WEB DESIGN: IT CAREER OPPORTUNITY FOR WOMEN?

A THESIS
by
Gabrielle Jazwiecki

Submitted in partial fulfillment
of the requirements for the degree of
Master of Arts
in
liberal studies

State University of New York
Empire State College

2009

First Reader: Nancy Gadbow

Second Reader: Frieda Mendelsohn

Abstract

The rapid evolution of computer technology has given rise to a global economy and information technology (IT) as a major industry. The projected growth in computers, software, and applications for IT will continue to have substantial impacts on employment opportunities in the United States. However, IT is a male-dominated field with a low percentage of women workers. Web design has been presented as an IT career pathway for women. This thesis examines whether Web design presents opportunities for women that have not existed in previous IT career paths, whether women face the same challenges as they do in other IT fields, and if Web design offers the type of work and work environment that is of interest to women and adaptive to their lifestyles and needs. Based on the available research, it does not appear that Web design presents a better IT career path for women than other IT fields.

TABLE OF CONTENTS

CHAPTER

Chapter 1: Introduction

The introduction of computer technology into the workplace has had a profound effect on the job market. It has created new job opportunities, but it also has rendered other jobs obsolete. Increasingly, knowledge and experience in the application of computers is no longer an option in today's job market. It is mandatory. The evolution of computerized communications technology and formats has been very rapid. Progressively more companies are requiring job applicants to have experience in applications of computer technology. This requirement reflects the shift in the business world to electronic communication and marketing formats, such as Web sites. Computerized and digital information technology (IT) drive today's global economy. Jobs in computers, software, and applications for IT are well paying and key positions in the changing economy of the 21st Century (U.S. Department of Labor, 2002).

According to an article by James Challenger (2000), president of an international recruitment firm, Web site design and development presents job opportunities for women in IT, which is known as a male-dominated industry. The purpose of this thesis is to establish whether this is true, and the extent to which this field opens doors for women in IT. To accomplish this objective, this thesis explores IT, the history and current status of women in the work place and IT, and careers in IT and Web design and development.

However, the rapid and ongoing development and evolution of IT technologies and Web design makes it challenging for researchers to keep pace with it (Kotamraju, 1999). When Web design first emerged in the mid-1990s, Web sites were simple and basic. Between 2001 and 2009, the time period when the related coursework and research for this thesis was conducted, the use of the World Wide Web accelerated at a phenomenal speed. During this time period, Web site designs became increasingly more complex as Web sites incorporated a growing range

of digital media, software, and databases. The skills and educational background required to be a Web designer expanded at an accelerated pace along with the use of the World Wide Web. Therefore, due to Web design's exponential growth, time has been a factor in this project.

Defining IT

In order to discuss career opportunities in fields related to IT, it is necessary to provide definitions for the terminology. According to Laudon, Traver, and Laudon (1994), information technologies range from physical devices like paper, pencils, books, newspapers, cameras, tape recorders, and computers to more symbolic tools like written language, mathematical symbols, chemical models, and tables of natural elements. These tools and techniques enable us to visualize, understand, and control our environment. Throughout history, the evolution and implementation of ITs have had a profound effect on the development of our society. Take writing, for example. Writing is an IT that emerged about 5,000 years ago. Writing enabled people to record and preserve their historical events, stories, and culture and pass them down to future generations. Writing combined with the invention of the movable type press in the 15th century gave us the printed word, newspapers, and books. According to Laudon at al. (1994), these ITs created the potential for widespread literacy and supported the development of self-governance, democracy, and popular culture. Prior to the union of computer technology and information technology, the printed word, the newspaper, and the book were the most powerful, far-reaching, and transforming ITs. Through computer technology, digital ITs are transforming the world in much the same way printed word technologies changed society 500 years ago. Digital ITs have made it possible to widely and easily distribute vast amounts of knowledge.

The Alliance for Telecommunications Industry Solutions (2007) defines IT as the branch of technology devoted to studying, applying and processing data (the automatic acquisition,

storage, manipulation, management, movement, control, display, switching, interchange, transmission or reception of data); and the development and use of hardware, software, firmware, and procedures associated with this processing. Computer technology is the engine that drives IT industries today. According to the Institute for Telecommunications Sciences (1996), the research and engineering branch of the National Telecommunications and Information Administration and a part of the U.S. Department of Commerce, a computer is a device that accepts data, processes the data according to a stored program, generates results, and usually consists of input, output, storage, arithmetic, logic, and control units. The Institute also defines a computer as a functional unit with the ability to perform substantial computation without human intervention, including numerous arithmetic operations or logic operations. This thesis employs the above definitions of IT and computer technologies to evaluate Web design as a job opportunity in IT.

The rapid evolution of IT industries and computer technologies has made it difficult to fully define the fields and the impacts to the workforce. In a pilot study to investigate the scope of work practices performed by the information technology workforce (ITWF), Burnett and Subramaniam (2004) found that a comprehensive agreed-upon and extensible definition of IT is lacking. A report by the US Department of Commerce states that the definition of IT worker depends on who is asked. Each organization may define an IT worker differently and the definition may change over time. In their review of the literature, Burnett and Subramaniam (2004) found that IT workers' vocational and academic training backgrounds vary enormously. They also found that IT workers obtain their education through diverse disciplines and work in various industries, not just industries specific to IT. For their study, Burnett and Subramaniam used the following National Research Council (NRC) definition of IT workers: "those persons

engaged primarily in the conception, design, development, adaptation, implementation, deployment, training, support, documentation, and management of IT systems, components, or applications" (p. 204). This thesis employs the NRC's definition of IT workers to assess opportunities in IT for women.

Role of IT in Today's Global Economy

According to a report issued by the Aspen Institute following its 13th Annual Roundtable on Information Technology (Bollier, 2005), information and communications technology is one of the most important forces shaping the global economy. The convergence of several technologies—the personal computer, software, the Internet, and broadband and wireless communications—is integrating international commerce and changing the way business is conducted. IT has made it possible to move finance capital around the world with unprecedented speed. IT also has made transportation and logistics more efficient so work and manufacturing can easily be relocated to reduce costs. Through IT, innovation and productivity are forging ahead at breakneck speeds.

The integration and incorporation of information and computer technologies in homes, workplaces, and markets has led to a third wave of globalization. According to the renowned author and financial journalist Thomas Friedman (Pink, 2005), the first wave of globalization began in 1492 AD, when Christopher Columbus discovered America and opened trade between the Old and New Worlds. The second wave of globalization occurred from 1800 AD until 2000 AD and was driven by companies searching for markets and labor for their businesses. This wave was supported by dropping transportation costs during its first half and by dropping telecommunications costs during the second half, which were primarily fueled by breakthroughs in technology. The third wave of globalization started around 2000 AD, gaining its leverage from

software applications and a worldwide fiber-optic network that allow individuals to collaborate and compete globally. Small businesses can compete in the same market as large corporations. The convergence of several technologies and political forces has led to a global, Web-enabled playing field that allows for multiple forms of collaboration without regard to geography or distance - or soon, even language (Pink). Networking technologies have made asynchronous and real-time communications among different regions and countries feasible, creating new ways of working and increasing opportunities for collaboration (Huang & Trauth, 2006, as cited in Trauth, Quesenberry & Huang, 2006).

The new information and communication technologies are also creating divisions and disparities due to different levels of education, training, and skills (Bollier, 2005). According to Robert Hormats, vice chairman of Goldman Sachs (International), "The tectonic shifts are not just among societies but within societies. There are new divisions within societies between skilled and nonskilled and between well-trained and non–well-trained workers" (as quoted in Bollier, p. 4). Similar to the Industrial Revolution, the rapid growth in IT and computer technology has changed the way people work by altering the workplace and creating different types of occupations to support its evolution and expansion. Those workers who do not have the necessary education, skills and training will find it difficult to secure positions with salary levels sufficient to support themselves and a family. According to Arnold and Niederman (2001), women, minorities and older workers are not fully represented in the IT work force in the United States. Although women hold more than half of all professional occupations in the United States, they hold fewer than 26 percent of all computing-related occupations and only 13 percent of Fortune 500 technology companies have women corporate officers (National Center for Women & Information Technology, 2007). The low percentage of women in a sector of the workforce

that the United States Department of Labor (2002) projects will continue to have substantial impacts on employment opportunities in this country makes it imperative for women to find career pathways in IT fields.

Current and Projected IT Labor Force/Job Market

The current IT job market has been shaped by the spread of the Internet and the increasing importance of networked computing (Mowery & Rosenberg, 1998 as cited in Rosenbloom, Ash, Coder & Dupont, 2005). This is a change from the IT workforce that evolved in the 1960s in response to the extensive use of mainframe computers. The composition of the IT workforce began to change in the 1990s when the IT industry confronted a major issue related to the usage of computers and computer technology: the Year 2000 (Y2K). From the 1960s through the late 1980s, it was a widespread practice in computer software development to use two digits to represent a year rather than four digits in order to save computer disk and memory space, which was costly at the time. As the year 2000 approached, IT experts began to realize that this would cause computer systems to misinterpret 00 as 1900, which would create havoc in all computerized systems. The impending Y2K crisis created a strong demand for IT professionals that contributed to a rapid expansion of the IT workforce and rising pay scales. Between 1983 and 2000, the IT workforce more than doubled in size, increasing from 1.47 million to 3.13 million workers. Although more than 200,000 IT jobs were lost when the technology bubble collapsed in 2001, the IT labor force in 2002 was still 96 percent larger than it was in 1983 (Rosenbloom et al., 2005).

