to the biggest Facebook group, Disability Awareness Advocacy Group, which has 761 members.¹² Larger, more socially focused sites like Facebook offer far greater diversity compared with the more professionally focused social-networking sites.

The Impact of HTML5

Another identified benefit was the potential offered by the adoption of new HTML5 standards. These standards promise to help greatly with the development of assistive technology tools, making them easier to use, more cost effective, and reliable, a view confirmed by our interviews with senior leadership at IBM. HTML is a standard for structuring and presenting content on the World Wide Web, and this latest incarnation aims to reduce the need for proprietary-rich Internet applications. At the time of writing this report, HTML5 was in draft standard state at the Web Hypertext Application Technology Working Group and in working draft state at the World Wide Web Consortium.¹³ To ensure that issues of accessibility with HTML5 are proactively addressed, the relevant objective of the HTML Accessibility Task Force is to “help ensure that HTML5 provides features to enable Web content to be accessible to people with disabilities. This includes review of existing features for potential accessibility problems, and the proposal of new features where needed.”¹⁴

The most important thing to note about accessibility in HTML5 is not so much the features as the change in philosophy that it entails. For example, bloggers working in this domain emphasize that HTML5 actively encourages Web authors not to put information into places where ordinary users cannot see it, such as alt and summary attributes, but rather into the normal body text.¹⁵

HTML5 has great potential in making assistive technologies more widely accessible, and it is these technologies that are often critical to people with disabilities functioning successfully within the workforce. If the result of HTML5 is technologies that are more streamlined, reliable, and affordable, it could be of great benefit to people with disabilities when seeking employment. The effect could be transformative, as described by a leading open-source director:

One advantage that OS products have is that they tend to be free. People with disabilities often have higher unemployment rates and can't afford assistive technologies. Having technologies that are free and readily available to download greatly increase the chances for disabled people to have access to needed technologies and could therefore make finding work much easier to do.¹⁶

4.2.3. Barriers: General Observations

One finding to emerge from the interviews was that traditional, linear skills are not the most desirable or relevant for employment in the technology sectors represented by the vectors. In particular, interviews in Vector 2 (social networking) and Vectors 3 and 4 (immersive digital environments) indicated that a broader, interdisciplinary approach was demanded by the complexity of the field. This finding is not new. Some leading American universities have recognized the need for these advanced skills and have begun incorporating these themes into strategic plans and curricula.¹⁷

Another general finding was the importance of relationships and social skills in order to solidify the work position. Successful employment still boils down to belonging to a

community and understanding how to build one's position. It is possible that having a disability might be seen as negatively affecting social intercourse, despite having a computer or handheld screen between you and others.

Another potential social issue that arose from the interviews was that of privacy and personal information. The use of social-networking and gaming sites has spread widely in a short period of time, which has tended to sideline some serious consequences or side-effects that they may produce, including the possible harmful effects of the information spread through these networks, or more specifically how an individual's digital persona may be perceived. Many employers have begun using online profiles for instant background checks on current and potential employees (Grasz, 2009). This may be lost on individuals who see their social profiles as part of "private" life, when in fact this is no longer the case, because of the blending of coworkers into friends or buddy lists, and the inclusion of their positions and employers into their profiles.

4.2.4. Barriers: People with Disabilities

One issue that emerged from the interviews was the perceived "invisibility" of people with disabilities. In an interview with a representative from the gaming sector in the immersive digital environment vector, the comment was made how few employees with disabilities can be found in the industry, but how their presence would be welcomed:

The gaming industry does not attract many people with disabilities or women. If I were given two equally matched candidates for an open position yet one was a female or a person with a disability, I would chose them. I find that teams that have multiple perspectives on them tend to be more dynamic and create a better working environment.¹⁸

The interviews also revealed a continued lack of awareness of the size and scope of the disability community, either as potential employees or as a potentially mobilized and profitable market opportunity. The same sentiment was repeated throughout the vector interviews that during the development phase, the disability community was not

important to be included in the development or design of vector artifacts. Several interviewees went so far as to say that they were unaware of how certain technologies had specific benefits for the disability community, indicating that there is still a widespread lack of knowledge about the uses of assistive technologies and how disabilities can be overcome in the workplace.

A potential explanation for this situation was identified as the lack of funding or support for different disability-associated projects. One of the interviewees in the open-source vector emphasized that, while the open-source community is in general underfunded, open-source accessible technologies suffer even more from inadequate funding. This, as the interviewee pointed out, is unfortunate:

Open source accessibility tools have great potential. Assistive technologies are often proprietary and expensive. This is often a burden on individuals who are statistically more likely to have employment issues or inconsistent funding because of their diagnosed condition(s). [In my opinion] it is a combination of funding and acceptance within the community of the newer technologies. This is where advocacy groups and people within the disability community could have tremendous impact.¹⁹

This call to action goes beyond the suggestion that the disability community embrace digital technology through raising awareness of its potential benefits to a grassroots effort to support and push the boundaries of what is possible in terms of employment for people with disabilities.

Another, related issue was the cost of the different accessible technologies. There are two costs discussed by the interviewees within this technology vector: that of developing specialized technologies or software/hardware compatible with the assistive technologies, and that of the consumer price of these technologies. This issue of cost produces a bad circle, as the poor economic circumstances of the disability population potentially results in multiple constraints on the need and use of assistive technologies to find work or compete properly in the workplace.

Overall, there appear to be more benefits than barriers for employment within these technology vectors than might be considered at first glance. One positive suggestion was that most of the barriers identified through the interviews could be addressed by more vocal and stronger leadership within the disability community and by more synergy of efforts. The comment was also made that this could easily be achieved with better communication channels and more openness within the leadership of the community.

4.3. V1 Sector-Specific Trend Analysis

Vector 1: Wireless Communication Platforms

Interviewees gave varied comments on the opportunities, offered directly by this technology vector, to create employment. Due to the diversity of platforms represented by this vector (e.g., Smart phones, PDAs, Laptops, Netbooks, Tablets, iPads) and the expertise these technologies and this domain demands (foundational programming knowledge and background are required), the barriers to entry for employment are greater than the other technology areas analyzed. However, using the technologies this vector represents in novel ways and integrating the use of new applications were seen to offer significant potential.

The strongest potential mentioned was the possibilities opened up by the flexibility allowed through both the mobility and the integrated services offered on most wireless devices. The mobility of the devices allows for a more distributed workforce, which could have obvious benefits. One of the interviewees, a technology director within this vector, gave a clear opinion:

Wireless technologies have changed the dynamics of the work environment. People are now able to participate within the workforce in a more decentralized and amenable manner. There are unrealized possibilities that these [characteristics] will afford workplace practices moving forward.²⁰

The ability for a distributed workforce to be implemented gives employers more options in the construction of their business models, therefore making the company more agile to the needs of the customers.

Another key issue for the interviewees is the effect that integrated services on handheld devices have on facilitating office or job requirements. This can be seen with the new capabilities that embedded GPS, barcode-reading software using the built-in camera, and additional software or peripheral hardware have to offer with smart phones. The combination of wireless Internet, access to social networking platforms, and GPS allows for real-time computing and locating, which can both facilitate work processes and aid in the search for employment opportunities—specifically, using a combination of social networking and GPS to find where and when there are potential employment opportunities. Similarly, the newer wireless tablets offer the potential to make the complete workplace situation truly mobile.

One employment opportunity area identified in the mobile platform interviews was the effect and importance of application development. The industry is starting to hit a saturation point, where applications are exhausting the capabilities of current mobile platform hardware. The prediction is that there will be a shift, where application needs will start driving hardware development, implying that application developers will play a fundamental, possibly primary role. One recommendation was that there needs to be more synergy and cooperation between application developers and developers within the assistive-technology sector, in order to achieve the goal of less costly, fully accessible applications and their more wide-spread use among users. Interviewees saw this goal as attainable, as the demographics of an aging population affect the general population over the next five to 10 years.

However, any alignment between application and software developers and the needs of the individuals using toolsets that are developed specifically with accessibility in mind will not be easy. One interviewee discussed the complexities involved when toolset developers are not directly responsible for or involved in, or even have any influence over, how application developers use those toolsets. A further issue is whether such

involvement or influence is even desirable, as the industry view is that dictating or controlling how the toolkits are used or integrated could have adverse effects on innovative use of the toolkits.

Overall, the interviewees in this vector were optimistic that with continued technological evolution and innovation, there are still huge possibilities for wireless communication platforms—especially with the increase of 4G deployment rates and concomitant capabilities, as well as associated advances in hardware like iPads and the Cisco Cius. The continued growth of interconnectivity of the operating systems embedded in the platforms and third-party peripheral technologies will expand the capabilities and usefulness of the technology for a multitude of purposes, business processes and employment opportunities being prominent among them.

Key Recommendation: All interviewees agreed that it is the applications of wireless communication platform technology, and not the development of it, that offers the most potential for creating or finding new employment opportunities.

Vector 2: Social Networking

Interviewees in this vector gave diverse opinions on how they perceived the uses of social-networking sites for employment opportunities. There was some disagreement over the major issues in this area, including how these sites could be used for effective employment opportunities. With a few exceptions, such as the use of social networking to conduct market surveys and polling, the interviewees saw few opportunities for using social-networking sites to facilitate workplace operations, compared with using them to find employment opportunities.

All interviewees discussed the division between different conceptions of networking, whether social, business, or hybrid social-networking sites. Sites like LinkedIn and Working Life focus on employment- and business-centered activities. Other platforms like Ning, Twitter, and The Site, may offer support for finding or creating employment opportunities, yet at the core are based on more social-affinity constructs. A common

theme for the interviewees was the importance of understanding the design of each platform and of the associated communities as expressed in an interview with a developer, because “having a well-rounded understanding of the platform will enhance the efficiency and applicability of the participation within each community.” This is of particular relevance for individuals (or companies) marketing themselves for employment purposes.

The most common benefit discussed was the ability to share large amounts of knowledge about an individual in a condensed and organized manner. Social-networking sites are a consistently accessible and easy way to learn about others, either in a deep or shallow manner, depending on the extent of the information presented (DiMicco and Millen, 2008). Also discussed was the validity of the insights that one gathers on another individual through this medium and how this could differ vastly depending on the context in which the personal information is being offered. All interviewees for the Social Networking vector discussed trends and dynamics for both individuals and groups. Many discussed the growing use of these platforms for non-personal, workplace or business related activities. Because these spaces and the dialogue between businesses and their patrons are more accessible and visible, the social networking platform becomes a much richer experience compared to a traditional web presence. It unites the group/business/individual to the general public immediately and directly, and can offer real-time dialogue between the parties - something that traditional websites do not effectively facilitate.

Online social networking is essentially an artificial process, which can give the illusion of being natural. This represents a disconnect that may be problematic—as one interviewee put it, “making the online social graph match the real-world social graph in its complexity—and how to leverage and garner benefit from one another.” This lies at the heart of the issue of managing multiple identities: If the persona displayed through online social profiles differ from platform to platform, how does one integrate and balance the different identities? In part, this “context collapse” is being driven by having to objectively specify the strength and nature of the relationships through the networking

media, which is not necessary in life. In my real-life identity, I do not have to identify levels of connectivity or security for individuals like a parent or sibling; they are inferred.

This situation regarding multiple identities may turn into a contentious issue, especially when discussing the appropriateness of information or opinions from the individual. This is sometimes described as the “digital presence,” or the overall impression that is given off by an individual’s collective data presented to the public. One interviewee pointed out that this has become an issue with many businesses and companies, where individuals represent themselves via an attachment through a corporate profile or information page. Because the company is now linked to the individual, personal actions and events that take place through this medium now potentially reflect back on the company or employer. This has led some companies to ban the use of company affiliations on employee profiles, which potentially affects the openness of an organization to the use of such technologies, and takes away the technologies’ potential to be a cost-effective marketing and communication tool.

There was a consensus among the interviewees that social networking has considerable potential for finding and creating work, especially when the social-networking sites were combined with mobile capabilities like GPS. However, there was no consensus on how effective these technologies might be specifically for people with disabilities—beyond organizing into or finding groups that are meaningful to the individual—or how these technologies would better facilitate common workplace practices. There was disagreement among the interviewees, on the level of true accessibility of social-networking applications and beyond the traditional social-media communication tools of instant messaging and mail clients, as to what toolsets or benefits these platforms might have to offer.

Key Recommendation: All interviewees saw a positive benefit in strategically using social media for enhanced communication and contact with the customer base. At this point, if a company is not active within certain business-focused platforms, like LinkedIn, it could be seen as a negative comment on the company itself. Social media were seen

as the most productive vector in terms of the ability to find work and therefore should be used more for these reasons.

Vectors 3 and 4: Immersive Digital Environments (Virtual Worlds and Casual Games)

The interviews concerning immersive digital environments (IDE) were the most varied of all the vectors. This variety is indicative of the dynamic nature of the field, which ranges from general entertainment console games to sophisticated immersive 3D simulations for education and training. Because of the breadth of the spread in both application use and typology, consensus within the interviews was difficult to achieve, and therefore general conclusions were difficult to arrive at.

In all the other vectors, employment opportunities can be created or found through the physical development of the technology and the use or application of the technology in some unique or distinctive way. While this situation holds true for IDE to some extent, the interviewees thought it much less relevant.

IDEs do offer some unique opportunities to create or find work. In virtual worlds, for example, the Second Life platform stands out. Second Life visitors are able to search for goods and establish services on a platform where there is an economy, where real money can be made, and where there is a large enough population to support a demand for such goods and services. Income is also generated by catering to the needs of the traditional casual-gaming community in virtual worlds, for example, by keeping game characters “powered-up” or by selling “enhanced” avatars in specialty online stores and auction sites.²¹ At present, these applications may represent niches in terms of employment opportunities, but the opportunities are there. Be it one of the larger MMORPGs like World of Warcraft or Tabula Rosa or a virtual world like Second Life or Open Sim, there are new and unique avenues for employment being created, with real financial rewards.

Another unique feature of digital worlds is immersion. The quality of “total engagement” via an avatar in a 3-D environment is what marks these platforms apart from other collaborative digital environments like wikis or discussion forums. An important feature of immersion is user-created content. The ability for an individual to create artifacts is compelling, allowing one to contribute to a space in a meaningful way, and to have that contribution persist. Persistence goes hand in hand with immersion. The environment is not static but dynamic, and persists regardless of whether or not you are a participant. This more realistic and familiar environment is appealing to those who are already into other such scaffold environments, like gaming or online collaborative workspaces.

One of the major barriers to employment opportunities in this field is the large technological know-how and ramp-up time that is needed to become proficient in the use, and even more so the development, of IDE technology. A diverse set of skills is needed to build and create: knowledge of the specific language used for the development of enriched elements within the specific platform, 3-D modeling experience, user experience, and graphic design skills, to name a few. Even the use of some applications may represent a steep learning curve for those not familiar with the platforms. During an interview with a technical director in the casual gaming industry, several facets of the development process were stigmatized as exclusionary for people with certain types of disabilities, due to the technologies employed. While this is not a new phenomenon, it represents a real barrier for employment within certain sectors of the game-development field.

Another issue is the difficulty of interoperability or transfer of assets or information from one platform to another. Platforms use different graphics engines, scripting languages, and 3-D asset integration. The user experiences are also different, as different platforms are developed for different purposes. Therefore, cross-platform integration and the use of multiple platforms is difficult if not impossible, potentially a major hindrance for someone looking to maximize employment opportunities within this domain.

Key Recommendation: This vector suggests more unconventional and entrepreneurial opportunities for employment. Within certain domains, specialized, employment-

oriented groups exist that would repay further investigation, to reach a deeper understanding of the employment opportunities they may represent.

Vector 5: Open Publishing

This vector represents a work in progress. Interviewees for this study were diverse, representing both traditional and new media sources. All interviewees identified key issues that still need to be addressed as the field continues to mature and develop. The sector also represents the newest most in transition of all those sectors analyzed. Because of this diversity and relative newness, the interviews were the most inconclusive.

The ability to self-publish thoughts or content for free through different social-media technologies has become a low-cost and highly effective way to have one's voice heard, especially compared with traditional modes of publication such as newspapers and television. The ability to use one's Twitter account, social-networking feed like Facebook, or blog to relay opinion, thought, and knowledge has spread far and fast, most recently into the mobile sphere. Anyone anywhere can capture and relay information in a triumph of disintermediation and at the expense of traditional news- and information-gathering conglomerates. The ability to commoditize that information, especially through mobile communications, represents a new business model that is still under development. One interviewee who is a marketing director pointed out that "within the blogosphere, adding a PayPal connection has allowed for individuals to profit off the communication of their knowledge or opinion." While this capability is not new, we are just beginning to see how these opportunities might develop with applications like TwitPay and others that are leveraging social networks for monetary purposes.

This openness brings its own problems, however, in particular how to distinguish one voice from another. The great benefit of citizen journalism, for example, is the low barriers to entry, but as an interviewee stressed, this puts great emphasis on maintaining an online persona once one has started, in order to compensate for the lack of professional training.

An associated issue is validation. It is difficult or impossible to validate or rate or even prioritize the barrage of information that is presented each day online. Again, the absence of a professional structure or context is appealing in terms of openness, but daunting in relation to controlling for quality or accuracy. Calls for transforming the teaching of digital literacy at the secondary and tertiary levels are well meaning but inadequate. In a world where literally anyone can publish—in conjuncture with social-media sites like Twitter, Facebook, Blogger, and Word Press—the publishing infrastructure has become literally open. Most of these sites have intuitive and simple-to-use user interfaces, allowing individuals to broadcast their messages in a form easily digestible and easy to broadcast to the world at large.

Key Recommendation: All interviewees agreed that there was vast untapped potential within this technology vector. What was not clear was the relative strengths of the different business models used to commoditize work within this vector. More in-depth analysis is needed, to better understand the emerging field in terms of employment opportunities.

Vector 6: Open-Source Processes

The open-source process vector was approached from both a development and an application perspective, but because of the difficulties of securing cooperation from different companies, only those from the application side were interviewed. In part, this situation reflects the nebulousness of the open-source domain. As one interviewee pointed out, while open source can touch any and all the technologies discussed in this research, it is also much more than a technology: it represents a new philosophical approach.

All interviewees agreed that the key characteristic of this vector is the community that supports open-source software and processes, whose depth and persistence lead to the dynamism and innovation of the open-source process. The interdisciplinary nature and diverse interest base of those people who participate in the community result in a

multitude of motivations and support the continued growth of open source, even though the business models and return on investments often take time to come to fruition.