According to Rosenbloom et al. (2005), full-time IT professionals earned about 20 percent more than full-time workers in non-IT occupations in 1983. By the late 1990s, IT professionals earned over 60 percent more than people working outside of IT. The growth in IT

employment coincided with important changes in the type of jobs performed by IT professionals. As the usage of mainframe computers declined, so did the number of computer operators. From a peak of 962,000 computer operators in 1986, the number of computer operators fell to 300,000 by 2002. Offsetting this decline was the rapid growth in the number of computer systems analysts and scientists. This segment of the IT labor force grew from 273,000 in 1983 to more than 1.7 million in 2002. By 2002, computer systems analysts and scientists constituted over 60 percent of all IT professionals (Bureau of Labor Statistics Current Population Survey March 2002, as cited in Rosenbloom, Ash & Dupont, 2003).

Information technology-related jobs are among the fastest and largest growing jobs in the economy (Dohm & Shniper, 2007). With a projected 24.8-percent growth rate, computer and mathematical occupations are expected to grow the most quickly. In comparison, the projected growth rate in the arts, design, entertainment, sports, and media fields is 11.4 percent. According to Dohm and Shniper (2007), demand for computer-related occupations will grow in almost all industries as organizations continue to adopt and integrate increasingly sophisticated and complex technologies. However, this growth will not be as rapid as during the previous decade since the software industry is maturing and more of the routine work is being outsourced overseas.

Some of the fastest growing occupations include positions as network systems and data communications analysts, computer software and applications engineers, computer systems analysts, database administrators, and computer software and systems engineers (Dohm & Shniper, 2007). The growth of electronic commerce and the integration of Internet technologies into business have created a need for specialists who can develop and support Internet and Intranet applications. An Intranet is a restricted computer or private network developed with

World Wide Web software (WordNet, 2006) that is used by many corporations to support internal communications. According to Robert Half International, a firm that provides staffing services, salary ranges for computer-related occupations range from $47,500 to $116,000 (as cited in Bureau of Labor Statistics, 2007). With a range of $84,750 to $116,000 per year, the position of database manager is the highest paying job. The table provides salary ranges from the Robert Half International 2007 Salary Guide that the Bureau of Labor Statistics applied to produce the 2008-2009 edition of its *Occupational Outlook Handbook* (2007).

Table

2007 Salary Ranges for Computer-Related Occupations

Position	Salary Range
Database Manager	$84,750 - $116,000
Network Architect	78,000 - 112,250
Database Developer	73,500 - 103,000
Senior Web Developer	71,000 - 102,000
Database Administrator	70,250 - 102,000
Network Manager	68,750 - 93,000
Web Developer	54,750 - 81,500
LAN/WAN Administrator	51,000 - 71,500
Web Administrator	49,750 - 74,750
Web Designer	47,000 - 71,500
Telecommunications Specialist	47,500 - 69,500

Adapted from the *Robert Half International 2007 Salary Guide* as cited in "Computer Scientists and Database Administrators" by Bureau of Labor Statistics, 2007, *Occupational Outlook Handbook, 2008-09 Edition*, http://www.bls.gov/oco/ocos042.htm#addinfo

In 2007, the median household income in the United States was $50,740 (Bishaw & Semega, 2008). Therefore, the salary ranges of computer-related occupations present the potential to earn an income that is at or above the nation's median income. Four of the eleven computer-related occupations in Table 1 are jobs related to Web design and development: senior Web developer; Web developer; Web administrator; and Web designer. Of the four, the job with the lowest salary range is Web designer.

IT occupations generally require long work hours and a significant time commitment (Rosenbloom et al., 2005). More men and women in IT work full time compared to men and women in non-IT jobs. In 2002, 95 percent of men and 91 percent of women in IT worked full-time, compared to 87 percent of men and 73 percent of women in non-IT jobs. The average woman in IT worked three more hours per week than the average woman in a non-IT job (39.5 hours compared to 36.2 hours). Rosenbloom et al. theorize that IT's longer work hours discourages women from entering or staying in the field, especially those with young children. Overall, IT professionals are younger than those in the non-IT workforce (Rosenbloom et al., 2005).

Increasingly, there is concern among IT workers about job losses due to outsourcing and off-shoring. There have been numerous reports of companies exporting technical support and programming jobs to suppliers in India, China, and other low-wage countries with well-educated labor forces. Given the significant differences in wages, shifting some tasks to IT workers in Asian countries is an attractive option for U.S. companies seeking to cut labor costs. Rosenbloom et al. (2005) do not view this as a serious threat to IT jobs in the United States since off-shoring is most effective when the tasks to be performed are more routine and these are jobs that will probably be automated in the near future. Jobs requiring specialized knowledge of

business practices and discretionary decisions are likely to remain in proximity to customers. Therefore, the majority of higher level IT jobs will most likely remain in the United States (Edwards 2004, as cited in Rosenbloom et al., 2005).

However, Rosenbloom et al. (2005), theorize that the composition of IT jobs will remain biased towards high skilled jobs where there are relatively few women. They project bleak prospects for increased representation of women in IT. Rosenbloom et al. speculate that since few women were drawn into the rapidly growing field of computer systems analysts and scientists during its period of rapid expansion in employment, opportunities for women are likely to remain limited in the future as aggregate growth slows.

IT as Male Dominated Field

In 1999, women represented 47 percent of the total U.S. workforce, but only 29 percent of the IT workforce (Chamberlain, 2001). In 2000, women comprised 26 percent of the country's computer scientists and 9 percent of computer engineers (Challenger, 2000). The percentage of women in the American IT workforce grew to 34.9 percent in 2002, but then declined to 32.4 percent by 2004 (Information Technology Association of America, 2003, 2005 as cited in Trauth, Quesenberry & Huang, 2006). As the data show, the under representation of women in the IT workforce continues to grow.

Many reports highlight the hostility that women encounter in IT fields (Margolis & Fisher, 2002; Teague, 2002). Goldin (2002) posits that men in an all-male occupation are hostile to a woman entering their occupation because, even if she is qualified for the position, society may not know that she has the requisite qualifications and view the occupation as altered, thus lowering the prestige associated with the position. In other words, she would "pollute" the occupation. According to Goldin (2002), this occurs because the economy is dynamic and

technological change can reduce the minimum level of the characteristic required for entry. Society has imperfect information regarding changes in technology and infers change from observables. One of these observables is the sex (or any group descriptor, such as race) of new entrants. Men might want women barred from their occupation to protect their status even if no skill-reducing technological change affected their occupation. Of course, there are also the financial considerations. Throughout history, when women are permitted to enter a field or profession, they are paid at a lower salary range and, for the most part, prevented from advancing. This has been particularly true in IT fields, where despite the need for more IT workers, women remain underrepresented. Women hold fewer than 26 percent of all computing-related occupations and only 13 percent of Fortune 500 technology companies have women corporate officers (National Center for Women & Information Technology, 2007).

Rosenbloom et al. (2005) attribute the decline in women in the IT workforce to the decline in computer operators that began in 1986 with the decreasing usage of mainframe computers. Rosenbloom et al. theorize that the decline in the number of women in America's IT workforce reflects the growing importance within IT of occupations that traditionally have been dominated by men.

According to Rosenbloom et al. (2005), women's representation declines as one moves up to higher level occupations within IT. While women are prominent in positions as data entry personnel and computer operators, they are less likely to be found in high-level occupations such as systems analysts and computer programmers. In fact, since 1985, women's share of the IT workforce in the United States has actually declined. This is in striking contrast to the general trend toward increasing female participation in most areas of the workforce. On its fact sheet, the National Center for Women & Information Technology (2007) notes that in 2006, 51 percent of

professional occupations in the United States were held by women, but only 26 percent of professional IT-related positions were held by women, and only 13 percent of the corporate officers at Fortune 500 technology companies were women.

In the male-dominated IT workforce, Challenger (2000) claimed that the Web was a great equalizer for women since entry in this field did not require a degree in computer science. Most positions in IT require a degree in computer science, and Challenger noted that the under representation of women in the IT workforce mirrored the decline in the number of women seeking degrees in computer science. Based on the available data, the situation is not likely to improve. In 2000, only 25 percent of the computer science degrees awarded went to women, a decline of 12 percent from a peak of 37 percent in 1984 (Challenger, 2000). Based on this data, Challenger projected that with fewer women pursuing degrees in computer science, the percentage of women in the IT workforce would continue to decline. In 2006, 77 percent of recent graduates with bachelor's degrees in computer and information sciences were men (Proudfoot, 2008). Recently, the Computing Research Association (CRA) (2009) reported that two-thirds of U.S. bachelor's degrees in computer science were awarded to white males and just 12 percent to women in the 2007-2008 academic year.

In response to the shortage of women in IT, Challenger (2000) recommended that women pursue a career track in Web design. He noted that Web design did not require a degree in computer science. According to Kevin Kennedy, a chief executive officer with Webgirls International, an aspiring Web designer needed little to no experience on the computer and HTML, the computer language used to design Web pages, was easy to learn (as cited in Challenger, 2000). All one needed to be a Web designer was creativity, an eye for design, and the ability to think through problems. Challenger presented Web design as a golden opportunity

for women to break into IT. He said that Web companies were "falling over themselves in an effort to bring skilled female designers and programmers aboard"(p. E1) due to the major shortage of women in the high-tech field. Women were particularly in high demand among Web-related companies because the number of women surfing the Internet was rapidly expanding and marketing research showed that women preferred Web pages designed by other women.

As a potential IT career path for women in a predominantly male sector of the workforce, the following section provides an overview of Web design, and the roles and responsibilities generally assigned to an individual working in this field.

Web Design

In simple terms, a Web designer designs pages for the World Wide Web (Sgobbi, 2002). As a research fellow with the Department of Economics and Production of the Polytechnic University of Milan, Sgobbi analyzed job postings on three employment Web sites (www.monster.com, www.computerjobs.com, www.jobengine.com) and interviewed sector experts to develop a definition of the role of a Web designer. According to Sgobbi (2002), "the Web designer defines and implements the strategic design of a Web site, supervising and coordinating all the issues related to the site layout, style, contents, and functions." (pp. 116-117) A Web designer works with a client to develop a plan and method for conveying the client's message to the Web site's users and plays a role in selecting the technical tools to develop and manage the Web site and its contents. During the implementation phase, the Web designer translates the site's contents into Web pages and develops the interfaces between the Web pages. For larger projects, the Web designer also is responsible for managing the design staff, overseeing the professional development of junior design staff, supervising the assembly of the site's components, and ensuring the overall coherence of the Web project.

Sgobbi (2002) notes that the process of constructing or modifying a Web site requires the Web designer to interact with several other professionals, such as the Web project manager, the marketing manager, the Web master, the system administrator, and graphics designers. The Web designer must have a solid technical background in the application of software graphic tools, Web-oriented programming languages, and editing tolls, as well as skills in communications, coordination, problem solving, and teamwork. Due to the rapid and continuous evolution of Web tools and applications, Web designers must constantly update their technical knowledge.

According to Kotamraju (2002), there are three concrete aspects of Web design: HyperText Markup Language (HTML) authoring, graphic production, and media development (Niederest, 1999, as cited in Kotamraju, 2002). HTML is the code that structures the appearance of text and images on a Web page. Graphics production is the software-driven process of manipulating digital images on a Web site. Media development is a polyglot of visual and technical components of a Website, such as videos on chat rooms. Web design also refers to the theoretical approach to creating Web sites with an emphasis on user interface. Interface for a Web site is defined as a crafted communication environment that houses the site's content and the navigation devices that users need to access the site's content (David & Merritt, 1998, as cited in Kotamraju, 2002).

The above descriptions of the roles and responsibilities generally assigned to a Web designer clearly demonstrate that the job requires knowledge in the application of various computer hardware and software, programming languages, and graphic design, as well as communication, management, and organizational skills. In addition to completing their projects, Web designers must continually upgrade their skills to keep pace with the rapid and ongoing evolution of information and computer technologies that support Internet and Intranet usage.

Web Design: Best Path to a Career in IT for American Women?

As previously discussed in the above sections, information technology is a major force in today's global economy and the need for people with skills in areas related to IT is projected to grow. However, men dominate higher-level occupations in IT industries and, due to the need for more qualified personnel in these fields, there have been many attempts to understanding and address this issue. The explanations for male domination in IT fields include the following:

- Men have more interest and ability in science, mathematics, engineering, and technology than women;
- People who work in information technology and computers are seen as loners and "nerds" and women do not want to be perceived that way.
- Women do not perceive themselves as capable of working in these fields;
- Men do not perceive women as capable of working in these fields; and
- Men are concerned that the presence of women in higher-level IT jobs may alter Society's perceptions of the qualifications required for these occupations and the pay scales would subsequently be lower (Golden, 2002).

Although these explanations appear to reflect gender biases and issues related to the second-class status of women in our society, they also may reflect an element of truth with respect to careers opportunities for women in IT at this point in time. Given the current environment for women in IT, Web design may offer the best and most realistic option as a career field in this industry. It may be possible that their presence in Web design will open up other fields for women in IT. Then again, it may be an option that steers them into an occupation where salary ranges will decline when it becomes overwhelmingly female. To answer this question, this thesis explores the past and current experiences of American women in the

workplace, historical and current perspectives of women in IT and disciplines related to IT, careers in IT, and Web design as an occupation and a career path for women. The next chapter will begin this process with a look at the history of American women in the workplace and trends that are currently impacting them.

Chapter 2: American Women in the Workplace

To evaluate whether Web design and development represents a career path in IT for American women, it is necessary to establish the advantages and disadvantages that the field presents for them. This type of assessment requires a review of the history of women in the workplace. This chapter explores American women's past and present experiences and opportunities in the workplace to identify social and economic factors that create or impede them, such as labor shortages, downturns in the economy, and the introduction of new technology that rapidly expands supply and demand markets.

History of American Women in the Workplace

Throughout human history, women have worked to provide for themselves and their families. Over the centuries, some of the specific tasks or jobs they have performed, or been allowed to do, have changed and some have not. A review of the type of work or professions open or closed to them is important in assessing job opportunities for American women since many of the obstacles that prevent them from pursuing careers in certain fields are based on historical and traditional perceptions of gender roles shaped by social and economic influences.

Prior to the European colonization of America, Native American women were primarily responsible for gathering wild plants for food, herbs for medicines and dyes, clay from the riverbed for pottery, reed for weaving cloth, and clamshells for jewelry and wampum (Wertheimer, 1977). The men hunted and fished; fought wars; made weapons and tools; and built canoes, longboats, wigwams and hogans. The women tilled the soil, sowed the seeds, cultivated and harvested, wove baskets and blankets, tanned animal hides, made clothing, cured meats and dried vegetables, cared for the children and maintained the home, which sometimes they also built. Nonetheless, they did not have the status of men, nor were they considered their equals.

According to Wertheimer (1977), the first European women to immigrate to America as members of colonizing expeditions performed many kinds of work generally considered male jobs due to the shortage of labor. When the male population in the colonies increased and the labor shortage ceased, women were then barred from doing these types of jobs. In the seventeenth and eighteenth centuries, American women produced almost all that their family needed and consumed, and bartered and sold any superfluous supplies for additional comforts. Baxandall and Gordon (1995) confirm that, prior to 1820, most manufacturing was done at home.

Men, women, and children tended to work together and the division of the labor was less rigid in America's pre-industrial society (Wertheimer, 1977; Baxandall & Gordon, 1995). Although men dominated the skilled crafts, women's work was visible and highly valued. While women had second-class status, they were not excluded from the mainstream of production and their work was integrated into other forms of production. In pre-industrial society, there were no sharp distinctions between housework, farming, and manufacturing. Both men and women worked primarily at home and women typically interspersed housecleaning, childcare, and productive labor throughout the day.

While most women worked full-time in their homes, some supplemented their income through paid employment (Wertheimer, 1977). One of the earliest occupations for women in the American colonies was that of innkeeper. Although some inns and taverns were run by husband and wife teams, many women managed these types of establishments by themselves. Women also engaged in other types of businesses. A woman owned the first printing press established in the American colonies in 1638. Women ran sawmills and gristmills, caned chairs and built furniture, operated slaughterhouses, printed cotton and other cloths, made lace, and owned and

operated dry-goods and clothing stores. They made concoctions that they sold in drug shops, and worked in tobacco shops and general stores that sold everything from pins to meat scales. Although only boys were apprentices to craft and artisan trades, women frequently learned these skills from helping their male relatives run home-centered businesses and workshops.

During the early nineteenth century, the Industrial Revolution ushered in new economic and social forces that transformed the way Americans worked, lived, and thought about society (Baxandall & Gordon, 1995). Factories began to produce items that traditionally had been made by hand in homes or shops. Unable to compete with the factories' large-scale production, many small enterprises went out of business. With dwindling incomes, many craftsmen were forced to become factory workers. Industrial production depended on wage labor, long hours, repetitive work, and new forms of labor disciplines. Even workers who did not earn wages became increasingly dependent on those that did. Industrialization dramatically changed the location of work, the kind of work women did, and the sexual division of labor (Baxandall & Gordon, 1995).

According to Hochschild (1989), as men left the farms to work in factories, women assumed responsibility for raising children and managing households. By assuming these responsibilities, women enabled men to trade their labor for pay. The economic changes ushered in by the Industrial Revolution required husbands and wives to divide up the workload necessary to maintain a family under capitalism. Since work in the factory was viewed as unsuitable for women, men assumed the workload associated with labor for pay outside the home. The workload at home became a woman's job. This division of labor formed the basis for the belief that housework and child rearing were solely women's work. In a pre-industrial setting, a woman's claim to honor was based primarily on her relation to her husband, children, and home.

As the cash economy spread, money became the dominant symbol of honor and worth. Unpaid work, like the kind women did at home, became devalued. Society came to view it as not 'real' work (Hochschild, 1989; Schor, 2000).

In *The Overworked American,* Schor (2000) states that as capitalism expanded in the 1800s, factories established prolonged work periods or shifts for their employees to meet production quotas. Since the factory shifts were not designed to accommodate human needs, employers found it difficult to get employees to work according to a shift schedule. In the interest of promoting capitalism, employers and social workers joined together and developed an educational format to accustom working-class children to shift work. Public elementary schools were designed "to break the laboring classes into those habits of work discipline now necessary for factory production" (Schor, 2000, p. 61) to support the transition to an industrial economy in the 1800s. Employers and social workers believed that putting little children to work at school for very long hours at very dull subjects prepared them for future labor and fatigue in the factories. This programming eventually shaped the way people structured their lives (Schor, 2000). The school day is still structured to resemble work schedules and routines. For example, school districts continue to schedule high school classes in the early morning hours despite studies that show teenagers consistently perform poorly in early morning classes due to hormonal changes associated with their physical development (Zielbauer, 2001). The emphasis is still on making students conform to business hours rather than helping them achieve their personal best. As the parent who traditionally is primarily responsible for care of the home and children, women have been forced to manage their work outside and in the home around schedules designed to support an industrial economy, which is now outdated.