As with open publishing, validation issues are important for the open-source community. Because so many additions are coming from different locations, validation of what is being submitted can sometimes be problematic. But because of the vast number of people using the code and continually improving it, this may actually be a non-issue. One interviewee pointed out that the open-source method of development is inherently more accessible and innovative than is possible in large corporations and potentially may be more reliable, precisely because it is not predetermined or limited, and is being developed by individuals in many different categories and positions.

Another common theme for this vector was the chronic lack of funding. Open source is seen as valuable and worthwhile, but for which it is often difficult to find consistent development funding. The military has started investing more in this domain because they see the value of this model to connect and empower a community of both civilian and military software and hardware developers. Organization and communication within the community might seem like a low-tech solution to the issue, but one interviewee identified this as a major focus.

Several interviewees saw finding work for people with disabilities as a major issue for several respondents within this vector. Several were discouraged by the lack of organization of support or advocacy groups in this domain. One of the interviewees stated that he had witnessed opportunities for employment of people with disabilities not being seized and supported by large organizations. He suggested that this was because of a lack of understanding of what these jobs entailed, and possibly represented a larger issue within the disability community: that because there is a lack of focus or understanding, employment opportunities were allowed to slip by.

Key Recommendation: This vector offers the lowest potential for finding work, but the most potential for assisting workplace practices. It also appears to be the least trusted technology of all the vectors. One problem is a lack of consensus or clear

understanding of open source in general, and in particular how open-source processes could have a positive effect both on employment opportunities and on the integration of assistive technologies into the work situations of people with disabilities.

4.4. Summary

Most interviewees saw potential in the use of these technologies to cultivate employment opportunities or to better facilitate workplace activities, especially among people with disabilities. Generally, the interviewees identified more opportunities in the development of employment opportunities through the vectors as opposed to using the vectors to find work or enhance work processes. Several interviewees commented that because of the rapid development of these technologies and their inherent dynamism, the situation is fluid and patterns visible today may be quickly outdated.

One common perception was that the disability community is not seen as a viable market, in that many technology companies are not considering developing specific product lines for it, and are not taking universal design principles into consideration during the initial prototyping and development phase of specific technologies. When disability issues were addressed, they were addressed as afterthoughts—how a certain technology could be modified to make it more accessible. Several interviewees interpreted this to indicate a need for stronger advocacy and information dissemination from among people with disabilities.

New technologies, in particular social networks and immersive digital environments, have created unique ways to market skills and to find companies or individuals in need of those skills. These technologies have made this process of self-marketing and promotion much more decentralized and viral.

Employment opportunities have begun to look quite different from what has been the norm in a traditional industry or domain. In particular, individuals who are creative in blending abilities from different disciplines stand to do well, as a mix of skills matches

what the job marketplace is looking for. Interdisciplinary abilities will become more essential. Individuals looking to find or create work will need not only to have such a mix of work-related skills, but also must be adaptable and show that they bring a unique characteristic to the table. In this sense, a disability could even be an advantage.

At the same time, some fundamental truths have not changed. As one interviewee reminded us, the world of work still revolves around interpersonal relationships and the levels of personal trust that can be established between an individual and a potential employer, co-worker, or sponsor. The technologies explored in this report are all at some level communication and demonstration media. Even in the digital world of social networks, the most successful individuals are those who create a strong online persona and then make sure they have the capabilities to back it up.

The individual has to be proactive in searching for potential employment opportunities, which means the lens through which we view viable employment opportunities has to change constantly—we have to keep pace with evolutions in the field or get left behind.

The technology vectors analyzed for this study have great potential for reducing institutional costs associated with training, communication, marketing, and similar areas. Using creative and innovative technological applications to strengthen these areas usually requires little up-front costs, as demonstrated clearly in the use of social-networking sites as marketing and communication channels.

Two vectors were earmarked as still having great, yet unexplored, potential: the use of open-source processes in business operations, and the use of immersive digital environments for training.

A prominent theme that recurred in all the vectors was that of mobility. Mobility was discussed from two angles: 1) the ability to access applications or processes via multiple platforms, or the common adage “anytime, anywhere”; and 2) the ability to transfer data seamlessly from one application to another. As the enabling hardware and

software continue to evolve, the interviewees were unanimous that this would be one of the driving motivators and standards moving forward.

With the vast landscape of vehicles for marketing or for conveying core concepts and capabilities of a company, a clear and consistent brand image is crucial. Such a brand is crucial for several reasons. One is to attract the right talent to the organization. Another reason is to foster consumers' confidence and trust. This point was highlighted in the interview of a technical director, who raised the issue of open-source software and its uptake (or rejection) based on perceived reliability. With 1001 different avenues to promote and market through, a clear message that is repeated in the appropriate channels is vital for stability and growth of a company in this day and age. A clear message is important to people with disabilities because of the opportunities to create assistive software that is essentially free or, at a minimum, much more affordable than what is currently available on the market.

One striking commentary was on the need to incorporate different perspectives, including those of people with disabilities, within the technological developments represented by the vectors. The perception that certain technological fields were not "suited" for people with certain disabilities is a pernicious one, and for reasons that are not necessarily clear: several interview respondents speculated on the typical lack of confidence that people with disabilities have, something instilled in them by the dominant culture. Social stigmatization also plays a role, as in the suggestion that the technical requirements of certain fields result in the automatic disqualification of specific mental or physical disabilities. An example given is that blind or colorblind individuals "cannot" create storyboards for video games.

Another striking commentary was the perception that the market consisting of people with disabilities is a "niche," not substantial enough to justify development work. The most convincing rationale offered for this view was that people with disabilities tend to have little disposable income and cannot invest in expensive software or hardware.

The counter argument—that the disability market is not “niche” at all—is one that needs to be broadcast, as several interviewees commented on the lack of advocacy among people with disabilities. Without such “marketing,” it will be difficult to envisage digital communication applications being created using universal design principles or developed with the specific capability of interacting with peripherals such as screen readers. In other words, the strong need for such connectivity and communication tools is unlikely to be met unless the nonvirtuous circle started by the perception that people with disabilities are outside the mainstream is broken within the marketplace.

Reaching this goal is not an impossible task. Several interviewees did not see a difference in the opportunities appropriate technology would afford the general population compared with people with disabilities. This observation signals that such companies view the integration of assistive technologies as a third-party responsibility. Noninclusion hence becomes one of developing and publicizing a market justification for the additional costs that may be entailed. Companies like IBM and AbleGamers have shown there is a market, but no one has communicated that message.

Finally, one major barrier that emerged across all the vectors and that was repeated across many interviews was the perceived “invisibility” of the disability community. Many interviewees stated that there was little to no focus on this domain because it was not perceived to be a profitable niche community to serve. This perception highlights the lack of awareness of the size and scope of this community.

Table 3 summarizes facilitators and barriers, according to vector.

Table 3. Facilitators and Barriers—Section 4

Vector	Facilitators	Barriers
Social-networking sites	<ul style="list-style-type: none"> • Promotion of self for employment purposes • Integration of wireless services • Unique business models • Cost effective—usually small or nonexistent costs for using platforms • Ability to share large amounts of information and data 	<ul style="list-style-type: none"> • Privacy and security concerns • Maintenance of self (time) • Dependent on certain social skills • Diminished segregation between personal and private time • Too much information; figuring out relevance and truth
Immersive digital environments	<ul style="list-style-type: none"> • Removes constraints of the physical work environment • Education and training opportunities • Choice of self-representation • Entrepreneurship opportunities/separate economy • Strength of economic sector 	<ul style="list-style-type: none"> • Steep learning curve • Need access to high computing power and powerful network • Skill sets to work in these domains is often diverse and unique • Dependent on certain social skills

Table 3. Facilitators and Barriers—Section 4 (continued)

Vector	Facilitators	Barriers
Open source	<ul style="list-style-type: none"> • Diversity of contribution, creative solutions • Access to information, resources, and tools • Low nontechnical barriers of entry 	<ul style="list-style-type: none"> • High tech savvy required in order to contribute • Lack of funding for robust and collective action • Misperceptions of the robustness and stability of products in this sphere
Peer publishing	<ul style="list-style-type: none"> • Less intermediation, more niche-relevant news and information available • Low barriers to entry • Blogs for personal and career development • Ability to easily commoditize work 	<ul style="list-style-type: none"> • Difficult to access an audience • High literacy, education, and tech savvy often required in order to publish • Is the newest and least defined space of the vectors

Table 3. Facilitators and Barriers—Section 4 (continued)

Vector	Facilitators	Barriers
Mobile platforms	<ul style="list-style-type: none"> • More communication options, especially for people with sensory disabilities • Flexibility of services and technologies • Variety of applications to facilitate almost anything wanted • Plethora of technologies that can be used singularly or in combination 	<ul style="list-style-type: none"> • High cost and fees • Need for wireless Internet access • Rapidity of new technologies and applications can be overwhelming on multiple levels • Diminished segregation between personal and private time

SECTION 5. User Studies

5.1. Introduction and Process

User studies were conducted involving people with disabilities, to explore user perceptions and awareness of accessibility-enabling features in the vectors studied, which can facilitate participation in the workplace or have the potential for becoming useful for finding or creating work. A three-stage strategy of data collection was developed: Stage 1, focus groups; stage 2, online social-network groups; and stage 3, Delphi study.

The research team took a holistic view of each of the vectors. For example, while valuable accessibility features may be already present in a product, platform, or process, inaccessibility of supporting applications or features, such as an activation or security requirement, may offset potential benefits they could offer users with disabilities (Holman et al., 2007; Johnston et al., 2003; Sasse et al., 2001).

The primary objective of these studies was to explore these perceptions, barriers, and facilitator conditions that affect vector accessibility. In part, this issue references the “barriers to adoption” approach identified by the Wireless RERC (Rehabilitation Engineering Research Center) for establishing benchmark indicators of accessibility: inadequacy/insufficiency of consumer information, lack of manufacturer/designer awareness of the needs of consumers with disabilities, device affordability, inadequacy of legislative/regulatory requirements for the use of operability of these technologies, and device incompatibility or poor interoperability, especially in technology-intensive settings such as the workplace (Baker and Moon, 2008).

A secondary objective was to learn from the experiences of people with disabilities in the new-media and digital-technology environments that the vectors represent, develop insight into future needs relative to such media and technologies, and assess how they may affect the employment of people with disabilities. Use and acceptance were

captured through the collection of data via focus groups, both in person and through online, including social-networking, platforms. The selection of focus-group participants was based on users' reported experience with the types of products representative of the six study vectors and recruited through online social networks and established email lists. Focus groups were conducted in person and other group experiences (e.g., social-networking platforms such as Facebook and LinkedIn), with information captured via a variety of accessible online platforms to allow for maximum access.

In addition, the research team employed a modified online Delphi process to capture input from other expert and informed stakeholders in the adoption and use of digital technologies in employment situations.

The research team strove to ensure diversity in respondents and in opinions received, through both the online social-network groups and the focus groups; by online solicitation on a variety of platforms; by invitations to stakeholder email groups; and consultation with target organizations, e.g., the Center for Assistive Technology and Environmental Access (CATEA), Southeast Disability & Business Technical Assistance Center (SEDBTAC), Rehabilitation Engineering and Assistive Technology Society of North America (RESNA), and National Association of Rehabilitation Research and Training Center (NARRTC).

5.2. Focus Groups: Introduction and Description

Three focus groups, with six to eight participants in each group, were conducted during May and June 2010, for a total of 21 participants. People with sensory, motor, learning, and some intellectual disabilities were represented.

A standard invitation, describing the project focus and the process to be undertaken, was sent to existing contact lists maintained by CATEA at Georgia Tech. The largest list is maintained by the Work RERC (the Rehabilitation Engineering Research Center on Workplace Accommodations, also at Georgia Tech), and includes over

1,500 organization representatives and individuals with an interest in research relating to people with disabilities in the workplace. In addition, contacts at the National Science Foundation and Syracuse University were forwarded information on the project, which was then passed on to contacts of their own. In total, about 1,800 to 2,000 individuals were contacted across a broad spectrum of interests. More than 70 requests for participation were received, with the majority from out of state.

Experienced Georgia Tech research scientists led the focus-group sessions. Participants were compensated for time and travel expenses. Participants in the focus groups were asked to discuss specific experiences with illustrative products or services from study vectors, with a particular sensitivity to their experiences as affected by their disability, with major disability classes (i.e., mobility, sensory, intellectual, learning) represented in the groups. Data and perceptions concerning both positive and negative experiences were collected. Participants discussed features that affect the accessibility, both positively and negatively, of products or services from the study vectors. In addition, accessibility features that users with specific disabilities judged critical to the operation of the device are noted.

A portion of the time spent with the focus groups was dedicated to questions concerning use in the workplace, as well as to probing focus-group participants on their experiences in the new media and digital-technology environment, especially focusing on how the technology affects the employment of people with disabilities.

5.2.1. Analysis, by Vectors

V1: Wireless Communication Platforms

A relatively commonly expressed sentiment among participants was the perception that their smart phones were important for keeping in touch, but noted that this was not generally the case with their employers, who prohibited the use of cell phones in some cases. One participant noted the emergence of devices like Kindles and iPads, which are becoming increasingly visible in and out of the workplace.

The utility of smart phones relates to their capacity to allow users to get out from behind a screen, and sidestep the mobility issue. One of the powerful aspects of smart phones is that they provide freedom to access online networks without being locked into a specific location. On the downside, keyboards can be inaccessible due to size limitations and interfaces that can be frustrating or slow. Several deaf participants mentioned using the video aspects of their smart phone both for communicating with other deaf people but also for communicating with hearing individuals, indicating that it gave them a great degree of connectivity and control over communication compared to traditional TTY services.

One of the most surprising findings from one of the groups rebutted an assumption about the accessibility of mobile devices. In one group, during a discussion of the accessibility of various mobile devices, a surprising three-quarters of the participants who were blind or had low vision actually preferred the iPhone for its accessibility, notwithstanding the graphic (visual) menus. Here, the apparent barrier of a graphically driven interface was, in the words of one participant, offset by the underlying accessibility: “Yeah, there is a really steep learning curve with the iPhone, but once you get it, the system is well designed and may be the most accessible one out there.”

Cost was considered the primary impediment to use of smart phones, especially if the user rather than the employer assumed the cost. The key concerns seemed to be “cost” (phones as well as service) and problematic support (with specific references to AT&T and to cell-phone stores). In addition, there was some perception that such phones were somewhat inaccessible, in terms of dexterity. One group (the second) used cell phones mainly for voice communications or texting, rather than the smart-phone functions.

Participants who used (or even relied on) smart phones noted that this was their choice and not necessarily encouraged in the workplace. Skype was widely used, as were instant-messaging (IM) systems, which allowed for both communications and transcription (viewed as less disruptive than a phone call). No one in the third group made regular use of advanced phone features, though texting and some email use were

mentioned. No members of the group owned a smart phone for themselves. Two participants mentioned that smart phones were gradually being integrated into their business structure, but only for professionals in supervisory roles. Workers below this level were not issued phones, and it was again mentioned that many workplaces prohibit phone use entirely.

V2: Social Networking

Participants were also familiar with social media/social networking and expressed a sense that these technologies had some workplace applicability, with Facebook being widely used but seen as somewhat inaccessible (of the various social networks, Facebook, LinkedIn, and MySpace were specially mentioned). Here, the perceived degree of inaccessibility mapped fairly closely to the particular disability group being represented, though the issue of accessibility, in general, of digital technologies was a matter of overall concern.

Interestingly, one participant mentioned that “the mobile version actually works better—it is easier to use with my screen reader” even though mobile versions are perceived by the general public as somewhat inferior due to the fewer features required for general use on small screens and limited processing ability of the mobile platforms. LinkedIn was seen as useful but also inaccessible. The importance of social networking for making contacts and doing business was well recognized but the graphical interface was problematic.

In a technology that crossed several vectors, IM/chat (which can be classified as a social-media/networking technology) was mentioned as helpful and rather commonly used at work. Specifically, the legacy IRC (Internet relay chat) system was mentioned as fading in popularity but still around. On the other hand, IM/chat use on smart phones was not common in the groups, though the participants were aware of its existence.

One participant noted that email and general Web 2.0-based technologies play a major part in work and school because the person does not always have to sit at the front of

the class to hear. “Everything is available online and I can communicate by chat and still get the degree that I’m seeking. I can get the experience of a classroom without the embarrassment of saying, ‘I didn’t hear that,’ and it opens up the classroom as a level playing field.”

V3: IDEs: Virtual Worlds and Serious Gaming

For the first two groups, the discussion on gaming focused mainly on virtual worlds, but was the subject of little specific discussion. Second Life is well known by name and reputation, but was not widely used. The participants noted that there was little in the workplace that specifically addressed gaming, although some felt that it would make an attractive option for training, team building, and other purposes.

In general, the focus groups conflated virtual worlds with gaming platforms, such as World of Warcraft. Second Life, for instance, is well known by name and reputation, but there was not a lot of use of the platform evidenced in the Focus Groups. Some of the comments made toward ancillary technologies (e.g., gaming, online simulations, training, and conferencing), however, have peripheral value in understanding aspects of this vector.

One of the barriers mentioned was that it is “very cumbersome, but fascinating in the potential for commercial exploitation. [One] can actually build a business and make money off of it in Second Life. The question is, ‘does the amount of time invested pay dividends?’” Another participant observed that “I can’t personally find how gaming would benefit my business or social life, but I can for others.”

V4: IDEs: Tiered Digital Interactions

Results from the third focus group differed from the first two groups, and offered some insights into the adoption of the technologies represented by Vectors 3 and 4. In the third group, gaming was a topic of much discussion primarily because of one participant who felt passionately about it. As a general observation, that an advocate or committed

adopter of a given technology can significantly affect the technology's uptake reflects an aspect of diffusion of technology and adoption both in and out of the workplace. The participant in question was deaf. He specifically mentioned World of Warcraft as a hobby and a game that he felt provided him with a fantastic suite of accessibility tools, and shared anecdotes relating to how he had entirely set aside his disability as an issue within the game because it provides captions, visual cues, and other feedback. He was able to maintain a leadership role within his online social circle without most members even realizing he was deaf.

V5: Open/Peer Publishing

In general, there was a high perception of the utility of open/peer publishing. The Internet was seen as a reliable source of product reviews and as a measure of customer satisfaction. Two users swore by eBay and Amazon as resources for investigating a product before making a purchase, and a third user always checked on the Web before purchases of automobiles. In general, the Web was seen as a valuable tool for opinions, but not as useful as an authoritative source.