With few options for channeling their talents and skills, and in response to the Industrial Revolution's impacts on society, many women were drawn to the reform movements that emerged during the mid-1800s (Baxandall & Gordon, 1995). Women became active in religious revivals, a popular health movement, labor reform, religious and social communities, and a women's right movement. This time period also saw the rise of the abolitionist movement in which women played a major role. In the early nineteenth century, the "True Womanhood" ideology emerged which promoted the idea that women should remain at home to provide a tranquil place for men buffeted by the stress and burdens of urban life (Baxandall & Gordon, 1995). Promulgated by the clergy and the new women's magazines, the ideology espoused that a woman's primary commitment was to the home and the family (Walsh, 1989). According to Weisberg (2004), local newspapers of the day urged young women to practice reason, prudence, and virtue through devotion to education and domestic duty and to govern their passions since anger and excitement could spoil the complexion. Heightened emotions could lead to hysteria, which was regarded as a woman's disease that originated in the womb and demonstrated female frailty and fallibility. Therefore, to avoid the fits and seizures induced by hysteria, it was important for a young woman to exercise self-restraint and to remain in a limited arena: the home.

The rise of the spiritualist movement in the mid-nineteenth century provided one of the few fields in which a woman could earn a living, and it also gave women a public format to voice their opinions by presenting them as the words of the spirits (Gabriel, 1998). It was through spiritualism that Victoria Woodhull, the first woman to manage a brokerage firm on Wall Street and run for the presidency of the United States, gained fame and fortune. However, Victoria Woodhull's success as a businesswoman, publisher, and politician was unique.

Throughout the nineteenth century, the largest employer of American women workers was private household service, with approximately 50 percent of them employed as domestic servants (Walsh, 1989). During that same period, about 22 percent of American women worked in agriculture (Matthaei, 1982, as cited in Walsh, 1989). Prostitution also emerged as a major source of income as working-class women, especially immigrants and ethnic minorities, who struggled to survive in a limited and poorly paid job market (Walsh, 1989). The expansion of textile factories and cotton mills in New England from 1832 to 1848 created a huge demand for workers (Robinson, 1883). To meet this demand, factories began recruiting women. Men were employed and paid by the head to recruit young girls from different parts of New England and Canada to work at the factories. By the 1840s, the myth that textile factory work was an opportunity for women and the "factory girl" a privileged lot had largely been dispelled (Baxandall & Gordon, 1995). Around this same time period, women began to organize to demand equal rights. In 1848, the first Women's Conference was held in Seneca Falls, New York, initiating a movement to gain women equality (Feminism and Women's Studies, 2005).

The need for rapid production to meet solders' needs during the Civil War drew 300,000 additional women into wage work, particularly as seamstresses making uniforms. According to Baxandall and Gordon (1995), "the increase in women's employment and the debate this engenders is always exacerbated by wars" (p. 75). This also was the case during World War II (1939-1945), when women were recruited as paid "computers" because the U.S. Army needed people to calculate ballistic trajectories to support the United States' armed forces (Todd, Mardis & Wyatt, 2005) and the enlistment of men in the armed forces had created a labor shortage. As described in Chapter 3: Historical and Current Perspectives on Women and IT, the U.S. Army's recruitment of women as "computers" initially opened the door for them to careers in the

development and implementation of computer technology. However, when the war ended and male soldiers reentered civilian life, women were discouraged from pursuing careers in the emerging field of computer technology (Williams, 2003; Todd et al., 2005).

According to Walsh (1989), women began entering other parts of the service sector around the 1900s, particularly clerical work. The introduction of new office machinery in the late nineteenth century supported an expansion in corporate and government office work that created a need for clerical workers. Young, educated, white, single women were attracted to city offices by wages that were higher than those of female factory workers and by the higher status associated with business jobs. Despite their higher status, female office clerks received lower wages than their male counterparts (Davies, 1982; Rotella, 1981 as cited in Walsh, 1989), which was a big incentive to hiring them.

By 1900, women comprised nearly one-third of the clerical labor force, rising to over half of an expanding force in 1930 (Walsh, 1989). Office work became feminized and by 1980, 98.3 percent of secretaries, stenographers and typists were female. According to Wright and Jacob (1994), the status and pay scales of the job decline when an occupation becomes "feminized." This occurs when a previously male-dominated field moves closer in parity with women's representation in the labor force as a whole. When the representation of women in a specific field increases to a point of surpassing the labor force average, the occupation resegregates and becomes more skewed in favor of women, switching from a predominantly male to a predominantly female labor force. One of the primary factors why a field becomes "feminized" is a decline in earnings relative to the male labor force as a whole (Reskin & Roos, 1990, as cited in Wright & Jacobs, 1994). As office work became feminized, the work became less fulfilling; subject to depressed wages, managerial control and the mechanization of information collection;

by the late twentieth century it presented a considerable number of unrecognized health hazards. Office work had become analogous to domestic work or sweatshop labor of the previous century. During this same time period, domestic service declined to 2 percent of total female employment, while farming declined to 1 percent.

The expansion of department stores, chain stores and other retail stores in the late nineteenth century created jobs in sales work for women and sales became one of the top ten women's occupations (Benson, 1978, as cited in Walsh, 1989). Sales work was considered respectable for women and initially young native-born white women filled these positions. Although their pay was not significantly higher than those of female factory workers, they enjoyed a higher social status and they were able to develop a work culture that allowed some initiative and autonomy (Benson, 1986, as cited in Walsh, 1989). However, by the mid-twentieth century, sales work became a less attractive option for women as their roles were reduced to stock-handlers and cash-register operators in self-service stores and supermarkets (Walsh, 1989).

The male labor shortage generated by World War I brought new employment opportunities for women in the federal civil services, as well as the chemical, automobile, and iron and steel industries; banking; and the stock market (Baxandall & Gordon 1995). However, when the war ended, women lost most of the ground they had gained. As the size and centralization of business and government increased, the need for clerical labor increased exponentially. In addition, the introduction of the typewriter, a new technology, created a need for efficient record keeping and a demand for typists that served as a facilitator of women's employment. As a new occupation, typing initially was "sex neutral." Since typing had not yet been identified as a masculine job, women employed as typists did not encounter the criticism that they were taking over "men's work." However, it did not take long for typing to become

"feminized." In 1890, 63.8 percent of clerical workers classified as stenographers and typists were women; by 1900, that proportion had risen to 76.7 percent (Baxandall & Gordon, 1995, p 208); and, as previously noted, the figure rose to 98.3 percent by 1980 (Walsh, 1989). Clerical work attracted women because it paid better than did most other jobs women could get. However, despite the fact that women were pouring into offices at the end of the 19th century, they still met with disapproval.

For the single career-oriented woman in the nineteenth century, the cult of domesticity restricted choice and opportunity. They were limited to jobs perceived as suitable for women because they employed feminine characteristics to benefit society that were essentially an extension of the domestic role assigned to women, such as teaching and nursing (Kessler-Harris, 1982; Riley, 1986; Ryan, 1979; Matthaei, 1982, as cited in Walsh, 1989). Towards the late nineteenth century, librarianship and social work slightly widened opportunities for women, but none of these gender-typed professions offered any real prospects for advancement (Walsh, 1989). By the turn of the century, a few women had established themselves as doctors, lawyers and scientists, but they had to make painful compromises and surmount major obstacles to survive in their fields (Drachman, 1984; Morantz-Sanchez, 1985; Rossiter, 1982; Walsh, 1977, as cited in Walsh, 1989). In 1920, after a long and hard struggle, women finally won the right to vote in the United States of America (Eisennberg & Ruthsdotter, 1998).

From 1900 to 1950, women in professions represented only 12 percent of total female employment, and by 1982, that percentage had increased only 6 percent to 18 percent (Blau in Freeman, 1984; Matthaei, 1982; Oppenheimer, 1970, as cited in Walsh 1989). The proportion of American women working in professions peaked in 1930, declined thereafter and recovered only in the 1960s (Blitz, 1974, as cited in Walsh, 1989). During the Great Depression of the 1930s,

large-scale unemployment militated against married women working (Walsh, 1989). The negative effect of the Depression brought losses in the job market for women that were not regained with wartime prosperity and postwar recovery (Hartmann, 1982, as cited in Walsh, 1989). It was the consumer boom, equal opportunity laws, and the feminist movement of the 1960s that enabled women to move into careers traditionally dominated by men, such as accountancy, architecture, law, engineering, management, dentistry and government office (Walsh, 1989).

In the late nineteenth century and early twentieth century, unions fought for and won higher wages for male workers on the basis that they needed more money than female workers in order to support wives and children (Hochschild, 1989). Unfortunately, this arrangement put men and women in vastly unequal financial positions, since under these arrangements the only way most women could be assured of a living wage was to marry. As women were increasingly excluded from the workplace throughout the second half of the nineteenth century, the cultural notion of what a child 'needs' at home correspondingly grew to expand the woman's role at home. The devaluing of labor at home, the increasing value society placed on paid labor, and the strides made by women's equal rights movements led to an increase in women seeking careers outside the home. However, the expanded role that the home economics movement and capitalism created for mothers did not diminish. Since housework and child rearing were so strongly identified with women, they remained the full responsibility of the working mother and a measure of her ability to do it all. Despite the increasing number of mothers working full-time year round, women remain the primary caregivers and homemakers. The redistribution of work at home necessary to support women's move into the workforce never really occurred. Work at

home became a gender identification issue that eventually led to the evolution of three working shifts for mothers.

Recent Trends for American Women in the Workplace

In 2008, the U.S. Census Bureau reported that the median annual earnings of women 16 or older who worked full-time year-round in 2006 was $32,649, and on average, women earned 77 cents for every $1 earned by men (DeNavas-Walt, Proctor & Smith, 2007, as cited in U.S Census Bureau). The median earnings of women working in computer and mathematical jobs, the highest for women among the 22 major occupational groups, was $61,081. In the community and social services group, women's earnings as a percentage of men's earnings were higher than 90 percent. According to the U.S. Census Bureau (2008), 22 million females work in educational services, health care and social assistance industries, and more women work in this industry group than in any other. Within this industry group, 11 million women work in the health care industry and 8.4 million in educational services (2006 American Community Survey, as cited in U.S. Census Bureau).

In July 2002, the U.S. Department of Labor (DOL) Women's Bureau issued a report on women in high-tech jobs in its *Facts on Working Women.* According to the DOL's Women's Bureau, projections for future growth indicate that computers, software, and applications for information technology will continue to have substantial impact on lives and employment opportunities in the United States. In addition, the rapid expansion in the use of the Internet and wireless technologies has created phenomenal growth and challenges in the manufacturing of this type of equipment. The DOL's report presented jobs in computers, software, and applications for information technology as paying well and key positions in the changing economy of the 21st Century. The report urged women to seriously consider careers in these

fields. The irony is that women had pursued careers in computer technology during the industry's infancy and made contributions that enabled the industry to expand into the private business sector. Recruited initially as "computers" during the labor shortage created by World War II, women were shut out from these fields once men returned to the labor force following the end of the war. Now that there is a labor shortage in IT due to the rapid expansion of a global market fueled by computer technology, women are once again being encouraged to pursue educations and jobs in these fields. This is a reoccurring pattern in job opportunities for American women. During labor shortages, women are aggressively recruited for jobs that were previously closed to them, only to find themselves receiving less pay then their male counterparts or out of a job once the labor shortage eases.

In its study titled *Women at Work* (2003), the American Association of University Women Educational Foundation reported that women's participation in the work force is greater than ever. However, the report also found that inequities persist in spite of women's dramatic strides in workforce participation. Women remain over represented in clerical and service positions and, despite the DOL's job growth projections, on the margins of new and high-status fields, such as computer scientists, engineers, and IT professionals. Women also remain highly concentrated in specific occupations. Of the 500 different occupations identified by the U.S. Census Bureau, approximately one-third of working women are concentrated in just ten of them. Although more women are in managerial and professional specialty fields, they are mostly in low paying and the traditionally female-dominated fields of teaching, nursing, and bookkeeping.

In a study of occupational differences between male and female college graduates, Joy (2006) found that women were more likely than men to enter female occupations out of college while men were more likely to enter the neutral and male-dominated occupations, even when

controlling for gender differences in demographics, college major, grades, some job preferences and job mobility. Gender differences in these factors accounted for gender differences in health care, engineering/computer, teaching, and service occupations, but not differences in clerical, manager, technical/sales, or labor occupations. Joy (2006) theorizes that the uneven effect of college major on occupational differences might stem from the fact that some college majors are closely linked to occupations while others are not. She reported that choice of college major is a de facto choice of occupation where the link is strong. For example, in health care and engineering fields, graduates choose these majors with a particular occupation or career track in mind. Where the link to major is weaker, the variation is much wider in a graduate's choice of occupation. Joy (2006) found that while nursing majors typically end up in nursing, sociology majors have a high chance of entering clerical, teaching, sales, or management positions.

When female college graduates enter the workplace, they still encounter many of the issues that women have run into throughout their history in the workplace, such as lower wages than their male counterparts. According to Seligson (2007), the American Association of University Women found that men who are a year out of college make 20 percent more in weekly pay than their female co-workers do. Seligson (2007, 2008) attributes this to a tendency among women to assume that the workplace is a meritocracy. As an example, Seligson cites a study of thirty-eight business students conducted in 2003 by Lisa A. Barron, an assistant professor of organizational behavior at the Graduate School of Management at the University of California at Irvine. Barron (2003) found that 85 percent of the men, but only 17 percent of the women felt that it was up to them to make sure their company paid them what they were worth; the remaining 15 percent of the men and the 83 percent of women assumed their worth would be determined by what their company paid them (as cited in Seligson, 2007). Women's reluctance

to initiate salary negotiations is costly. By not negotiating on her first job offer, a woman sacrifices more than half a million dollars over the course of her career (Babcock & Leschever, 2003 as cited in Seligson, 2007).

As a female born about 20 years after the women's right movement began in the 1960s, Seligson (2008) states that she did not experience institutional gender bias and felt all doors were open to her when she graduated from college. However, she found the adjustment from the egalitarianism of the classroom to the realities of the work world difficult. Inspired by her own experiences in entering the work world, she interviewed other young women and discovered that they also had encountered a steep learning curve. Common experiences included older women undermining or sabotaging a new female employee; men refusing to take young women seriously; and young women being given the least desirable assignments. In a recent article for *The New York Times*, noted executive coach Peggy Klaus (2009) also identified women undermining or sabotaging other women at work as a hurdle to gender parity and career success. Seligson (2008) found that the more traditional feminine trait of sensitivity, while often appreciated, is not always an asset in the work world. Klaus (2009) also cited a woman's tendency towards empathy as problematic in the workplace. Seligson's (2008) approach to addressing the issues she encountered is to build a new arsenal of skills to mitigate some of her more feminine tendencies, while Klaus advocates that women in the workplace treat one another as they would want their female relatives treated. Based on the experiences reported by female workers who grew up in a post-feminist culture (Seligson 2007, 2008), it appears that the work environment is still dominated by attributes traditionally associated with males, and feminine attributes are poorly viewed rather than integrated to provide a more balanced perspective and approach to management and work.

In addition, although women have made strides in the workforce, they are still performing the majority of the work associated with raising a family and maintaining home (Hochschild, 1989, 1997; Belkin, 2008). To accurately reflect the dominance of work in women's lives today, Hochschild (1989, 1997) described their efforts to meet their responsibilities at home and at work in terms of "shifts," which is widely used to define a scheduled period of work. As previously noted, the work shift was developed during the Industrial Revolution to meet factory production quotas and not to accommodate human needs (Schor, 2000). According to Hochschild (1989, 1997), for working women the first shift is their job outside the home; the second shift is the non-paid work hours that women put in at home in addition to their paid work hours outside the home; and the third shift is their attempt to make up for the lack of time spent interacting with their children due to the time consumed by meeting the responsibilities imposed by the first two shifts. The most recent figures from the University of Wisconsin's National Survey of Families and Households indicate that in households in which both husband and wife have full-time paying jobs, the wife does 28 hours of housework and the husband does 16 hours (Belkin, 2008). Not surprisingly, the workload and women's efforts to maintain it are impacting their health, relationships, and self-esteem.

Several studies have reported significant relationships between work-family conflict and various measures of psychological distress in women. Erdwins, Buffardi, Casper and O'Brien (2001) found significant connections between role conflict and women's depressive symptoms, as well as higher levels of alcohol consumption and decreased life satisfaction. In one study, the National Institute for Occupational Safety and Health found that gender-specific work stress factors, such as balancing work and family demands, may have an effect on women workers above and beyond the general job stressors (Risk & Insurance, 2000).

Studies indicate that mothers joining or re-entering the workforce are already laboring under a significant amount of stress. Barnett and Baruch (1985) concluded that, more than any of their other life roles, the maternal role constituted a major source of stress and overload for women. When they do work for pay outside the home, their jobs are more stressful than men's jobs. Karasek (1972) found that women are more likely to experience high demands for work performance while exercising less control than do men over the pace of that demand. In fact, women in service jobs have a higher rate of stress-related coronary disease than middle class male executives, a group perceived as more at risk for this disease (Hochschild, 1989).

Hayghe and Bianchi (1994) found that, despite the additional stress load, contemporary mothers are not only more likely to work, but they are also far more likely to work on a year-round full-time basis than their predecessors. Although this is partly the result of strides made through women's equality movements, it also reflects the dramatic widening of wage inequality among workers, the substantial decline in the real wages of the men as the traditional family wage earner, and the widespread belief that dedication to a job is demonstrated by the number of hours worked. According to Cohen and Bianchi (1999), labor force rates for married mothers have risen rapidly in recent decades, and this increase has been attributed to the stagnation or, in the case of the least skilled, the substantial decline in the real wages of men (Levy, 1995, as cited in Cohen & Bianchi). Consequently, a contemporary mother is more likely to work at a highly stressful job, under stressful economic conditions, while maintaining a maternal role that researchers have identified as one of life's most stressful roles.