One of the issues that came up in discussion of the use of the technologies was accessibility. Blogging, for example, was perceived as generally more accessible than social-media sites (Facebook was specifically mentioned), perhaps because the sites are less visually oriented. The participants were generally familiar with wikis, such as Wikipedia, which were generally believed to be accessible, and many have used internal wikis for work. About one-third of the participants across the groups have contributed to a wiki in some way.

YouTube was mentioned in one group as being very popular with the deaf community because it is a visual medium, usable for signing, telling stories, etc., and provides an analogue of communication for deaf people equivalent to hearing people's experience with phones. One participant noted that YouTube provides the opportunity for deaf people to show off skills such as dancing, poetry, or even music, as well as for making political statements about deaf culture or just what's going on in the world. An example

of such use of video media is the blog run by the National Association of the Deaf, which consists mostly of deaf people signing to one another. You can type your comments or sign back. Everyone has the ability to understand. This suggests the possible use of this vector for entrepreneurial (employment) activity, exploring the use of this type of publication to meet unmet market niches.

The perception was less positive with respect to broader collaborative applications of the information-sharing aspect of online publishing technologies. Wikis and similar collaborative tools were regarded as difficult to implement without top-down pressure from supervisors to use functions appropriately. According to one participant, wikis simply became a “document-dumping ground” rather than a place for new content. The observation was made that without real effort to sustain a growing knowledge base, it becomes a “dead-end tool quickly.” A few participants also raised questions of trust with collaboratively developed information tools such as wikis. One participant, a school teacher, insisted that his students not use Wikipedia and similar sites as trusted sources. He did not feel that they have the same sort of authority as publications or peer-reviewed sources. In this case, the use was as a jumping-off point for research, but he did not allow his students to use these sites as primary sources.

V6: Open-Source Processes

The groups were generally familiar with open-source platforms and processes, especially after well-known names (e.g., Firefox, Wikipedia) were presented as examples. These were not viewed as accessible. The primary assistive-technology application mentioned as accessible to screen readers was the R operating environment. Google doc was seriously criticized as terrible due to formatting changes and lack of accessibility. In contrast, Microsoft Live was seen as more accessible but not popular because it required yet another set of accounts and passwords. One participant noted that “JAVA is a four-letter word.” In general, while there was an awareness of open source, and a use of it, the technologies were seen as something “in the background,” and not particularly key to participation in the workplace. At the same time, users saw the possibility of growth in these areas because they offer the

opportunity for enhanced employment, with much of the work done offsite, or in virtual spaces, enhancing the accessibility of these vectors for employment.

In general, the perception of the users was that barriers to digital-media deployment in the workplace were not related to the users, but stemmed from such factors as the employers' lack of flexibility or understanding of how people used technology, or general insensitivity to how digital media acted to make the workplace more inclusive. One participant expressed frustration with how the sighted world made assumptions, saying she finally reached the point where she took out her "eyes" (the prostheses) and said, "Can you read with these?" She said this was effective at making the point. Another two participants noted that these technologies were nice but that existing technologies were not even properly deployed. Many people were not aware or unable to use the accessibility settings. Screen readers turned out to be problematic for a variety of reasons, but because there was no alternative they had to make do with them. Overall, the key theme that emerged is that the barriers were more cultural and awareness from the employers' side, and less so from the employees' side. This suggests that any deployment of the new technologies needs to be accompanied by best practices or training and awareness tools to ensure success.

5.2.2. Facilitators and Barriers

The vectors are looked at through two lenses: one, the use of the digital technologies or processes that the vectors represent to enhance participation by people with disabilities in the workplace; and two, the possibilities the vectors suggest as avenues to finding or creating employment.

The first dimension broadly suggests that much of the awareness of the technology or the process relates to the ways individuals can use them in a current occupational context. Elements that emerged in the focus groups suggested that awareness of the technology or process themselves was not an issue, but rather the question was about the direct pertinence of the vectors to the users. A second issue raised was where the

users saw themselves as aware of the value of the technology or the process, but saw employer resistance as a barrier to use in work situations.

As for the second dimension, the possibilities the vectors suggest to provide opportunities for finding or creating new employment, the focus group respondents were not optimistic. This may be less a problem of the vectors per se, but may relate to larger social and cultural issues about the ability or the tolerance for risk and engaging in new types of activities. To some extent, these factors can be addressed via policy and other types of interventions, and will be addressed more fully in the outcomes and policy recommendations made at the end of the report.

Most of the focus groups' discussions focused on barriers to adoption in the workplace rather than on the potential for creating new industry/vector employment. The more "concrete" the technology (e.g., smart phones, online or computer gaming, publication or information-sharing tools), the more likely the group participants were to envision the technology as facilitating participation in the workplace. The more nebulous the vector (e.g., open-source processes, virtual worlds, and serious gaming), the more difficulty the users had in perceiving utility. The technologies also represent relatively new areas, suggesting that the barriers to entry might be lower (that is, given less competition) and hence represent new work potential. The downside is that the technologies appear "tech heavy," and therefore daunting.

Table 4. Facilitators and Barriers: Focus Groups

Vector	Facilitators	Barriers
<p>The Internet and digital technology in general</p>	<ul style="list-style-type: none"> • Enhanced access to information and advice for problem resolution • Enhanced recreation and entertainment opportunities • Keeping track of friends and activities • Enhanced online and physical community participation • Increased workplace flexibility and employment opportunities • Ability to “manage” or influence online image/identity • “Level playing field” for small business/entrepreneurs 	<ul style="list-style-type: none"> • Cost of connectivity, as well as hardware and software • Interoperability issues; changing technology can “break” AT • Lack of access to digital technology, as well as broadband connectivity • Lack of digital literacy (particularly for people aging into disability) • Disability-disclosure anxiety: concern about social and professional stigmatization or isolation • Text-based communication lacks some “cues” and can be misinterpreted
<p>Mobile platforms</p>	<ul style="list-style-type: none"> • Electronic schedulers and PDAs useful as assistive tech for people with intellectual or information-processing disabilities • Larger devices facilitate use of information sources 	<ul style="list-style-type: none"> • High cost and fees • Somewhat fragile • Need for wireless Internet access • Physical size can be a problem

Table 4. Facilitators and Barriers: Focus Groups (continued)

Vector	Facilitators	Barriers
<p>Mobile platforms (continued)</p>	<ul style="list-style-type: none"> • More communication options, especially for people with sensory disabilities • Access to email and work communication • Keeping people in touch; reduces sense of isolation • App development represents new employment opportunities 	<ul style="list-style-type: none"> • Facilitated use for telework only an option for information workers • Employer reluctance to pay • Devices of variable (and unpredictable) accessibility
<p>Social-networking sites</p>	<ul style="list-style-type: none"> • Helps maintain communities of interest; use somewhat a function of age and awareness • Predominance of several major platforms reduces learning curves • Facilitates access to large populations of tech-savvy users • Facilitates rapid dissemination of communications • Allows social and political advocacy 	<ul style="list-style-type: none"> • Privacy and security concerns • Variable accessibility of mainstream platforms (e.g., Facebook, LinkedIn, MySpace) • Learning curve (too complicated) • Network issue: none of my friends use • Excludes those not familiar or comfortable with social media

Table 4. Facilitators and Barriers: Focus Groups (continued)

Vector	Facilitators	Barriers
Immersive digital environments	<ul style="list-style-type: none"> • Workplace applications primarily education and training oriented • New kinds of community • Space for collaboration and group meetings • Choice of self-representation • Entrepreneurship opportunities • Minimal barriers for some types of disability 	<ul style="list-style-type: none"> • Complex and somewhat inaccessible interfaces • Requires more sophisticated computers and broadband access • Dynamic multimedia features often incompatible with AT • Privacy and security concerns • Gaming communities can be insular • Little effect on nonwhite-collar work
Open source	<ul style="list-style-type: none"> • Some products (e.g., Firefox) well-known and respected by end-users • Products widely deployed in technical business settings • Highly adaptable/modifiable for business purposes • Development by individuals and small enterprises common 	<ul style="list-style-type: none"> • As employment vector, requires substantial technical skills • Accessibility not well developed • Not as “user friendly” as commercial products • Product and business model not well understood • Primary use still “back-end” infrastructure rather than user oriented

Table 4. Facilitators and Barriers: Focus Groups (continued)

Vector	Facilitators	Barriers
Peer publishing	<ul style="list-style-type: none"> • Rapid dissemination and immediacy • Increased diversity in “voices” • New viewpoints and opportunities for exchange of ideas • Blogs for personal and career development • Potential for new kinds of business based on information aggregations and packaging • Useful for training and reference purposes both intra and extra workplace • Creative opportunities and new media venues (e.g., YouTube) 	<ul style="list-style-type: none"> • Highly specialized audiences • Many channels/much competition reduces revenue opportunities • Tends to exclude “nonsavvy users” • High literacy, education and tech savvy often required in order to publish • Can be resource and equipment intensive • Potential privacy issues

Facilitators

Facilitators (or opportunities) can be classified into several broad categories: regulatory/policy facilitators, market mechanisms, and outreach/awareness facilitators (Baker and Moon, 2008).

Policy and Regulatory Facilitators

Policy and regulations in this field address many issues and take many forms. While participants only tangentially touched upon these considerations, they did make comments that suggest external (public-sector) interventions could be helpful in specific circumstances.

Market Mechanisms

Historically, much of the focus on the deployment of technologies that have use for people with disabilities were on specialized “assistive technologies”—specific products designed for a limited portion of the population, namely, those people with disabilities. One of the characteristics of the digital vector technologies is the malleability of the control or user interfaces, rendered possible by software. Further, with the aging of the population, vector technologies can affect a larger portion of the population, and hence awareness of the vectors and the capabilities grows. The growth in the market for as well as the availability of vector technologies creates opportunities for diffusion of these technologies into the workplace, and to end-users.

Outreach/Awareness

This category has a variety of dimensions. For instance, vector technologies can facilitate more efficient information sharing among users who would otherwise have difficulty using conventional means of communication. In terms of innovative deployment of vector technologies, inefficient dissemination of information regarding vector technologies, products, and methodologies continues to be a barrier to the effective delivery, use, and understanding of such technology. Outreach and awareness are vital to successful use.

Barriers

Previous work by the Center for Advanced Communications Policy (CACP), among others, suggests that barriers (as well as opportunities or facilitators) can be classified into several broad categories: awareness, economic, technological, and organizational (Baker and Moon, 2008).

The factors include issues of accessibility/form, awareness, organizational inertia and barriers, steep learning curves and privacy, and cost and perceptions of cost in using and adopting the technologies. A primary concern associated with the technology vectors by people with disabilities occurs along several dimensions, including the following:

Accessibility/Form

Again, one of the most surprising findings was that three-fourths of the participants who were blind or had low vision actually preferred the iPhone as being accessible, notwithstanding the visual menus. Participants mentioned that issues of accessibility were not always, in reality, what researchers assumed. Accessibility represents a real, as well as a virtual, barrier. The real barrier is the literal inaccessibility of the technology, as well as the physical inaccessibility of technology (e.g., keyboard being too small on smart phones, new interface/operating system technologies that render screen readers inoperable, inaccessible interfaces). The virtual barrier, as noted by some of the group participants, can occur on the part of decision-maker or other stakeholders that make assumptions about people with disabilities, or the utilities of specific vectors, without entering into full consultation with the affected stakeholders.

Awareness

Lack of awareness that a given technology exists, or of the characteristics and capabilities of the technology or its possible benefits, came up peripherally in group discussions. However, this lack of awareness holds true on the part of the employer and the employee, or user of the technology. Awareness of technology and a user's proficiency with a technology constitutes a key barrier to use of vector technologies.

Based on the focus group input, however, it appears as if the deployment barrier is a great issue on the supply side (that is, the employer) rather than on the employee.

Cost/technological Change

Because vector technologies are in a state of continual change and innovation, keeping up with the volume of new products and technologies is problematic. In addition to lacking consistent channels of communicating about accessibility advances in vector technology, assessment of these new products is infrequently undertaken without consideration of the specialized needs and requirements of people with disabilities. As a result, employers may be unaware of the availability of vector technologies, or make inaccurate assumptions about the cost of deployment of these technologies.

Organizational Inertia and Barriers

This dimension includes the lack of use of technologies (such as smart phones) to help mitigate a disability or limitation because the technologies' use does not fit into the protocols or practices of the employer.

Summary

While all participants were generally familiar with the range of digital technologies (vectors) represented, there was a rather significant difference among the three groups, which we believe to be a function of the disability-related characteristics of the different groups. Not unexpectedly, the most commonly mentioned technology related to wireless communications platforms was the smart phone. Perhaps because of their "personal" nature, such mobile devices are used more as communication devices rather than "work tools," as opposed to "office" equipment such as computers that can be thought of as relatively ubiquitous, but attached to the workplace.

One topic that several participants felt strongly about, which we did not anticipate, was telework, referring to the application of new technologies rather than the underlying technologies per se. Most participants spend a sizable portion of their workweek on a computer. Teleworking was seen as a way to avoid numerous difficulties getting to and from the office, as well as allowing for more flexibility of accommodations using equipment

at home. One participant spoke passionately about the larger effect on society that greater acceptance of teleworking could have, such as reduced traffic congestion and environmental impact. “Teleworking is also seen as an equalizer because it eschews face-to-face communication in favor of text or voice. No one has to know if you have a disability. The only things that matter in this scenario are the results.” This point suggests that a key aspect of the use of the digital vectors relate to the context in which they are deployed as well as to the vectors as free-standing technologies.

Technologies that allowed the user to control the interaction, or made information more manageable (wireless platforms, social media) or had reference utility (open peer publishing), were perceived to have the most use, and believed to be the technologies most immediately able to increase workplace engagement, and hence opportunity. There was familiarity with IDEs (virtual worlds and tiered digital interactions), but these were not seen as particularly engaging other than recreationally. The applications were seen to have potential as new kinds of employment, but the enthusiasm for this aspect was somewhat muted, suggesting that this might be an avenue that could be developed via outreach and awareness efforts. Finally, open-source applications were generally familiar technologies to the participants, but as a technology that ran more in the background (“workplace infrastructure”). Overall, it can be concluded that, at least based on the self-selected participants, many of the digital technologies covered in the study are familiar to technologically savvy people with disabilities, and we infer that barriers to use of these are as much a workplace and employer issue as resistance on the part of employees. With respect to new vectors for employment opportunities, we believe that there is employment potential, but that the barriers here are a combination of a disconnect with the technical skill set required to produce these technologies (as opposed to use them), as well as the absence of widespread established locales for the convenient participation in these technologies and new employment sectors.

5.3. Online Social-Network Groups: Introduction and Description

Two different approaches were undertaken to explore the use of social networking and online participation as part of the user studies component of NCD’s research. Based on a demographic analysis of platform use and characteristics, two venues were chosen for

analysis as part of the user studies: Facebook and LinkedIn. Several groups were developed. A Facebook group, “The Inclusive Digital Media Network,” was implemented: www.facebook.com/group.php?gid=114027775278860. At the time of this report, the group has 52 members. A mirror group was established about two months later on LinkedIn, partly as a means of comparing how the different platforms (and focuses) affect the use of social networking.

Also, to triangulate the use of the groups with the general characteristics of the platforms, the research team conducted a census of the group landscapes in both LinkedIn and Facebook with regards to employment focus. The most pervasive groups in both platforms were general (not specific to employment). LinkedIn had more groups that pertained specifically to employment than did Facebook. A telling result was that employment groups comprise less than 1 percent of the total groups in both Facebook and LinkedIn (.004 percent and .00003 percent, respectively).

5.3.1. Analysis

A look at the individual platforms gave rise to some interesting observations. Within Facebook, a majority (73 percent) of groups are generally focused on community discussions, not on specific activities or individual sectors, as shown in Figure 1. Within Facebook, disability-specific groups represented only 2 percent of the total groups returned in the search.

Another interesting outcome of this high-level census study was that employment-based groups, while mainly focused within the United States, are also available worldwide. Within the LinkedIn platform, Israel was the second most common country returned, with the United Kingdom and Canada following closely behind. Within Facebook, South Africa returned high results, whereas in LinkedIn there were no returns.

This reinforces the sentiments expressed above about understanding context – Facebook is the preferred social platform in South Africa (ranking as the second most visited Web site as compared to LinkedIn, which is fourteenth). Context is important in guiding people to where their potential audiences are.²²

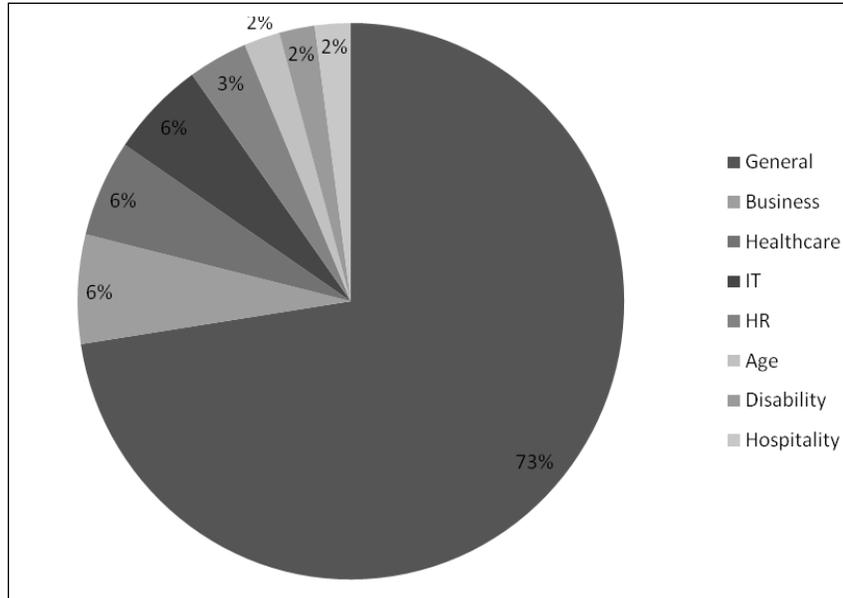


Figure 5. Facebook Employment Groups, by Category

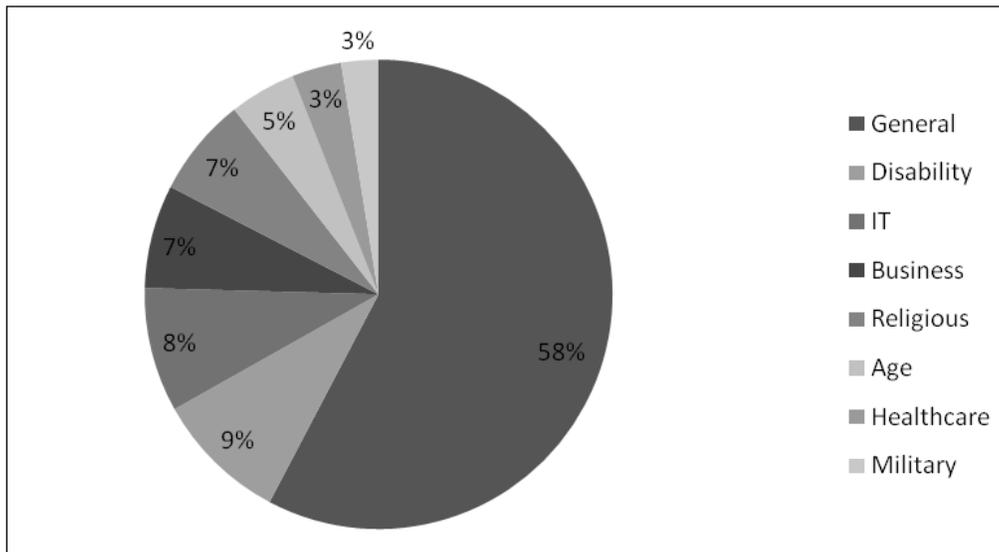


Figure 6. LinkedIn Employment Groups, by Category

Looking at the same figures, but on the LinkedIn platform, it is evident that the majority (58 percent) of groups are general, as shown in Figure 2. There are much larger swaths of sector-focused employment groups: people with disabilities represent the second largest (8.98 percent) of employment groups, followed by the IT industry. This

observation reflects the stronger business orientation of LinkedIn versus the community and personal orientation of Facebook.