Two-thirds of women who had their first child between 2001 and 2003 worked during their pregnancy compared with just 44 percent who gave birth for the first time between 1961 and 1965, according to a report released by the U.S. Census Bureau. The report, *Maternity Leave*

and Employment Patterns: 1961–2003 (Johnson, 2007), analyzes trends in women's work experience before their first child, identifies their maternity leave arrangements before and after the birth and examines how rapidly they returned to work. Women are more likely to work while pregnant than they were in the 1960s, and they are working later into their pregnancies. Eighty percent who worked while pregnant from 2001 to 2003 worked one month or less before their child's birth compared with 35 percent who did so in 1961-1965. Women are also returning to work more rapidly after having their first child. In the early 1960s, 14 percent of all mothers with newborns were working six months later, increasing to 17 percent within a year. By 2000-2002, the corresponding percentages had risen to 55 percent and 64 percent.

The demands of the job, flexibility of the work schedule, and potential impacts to health are important considerations in evaluating careers opportunities for women in IT, especially those with children or considering having them. For example, due to the length of time they spend sitting in front of computer terminals and typing on keyboards, both Web designers and computer scientists are susceptible to eyestrain, back discomfort, and hand and wrist problems such as carpel tunnel syndrome and cumulative trauma disorder (Bureau of Labor Statistics, 2004). On the other hand, due to advances in technology, telecommuting is an option for professionals in IT fields. Increasingly, the type of work that they perform can be done from remote locations through modems, laptops, electronic mail, and the Internet. The ability to telecommute may alleviate some of the stress working women encounter in attempting to manage work and family responsibilities. In the late 1980s, there was concern that workers using computers might be exposed to more electric and magnetic radiation than they should be (Health Physic Society, 2009). However, vendors reworked how computers were constructed so that users were not exposed to high amounts of radiation. According to the Health Physics Society

(2009), computer usage does not present a risk of radiation exposure to women or workers who might be pregnant.

In reviewing the historic and current social and economic factors that impact women in the workplace and job opportunities for them, the following factors have emerged with regard to assessing the potential of Web design as a doorway to opportunities in IT for women:

- Work and job opportunities in traditionally male occupations open up to women when there is a shortage of male workers or employees. The shortage of male workers may be due to war, a rapid increase in market demand, or a decline in the status of the occupation. Currently, the rapid growth of computer and information technology has fueled an expansion of the global economy and created a need for more skilled workers in computer and information technology fields, so women are being recruited to meet the need (DOL, 2002).
- When there is an influx of women in an occupation it becomes "feminized." When that occurs, the status and pay scales of the job decline. The primary reason why an occupation becomes "feminized" is a decline in pay scales (Reskin & Roos, 1990, as cited in Wright & Jacobs, 1994). If women move into IT and computer fields, such as Web design, these occupations may become feminized and pay scales may decline. Female-dominated jobs and occupations are generally paid less than male-dominated positions with similar educational requirements, job demands and working conditions (England, 1992; Jacobs & Steinberg, 1990, as cited in Wright & Jacobs, 1994).
- The Industrial Revolution had a profound impact on women as workers: their work at home became devalued because it was not tied to a paycheck. It also dramatically changed the location of work, the kind of work women did, and the sexual division of

labor (Baxandall & Gordon, 1995). The work shift model developed during the Industrial Revolution and still used by employers today is not compatible with human and family needs. The burdens associated with accommodating work shifts and family life primarily fall to women and stems from the role society imposed on them to support the Industrial Revolution. As a result, contemporary women working outside the home have experienced an increase demand on their time and energy (Hochschild 1989, 1997; Belkin, 2008). The option of telecommuting within IT fields, such as Web design, provides the flexibility that women may need to manage job and family responsibilities.

- Women's jobs tend to be more stressful than men's jobs. Women are more likely to experience high demands for work performance while exercising less control than do men over the pace of that demand (Karasek, 1972). Women in service jobs have a higher rate of stress-related coronary disease than middle class male executives, a group perceived as more at risk for this disease (Hochschild, 1989).
- Women are consistently paid less than men. Although women have made strides in the workplace, they earned 77 cents for every $1 earned by men in 2007 (DeNavas-Walt, Proctor & Smith, 2007, as cited in U.S Census Bureau). Even though there are more women in managerial and professional specialty fields, they are mostly in low paying and traditionally female-dominated fields (American Association of University Women Educational Foundation, 2003).
- The work world is still dominated by men and reflects their perspective, values, and characteristics traditionally viewed as masculine. Feminine attributes are poorly viewed rather than integrated to provide a more balanced perspective and approach to management and work.

To determine the extent to which the above factors impact the potential for Web design and development to offer career opportunities in IT for women, the next chapter focuses on how women have fared in IT and computer technology so far. Chapter 3 explores the historical experiences and current status of women in fields related to IT and computer technology.

Chapter 3: Historical and Current Perspectives on Women and IT

To assess the potential of Web design to provide career opportunities in IT for women, it is necessary to understand the foundation upon which the field is built. Web design first emerged as a skill set in the mid-1990s with the commercial growth of the Internet (Kotamraju, 1999), which was fueled by the development of the World Wide Web. Tim Berners-Lee invented the World Wide Web in 1989 as an Internet-based hypermedia initiative to support global information sharing while working at the Conseil Européen pour la Recherche Nucléaire (CERN) (Berners-Lee, 2008). Inspired by a vision of the Web as a powerful force for social change and individual creativity, he developed the first Web client and server in 1990. During an interview in 1997 with David Brake for an article in *New Scientist*, Berners-Lee credited his interest in physics, which lead to his development of the World Wide Web, to his parents (Berners-Lee). He told Brake that both of his parents were mathematicians who worked on developing the Ferranti Mark I, the first commercially sold computer (Berners-Lee). According to Berners-Lee (2008), his mother has been dubbed the "first commercial computer programmer" because she accompanied the machine when it was installed on customers' sites. As a component of today's IT industry, Web design emerged through mathematics and science since these disciplines are the bedrock of IT technologies.

Therefore, this chapter reviews the history of women in mathematics and sciences through the development of computer technology. It provides an overview of the historical experiences of women in these fields, women's contributions to advances in the computer technology upon which IT is built, and the current status of women in these disciplines.

Historical Experiences of Women in Mathematics and the Sciences

Mathematics and the sciences have been male-dominated fields for centuries. The bias and hostility to women pursuing studies or careers in these areas are embedded and well documented. In their investigation of 46 famous women mathematicians from the 4th through the 20th centuries, Bossé and Hurd (2002) found that "virtually every woman within this investigation was hindered in some significant manner in her pursuit of mathematics" (p. 220) and aggressively discouraged from studying it. As examples, they report that the parents and guardians of mathematicians Sonya Kovalevskaya (1850-1891), Mary Somerville (1780-1872), and Sophie Germain (1776-1831) tried to curtail their passion for mathematics through such harsh measures as deprivation of heat and light. They also found that professional mathematicians, university educators, husbands, and parents worked in unrecognized, tacit collaborations to thwart women mathematicians who are now renowned for their work in the field. Bossé and Hurd (2002) reported that most of these women were only able to pursue their studies and research in mathematics through a subservient relationship with a male professional mathematician or professor of mathematics.

According to Bossé and Hurd (2002), "the historic social factors inhibiting women in the pursuit of mathematics were firmly connected to parallel academic cultures....Before the emancipating later portion of the 20th century, universities consistently refused admission to women" (p. 220-221). In support of their assertion, Bossé and Hurd (2002) cite Armstrong and Kahl (1979), Burton (1999), Clements (1979), Cooney (1996), Levine (1976), Oakley (1972), Osen (1974), and Rossi (1972). Bossé and Hurd (2002) also state that most of the few universities that accepted women refused to offer them recognized degrees in mathematics, instead offering them programs in mathematics that conferred certificates considered sub-standard to degrees. For the most part, women were excluded from studying mathematics at

universities because they were regarded as intellectually inferior, less able to grasp advanced topics, and less competent at cognitive abstractions than men (Becker, 1981; Clements, 1979 as cited in Bossé & Hurd, 2002). In spite of the many obstacles that their subjects encountered, Bossé and Hurd (2002) report that seven of the 46 women mathematicians included in their investigation received doctoral degrees in mathematics. Without providing a specific time period, they also report that, prior to the last century, only a handful of women succeeded in securing positions teaching mathematics at the university level.

History of Women in Computing and Computer Technology

Underscoring the link between mathematics and IT, several of the 46 female mathematicians investigated by Bossé and Hurd (2002) played a key role in the development of computers and programming. According to Gürer (1995, 2002), Augusta Ada Byron Lovelace (1815-1852) invented the first programming constructs through her collaboration with Charles Babbage (1791-1871) on the Difference and Analytical Engines. The Difference Engine was the first automatic calculating device and the Analytical Engine contained the first set of principles for a general-purpose programmable computing machine (Gürer, 1995). In 1843, Lovelace developed a table to describe the operations necessary for the machine to solve mathematical problems (Gürer 1995, 2002). She also developed a method of storing sequences of operations or instructions as well as informational values, similar to today's concepts of subroutines and a stored program, a century before the first electronic computing machines appeared (Gürer, 1995, 2002).

According to Croarken (2003), women's involvement in computing predates Lovelace. Although today we use the word "computer" to describe a machine, Sir Thomas Browne (1605-1682) originally coined the term in 1646 to describe a person employed to compute, calculate,

and reckon calculations for an observatory or for surveying purposes. As an 18th century "computer," Mary Edwards (1750-1815) faced obstacles that women have historically encountered in pursuing careers related to mathematics or science, and in this particular instance, computing. In the 18th century, positions as a "computer" were rare and a woman employed as a paid computer was exceptional. Through sheer determination, Edwards worked for 30 years as a paid computer for the British *Nautical Almanac*, a publication first printed in 1767 to provide astronomical tables with supplied pre-computed data to help sailors find their latitude and longitude at sea (Coarken, 2003).

Mary Edward's career as a computer began when the *Nautical Almanac* hired her husband John Edwards as a computer. Mary did most of the computing work, and when her husband died in debt in 1784, she asked Maskelyne, the Almanac's founder, if she could continue to work as a computer in order to support herself and her two young daughters. She became one of the *Almanac's* most prolific, reliable, accurate, and timely computers, carrying half the computing workload. She also trained others as computers and worked as a comparer responsible for checking for discrepancies and errors, a higher paying position. When Maskelyne died in 1811, his successor cut back on the work assigned to Edwards and discontinued her work as a comparer. Edwards successfully petitioned the Board of Longitude and the House of Commons and negotiated an arrangement that allowed her to continue with the *Nautical Almanac* as a computer. However, she was not reinstated in the more prestigious position of comparer (Croarken, 2003).

Although Edwards was exceptional as a female computer in the 18th century, she was not unique. Croarken (2003) describes Nicole-Reine Lepaute (1723-1788) as an 18th century Frenchwoman who devoted her life to making astronomical calculations. Her skills and

knowledge came to the attention of Jérôme Joseph Lalande, director of the Paris Observatory and Maskelyne's French counterpart, who recruited Lepaute to help him compute the predicted timing of the 1759 reappearance of Halley's comet (Croarken). When Lalande became editor of the *Connaisance des Temps* (a French almanac similar to the British *Nautical Almanac*), he hired Lepaute as his computer, a position she held for 15 years. Other 19th-century women are known to have worked as unpaid computers in support of their husband's scientific work. However, these women often went unacknowledged, so it is hard to judge just how widespread the practice might have been (Croarken, 2003). There is evidence that the wives of Henry Kater (1777-1835) and Edward Sabine (1788-1883), two well-known pillars of 19th-century London scientific society, regularly calculated for their husbands (Somerville, 2001, as cited in Croarken, 2003).

Women working as paid "computers" became more prominent during World War II (1939-1945) when the U.S. Army needed "computers" to calculate ballistic trajectories to support the United States' armed forces (Todd, Mardis & Wyatt, 2005). The shortage of men due to enlistments and conscriptions in the armed forces led the U.S. Army to employ women to compute the trajectories. During World War II, job opportunities for women opened up throughout the workforce since they were the only available labor force (Baxandall & Gordon, 1995). Due to the male labor shortage, the proportion of women working increased from 25 percent to 36 percent during the war, a jump greater than that of the previous forty years (Baxandall & Gordon). Within a short period of time, the Army found the women performed the work more quickly and more accurately than their male counterparts. By 1943, most of the Army's "computers" and their direct supervisors were female (Todd et al., 2005). The need to generate the trajectory calculations faster led the Army to fund the development of the Electronic Numerical Integrator and Computer (ENIAC), the first mechanized computer. Women hired as

"computers" or "computer" supervisors played a key role in this project. Designed by Presper Eckert and John Mauchly at the Moore School of Electrical Engineering of the University of Pennsylvania to perform ballistic computations, ENIAC needed to be provided with a series of instructions or "programmed" in order to conduct the necessary calculations (Gürer, 2002). Six women originally hired as "computers" developed the programming necessary for ENIAC to perform the computations: Kathleen McNulty Mauchly Antonelli (1921-2006); Jean Jennings Bartik (1924-); Frances Snyder Holberton (1917-2001); Marilyn Wescott Melzer; Frances Bilas Spence (1922-); and Ruth Lichterman Teitelbaum (1924-1986) (Gürer, 1995, 2002). Their work laid the foundation for the development of software that made today's computers so versatile (Gürer, 2002).

According to Gürer (2002), to appreciate their accomplishment, it is important to realize that they were developing programming as they went along. Although Lady Lovelace had provided the concept through her work with Babbage, no one had ever actually programmed an electronic computer before. This was uncharted territory with no books or experts to consult. The work required an intimate understanding of ENIAC's basic hardware and schematics since the programming was all in machine code. In addition to being intellectually challenging, it required physical strength and stamina (Gürer, 2002). According to Todd et al. (2005), although their work was crucial to the success of the project, the six women received no credit or public acknowledgement during the publicity and celebrations surrounding the unveiling of ENIAC. For over 50 years, their contribution to computing was ignored. In fact, prior to 1996, society generally assumed that the women shown in the various pictures of ENIAC were either models or secretaries doing trivial tasks (Todd et al., 2005). To add insult to injury, even though these women had the same education and experience as their male counterparts, they were not given

the same professional rating as the men. They were labeled SPs, which literally meant "sub-professional" (Moye, 1996, as cited in Todd et al., 2005). Jennings Bartik, one of the six women who worked on ENIAC, stated in a personal communication to Todd et al. (2005) that she and the other women computers were confronted with both overt and subtle forms of gender bias during their work on the project.

Gürer (2002) reports that in the early days of computing, programming was not highly regarded. As a field with a high percentage of women, programming took a backseat to the more male-dominated field of designing and building computers. However, as programmers, women played a major role in making computers easier to use and more accessible to society as a whole. For example, Betty Holberton (also known as Frances Snyder-Holberton) developed software for the Universal Automatic Computer (UNIVAC) for the U.S. Census Bureau that provided one of the first practical applications of a computer and revolutionized the way the world perceived and used computers (Gürer, 2002). Grace Murray Hopper conceived the idea of writing a program to create a program (Gürer, 2002). She created FLOWMATIC, the first widely used programming language for business, and oversaw the development of the Common Business Oriented Language (COBOL) (Gürer 1995, 2002). Hopper also helped develop the A-3 and AT-3 languages for UNIVAC, which alleviated the tedious demands of machine coding and enabled programmers to create faster, more powerful programs (Gürer, 1995, 2002). This opened programming up to business and industry, as well as scientists and technicians (Gürer, 2002).

In her account of the early days of programming, Adele Mildred Koss (2003), one of the UNIVAC I programmers, appears to contradict Jennings Bartik by stating that the computer field was almost gender blind in the beginning. According to Koss, women thrived in the field, especially those with a background in mathematics or science, because there were few prior

work-related practices to hamper them in achieving success. She describes the culture as open and flexible, and the environment supportive and stimulating. Koss claims that there were no apparent prejudices against a woman working and having a family and she presents her own experiences as an example. When Koss became pregnant, she thought she would have to take a few months leave, but Grace Hopper, her supervisor, made arrangements for her to work at home. Koss had to come into the office only twice a week, which enabled her to balance family and work and have a professional part-time career for a long time (Koss, 2003).

Like many other women in the early days of the computer industry, Elizabeth Phillips Williams (2003) started her career as a systems analyst during World War II. Due to the manpower shortage, the emerging industry hired women to fill the need for people with skill sets related to specific job requirements. Williams was one of 100 women hired as analysts by Standard Register to apply a paperwork simplification technique developed to help the company's customers solve problems in systems related to the flow of data. Although Williams and the other female system analysts were frequently referred to as "cuties," she enjoyed her work for the most part. When War II ended and the men returned home, Williams helped train them to work as systems analysts. She then was dismayed to see them move up the career ladder so quickly (Williams, 2003). This was by no means unusual. Overall, when the soldiers returned home after the war, women in all industries were relegated back to their pre-war roles (Todd et al., 2005). Educators, social workers, psychologists, and journalists all engaged in trying to convince women that their place was in the home rearing children, which also served to drive women out of the labor force as employment contracted (Baxandall & Gordon, 1995). However, the war had challenged stereotypes in the workplace and after the war women began to enter the workforce in greater numbers (Feminism and Women Studies, 2005).

In 1958, Williams (2003) took a position as a systems analyst with the Electric Boat Company, which designed and constructed the country's submarines. She subsequently learned that the salary she requested was considerably less than that expected by the male systems analysts who had applied for the job and this was a factor in the decision to hire her. Her manager told her that he and the other men in the department thought it was reward enough for her to come in as the highest-paid woman in the company. Williams receiving less salary than the men in her department for the same work was by no means unusual at this time. Up until the early 1960s, it was legal and customary to pay women differently for exactly the same work (Baxandall & Gordon, 1995). In 1963, the Commission on the Status of Women convened by President Kennedy documented discrimination against women in every aspect of American life (Eisenberg & Ruthsdotter, 1998). Williams undertook a major project to simplify paperwork connected with that portion of material the federal government furnished for use in the submarines. After much research, she and her male supervisor had almost finished a comprehensive proposal to develop a computerized information control center to better serve their customer when the corporate owners brought in a new management team. The new management team fired all the managers at Electric Boat. As William's new supervisor cut up the proposal into his wastebasket in front of her, he said, "No real lady would work in a shipyard in the first place" (Williams, 2003, p. 38).