Because of the greater representation of disability-related groups on LinkedIn, the team performed a more in-depth analysis of groups with both employment- and disability-related themes. The results generated by the search function were grouped within one of three types of entities: Networking groups (62.5 percent), nonprofit groups (15.6 percent), and professional groups (21.9 percent). These groups focused mostly on the dissemination of best practices and opportunities available within the community. Some focused on coaching and assistance or placement within jobs. Even fewer groups focused on a hybrid of advocacy plus support. There was a group (Colorss Foundation) focused on a location (India), where there were opportunities for training and finding employment. Another interesting discovery was that 66 percent of all groups were established within the last 18 months, suggesting an increase in awareness and utility of group participation.

Employment groups are defined as groups with a mission or description of dealing with employment issues, including job placement, advocacy groups, employment-focused networking groups, and dissemination of best practices. These groups were found using specific key terms within the built-in search function of both platforms. The research team observed that general groups were the most pervasive in both platforms. We discovered that LinkedIn had more groups that pertained specifically to employment than did Facebook. What is also evident from this survey is that employment groups make up less than 1 percent of the total groups in both Facebook and LinkedIn (.004 percent and .00003 percent, respectively).

**Table 5. Geo-Location of Returned Group Search
in the Facebook and LinkedIn Platforms**

	LinkedIn	Facebook	TOTAL
United States	294	45	339
Global	48	14	62
United Kingdom	16	30	46
Israel	21	3	24
Canada	17	6	23
South Africa	0	16	16
Australia/New Zealand	8	5	13
Europe	7	0	7
Egypt	0	6	6
MidEast	3	3	6
India	4	1	5
Saudi Arabia	2	2	4
Japan	3	1	4
Pakistan	0	3	3
Malaysia	1	2	3
Philippines	2	1	3
Asia	3	0	3
Indonesia	0	2	2
Nigeria	0	2	2
Finland	1	1	2
China	2	0	2
South America	2	0	2

This brief review highlighted the potential for using social networks as a platform to bring people together for multiple reasons, including general employment as well as more specific employment opportunities. Generally, certain sectors like information technology, health care, and human resources are represented within this domain, but in the LinkedIn platform, the disability group was more represented. This should be a clear indication that people with disabilities are actively seeking these types of outlets, who should be used more by the community at large.

5.3.2. Facilitators and Barriers

The research team's look at the test groups on Facebook and LinkedIn shows that group activity and use have been less than expected; however, we have drawn several conclusions from our observations to date. Most of the posts and comments have been by professionals involved in electronic accessibility and technology. Thus, the group on Facebook functions more as a newsletter than an interactive group. One of the critical components of adoption is the context (community) in which the use takes place, which may be as important as the technology itself. We view this both as a barrier (in this case, the additional aspects needed to build and maintain a community) and an opportunity (the incredible power of social networking combined with the crowd-sourcing potential). Within this context, a common ethos, or catalyst, is needed that motivates individuals to actively engage and participate in the sub-community (group) in question. If this is achieved, as evidenced by the group research discussed below, the context and platform cease to be barriers, and instead become an opportunity for communication.

Another observation is that, as evidenced by the membership of the two test groups, getting people to join is not the key barrier; rather, it is the process of encouraging, "feeding," and sustaining active group participation. This may be an issue of generating sufficient "critical mass" in terms of membership, or the catalytic role of a specific individual or individuals who generate activity. At a minimum, it appears as if successful groups, absent a self-sustaining level of activity, require a moderator to serve as "yeast," to keep activity fermenting, and adding new material that captures

the attention of group participants. Again, this finding might also relate to the nature of the group (i.e., professional, technical, issue oriented, user, advocacy), and the end to which it was designed.

Evidence from the literature (see, for example, Conceição et al, 2009) suggests that social media are tremendously effective at some types of community social and cultural activity, and therefore have use in workplaces as educational, training, and informative venues (internally) and also for maintaining certain types of community and marketing (for instance, the growing role of social media-driven marketing) for business purposes.

Iteratively, when exploring the use of social media on two platforms (Facebook and LinkedIn), we see replicated the occurrence of several different patterns of use, not uncharacteristic of any digital technology. Much of the activity, posts, and comments have been by professionals involved in e-accessibility and technology, at least in regard to technological use and workplaces, though this might be a selection factor of how the groups were developed and populated. A common purpose or catalyst is needed that motivates individuals to actively engage and participate. This may be an issue of generating sufficient “critical mass” in terms of membership, or the catalytic role of a specific individual or individuals that generate activity. Social media are tremendously effective at some types of community social and cultural activity, and therefore have use in the workplaces as educational, training, and informative venues (internally) and also for maintaining certain types of community and marketing (for instance, the growing role of social media driven marketing) for business purposes.

Table 6. Facilitators and Barriers—Section 5

Activity	Facilitators	Barriers
General social-networking sites	<ul style="list-style-type: none"> • Low barrier to entry • Cost effective—usually small or nonexistence costs for using platforms • Easy to search and find connections • Easily accessed via mobile networks • Integration of sensor nodes (e.g., GPS) for greater immersion 	<ul style="list-style-type: none"> • Privacy and security concerns • Maintenance/sustainability (time-cost) • Dependent on certain social skills • Conflation of personal and private activity • Too much information; figuring out relevance and truth
Social networking through mediated channels	<ul style="list-style-type: none"> • Greater return on investment of time—a post on the mediated channel will link this to any social-networking site linked • Choice of self-representation • Easily accessed via mobile networks 	<ul style="list-style-type: none"> • Privacy and security concerns • Dilution of presence due to overexposure • Different platforms have different norms of language and practice that could dilute the effect of the message

Table 6. Facilitators and Barriers—Section 5 (continued)

Activity	Facilitators	Barriers
Social networking through mediated channels (continued)	<ul style="list-style-type: none"> • Easy to manage multiple social-network identities at one time • Low barrier to entry • Integration of sensor nodes (e.g., GPS) for greater immersion 	
Social networking in terms of advocacy	<ul style="list-style-type: none"> • Easy for audience to find groups • Easy channel for groups to communicate with participants • Low barrier to entry • Low tech savvy required in order to contribute • Cost effective (small costs may be incurred setting up a professional or group account, but more often there is no cost) 	<ul style="list-style-type: none"> • Difficult to manage dialogues and inputs from other individuals • Privacy and security concerns • Maintaining current content and cohesive message while integrated into a dynamic existence • Establishing a group does not equal establishing a community

5.3.3. Summary

Social media seem to have several broad patterns of use, generally, which is not particularly different among people with disabilities. Much of the activity, posts, and comments have been by professionals involved in e-accessibility and technology, at least in regard to technological use and workplaces. We did not do an assay of groups that were specifically oriented to disability advocacy, so the conclusions are limited to general-purpose platforms as opposed to discussions (social media and networking) that occur on

Web 2.0 special-purpose Web sites. Additionally, a good deal of more traditional social networking (e.g., listservs, emails) occurs, which again is beyond the focus of this study.

One of the critical components of adoption or use of groups is the context (community) in which the use takes place, which may be as important as the technology itself. Within this context, a common purpose or catalyst is needed that motivates individuals to actively engage and participate. This may be an issue of generating sufficient “critical mass” in terms of membership, or the catalytic role of a specific individual or individuals that generate activity. Social media are tremendously effective at some types of community social and cultural activity, and therefore have use in the workplace as educational, training, and informative venues (internally) and also for maintaining certain types of community and marketing (for instance, the growing role of social media-driven marketing) business purposes.

5.4. Delphi Study: Introduction and Description

Findings from the focus groups became part of a Delphi study, a variation of iterative nominal group technique (NGT) and decision-making method for establishing consensus on a given issue (Delbecq and VandeVen, 1971; VandeVen and Delbecq, 1974). In this case, the specific application of NGT is the Delphi process, which allows for an open-ended, participatory means to develop solutions to a problem. The process combines the complexity and nuance of group discussion with the immediacy of voting. For ill-structured or complex problems, where ideas or solutions may not be directly relevant to the problem under consideration, the Delphi process can be adapted by clustering ideas into coherent groups, which are then treated as problems in their own right. The Delphi, as is characteristic of NGT, is applied to these subproblems, with the aim of working back to or referencing the original problem (Bartunek and Murnighan, 1984). While Delphis in general tend to focus on finding a solution to a single problem at hand, the complexity of our study of accessibility of online technologies suggested that an iterative approach would be more germane, where the results of one Delphi round

may inform a follow-up Delphi round. The “iterative” nature of study was derived from issue-driven Delphi technique, useful for discerning views on pertinent policy issues.

The CACP’s successful use of the policy Delphi method in research projects for the Wireless RERC and Workplace Accommodations RERC, as well as its use of other qualitative research instruments such as the NCD study’s Delphi, provided an experiential basis for the proposed Subtask D.2.

As implemented in the NCD study, invitations were issued to target (expert) stakeholders describing the project focus and the process to be undertaken. This email was then selectively forwarded to existing contact lists maintained by CATEA, as well as to a target range of groups on LinkedIn and Facebook. The largest list is maintained by the WorkRERC, and includes over 1,500 organization representatives and individuals with an interest in research relating to disability in the workplace. In addition, contacts at the National Science Foundation and Syracuse University were forwarded information on the project, which was then passed on to contacts of their own.

Three rounds were conducted with targeted participants totaling about 30 individuals. The study, run over about 12 weeks, consisted of between 10 and 20 closed and open-ended probe questions on the vectors analyzed and restated during the three rounds based on (expert) participant input. The areas were 1) applicability of digital technologies to work, 2) awareness, 3) affordability, 4) accessibility, and 5) adoption. The sample frame was purposive: invitations were sent to those who expressed interest and drawn from 1) informed sources and CATEA emailing lists, and from 2) a range of technology-focused groups on LinkedIn. The target participants were experts familiar with the various vectors or accessibility issues related to digital technologies.

The major findings of the Delphi study include:

- A belief that technology will become more important to employment, as well as a belief in the idea that increased use of accessible digital technologies will increase employment opportunities for people with disabilities.

- Universal (inclusive) design was viewed by most of the Delphi panel as a way to achieve goals of greater accessibility for people with disabilities where digital technologies are concerned.
- Adequate marketing of accessibility features, especially those “built-in” to mainstream devices, was perceived as a major awareness problem by most of the Delphi participants.
- Populations “aging into disability” and their potential to shape markets for accessible digital devices were viewed as vitally important among the Delphi panel.
- Delphi respondents were divided on how competing concerns of accessibility mandates and voluntary, market-based solutions could be balanced to ensure optimal adoption and usability. Half of the panelists believed the two concerns could be managed, while the other half expressed concerns that these issues could be resolved satisfactorily.
- Employer-side issues, such as workplace technology policies and a lack of organizational flexibility, were viewed by much of the Delphi panel as potential barriers to the adoption of novel, accessible technologies.
- Social-networking Web sites and applications received relatively strong support for their potential in the workplace, especially for collaboration.
- Open-source software applications also received strong support from much of the Delphi panel, which pointed to the fact that accessibility features could be developed through user participation.
- Virtual-worlds applications received moderate, but mixed, support from Delphi participants regarding their potential for improving or enhancing the employment of people with disabilities.
- Gaming applications, especially those for entertainment, did not receive much support among respondents regarding their potential for enhancing the employment of people with disabilities.

- Online peer publications, notably blogging or wikis, received mixed support from much of the Delphi panel regarding the employment of people with disabilities.

5.4.1. Analysis

The first round of the Delphi established respondents' overall views on five categories related to digital technologies for people with disabilities: applicability, awareness, affordability, accessibility, and adoption. Building on the results to these questions, the second round examined specific digital vectors in greater detail and sought to clarify opinions from the first round. Finally, the third round distilled the findings of the first two rounds into a summary of conclusions and recommendations, which were presented to the Delphi panel for their comment. Throughout the entire Delphi process, the relevance of digital technologies to the employment of people with disabilities was a prominent theme. As one participant observed: To be competitive in the employment arena, people with disabilities must be able to access and work with all information available to people without disabilities, and that access needs to be affordable.

In the first round, respondents agreed strongly with forecasts that technology will become more important to employment, as well as the idea that increased use of digital technologies will increase employment opportunities for people with disabilities. Of the five aforementioned categories, awareness received the greatest amount of interest. Participants expressed particular concern about the possibility that people with disabilities are not aware of how digital technologies may be used to help locate work opportunities or be used as workplace accommodations. The adoption of technology, also viewed as important, was perceived as hinging on both its accessibility and affordability. Of these two, the Delphi panel seemed to prioritize affordability as slightly more important.

Regarding the applicability of digital technologies to the workplace, almost 90 percent of respondents believed that jobs will increasingly depend on broadband access, and an even higher proportion, 95 percent, believed that work tasks will become more reliant on

digital technologies. Regarding disability, 79 percent believed that the increased use of accessible digital technologies will increase employment opportunities for people with disabilities. However, when queried about specific technologies and their potential for people with disabilities, the Delphi panel became more divided. The highest proportion, 63 percent, believed that wireless communications would open job opportunities. A slim majority (53 percent) expressed confidence in peer-driven publishing to create job opportunities. In terms of changing the employment environment more broadly, it is worth noting that 63 percent of participants believed that blogging and other forms of online communication would do so. There was less confidence in projections for other technologies to open job opportunities. Only 42 percent believed that open-source applications and processes would do so, and even fewer were confident in projections for social networking (37 percent), virtual worlds (26 percent), and electronic games for entertainment (26 percent). However, 50 percent did note that gaming for serious purposes would open job opportunities for people with disabilities.

Delphi participants expressed significant ambivalence about the awareness of people with disabilities. Only 16 percent believed that people with disabilities were aware of the uses of digital technologies for finding employment, and only 16 percent believed that they were aware of how these technologies could be used to enhance the workplace. However, respondents' awareness concerns were not limited solely to individuals with disabilities. An overwhelming majority, 89 percent, believed it important that manufacturers' and designers' unawareness of accessibility issues be addressed.

Regarding affordability of digital technologies, Delphi participants strongly agreed that it was important. Of particular concern was the observation that the cost of wireless communication devices such as smart phones may be prohibitively high for people with disabilities—95 percent of respondents believed it to be important and should be addressed. There was similar concern over the affordability of assistive technology such as the JAWS screen reader, as 90 percent of the panel also believed it to be an important issue. Finally, 90 percent of participants believed perceived training costs for employees in the workplace were important and should be addressed.

Delphi respondents were somewhat divided on the issue of accessibility of digital communications. A strong majority, 89 percent, believed that the issue of device incompatibility was important and needed to be addressed. However, a significantly smaller proportion, 50 percent, agreed with the projection that attention to accessibility will increase as the population of people with disabilities goes up.

The final category in round 1 probed several projections on the adoption of communications technologies. A slight majority of participants, 57 percent, believed that the adoption of inclusive digital technologies in the workplace will increase in the future. When asked about factors that would lead to increased adoption, almost 95 percent believed that increased affordability would do so. Almost as many respondents, 84 percent, believed that increased accessibility would be matched by increased adoption. Finally, participants were asked, “What policy options would be most effective at promoting sustainable adoption of digital technologies by people with disabilities?” Answers ranged from better enforcement of existing laws and adoption of stronger ones to the provision of training, information, or other supports to select or use technologies. More specific answers included having employer accommodation policies that were formalized or written to address technology explicitly. Others pointed to the possibility of fostering universal design. Yet, the problem of individualized needs or specialized markets remained a constant issue.

Round 2 of the Delphi focused more closely on specific vectors, while retaining much of the same organizational structure that drove round 1. On the whole, Delphi participants were more divided in this round, but they agreed most strongly on the importance of marketing of accessibility features and the need to design for an expanding population of people “aging into disability.” In both instances, and throughout this round, universal (inclusive) design was viewed as the optimal means for achieving these goals, especially given its potential to offset the high costs associated with assistive technology. The potential of employer policies to hinder the adoption of novel accessible technologies was also viewed as a concern by most participants. In terms of the individual vectors, those items involving social networking and, especially, open-source

software received the broadest base of agreement. By contrast, questions pertaining to blogging and gaming did not have as much support. In open-ended responses, participants consistently pointed to the possibilities of virtual environments and open-source software.

On the issue of how digital vectors might be deployed by people with disabilities in the workplace, we closely examined employer-side factors as possible barriers to their adoption. Regarding the role of employer work rules and the lack of an organization's flexibility in possibly inhibiting the adoption of novel digital technologies in the workplace, 60 percent of participants (those answering either "extremely" or "mostly") viewed this issue as important. The same proportion of participants believed it important that employer technology policies (i.e., permissible operating systems) are key barriers to the adoption of accessible digital technologies in the workplace. Probing the issue of digital technologies and the workplace further, researchers asked what applications offered the greatest potential for enhancing work opportunities for people with disabilities. Many participants believed that collaboration is an important application. Telework and remote-work opportunities and accessible Web conferencing were most widely cited as technologies. Alternative means for computer input and output were also mentioned frequently, and open-source assistive technology and social networking were mentioned somewhat less.

Returning again to the issue of awareness, 90 percent of the Delphi panel agreed on the reliability of a projection that manufacturers and designers would develop more universally designed technologies as the general population "ages into disability." Regarding the importance of issues put forth for their consideration, however, respondents were decidedly mixed in their assessment. Many members (70 percent) believed it important that manufacturers and designers may not be adequately marketing the built-in accessibility features of their products or services. The same proportion also believed that the use of social networking to facilitate work opportunities is important. However, two other issues (one on the technical skills of people with disabilities and another on blog authorship) failed to receive a majority of support.

A forecast on affordability in general elicited strong support from the Delphi panel. In response to the issue of comparatively smaller markets for assistive technologies and higher prices as a result, 90 percent believed it reliable that accessibility features implemented within universally designed devices would help offset this problem of affordability for individual consumers with disabilities. However, participants were divided on issues related to specific technologies. In the area of open source, 70 percent of respondents believed it reliable that increased availability, in which accessibility features can be developed through user participation, will create work opportunities for users with disabilities. Conversely, only 20 percent of the Delphi panel believed it important that the cost of online gaming platforms and virtual worlds be addressed. Public-sector (i.e., government) incentives, such as tax credits, subsidies, and grants, are frequently suggested to make digital technologies and services more affordable for people with disabilities. In response, we asked what private-sector initiatives might also assist in lowering costs for consumers. The most common response was a need for manufacturers and designers to take a universal (inclusive) design approach to their products. Other notable responses included the promotion of best practices by manufacturer associations, private–public partnerships, and involvement of consumers with disabilities in research and development.

In the area of accessibility, there was relatively strong support for the items presented. A big majority of participants (80 percent) believed that the lack of underlying technical skills as a barrier to entrepreneurial activity in the digital vectors was an important issue. In addition, 70 percent thought increased graphical elements mean that more people who are blind or have low vision may be excluded from technological advances.

Delphi Round 3

In the third and final round of the Delphi study, we presented a summary of findings from the first two rounds of the Delphi in the form of four sections. The sections included an overall consideration of the major issues, as well as discussions of social-networking and wireless platforms, immersive digital environments, and commons-based peer

production. After each section, respondents were asked to comment on the findings of each section.

In our first item, we asked panelists to respond to the observation that digital technologies would become increasingly important to the employment of people with disabilities. In particular, we sought input on universal design as the optimal means for achieving accessibility goals, as well as insights on persisting barriers such as employer policies.

All of the respondents agreed on the importance of universal design in achieving accessibility for people with disabilities. One participant went further to note that UD approaches were fundamental precisely because of a lack of access to and the expense of adaptive technologies. Another observed that UD needed to extend beyond the information communication technologies (ICTs) of the workplace, in order to address large-scale systems that are frequently inaccessible to people with disabilities.

Several panelists also pointed to a need to mitigate ongoing employer-side barriers. Of concern to one respondent was the divide between workplace policies, especially those implemented with security in mind, versus approaches such as telework that can enhance access for employees with disabilities. Another panelist spoke of a need for formalized employer policies to actively engage IT rules and ensure access. Several other issues arose—of particular note was a concern that an orientation toward social networking might overshadow the continued importance of education and credential building.

Next, we asked respondents to comment on social networking and the platforms it operates on. *Panelists generally confirmed the usefulness of social networking for employment by people with disabilities.* However, some respondents expressed caveats about a dearth of fully accessible social networking Web sites and ongoing accessibility problems with many others. It was pointed out, however, that developers are beginning to address these issues. Toward those ends, one panelist stressed the need to educate

the programmers of both platforms and user interfaces about how to make graphical elements accessible.

We then asked the Delphi panel to respond to mixed support for the role of immersive digital environments. While virtual-world applications did receive support for their role in improving work for people with disabilities, electronic games failed to receive support. *Respondents were decisively split on the role that virtual-world applications could play.* One respondent opted out of the discussion because of a lack of sufficient knowledge on the topic. Two respondents agreed that virtual worlds do not add sufficient value to the employment of people with disabilities. One of them went further to note that virtual worlds will not play a significant role in the workplace for some time. For that reason, effort should be placed first into making more accessible those applications and platforms with more practical employment applications. Two other respondents countered these views, contending that these worlds are often inclusive.

Finally, we asked for comment on the potential of commons-based peer production to improve employment for people with disabilities. *In general, the Delphi panel expressed some support for these vectors, but with major caveats.* While there might be some potential for open-source, blogging, and similar vectors to improve employment for people with disabilities, one panelist noted that the potential was not substantial. Another noted that there was potential, but that these areas need further development. Yet another respondent expressed some support for the role of blogging and participatory communications to improving interaction and perhaps opening economic opportunities. This person's optimism did not extend to open source, however. Another respondent had the opposite response, believing that open source had more potential for improving employment.

In conclusion, the third round of the Delphi generally confirmed the four major findings from the preceding two rounds. Universal design remains an important strategy for improving accessibility of ICTs, and it is pivotal that employer-side barriers are also addressed. Social networking may be important to improving employment for people with disabilities, provided that barriers to the accessibility of these platforms are

addressed. The potential of immersive digital environments is still unclear—they may support inclusivity, but their current utility and significance has been called into doubt. Finally, there is some sense that commons-based peer production may improve employment, but there is still a lack of consensus about how.

5.4.2. Facilitators and Barriers

In terms of the individual vectors, those items involving social networking and, especially, open-source software received the broadest base of agreement. By contrast, questions pertaining to blogging and gaming did not have as much support. In open-ended responses, participants consistently pointed to the possibilities of virtual environments and open-source software.

Regarding open source, we inquired whether it fostered more accessible development, and if so, how. Half of respondents believed that it does. Reasons given included the ability of user-developers to develop more inventive solutions that might have been missed by companies, the fact that people with disabilities are working with open-source software, and low economic barriers. A notable minority believed open source might spur more accessible development, but it remains critical to communicate with end-users about accessibility, and the conflation of digital and visual continues to be problematic. A couple of participants replied that open source did not help, on the grounds that the percentage of people with disabilities contributing to open-source developments is small.

We also asked what might make using virtual worlds more compelling than traditional collaborative 2-D Web spaces. The most popular responses were the facilitation of real-world characteristics, such as talking instead of texting, in virtual environments, as well as their ease of access and use. Other responses included the ability of virtual worlds to allow for distance collaboration and the use of avatars to overcome others' initial misconceptions about a person's disability. At least one respondent believed that virtual worlds were not more compelling, finding them to be isolating.

5.5. Summary

Across the different user studies, participants were generally familiar with the range of digital technologies represented, and some general agreement existed with respect to the utility and use of the vectors. There was a significant difference in perception of the vectors when taking into account the nature of the disability and the degree of familiarity with a particular technological pathway. Not unexpectedly, the most familiar vector was wireless communication platforms, in particular smart phones.

One topic that several participants felt strongly about was telework, referring to the application of new technologies. Teleworking was seen as a way to avoid numerous difficulties getting to and from the office, as well as to take advantage of the convenience of using equipment at home.

Vectors that allowed the user to control the interaction, or made information more manageable (wireless platforms, social media) or had reference utility (open/peer publishing), were perceived to have the most use, and the most immediately able to increase workplace engagement, and hence opportunity. There was limited familiarity with immersive digital environments, both virtual worlds and gaming, but these were seen as essentially recreational, although having potential for offering new kinds of employment. Open-source applications were generally familiar to the participants, but as a technology that ran in the background, a kind of “workplace infrastructure.”

Overall, the vectors were familiar to technologically savvy people with disabilities among the self-selected participants, and we infer that any barriers to their use that may exist are as much a workplace and employer issue as resistance on the part of employees. As regards employment opportunities, the participants could in most cases see the potential of at least some of the vectors, but the barriers seem to be questions of the level of education or understanding necessary to participate in the work opportunities suggested, and of convenience in terms of local availability of possible employment.

Drawing from expert opinions, preliminary Delphi analysis suggests that in general respondents agreed that digital technology and its applications, as represented by the vectors, will become more important to employment. The analysis also showed that respondents agreed that increased use of accessible digital technologies will increase employment opportunities for people with disabilities. Universal (inclusive) design was viewed as the optimal means for achieving accessibility goals, especially given its potential to offset the high costs associated with assistive technology. The potential of employer policies to hinder the adoption of novel accessible technologies was also viewed as a concern by most participants.

Social networking and, especially, open-source software received the broadest base of agreement as to useful digital technologies for employment purposes. Immersive digital environments and open/peer publishing did not have as much support. However, in open-ended responses, participants consistently pointed to the possibilities of virtual environments and open-source software, especially in the context of new work opportunities.

SECTION 6. **Analysis of Facilitators and Barriers, Findings and Recommendations**

6.1. Analysis of Facilitators and Barriers

For each of the original research sections of the report, summary charts identifying “facilitators” and “barriers” were prepared. The intention was to prepare a grid of perceptions of how the vectors could either support people with disabilities in the workplace or in the search for work opportunities, or might block them in those endeavors. Some commonalities in those perceptions emerged, and are described below. Notably, there were more facilitators held in common than there were barriers.

In looking at the environment from which the vectors spring—the Internet and digital technology as the underpinnings of the networked economy—there was one constant, and it was clearly a barrier: the cost of connectivity, as well as of hardware and software. This is a fundamental issue. For people with disabilities there are significant issues of affordability and accessibility that lead to low broadband adoption rates, and for some make the promise of the vectors remote. According to the 2010 FCC report, *A Giant Leap and a Big Deal: Delivering on the Promise of Equal Access to Broadband for People with Disabilities*, only 42 percent of people with disabilities have broadband in the home compared to the national average of 65 percent.

It is therefore no surprise when “high costs and fees” and “need for wireless Internet access” are mentioned in several of the grids as barriers to the usefulness of Vector 1, wireless communication platforms. However, there was a common appreciation of the fact that the platforms offered more communication options, especially for people with sensory difficulties, and that electronic schedulers and PDAs can be helpful for people with intellectual or information-processing disabilities.

For Vector 2, social networking, it was also not surprising that various aspects of networking emerged as common themes, including “ability to share large amounts of

information and data,” “making connections,” and “access to information and advice for problem resolution,” as well as connecting for specific work or education functions. However, another strong negative constant was seen: privacy and security—concerns that may have a special force for people with disabilities who may feel themselves more than usually vulnerable.

Vectors 3 and 4, immersive digital environments, were somewhat of a surprise, as they had the most positive responses in common of all the vectors. Facilitators ranged from the predictable—“removes constraints of the physical work environment” and “choice of self-representation”—to the thought-provoking, including entrepreneurship, education and training opportunities, and space for collaboration and group meetings. Negatives again touched on privacy and security concerns, the steep learning curves that gaming and virtual worlds sometimes require, and the need to access high computing power and fast, powerful networks.

Vector 5, open or peer publishing, also elicited a higher range of common themes. The need for high rates of literacy, education, and tech savvy was seen a potential drawback, as were, again, high costs and fees; however, there was an appreciation of the disintermediation that commons-based publishing implies, from the possibilities that open up for catering to niche interests, including those of people with disabilities, and in particular a surprise vote for blogs for personal and career development.

Finally, the only barrier seen in common for open-source processes (Vector 6) was the need for “substantial technical skill” or tech savvy, while the promise of this vector was recognized as the diversity of the contribution, the creativity of the solutions, and the access to information, resources, and tools.

It was interesting that these last two vectors, grouped together as commons-based peer production, also were singled out in the exemplar study, where respondents identified this grouping as having great, unexplored potential: the use of open-source processes in business operations, and the use of immersive digital environments for training.

6.2. Findings and Recommendations

The transition to an economy based around the manipulation of information has had a huge effect on employment. This research was designed to investigate what specific relevance the new networked economy might have on the employment prospects for people with disabilities, in the face of an employment situation that has worsened over the past 20 years.

Reports released in July 2010 indicated that people with disabilities continue to be disproportionately negatively affected by the recession (Diament, 2010). According to the Department of Labor, the unemployment rate of people with disabilities has continued to increase, while the employment rate of Americans generally has stabilized and decreased over the past few months. The rate of unemployment for people with disabilities in July 2010 stood at 16.4 percent, compared with 9.5 percent for the general population. This is further reinforcement for the view that people with disabilities are a contingent labor force, first to be let go when industries retrench, and last to be hired when there is industrial growth (Braddock and Bachelder, 1994). Instead of this social exclusion, is there a prospect of digital inclusion?

Finding 1. Old realities remain: the necessity of education to increase awareness and technical skills.

A well-known barrier to realizing the potential of the vectors was education. Lack of education was perceived as a barrier to achieving full employment potential by 20.3 percent of people with disabilities (Yeager et al., 2006). The user studies often interpreted this to mean the need to be “tech savvy,” seemingly a higher level of education than the norm. The Department of Labor as well as some of those interviewed for the exemplars, added a further caveat in looking for new working opportunities and improving on existing ones: the need for flexibility, implying a constant readiness to learn and adapt in order to keep abreast of a situation that is ever changing.

At the same time, Vector 3, serious gaming, may be part of the solution, by making education and training more appealing to those who consider traditional classroom training beyond endurance or otherwise unmanageable (Horton, 2003), which could be helpful for people with intellectual and learning disabilities.

- **Recommendation 1: Develop model programs to tackle the core issues of education in conjunction with key stakeholders at the federal, state, and local level.**

We recommend that the Department of Education (Office of Special Education and Rehabilitative Services and Office of Special Education Programs) work in conjunction with the National Institute for Disability and Rehabilitation Research (NIDRR), the Institute of Education Sciences, the Department of Labor (Office of Disability Employment Policy) and the Interagency Committee on Disability Research, as well as other key stakeholders, including members of the business community (e.g., the U.S. Business Leadership Network, U.S. Chamber of Commerce, and Society for Human Resource Management). The aim of the model programs would be to capitalize on the collaborative community-building potential of the networked economy, commit resources, and help prepare people with disabilities to build up appropriate job skills specific to that economy. This is also in accord with recommendations under the National Broadband Plan (<http://www.broadband.gov/plan/13-economic-opportunity/#r13>), which state that “The Department of Labor (DOL) should accelerate and expand efforts to create a robust online platform that delivers virtual employment assistance programs and facilitates individualized job training.”

In addition this is consistent with the Social Security Administrations (SSA) efforts to build web based work incentive sites in the states.

The model programs would encourage the states and local communities to maximize the use of current infrastructure, in particular community and technical colleges (CTC). CTCs offer multiple advantages, most especially closeness, as

the availability of accessible transportation remains a major obstacle for many people with disabilities (Kessler and NOD, 2010). An exemplar of such a program has been developed by the Georgia Institute of Technology, under the title of SIDE (Support and Information for People with Disabilities Employment). SIDE addresses the two core issues of education and accessibility through a program intended to change how people with disabilities seek employment and education through broadband use (see recommendation 2 below). SIDE includes Broadband Learning and Support Centers for broadband education, access, equipment, and support; the SIDE Consolidator Platform, a virtual public/private network that helps people with disabilities connect with employers, as well as advance job skills and education; and a comprehensive awareness campaign to promote the program.

- **Recommendation 2: Develop an accessible online literacy curriculum aimed at people with intellectual disabilities in conjunction with family, self-advocate and service-provider groups.**

We recommend that the Center on Medicare and Medicaid Services (CMS) collaborate with the Federal Communications Commission (FCC) and relevant community organizations to develop a training on online literacy accessible for people with intellectual disabilities. This population of people with disabilities is disproportionately excluded from the economic and social mainstream of American life. Although training is currently available for persons with intellectual disabilities for such tasks as using a telephone and other instrumental activities of daily living, in today's day and age internet usage is an equally important skill set. Such a training program would enhance the ability of a particularly underserved component of the disability community to benefit from the other recommendations of this report and broader efforts to bridge the digital divide.

Finding 2. There are significant barriers to making a dispersed workforce a successful reality for people with disabilities.

The environment from which the vectors spring—the Internet and digital technology as the underpinnings of the networked economy—revealed one constant, and it was clearly a barrier: the cost of connectivity, as well as of hardware and software. This is a fundamental issue. Computer use and ownership and Internet use are significantly lower for people with disabilities compared with their counterparts without disabilities. As DiMaggio suggests, this means going beyond the conventional focus on access “to explore inequality in the combination of technical and social resources required for effective participation” (2001: 328). For people with disabilities there are significant issues of affordability and accessibility that lead to low broadband adoption rates, and for some make the promise of the vectors remote. According to the 2010 FCC report, *A Giant Leap and a Big Deal: Delivering on the Promise of Equal Access to Broadband for People with Disabilities*, only 42 percent of people with disabilities have broadband in the home compared to the national average of 65 percent.

As social networking sites become a major mechanism for matching potential employees with potential employers, access to such sites, and to the right connections within them, will become increasingly important for finding work. Network inclusion or exclusion may largely govern resource distribution, a point directly relevant to the situation of people with disabilities, who may feel or create a sense of exclusion from social networks.

Companies are already using a variety of approaches to incorporating mobile platforms into their work environments. One of these, known as the dispersed workforce, involves the collaboration of geographically decentralized people on a common project or job. The concept of a dispersed workforce is broader than telework, as it also includes the ability for an employee to travel from a central office to another location for temporary strategic collaboration. One survey showed there were already 34 million Americans working at least occasionally from home by 2009, a figure that is projected to grow to 63 million by 2016 (Schadler, 2009).

To realize the employment potential that the vectors represent, the issues of broadband access, as well as the costs of connectivity and of the hardware and software at the center of the vectors, were clearly spotlighted as major barriers.

- **Recommendation 3: Address issues of Internet access as a critical component of the vectors.**

The Federal Communication Commission's (FCC) National Broadband Plan includes several accessibility initiatives for people with disabilities, under the heading "Address issues of accessibility for broadband adoption and utilization." These initiatives include the Executive Branch to convene a Broadband Accessibility Working Group (BAWG) to maximize broadband adoption by people with disabilities; the FCC to establish an Accessibility and Innovation Forum; and Congress, the FCC, and the U.S. Department of Justice (DOJ) to consider modernizing accessibility laws, rules, and related subsidy programs. Congress appropriated substantial funds to assist industry to build out broadband. The industry should support an effort specifically targeted to increasing broadband access for people with disabilities.

We recommend that the FCC collaborate with the U.S. Access Board through a working group or committee to take an active role in identifying the barriers that people with disabilities face with regard to broadband access, and introduce policy proceedings designed to facilitate broadband adoption and use by the disability community. We further recommend that virtual town-hall meetings (telephone, Internet, and other technologies) be conducted to build awareness for this initiative.

- **Recommendation 4: Explore industry partnerships to address cost, for example, by providing in-kind services, devices, or partnerships to minimize cost to the end-user.**

This would be an important element to be included in Recommendation 3 above. Outreach should include such groups as CTIA–The Wireless Association

(Cellular Telecommunications Industry Association), TechAmerica, COAT (Coalition of Organizations for Accessible Technology), and other technology industries and nongovernmental organizations (NGOs) to support the work. Create a tax credit for manufacturers of equipment that provide the latest to NGO's for distribution to persons with disabilities. Such manufacturers should also provide training to both the NGO's and clients on use and maintenance.

- **Recommendation 5: Work on federal and state legislative and regulatory language with regard to assistive technology (AT) and meta-design, and develop a standardized instrument to measure AT outcomes.**

We recommend that the Department of Education (Rehabilitation Services Administration, charged with administering the Assistive Technology Act of 1998 and 2004) consult with the U.S. Access Board to review pertinent federal and state legislative and regulatory language that affects policies hindering the ability to purchase off-the-shelf hardware and software and require more expensive equipment for people with disabilities (see Field and Jette, 2007).

In addition, we recommend that the Office of Special Education and Rehabilitative Services (OSERS) in the Department of Education develop a standardized instrument for measuring AT outcomes. Measures should include the quality of AT services and equipment and the effects of AT on employment and independent living, for both specialized and off-the-shelf applications, to the benefit of both caregivers and consumers. The overall goal would be to encourage migration from the realm of specialized, dedicated, and expensive equipment to the universe of meta-design. The specific aim would be wide use of this instrument in various AT settings to measure outcomes, and to achieving comparability between systems and consistency in reporting AT outcomes nationally.

Ultimately, this effort is likely to affect the Improving Access to Assistive Technology for Individuals with Disabilities Act of 2004, with the potential for amendments. Also, we recommend that this report as a whole, and the results

of the work embedded in this recommendation in particular, be shared with the relevant committees in Congress: in the Senate, the Committee on Commerce, Science and Transportation, and the Subcommittee on Communications and technology; and in the House, the Committee on Science, Space and Technology, and the Subcommittee on Technology and Innovation.

Note also that this recommendation is in accord with Section 104 of the 21st Century Communications & Video Accessibility Act of 2010 (S. 3304) that requires the FCC to establish a clearinghouse of information on the availability of accessible products and services, and should be coordinated with the establishment of such a clearinghouse.

Finding 3. Through building social capital, the vectors may offer pathways to employment, but only through proactive social interaction, led by the young.

In attempting to discover the underlying reasons for high unemployment among people with disabilities, this report has zeroed in on the mechanisms that match the two sides of the unemployment equations: job opportunities (their availability or lack) and the job seeker (i.e., human capital). In part, the unemployment experienced by people with disabilities may be attributed to a perceived weakness of social capital. In that sense, networks are likely more important for people with disabilities than for the general population. The implications are significant, because the effects of networking spread beyond the employer–employee nexus, to self-employment and entrepreneurship for people with disabilities. Also, the nature of the social network is likely to heavily influence job satisfaction, job retention, and career advancement.

The role of networks in matching characteristics with opportunities is important not only in trade but also in the labor market, where social networks mediate employment opportunities and match employer needs with employee characteristics. Empirical studies reveal that typically around 50 percent of individuals obtain or hear about jobs

through friends and family (Corcoran et al., 1980; Holzer, 1988; Montgomery, 1991; Addison and Portugal, 2002).

The new information economy of which the vectors are a part, and some or all of the vectors themselves, may offer a solution (provided the issues identified in Findings 1 and 2, above, are addressed). It requires coordination of social and technical practices into communities of interest, creation and production. This solution would ideally involve a collaborative-community model that is particularly relevant for people with disabilities, because networked social connections lead to collaboration, empowerment, and potentially autonomy. The vectors serve as such coordinators or conduits. The collaborative-community model is particularly relevant for people with disabilities, because “the extent of interconnectedness and interdependencies emerges more distinctly in experience that includes disability” (Ells, 2001), and the new model suggests a network of diversified relationships enhancing the autonomy of the individual—and his or her social capital.

The most common uses and gratifications in Facebook, for instance, include social connection, shared identities, content, social investigation, social network surfing, and status updating (Joinson, 2008). A study of college students demonstrates a robust connection between Facebook use and indicators of social capital (Ellison, 2007). This connection is directly relevant to young people in the disability community, who are already using social media and socializing, in ways that strikingly contrast with the older generation. Above 30 years of age, people with disabilities are less likely to socialize than people without disabilities, across a range of activities, but for those between ages 18 and 29 the gap is nonexistent. Young people with disabilities also report themselves to be much closer to their counterparts without disabilities in terms of Internet access, the basis of the vectors, compared with the large gap (from 21 to 33 percentage points) for older people with disabilities (Kessler Foundation and NOD, 2010).

This observation is not to suggest that the new networked economy constitutes a brave new world, but rather that it does offer new opportunities. Specifically, the idea of collaborative community offers a door to a place where diversity is prized. The vectors

should not be seen as employment panaceas, but rather, in different ways and to different extents, they may offer pathways to employment. However, for all the vectors, a key point to emerge was that the different types of digital connectivity that the vectors represent are essentially latent, activated only by some sort of social interaction.

This view was reinforced by the exemplar study, which reminded us that the technologies explored in this report are all at some level communication and demonstration media. Even in the digital world of social networks, the most successful individuals are those who create a strong online persona and then make sure they have the capabilities to back it up. The individual has to be proactive in searching for potential employment opportunities, which means the lens through which viable employment opportunities are sought has to change constantly.

- **Recommendation 6: Develop a social-media campaign directed at people with disabilities between ages 15 and 30.**

We recommend that the Department of Labor (Office of Disability Employment Policy) develop and implement a social-media campaign aimed at the younger people with disabilities, who are more socially involved and vector aware than people with disabilities in general. This campaign will serve as a “wedge” or opening that would then diffuse back into the general community of people with disabilities.

Campaign approaches would include:

- identifying and recruiting an advisory board of the target audience (15- to 30-year-olds) to help focus messages;
- collecting and disseminating success stories of the positive effects of employment of the use of the vectors;
- collecting and disseminating case studies of companies with some direct or indirect connection with the vectors who employ people with disabilities as a resource, not as an exception); and

- collecting evidence-based best practices, intended to go toward a resource portfolio that can be used to support specific policy recommendations for government.

These stories, studies, and best practices would be combined into a strategic social-media campaign, focusing on “ability,” in a variety of vector-specific employment settings, presented in an innovative, compelling, and interesting manner. We recommend developing a subcampaign to focus on entrepreneurship, because small business offers the greatest practical opportunity for generating new employment possibilities.

- **Recommendation 7: Initiate national awards modeled after the Malcolm Baldrige National Quality Award.**

The Baldrige Award, given by the National Institute of Standards and Technology, recognizes U.S. business, health-care, education, and nonprofit organizations for performance excellence. NCD recommends that public and private organizations, such as the American Association of People with Disabilities (AAPD), explore the possibility of national awards modeled after the Malcolm Baldrige National Quality Award. The awards should be given in four areas:

- An award for creative use of the vectors and other digital technology in developing new employment opportunities for people with disabilities. This would be aimed at the younger generation, but would have an additional motive of raising awareness among people with disabilities in general disability about the transformative potential of digital technologies like the vectors in the employment sector.
- An award, aimed at the business sector, to recognize employment creation for people with disabilities (see below).

- A “Design for Ability” award, focusing on meta-design principles (see below). To receive this award, an organization would have to demonstrate a design management system that ensures a continuous commitment to the incorporation of meta-design and universal design (UD) principles in its products and services.
- An “Entrepreneur with Disabilities” award that recognizes people with disabilities, or organizations staffed by people with disabilities, for original work in developing new types of business using networking technologies, under the theme of “computer-supported collaborative work.”

Finding 4: The disability community needs to expand efforts to enhance awareness of the presence, capacities and potential of people with disabilities.

One of the major themes to emerge from the exemplar study was the perceived “invisibility” of people with disabilities the disability community, and that business has not focused on this domain community because it is perceived to be a “niche,” not substantial enough to justify development work. The most convincing rationale offered for this view was that people with disabilities tend to have little disposable income and cannot invest in expensive software or hardware, a view that highlighted a lack of awareness of the size and scope of the community.

A highly unfortunate consequence of people with disabilities not being seen as a viable market is that many of the technology companies interviewed are not considering developing product lines for them, and are not considering universal-design principles during the prototyping and development phase of technologies. Several of the exemplar study interviewees interpreted this observation to indicate a need for stronger advocacy and information dissemination from the disability community.

Alongside this view, another commentary that came from the exemplar study suggested the need to incorporate different perspectives, including that of people with disabilities,

within the technological developments represented by the vectors. The perception that certain technological fields were not “suited” for people with disabilities is a pernicious one, and for reasons that are unclear. Several interview respondents speculated on the typical lack of confidence that people with disabilities have, something instilled in them by the dominant culture—another way to describe a shortage of social capital.

The vectors in this study all serve as coordinators or conduits. A key point to emerge in this research is that the different types of digital connectivity represented by the vectors are all essentially latent, activated only by some sort of proactive, social interaction. It is essential for people with disabilities to take on that role, to act and be seen as active participants in the networked economy.

- **Recommendation 8: Expand efforts to advocate for people with disabilities as an untapped resource and as a market, using traditional as well as social-media channels.**

In part, this awareness gap can be filled by the social-media campaign indicated above, especially in terms of the potential that people with disabilities have as employees.

However, there is a pressing need for business and industry to develop a greater awareness of people with disabilities as a potential market. We suggest building on Recommendation 16 from the NCD report “Design for Inclusion,” which was to develop a clearinghouse where users can obtain information about accessibility issues and the features to address them. We recommend that the Office of Special Education and Rehabilitative Services (OSERS) in the Department of Education serve as the base for this clearinghouse, and the remit be expanded to include involvement from the private sector. The latter might include linking with the U.S. Business Leadership Network (USBLN) and with advocacy organizations like the Arthritis Foundation and AARP, as well as identifying existing dissemination channels and developing targeted material for them.

Note also that this recommendation is in accord with Section 104 of the 21st Century Communications & Video Accessibility Act of 2010 (S.3304) that requires the FCC to establish a clearinghouse of information on the availability of accessible products and services, and should be coordinated with the establishment of such a clearinghouse.

- **Recommendation 9: Create discussion forums focused on the potential of the market that people with disabilities represent.**

We recommend that the Department of Labor (Office of Disability Employment Policy) partner with the U.S Business Leadership Network (USBLN), the Society for Human Resource Management (SHRM), and the U.S. Chamber of Commerce to facilitate a conference and a follow-up online community of practice. The conference would be aimed at government and industry, with panels to discuss the potential of the market that people with disabilities represent. Speakers from leading industry sectors, with a focus on those working in the areas represented by the vectors, would be invited together with government and NGOs, including OSERS, the Interagency Committee on Disability Research (ICDR), NCD, ACCESS Board, and the Office of Disability Employment (ODEP).

NCD also plans to incorporate discussions centered on the potential of the networked economy for people with disabilities into its own national forums, such as the three regional forums planned for 2011, in alignment with the theme *Living, Learning, & Earning* used at NCD's National Summit on Disability Policy 2010.

Finding 5: Social, technological, and attitudinal barriers exist to raising awareness of the potential of the new networked economy among people with disabilities.

NCD conceived of this research as examining the utility of the vectors through two lenses: how the vectors might enhance the ability to do work, and how they might help in finding or

creating work. One clear result from the focus-group discussions was their essentially negative focus on barriers to adoption in the workplace, rather than on the potential for creating new industry/vector employment. This result suggests larger social and cultural issues about the tolerance for risk and ability to engage in new types of activities.

The focus group discussion suggested that a key aspect of the use of the digital vectors relates to the context in which they are deployed, as well as to the vectors as free-standing technologies. There is also a considerable gap between whatever the potential of the vectors may be, and an appreciation or realization of that potential by the disability community. To a degree, this view was reinforced by some of the findings of the online social-network groups, where there was a challenge in moving the discussion out of the arena of the “experts” and onto a more public stage, sustaining popular participation.

As part of Recommendation 7 (above), an award could be given for creative use of the vectors and other digital technology in developing new employment opportunities for people with disabilities. The additional motive would be to raise awareness among people with disabilities about the transformative potential of digital technologies like the vectors in the employment sector.

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- **Recommendation 10: Develop and conduct an information campaign focused on the potential of information technologies to create new job opportunities.**

We recommend that the Department of Labor (Office of Disability Employment Policy), leading an industry partnership featuring businesses involved in the vectors (such as Google, IBM, and Facebook), initiate an information campaign.

The campaign could be centered on a major job fair, moving every year to a different major urban center, and focusing on the job potential of the networked economy as represented by the vectors.

Finding 6: Encourage the adoption of meta-design approaches.

One clear agreement to emerge from the Delphi study was the importance of universal design (UD) in achieving accessibility for people with disabilities. One participant noted that UD approaches were fundamental precisely because of a lack of access to and the expense of adaptive technologies. Another observed that UD needed to extend beyond the information communication technologies of the workplace, in order to address large-scale systems that are frequently inaccessible to people with disabilities. This reinforces some of the conclusions of the NCD report “Inclusion for Design” (2004).

Since that time, UD has evolved to meta-design, which shares and transcends the characteristics of participatory design. To foster creative production and enable diversity of access, socio-technical environments must “not only build new technologies but seed new practices, new genres, new communities” (Fischer, 2005: 24). Central to meta-design is learning to communicate with others who have a different perspective, integrating diversity and making all voices heard. This enables informed participation and social creativity in communities of interest. The ultimate goal is media-augmented social creativity to make all voices heard and integrate diversity (ibid). Meta-design may represent an ideal for meeting the needs of people with disabilities, in so far as it does not try to predict the diverse needs of a heterogeneous population in a changing work environment, and strives to avoid ever-lengthening lists of accessibility guidelines that always run a step behind the rapid pace of technological change. Meta-designed technology encompasses not only accessibility concerns and human-capital requirements, but also social-capital and creativity requirements, in line with the needs of the new economy.

One of those needs is to harmonize standards. The phrase “mobile accessibility,” for instance, is often used not in the context of disability, but of making the Web as

accessible on mobile platforms as on desktop platforms. Interestingly, users of mobile devices and people with disabilities experience similar barriers when interacting with Web content. For example, users of mobile phones and people with mobility or dexterity disabilities can have a hard time if a Web site's navigation requires the use of a mouse (Web Accessibility Initiative). The Web Content Accessibility Guidelines (WCAG), a guide for making Web sites accessible to people with disabilities, overlaps the Mobile Web Best Practices (MWBP), a guide for making Web sites usable from a mobile device. For instance, the MWBP best practice "Label all form controls appropriately and explicitly associate labels with form controls" corresponds with the WCAG technique of "Using label elements to associate text labels with form controls" (ibid). Following both sets of guidelines—or aligning both to become one—makes Web content more accessible for a wider variety of people on a wider range of devices.

This approach fits in well with another need, acknowledging the potential of HTML5. As the exemplar study points out, the most important thing to note about accessibility in HTML5 is not so much the features as the change in philosophy that it entails. For example, bloggers working in this domain emphasize that HTML5 actively encourages Web authors not to put information into places where ordinary users cannot see it, such as alt and summary attributes, but rather into the normal body text, a move that follows meta-design principles.

A third need is to build on the work of W3C WAI in developing guidelines for authoring tools and user-access agents, to ensure adherence to the principles in the guidelines as we move toward Web 3.0, the semantic Web (Neville and Kelly, 2008).

While the government provides funding to support universally designed technologies—such as the National Institute on Disability and Rehabilitation Research's (NIDRR) Rehabilitation Engineering Research Center on Universal Interface and Information Technology—the desired outcome is "seamless integration of the various technologies used by individuals with disabilities in the home, the community, and the workplace," which may be an underestimation of the potential offered for a meta-design approach.

As part of Recommendation 7 (above), an award could be given for “Design for Ability,” focusing on meta-design principles. To receive a “Design for Ability” award, an organization would have to demonstrate a design-management system that indicates an understanding of, and ensures a continuous commitment to, the incorporation of meta-design and UD principles in its products and services.

- **Recommendation 11: Conduct hearings with business and industry representatives.**

We recommend that key stakeholders identify and approach key members of Congress about the potential to convene hearings on the role of universally designed and accessible technology to drive new job creation. The American Association of People with Disabilities (AAPD) and AARP have already demonstrated their awareness and interest in universal design. We recommend they lead in organizing hearings with industry associations (such as the Mobile Manufacturers Forum and the CTIA) and, with industry leaders, help identify what incentives would be helpful in adopting meta-design principles as a way of providing more cost-effective products for *all* users, and of reinforcing the message about the size of the market. The involvement of Department of Commerce (Small Business Administration) and FCC should also be invited. The main thrust of the hearings should be to encourage a frank discussion. In this regard, we recommend reevaluating the recommendations given in “Design for Inclusion: Creating a New Marketplace” (NCD, 2004), to see which have been followed and which have not, and, where necessary, to turn those recommendations into a policy for action based on feedback from the listening sessions.

- **Recommendation 12: NIDRR should solicit input on the importance of research and development of meta-design applications as part of its focus on universal design for all government-funded projects.**

Finding 7. Encourage entrepreneurs with disabilities to flourish as part of the collaborative community, and encourage development of that community.

One suggestion from the literature review is that the shift to a networked economy could be good for people with disabilities, who might have unique qualifications for the new jobs that are evolving. These are jobs in which creative, networked people transform problems into opportunities, and where networking technologies make entirely new types of business specialties possible by enabling people to express highly specific preferences that enterprising producers can meet. For example, one of the recommendations from the exemplar study was that immersive digital environments represent unconventional and entrepreneurial opportunities for employment. Within certain domains, specialized, employment-oriented groups exist that would repay further investigation in order to reach a deeper understanding of the employment opportunities they may represent. Many employers find the skills acquired through “accidental learning” even in casual games—the “learning to be” that is a natural byproduct of adjusting to new cultures inside the game—as advantageous as traditionally acquired skills. This process is bringing about a profound shift in perceptions and reactions to the “real” world, with users becoming “more flexible in their thinking and more sensitive to social cues” (Brown and Thomas, 2006: 1). Leadership and business-oriented skills can be developed through collaborative casual gaming, which prepares people for “computer supported collaborative work” (Nardi and Harris, 2006: 149).

This kind of collaborative work has real potential of people with disabilities. The literature shows that one of the most effective channels for disseminating institutional knowledge and expertise within an organization is informal networks of colleagues and friends (Kraut et al., 1990; Wasserman and Galaskiewicz, 1994). Social capital (“know-who”) may be more significant organizationally than human capital (“know-how”) (Downes, 2004). Heckscher and Adler (2006) point to IBM as a corporation that has internalized these informal networks, adopting the structure, values, and character of a collaborative community, where it is expected that people will take responsibility for

things they cannot fully control and that they will move outside the zone of their formal accountability. While in a traditional bureaucracy, power and influence flow downward, the collaborative approach includes high levels of participation, as processes are defined and refined over time by input from all levels. The shift is to a focus on contribution to collective company goals, with pay varying based largely on assessments of the individual's contribution to the corporation.

The dynamic potential of the vectors should not be underestimated: open-source processes, for example, cause conventional economic narratives to be questioned. Economic theory asserts that for people to engage in a task such as software development, they must reap both immediate and delayed rewards (Lerner and Tirole, 2000). Immediate rewards include monetary compensation or the use of customized software to complete a task. Delayed rewards, called the “signaling incentive,” are further divided into two categories. The “career concern incentive” refers to collaborators being motivated to produce open-source works because future employers may recognize their work. This motivation is important for the disability community because the source code produced is the sole component leaving an impression on employers, providing people with disabilities with an even playing ground for displaying their capabilities to potential employers. Because there is such a low barrier to entry on open-source collaborations, people with disabilities can put their talents and capabilities on display for potential jobs in the future.

The second motivation is called the “ego gratification incentive,” in which a programmer desires recognition for his or her individual contribution (Lerner and Tirole, 2000). There is a third motivation, the “alumni effect,” in which students use open-source code while learning to program and continue to do so once their skills have developed (ibid). One of the principal benefits of the collaborative community may be precisely that the rewarding process for work is open and unconventional.

As part of Recommendation 7 (above), an award could be given for “Entrepreneurs with Disabilities,” to recognize people with disabilities, or organizations staffed by people with

disabilities, for original work in developing new types of business using networking technologies, under the theme of “computer-supported collaborative work.”

- **Recommendation 13: NCD recommends exploring a programmatic initiative to encourage enhanced interagency coordination and collaboration and to build outreach efforts. The aim will be to increase awareness both of the potential of the collaborative community for people with disabilities in finding employment, and of the vector-related barriers to employment that affect people with disabilities, as described in this report, by conducting workshops, expanding outreach activities, and using social-media channels, with key stakeholders.**
- **Recommendation 14: Create field workshops among the research, policy, and advocacy communities to expand “community level” input into public-sector processes that affect growth of communications channels,** in particular for the idea of the collaborative community and employment. We recommend that the Department of Commerce (NTIA—possibly the Office of Telecommunications and Information Applications) take the lead in organizing the workshops. The aim would be to go “outside the beltway,” to draw on existing and new online and social-media channels for new and innovative ideas, as well as support for evidenced based practices. Such efforts might include tool kits (for example, those used by the FCC) that make it straightforward for key stakeholders to provide input into the regulatory and policy processes—encouraging them to submit filings, respond to regulatory and public-sector requests for information and comments, and engage in public participation.

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APPENDIX 1. Exemplar Studies: Companies Targeted, Companies Interviewed, Interview Protocol, and Interview Questions

Table 1 identifies the companies initially “targeted” to be interviewed for this project, as well as the companies actually interviewed. Table 2 categorizes the questions asked of each interviewee.

Table A1: Companies (Both “Targeted” and Interviewed) Approached for This Project

Vector	Companies (“Targeted”)	Companies (Interviewed)
Wireless communication platforms	<ul style="list-style-type: none"> • RIM • Android 	<ul style="list-style-type: none"> • RIM • Google (Android) • Georgia Tech Research Institute
Social networking	<ul style="list-style-type: none"> • Facebook • LinkedIn • Twitter 	<ul style="list-style-type: none"> • Backnoise • Ning • NokiaMOSH
Immersive digital environments—virtual worlds	<ul style="list-style-type: none"> • Linden Labs (Second Life) • Forterra Systems (Olive) • Kaneva 	<ul style="list-style-type: none"> • Kaneva • VRising
Immersive digital environments—casual gaming	<ul style="list-style-type: none"> • EA Games • Activision • Able Gamers 	<ul style="list-style-type: none"> • FredSquared • Torpex Games • AbleGamers
Open publishing	<ul style="list-style-type: none"> • CNN • Turner • Cox Communications 	<ul style="list-style-type: none"> • Clinch Media • EPredator • Cox Communications
Open-source software/processes	<ul style="list-style-type: none"> • RedHat • IBM 	<ul style="list-style-type: none"> • IBM • MIIOSS

Table A2. Interview Questions

General	
These questions were posed to all interviewees.	<ol style="list-style-type: none"> 1. In what way does (insert vector) increase general opportunities to find and/or create work? 2. In what way does (insert vector) increase the general ability to do work? 3. In what way does (insert vector) increase people with disabilities opportunities to find and/or create work? 4. In what way does (insert vector) increase people with disabilities opportunities to do work? 5. What are the major issues/challenges in your technology field? 6. What foreseeable innovations in your field do you see affecting how your technology is used in the workplace?
Vector-Specific Questions	
Wireless communication platforms	<ol style="list-style-type: none"> 1. Do innovations within mobile-business applications drive hardware development or vice versa? 2. Do RIM developers follow universal-design principles during the design and development process? Does (insert company) work with disability/UD design experts? 3. What sectors currently drive the development of mobile platforms? 4. In what ways do you think the “smart phone” has and will affect common business operations in the next few generations?
Social networks	<ol style="list-style-type: none"> 1. Based on the constant change in social networks and their associated plug-ins, how does (insert company name) keep pace with innovations within the field? 2. To your knowledge, are there specific initiatives that (insert company name) has implemented to engage the disability community? 3. What differentiates (insert company name) from its competitors? 4. In what ways have the (insert company name) community used the technology that surprised the company?

Table A2. Interview Questions (continued)

Vector-Specific Questions (continued)	
Immersive digital environments—virtual worlds	<ol style="list-style-type: none"> 1. What dimensions/characteristics does (insert company name) provide that benefit people with disabilities? What percentage of the platform is being used to support/train/educate the disability community? 2. In what ways do you see the virtual world domain bridging the gap between the flat Internet and multidimensional experiences found in immersive 3-D environments? 3. What makes using the (insert company name) platform more compelling than traditional collaborative Web spaces?
Immersive digital environments—casual gaming	<ol style="list-style-type: none"> 1. How can casual games be used for cultivation of new jobs? 2. How can casual gaming be used to cultivate business-oriented practices/principles in an individual? 3. Does (insert company name) work with UD/disability experts in developing games and/or hardware? 4. What pipeline innovations does (insert company name) see as potential “game changers” within the gaming domain?
Open publishing	<ol style="list-style-type: none"> 1. What current open-publishing processes are being employed at (insert company name)? 2. How has citizen/user-created content affected your workplace? The entirety of (insert company name)? 3. How do you see the policing of the content in open channels working in the future? 4. How does (insert company name) authenticate/validate citizen/user content?
Open-source software/processes	<ol style="list-style-type: none"> 1. How much of what is being produced is by the community versus (insert company name)? 2. What impacts does the community-centric model of open-source processes have on business practices? 3. Do you view the open source production/process as one that enables people with disabilities to find employment that might otherwise have been unavailable to them?

APPENDIX 2. **Background to Industry and Occupational Data Sources**

The North American Industry Classification System (NAICS) is the standard used by federal statistical agencies in classifying business establishments for data related to the U.S. business economy. Classifications are reviewed every five years, with the latest review in 2007. NAICS is a two- through six-digit hierarchical classification system. The first two digits designate the economic sector, the third digit designates the subsector, the fourth digit designates the industry group, the fifth digit designates the NAICS industry, and the sixth digit designates the national industry. Each NAICS six-digit industry classification is described in detail on the NAICS Web site.

A benefit of using the NAICS codes to analyze employment statistics and trends is that at hierarchy level, classifications are nonoverlapping, so establishment-level Census Bureau data and employment figures are not double counted. A similar benefit comes from using the Standard Occupational Classification (SOC) system. Another benefit is the ease of cross-referencing with other federal statistical agencies that also use NAICS. Additionally, since comparable data will be available every five years, this report can serve as a benchmark for measuring employment trends in information and digital-media industries.

The **U.S. Census Bureau's Economic Census**, also conducted in years ending in 2 and 7, profiles the U.S. economy every five years. Economic Census statistics are aligned with NAICS and are collected and published primarily by establishment. An establishment is a business or industrial unit at a single physical location that produces or distributes goods or performs services.

The **Bureau of Labor Statistics (BLS)** of the U.S. Department of Labor includes the **Occupational Employment Statistics (OES)** program, which conducts a semiannual mail survey designed to produce estimates of employment and wages for specific occupations. In 1999, the OES survey began using the Office of Management and Budget (OMB) Standard Occupational Classification (SOC) system. The SOC system consists of 821 detailed occupations, grouped into 449 broad occupations, 96 minor groups, and 23 major groups. The OES program collects data on wage and salary workers in nonfarm establishments in order to produce employment and wage estimates for about 800 occupations.

For occupation-level data within and across NAICS sectors, subsectors, and industries, BLS publishes Economic and Employment Projections and the National Employment Matrix database. Each month the BLS Current Employment Statistics (CES) program surveys about 140,000 businesses and government agencies, representing some 410,000 individual worksites, to provide industry data on employment, hours, and earnings of workers on nonfarm payrolls.

To derive employment projections for 2018, "BLS economists place base-year staffing patterns under an iterative process of qualitative and quantitative analyses. They

examine historical staffing pattern data and conduct research on factors that may affect occupational utilization within given industries during the projection decade. Such factors include shifts in product mix, and changes in technology or business practices. Once these factors are identified, change factors are developed which give the proportional change in an occupation's share of industry employment over the 10-year projection period. These change factors are applied to the 2008 occupational staffing patterns to derive projected staffing patterns.

Detailed industry employment projections are based largely on econometric models, which, by their very nature, project future economic behavior on the basis of a continuation of economic relationships that held in the past...However, one of the most important steps associated with the preparation of the BLS projections is a detailed review of the results by analysts who have studied recent economic trends in specific industries. In some cases, the results of the aggregate and industry models are modified because of the analysts' judgment that historical relationships need to be redefined in some manner" (BLS Projections Methodology).

Nongovernment Sources

Several nongovernment resources are useful.

First Research is a division of Hoover's Inc. and a provider of market analysis tools. First Research industry specialists study a wide range of primary and secondary sources, including trade publications, company annual reports, and SEC filings such as 10Ks, government Web sites and resources (such as the Census and the Bureau of Labor Statistics), news articles, business publications, and in-depth industry reports.

First Research groups NAICS 517, 518, 3344, 5112, 5415, 54171, 325414 together in what they call the technology sector. First Research also reports on the Internet Service Providers Industry (NAICS 517210, 518111), the Internet Publishing and Services Industry (NAICS 5161, 518112), Wireless Telecommunications Services Industry (NAICS 51721), Wired Telecommunications Services Industry (NAICS 51711), Computer Software Development Industry (511210, 541511), Information Technology (NAICS 5415), Entertainment and Games Software Industry (NAICS 511210), and Electronic Gaming Products Industry (NAICS 339932), among others.

The First Research reports reference NAICS codes in the industry categories they define; however, the alignment is not exact and there is overlap between First Research industry categories, so summing employment across industries is not straightforward. Nonetheless, some of the reports contain useful information.

Another nonfederal resource used in this report is a research and consulting firm called the International Data Corporation (IDC).

APPENDIX 3. The First Research Approach

First Research, a division of Hoover's Inc., groups the North American Industry Classification System (NAICS) 517, 518, 3344, 5112, 5415, 54171, 325414 together in what they call the technology sector. First Research also reports on the Internet Service Providers Industry (NAICS 517210, 518111), the Internet Publishing and Services Industry (NAICS 5161, 518112), Wireless Telecommunications Services Industry (NAICS 51721), Wired Telecommunications Services Industry (NAICS 51711), Computer Software Development Industry (511210, 541511), Information Technology (NAICS 5415), Entertainment and Games Software Industry (NAICS 511210), and Electronic Gaming Products Industry (NAICS 339932), among others.

The First Research reports reference NAICS codes in the industry categories they define; however, the alignment is not exact and there is overlap between First Research industry categories, so summing employment across industries is not straightforward. Nonetheless, the reports contain useful information and overviews.

The *technology sector* in the United States (by First Research definition) includes more than 140,000 companies with combined annual revenue of about \$900 billion. Average annual revenue per worker is about \$300,000 (First Research, 2009). Hence, the technology sector represents some 3 million jobs.

The U.S. *electronic gaming products manufacturing industry* includes a small number of companies with combined annual revenue of \$7 billion. The industry is highly concentrated: the top three companies (makers Microsoft, Nintendo, Sony) account for the majority of revenues.

The U.S. *entertainment and games software industry* includes about 220 companies with combined annual revenue of \$28 billion. Major companies include Activision Blizzard, Electronic Arts, Take-Two Interactive, and THQ, along with divisions of Microsoft, Nintendo, and Sony. Video-game software accounts for about 70 percent of revenue, while most of the rest is from PC game software.

The U.S. *computer software development industry* includes 50,000 companies with combined annual revenue of \$220 billion. About 60 percent of revenue comes from software publishing and the rest from custom programming. Large companies include Activision Blizzard, CA, Microsoft, Oracle, and Symantec. The 50 largest companies generate about 70 percent of revenue.

The U.S. *Internet service provider industry* includes about 4,000 companies that generate combined annual revenue of some \$20 billion. Major companies include AOL, AT&T, Comcast, Microsoft, and Verizon. The 50 largest companies generate about 80 percent of revenue; the four largest companies account for more than 50 percent. The industry includes companies that provide access to the Internet via wired or wireless connections. Internet access operations of telecommunications carriers are included in the industry, but telecommunications companies themselves are covered in

separate industry profiles. Internet access accounts for about 75 percent of industry revenue; the remaining revenue comes from Web site design and hosting and technical support services.

The U.S. *Internet publishing and broadcasting and search portal industry* includes about 2,600 companies with combined annual revenue of \$35 billion. Major companies include Google, IAC, and Yahoo!. Major products are search portals and Web sites devoted to news, sports, entertainment, gaming, networking, and other topics. Advertising is the primary source of revenue. Average annual revenue per worker is \$450,000. Hence, the sector represents about 78,000 jobs.

APPENDIX 4. **Choosing the Vectors**

1. Initial Vector and Exemplar Analysis

A preliminary analysis by the Georgia Tech research team resulted in six candidate vectors to evaluate: wireless communications technologies, social networks, virtual worlds, Web 2.0 and beyond, applications consolidators, and computational journalism. Each of these vectors was chosen to represent new digital-media sources and digital technology, broadly conceived. For each vector, an exemplar new media source, or digital technology product or service, was analyzed from three different perspectives: for utility (or potential utility) in employment settings; for accessibility to the general population and to people with disabilities; and for identification of best practices.

The initial selection of vectors was informed by the experience of the research team, with the ultimate objective of designing a research project capable of capturing the diverse goals of all users. The first phase of the project was to formally analyze and evaluate the vectors, and the vector exemplars, for their suitability as references for the remainder of the study.

1. *Wireless Communications Technologies*

Wireless communications technologies continue to spread and push the limits of convergence and quality of experience for users. Such advances are exemplified by portable computers, gaming devices, and “smart phones,” mobile phones that offer advanced capabilities by incorporating much of the functionality of computer technologies (Needle, 2005; Best, 2006). The emergence of smart phones and their close cousins like tablet computers and the iPad, coupled with the expansion of third-generation (3G) networks characterized by increased robustness, speed, and reliability, has supported an increasingly mobile workplace. Applications are no longer driven solely by humans using keyboards, but increasingly by sensors—data can be collected, presented, and acted upon in real time (O’Reilly and Battelle, 2009). Despite the accessibility issues they may pose, these advanced mobile technologies have conferred some benefits on users with disabilities. Wireless-enabled PDAs have facilitated Web communities for some people with disabilities, such as blind users who may not feel comfortable using traditional, or nonmobile, computer technology (Keating et al., 2007). Providers are also offering plans developed for people with specific disabilities. The convergence of the technology and enabling applications has created an opportunity for greater integration of people with disabilities into mainstream society and the average workplace (ibid).

Yet, significant issues of accessibility still persist for people with disabilities, in the areas of device compatibility, awareness by manufacturers, employment of people with disabilities, and accessibility to emergency communications (Baker and Moon, 2008). Making up to one-fifth of the U.S. population (U.S. Census Bureau, 2006), people with disabilities face unique technological barriers and prejudices and may end up being excluded from the Internet (Hamburg & Busse, 2006). However, recent studies in the

area of education have suggested that technologies, especially those with a degree of customizability, may mitigate some of the barriers faced by people with disabilities (Mitchell et al., 2004; Hamburg & Busse, 2006; Georgiev et al., 2004).

Potential exemplar: *Research in Motion (RIM)*, manufacturer of the BlackBerry.

RIM was initially considered to represent the larger vector of wireless communications technologies, because of its strong position in the market, especially among business and professional users, and its worldwide market share of almost 20 percent (Elmer-Dewitt, 2010). A typical BlackBerry supports access to social applications like email, SMS (Short Message Service), MMS (Multimedia Messaging Service), and the phone, as well as Internet and Intranet-based applications through multiple wireless network standards (RIM, 2009).

2. Social Networks

The second vector considered was the social network, defined as a social structure made of nodes that are generally individuals or organizations. A social network represents relationships and flows between people, groups, organizations, etc. (Social Network, n.d.). Social-networking platforms, like Facebook, Twitter, and LinkedIn, have become the most popular form of individual and group associations and collaborations. The ability to access these interfaces is rapidly becoming essential: 50 percent of the top 10 and top 20 Web sites worldwide are social-networking platforms (Alexa–Facebook, 2009). With the pervasiveness of Web 2.0 tools within social, educational, and workplace structures, accessing and understanding them will become vital to business and personal practices. For example, LinkedIn and Twitter are extending professional networks, allowing for consolidating ways that companies approach business development (Kwek, 2009). The landscape of today’s job market is shifting, and the shift favors individuals who are savvy in social media (Knoor, 2009; Manjoo, 2009; Brown, 2009).

At the same time, one of the largest challenges posed by this vector is that the new interaction models of social-networking platforms are pushing the limits of the technologies of the Web and the ability of assistive technologies to interpret the changing face of the Web (Gibson, 2007). Common tools used to address accessibility include Web Accessibility Initiative (WAI) technical guidelines. However, an emerging school of thought seeks to shift focus from enhancing accessibility through technical innovations to a user-focused approach, which embeds best practices through the development of achievable policies and processes (Kelly et al., 2007).

Potential exemplar: *Facebook*.

Currently, the company claims that there are over one million developers and entrepreneurs from more than 180 countries working within this platform (Facebook-Statistics, 2009). According to company statistics, Facebook has one of the largest reaches of any online outlet—it currently is the third most visited site in the world (Alexa–Facebook, 2009). More

than 120 million users log onto Facebook at least once each day (30 million of whom access Facebook through their mobile devices), and the fastest growing demographic is those 35 years and older (Facebook–Statistics, 2009).

3. *Virtual Worlds*

The third vector investigated was virtual worlds, defined as artificial environments created with computer hardware and software and presented to the user in such a way that it appears and feels like a real environment (Virtual Worlds, n.d). A unique feature of this vector is that the individual can create and manipulate a personal interface within the platform. Accessibility in virtual worlds has not yet received the same level of attention as wireless technologies or social-networking platforms, but it is beginning to interest accessibility and game-design researchers, and game developers looking to broaden their audience (Trewin et al., 2008). This interest and concern is timely and necessary, given current estimates that about 80 percent of active Internet users will be using a virtual world by 2012 (Adams-Spink, 2007). As 3-D worlds have grown in importance, some indicators show they will become a common tool for interacting between users and accessing services in the near future (Eiffel, 2009).

Thanks to the work of organizations like IGDA (Weston, 2004), AudioGames.net (AudioGames, 2002), and OneSwitch (Ellis, 2002), the mainstream games industry is beginning to seriously investigate the feasibility and benefits surrounding accessible gaming (Atkinson et Al., 2006). Virtual worlds like Second Life have added accessibility considerations such as the Dazzle UI, which deals with color blocking and the individual's ability to further modify and specify appearance (Accessibility, n.d.). A driver behind the move to make these spaces more accessible is the fact that platforms like Second Life have a robust economy, and people with disabilities have begun finding social outlets and employment within the platforms. Training, modeling, and education continue to be the primary focus, mainly because individuals have full control of the environment and their individual representation. Groups like Virtual Ability and Wheelies have organized to give people with disabilities voices within the platform, while at the same time giving them an organized community that can speak with one voice to promote changes.

Potential exemplar: *Second Life*

Second Life was chosen as the representative for this vector because of its growth, economic impact and potential, and the openness of the platform. Currently there are several hundred businesses operational within the platform, several of which are legally registered specifically for Second Life. As a tool for shaping business practices and trends, Second Life is considered the creative laboratory of the genre, whose membership grew by 39 percent in the second quarter of 2009 to an estimated 579 million (Keegan, 2009).

4. Web 2.0 and Beyond

This vector refers to emerging Web technologies for facilitating communication, information sharing, interoperability, user-centered design, and collaboration. This wave of technologies—not yet fully realized commercially—has the promise to radically change how Web users communicate and work, for example, redefining email and Web communication (Parr, 2009). One example of this is Web² (“Web squared”) —where “Web 2.0 meets the world” (O’Reilly and Battelle, 2009). These technologies see the Web as a platform: the systems learn and improve as people use them (ibid).

Another example is Google Wave, a personal communication and collaboration tool that is a Web-based service, computing platform, and communications protocol designed to merge email, instant messaging, wiki, and social networking (Google Wave, 2009). Tools like Google Wave show great opportunity for accessibility within the workplace because they are based on an open-sourced protocol and therefore are more customizable for the individual’s needs. These tools are focused on reducing the latency of online actions, and as O’Reilly states, bringing online happenings closer to our real-world experience (O’Reilly, 2009). O’Reilly also suggests that these types of technologies may lead to a change in behavior, in that conversations become shared documents. For those people traditionally excluded, the technology has the chance to level the playing field; the technology could be an inclusion enabler.

This attempt at unification of communication will exacerbate the issue that Gibson highlights in regards to accessibility—that current accessibility tools are being pushed to the limits of capacity with current Web 2.0 interfaces (Gibson, 2007). Google Wave is being pushed to accommodate Accessible Rich Internet Applications (ARIA) enhanced solutions, and Google Calendar, Finance, and News have all added ARIA support enhanced accessibility (Raman, 2009). As these integrated platforms continue to emerge, efforts at factoring accessibility into the design process will need to be supported.

Potential exemplar: Google.

Google was chosen to represent this vector because of its focus on convergence, its ubiquity, and its openness to the development community.

5. Applications Consolidators

The fifth vector analyzed was characterized as applications consolidators, defined as platforms that provide the user with tools to accomplish one or several tasks. Consolidators like the Apple or the Android marketplace face the same accessibility and design issues that wireless technology and social networking/Web 2.0 interfaces carry because they are often integrated into those systems. These aggregator suites are powerful sets of tools bundled together to meet the needs of businesses, schools, and other organizations (Teeter and Barksdale, 2008). One such feature is the ability to rapidly share input, therefore increasing one’s ability to be heard (Schwartz et al. 2008). These tools are “on-demand” (available anytime, anywhere), greatly expanding the

impact that wireless communication and social networking technologies have within the workplace and within our personal lives. There are two types of consolidators to be analyzed within this domain: open source or open platforms (Android, Google) and proprietary or closed (Apple, Microsoft). Open source generally refers to software, yet can also refer to processes, business management, and even product development in technological areas beyond software (Baker, Moon, and Noonan, 2008). For this research, the advantage of open-source process is the shift it represents to the notion of the community being responsible, and hence the technology being responsive to the needs of the community (Bonaccorsi and Rossi, 2006), including niche communities, like those with disabilities, that want to expand capabilities on mobile devices or within their online environments. Microsoft and Apple represent communities where the development of the environment is not completely closed, but for the average developer is highly restricted. Firms that sponsor proprietary de facto compatibility standards suffer a trade-off from the control of standards: control makes them less agile in meeting specific needs, be they accessibility, education, or general community response (West and Dedrick, 2001).

Potential exemplars: *Apple, Red Hat.*

This vector category is subdivided into proprietary and open-source approaches. Apple and Red Hat were chosen due to their respective standings in their fields. Apple represents the more proprietary, and Red Hat the more open, application suite.

6. Computational Journalism

The sixth and final vector analyzed was computational journalism, a new way of thinking about how information is captured, shared, and processed. The vector is more narrowly defined as the applications of computational algorithms to collect, contextualize, and make sense of news information (Diakopoulous, 2007). Accessing and reporting news is enabled and facilitated through the networked computing environment and increasing pervasiveness of digital cameras and phones (ibid). Related to this vector is the computational media domain, which is sometimes equated with new media. This is the space where augmented reality, immersive environments, interactive television and film, physical computing, and interactive narrative interact (Computational Media, 2009)—the possible future of media. This domain will become increasingly more important, especially when related to Web 2.0 and beyond (see above)—the ability of all these systems to interoperate with one another will be crucial for accessibility and inclusivity.

Potential exemplar: *Wikipedia.*

The well-known online collaborative encyclopedia represents both the promise and the pitfalls of computational journalism. A key issue revolves around the role of professional editors to control hierarchical and content judgment. Wikipedia's multitude of anonymous users, who can create and change articles whether or not they are subject experts, lacks any such authoritative control. But Wikipedia's popularity as a source for quick reference is formidable, with estimates that put the number of daily page views in the hundreds of millions. The concept of a wiki, for

communicating and collaborating on information and specifically for organizing a group's information, has enormous potential for the workplace.

2. Review of the Vectors

The original candidate list of vectors²³ was chosen to represent new digital-media sources and digital technology, broadly conceived. Each vector was subsequently analyzed from three different perspectives.

Perspective 1: Analyzed for utility (or potential utility) in employment settings, and to understand how these new media sources and digital-technology products and services act as facilitators or barriers to the employment of people with disabilities.

Perspective 2: Analyzed for accessibility to the general population and to people with disabilities.

Perspective 3: Identification of best practices.

Each of the exemplar media sources and digital-technology products and services was chosen for its openness to analysis from these three perspectives; for its ability to serve a representative role of a larger technological vector with employment facility or usefulness; for its apparent capacity to shape the future of employment, based in part on its leadership in the marketplace; and for its potential ability to deliver candid representations of their experiences due to existing connections with the authors of this report (staff of Georgia Tech in general, and the CACP in particular).

The vectors underwent an extensive review. As a first step, a new definition of the term "vector" was arrived at, aiming at clarity and also at embodying the notion of a change agent:

An influential agent or means by which information moves, and that embodies the notion of change.

This definition was used as the basis for reviewing the six vectors first proposed, and in developing the three new vectors described below. The initial six vectors were reviewed as follows: first, with reference to the new definition; second, with reference to whether the vector is sufficiently developed that it actually represents a market environment and market trends that can be researched and described; and third, with reference to the parameters previously identified: 1) does the vector enhance social engagement? 2) does the vector increase opportunities for workplace participation? and 3) does the vector heighten employment prospects for people with disabilities?

Broad themes emerged from the review:

- Vector 1:** Some disquiet was expressed about the use of the word “technologies,” as being too broad and potentially misleading. The consensus was to introduce a new title for Vector 1: “Wireless communication platforms.” For purposes of market specification, and to encompass hybrid devices like the iPad, these platforms were identified as mobile telephony, computers, and gaming devices. The definition of this vector was changed to “an approach to the deployment or process of the provision of services.”
- Vector 2:** This vector (social networks) was generally seen as the most robust, in terms of general acceptance and definition, and the consensus was to stay with the existing term. A definition developed for this vector (based on Ellison, 2007) was: “Web-based services that allow individuals to 1) construct a public or semipublic profile within a bounded system, 2) articulate a list of other users with whom they share a connection, and 3) view and traverse their list of connections and those made by others within the system.”
- Vector 3:** The existing vector (virtual worlds) was also generally accepted, although the practical value of the sector was questioned. There was some discussion about what would serve as the best exemplar(s), and also about whether this represented an overlap with the gaming industry (see below). Finally, the consensus was to stay with the existing term.
- Vector 4:** This was the vector (Web 2.0 and beyond) that caused the most debate, mainly because of its lack of definition or agreement about what was being discussed. If the intention was to examine “alternative facilitated communication modalities,” then there seemed to be other vectors that already approached this area. The practical question was raised about how to conduct a market overview for something that basically still does not exist, and the decision was made to substitute this proposed vector with something more robust.
- Vector 5:** Again, there was some confusion about what the phrase “applications consolidator” means. One argument was that, with the success of the Android platform, the real purpose should be to focus on open source. The final consensus was to introduce a new title for Vector 5: “Open-source process.”
- Vector 6:** As this is a new, rapidly developing area (computational journalism), there was a question about how it relates to employment, and also how to define it. Several examples emphasized that the focus should be on how *information* is captured, shared, and processed, rather than use of the word journalism, which may be misleading. This may be extended to cover three key elements: information processing, information authentication, and information licensing and distribution. The argument was also made that a new term should be sufficiently flexible to, for example, encompass

YouTube as well as existing publishing conglomerates like New Corporation. After some debate, a new title for Vector 6: “Open publishing” was developed.

Following this process of clarification, new suggestions were reviewed at length. Ultimately, three new vectors were offered for consideration:

Vector 7 (new): Online Marketplace.

This vector was offered in reference to the outsourced workplace and to job search and “skills-for-sale,” as well as items for sale. Potential exemplar: eBay or Craigslist.

Vector 8 (new): Games, or Tiered Digital Interactions.

This area was suggested partly in recognition of the huge size and impact of the existing gaming industry, but also because of the potential impact on other sectors such as education, and the idea of learning by participating in a process.

Vector 9 (new): Smart Interfaces.

This term emerged from some early findings of the literature review, in particular, The Horizon Report 2009 Edition, which identified the personal Web, geolocation tools, semantic-aware applications, and smart objects.

3. Choosing the Vectors

After several meetings, the research team refined the definition of the term “vector” to: *An influential change agent by which information moves.*

The nine vectors were reviewed as follows: first, with reference to the new definition; second, with reference to whether the vector is sufficiently developed that it actually represents a market environment and market trends that can be researched and described; and third, with reference to the parameters already identified in the proposal: 1) does the vector enhance social engagement? 2) does the vector increase opportunities for workplace participation? 3) does the vector heighten employment prospects for people with disabilities? In addition to referring to these general elements, five measures of importance and relevance were weighed:

1. Importance to people with disabilities/perceived product importance—market penetration in disability community, evidence of marketing use, affordability
2. Relevance to new workplace and to creating work opportunities
3. Relevance to getting a job
4. Relevance to doing a job.
5. Relevance to the employer—does it build business, increase competitiveness, etc.?

Finally, the review board took an open vote, based on the following vetting measures:

1. This vector has high utility as a means of moving information
2. This vector has high utility/potential as an aid to help people **find** work
3. This vector has high utility/potential as an aid to help people **do** work
4. This vector has high utility/potential as an aid to help people with disabilities **find** work
5. This vector has high utility/potential as an aid to help people with disabilities **do** work

The review board identified the six vectors below, described in the research:

Vector 1: Wireless Communication Platforms.

Identified as mobile telephony, computers, and gaming devices. Defined as “an approach to the deployment or the process of the provision of services.”

Vector 2: Social Networking.

Defined as “Web-based services that allow individuals to (1) construct a public or semipublic profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system” (Ellison, 2007).

Vector 3: Virtual Worlds.

Defined as “computer-simulated worlds in which the user takes on a role.”

Vector 4: Electronic Games, or Tiered Digital Interactions.

Defined as electronic systems that involve interaction with a user interface to generate feedback on a display device. This may include “serious games,” i.e., games designed for a primary purpose other than pure entertainment, such as education, scientific exploration, health care, emergency management, city planning, engineering, religion, and politics.

Vector 5: Open-Source Process.

Providing the user with tools to accomplish a task as part of an open-source process, defined as “a collaborative process in which programmers improve upon code and share changes within the community.” Open source is usually depicted as a response to proprietary software owned by corporations.

Vector 6: Open Publishing.

Defined as information capture, sharing, and processing. This may be extended to cover three key elements: information processing, information authentication, and information licensing and distribution.

Endnotes

¹ For the purposes of this research, objects were identified as mobile telephones, computers, and gaming devices.

² There is an element of triumphalism to Benkler's account. Counter balance to his narrative can be found in Lanier (2010) and Carr (2010), who both make humanistic pleas for caution in the face of technological determinism. Neither denies the effect digital technology is having on society, however.

³ In the 2004 report, a distinction is made between universal design and accessible design. Accessible design has to do with creating a product or a version of a product specifically to fill some accessibility gap. A specialized speaking alarm clock might be an accessible design. This was contrasted with universal design, which was creating mainstream E&IT with accessibility built into the device or service.

⁴ The sources are described fully in Appendix 2: Background to Industry and Occupational Data Sources.

⁵ 3G (3rd Generation) allows simultaneous use of speech and data services, and provides high rates of data transmission. This makes possible wide-area wireless voice telephone, mobile Internet access, video calls, and mobile TV, all in a mobile environment.

⁶ JBoss is owned by Red Hat.

⁷ Interview with a technical director at a mobile platform technology company. Conducted June 20, 2010.

⁸ Search conducted on May 29, 2010, in the Second Life platform, using the search term "employment."

⁹ Interview with a leading social-networking technology director conducted on May 19, 2010, for this NCD report.

¹⁰ Search conducted on May 29, 2010, on <http://www.facebook.com> using the keywords "disability" and "disability + employment" within the group search feature.

¹¹ Search conducted on May 29, 2010, on <http://www.linkedin.com> using the keywords "disability + employment" within the group search feature.

¹² Data mined while performing keyword searchers. Facebook group can be found at <http://www.facebook.com/search/?init=srp&sfxp&o=69&q=disability+employment&s=50#!/group.php?gid=5134953450&ref=search&sid=kLTQSaBmDmCDbRoHL043nA.2564412928..1>. LinkedIn group can be found at http://www.linkedin.com/groups?gid=73241&trk=anetsrch_name&goback=.gdr_1275651765304_1

¹³ “HTML5: A Vocabulary and Associated APIs for HTML and XHTML (Editor’s Draft).” Retrieved on May 28, 2010, from <http://dev.w3.org/html5/spec/>.

¹⁴ Objective of the working group retrieved on May 28, 2010, from <http://www.w3.org/WAI/PF/html-task-force>.

¹⁵ Response to the question “What Improvements to Accessibility Are Offered by HTML5?” by the user Alochi. <http://stackoverflow.com/questions/1315076/what-improvements-to-accessibility-are-offered-by-html5>. Posted on April 22, 2009, and retrieved on May 29, 2010.

¹⁶ Interview with a leading open-source software project director conducted on April 8, 2010, for this NCD report.

¹⁷ Examples of universities that have incorporated transdisciplinary themes include Georgia Tech (<http://www.gatech.edu/vision/themes/transdisciplinary.html>), UNC Chapel Hill (<http://gradschool.unc.edu/policies/transdisciplinary.html>), Wilson College (<http://www.wilson.edu/wilson/asp/content.asp?id=1021>), and Claremont Graduate University (<http://www.cgu.edu/pages/6078.asp>).

¹⁸ Taken from an interview with a tiered immersive environment, conducted on March 5, 2010.

¹⁹ Taken from an interview in the open-source community vector that took place on April 10, 2010.

²⁰ Interview with Communications Research Lab Senior Research Scientist, conducted April 8, 2010.

²¹ After the interview, the conductor looked further into these types of sites. Good examples include <http://www.buymmoaccounts.com/>, <http://www.gamepal.com/content.php>, and <http://www.ebay.com>.

²² Taken from Alexa.com’s use statistics on Web activity in South Africa (<http://www.alexa.com/topsites/countries/ZA>).

²³ The term “vector” is taken from the work of McKenzie Wark (1994, 2009) and originally defined as any influential force or means by which information moves.