In comparing Williams' and Koss' experiences as women during the pioneering days of the computer industry, it is interesting to note the differences as well as the similarities they report in their work environment. Both state that they enjoyed their work. However, under a female supervisor, Koss found her work environment supportive. She was able to continue working during her pregnancy and as a mother. Working under two male supervisors, Williams

was paid less than her male counterparts and demeaned. She was told that it was a privilege for her to work for less because she came in as the highest paid female worker, and later a proposal on which she had spent considerable time and effort was destroyed in front of her by a male supervisor as he made derogatory remarks about her character and upbringing. Since work environment is an important consideration in determining potential career opportunities for women, the next section will review the current structure of the management stratum in IT.

Current Status of Women in the Sciences and Computing

In a recent study, Handelsman, Cantor, Carnes, Denton, et al. (2005) found that women in science still face bias, hostility, and a lack of respect that continues to hold them back. Handelsman et al. uncovered "no convincing evidence that women's representation in science is limited by innate ability" (2005, p. 1190). Nonetheless, during his tenure as president of Harvard University, Dr. Lawrence H. Summers advanced this supposition to explain why so few women have reached the highest ranks of science and mathematics in universities (Dean, 2006; Finder, 2006). Finder (2006) reports that women have not reached the top academic ranks in numbers that their growing presence should reflect despite the dramatic increase in the number of females in undergraduate and graduate degree programs in science and mathematics. Studies also show that women in science still receive less research support than their male colleagues (Finder, 2006). As another example, Finder (2006) states that in June 2006, only eight percent of the tenured professors in natural sciences at Harvard University were women. In comparison, 80 percent of the faculty members on a tenure track in Harvard's Graduate School of Education are women, as are 38 percent at the School of Public Health and 48 percent in the social sciences. In 2004, the American Association of University Women Educational Foundation (2004) reported that a pervasive gender gap in science, technology, engineering, and mathematics (STEM)

disciplines remains despite the many programs and projects that have been initiated to encourage young girls to pursue educations and careers in these fields.

In her book *Women, Work and Computing*, Woodfield (2000) states that, despite the lack of equal pay and recognition, it was widely expected that computing would prove to be a gender-neutral activity and the computer industry would provide a blueprint for a bright, new future for women in scientific or technology-oriented occupations as computer technology emerged as a viable industry. This expectation is confirmed by Koss (2003), who described the field as open, flexible, supportive, and stimulating with few prior work-related practices to hamper women in achieving success. During the 1960s and 1970s, a period of significant growth in the computer industry, the feminist movement brought women's issues to the forefront, demanding equality in the workforce and equal pay for women (Feminism and Women's Studies, 2005). Although during this period women made progress in gaining entrance to jobs that had previously been closed to them, by the end of the 1980s, it was clear that women were significantly less engaged and successful in computational activities than men (Woodfield, 2000). In the IT workforce, Morwena Griffiths observed that men had appropriated computers and it had only taken them a little over a decade to do it (Griffiths, 1988 as cited in Woodfield, 2002). According to Gürer (2002), women were squeezed out of the field when the computer industry became profitable and adopted a male hierarchy business structure. Based on the history of women in the workplace, the computer industry's transition to a male hierarchy business structure brought with it all the inequities that women in the non-IT workforce encountered, in addition to a work environment that was hostile to women. Although women in IT generally are paid more than women in non-IT fields (Rosenbloom et al., 2005), it would be difficult to pronounce one group as experiencing more equality in the workforce at a specific point.

Woodfield (2000) states that by the mid-1990s, women comprised approximately 70% and 60% of computer operators in the United Kingdom and United States (US) respectively, but they primarily held positions in data preparation and entry and at the front and help desks of computing organizations. Women disproportionately occupied jobs at the bottom end of the computing industry that earned little respect or remuneration, while men dominated the management stratum within occupational computing (Equal Opportunities Commission 1995-1998; US Bureau of Labor Statistics [BLS], 1995; Virgo, 1993; *The Times*, 8 April 1994, as cited in Woodfield, 2000). The occupational segregation in computing along gender lines also was reflected in the large salary differentials that emerged between men and women during this period, with female computer professionals in the US earning 75-85 percent of what their male co-workers' earned for the same work (Zimmerman, 1990; BLS, 1995, as cited in Woodfield, 2000). This percentage was only slightly better than the average difference in pay between men and women in the American workforce where women earned $.74 for every $1.00 a man earned (U.S. Census, 1996 as cited in Sciammacco, 1998).

Contrary to the trends in most of the US labor force, the percentage of women in the IT workforce has declined substantially over the past 20 years (Rosenbloom et al., 2005). In 1983 women comprised 43 percent of the full-time IT workforce, compared to 40 percent of the full-time non-IT workforce. However, by 2002, the share of women in IT had dropped to 30 percent, while the share in the non-IT workforce had risen to over 49 percent (Rosenbloom et al., 2005). At the 2001 Forum on Women and the Field of Information Technology at the University of Connecticut in Stamford, Kathy Dechant, an assistant professor-in-residence of management, noted, "Women are the most under-represented in information technology occupations where the pay is the highest" (Chamberlain, 2001, para. 7). According to the Women's Bureau, U.S.

Department of Labor (2002), median weekly earnings for workers in technology-oriented occupations ranged between $713-$1,174 in 2001, compared to the $597 median weekly earnings for all other occupations. In *Facts on Working Women*, the Women's Bureau (2002) reported an increase in the employment of computer scientists and systems analysts, along with an employment gap between women and men in these occupations. According to the Women's Bureau (2002), employment of women lagged in most of the high-tech occupations that show promise for future growth.

In summary, the following factors have emerged with regard to assessing the potential of Web design as a doorway to opportunities in IT for women:

- Historically, women have experienced bias, hostility, and discrimination in mathematics and the sciences, the fields that gave birth to IT. Despite expectations to the contrary, this appears to have carried over to IT fields.
- Despite the bias and hostility, women have played a key role in computing and the development of computer technology. Nonetheless, their contributions to the field have been largely ignored. Although there has been an increase in the employment of computer scientists and systems analysts, women are still under employed in these areas, or confined to lower-paying positions.
- Historically, opportunities for women have opened up when there is a shortage of men. For example, women were recruited to serve as "computers" during World War II because so many men were enlisted or conscripted to serve in the armed forces. The growing demand for IT workers may lead to a shortage in qualified personnel that would, once again, open IT fields that previously or currently are male dominated.

- There continues to be a gap in the pay scales and employment of women in IT and high-tech occupations. Although more IT fields may open up to women due to supply and demand, historical and current evidence suggests that women seeking careers in IT fields closely associated with mathematics and science will continue to encounter obstacles and difficulties in a work environment dominated by a male management stratum.

The next chapter explores current IT careers, the overall educational and skill set requirements, the salary ranges and opportunities for advancement, and women in IT careers.

Chapter 4: IT Careers

As noted in Chapter 1 of this thesis, IT jobs are among the fastest and largest growing jobs in the economy with a projected growth rate of 24.8 percent (Dohm & Shniper, 2007). Demand for computer-related occupations is expected to grow in almost all industries as organizations continue to adopt and integrate increasingly sophisticated and complex technologies (Dohm & Shniper, 2007; Roher, 2004). In 2004, the National Workforce Center for Emerging Technologies issued a report on trends in IT applications that projected an increasing demand for IT workers in companies that use or modify technologies for their specific needs (Roher, 2004). According to the report, government agencies and industries such as healthcare, insurance, banking, finance and e-commerce will experience significant growth in the employment of IT-trained professionals. As information and computer technologies have matured, the careers in areas related to these fields and the skills sets and educational requirements also have evolved.

This chapter explores the education, experience and skill sets required to support careers in IT, pay scales and advancement, and whether the work environment or job opportunities in IT for women has improved, remained static, or worsened since Challenger (2000) first recommended Web design as a career path in IT for them.

Educational/Skill Set Requirements

As IT and computer technologies mature, the focus is shifting from the development of the technologies to their applications in different industries. This shift requires IT professional to have a more cross-disciplinary knowledge, particularly in business (Roher, 2004). Due to outsourcing and the large number of IT workers, employers are now requiring applicants to have higher levels of IT skills and knowledge, advanced educational degrees, and more experience in

the field. IT jobs that previously only required a 2-year degree now require at least a 4-year degree.

According to the Bureau of Labor Statistics (2007), more than 68 percent of computer programmers had a bachelor's degree or higher in 2006. However, the proportion is expected to increase as the level of education and training required by employers continues to rise. Some computer programmers have baccalaureate degrees in computer science, mathematics, or information systems, whereas others have taken special courses in computer programming to supplement degrees in accounting, finance, or business. Although there is no established path for a career as a network systems analyst, computer scientist, or database administrator, most positions require some formal college education. Generally, a bachelor's degree is a prerequisite for most jobs in these fields; however, some jobs may require only a 2-year degree. Relevant work experience also is very important. For more technically complex jobs, persons with graduate degrees are preferred. Most computer scientist positions require a doctoral degree, as their main role is conducting research. Computer scientists with only a bachelor's or master's degree are generally limited in their ability to advance.

For database administrator and network systems and data communication analyst positions, most employers seek applicants with bachelor's degrees in computer science, information science, or management information systems (MIS) (Bureau of Labor Statistics, 2007). MIS programs differ considerably from computer science programs, emphasizing business and management-oriented coursework and business computing courses. As more firms move their business to the Internet, employers are increasingly seeking applicants with a master's degree in business administration (MBA) with a concentration in information systems. For some network systems and data communication analysts, an associate degree or certificate is

sufficient. However, advanced positions in these fields generally require a computer-related bachelor's degree.

For a position as a computer software engineer, an applicant needs to have at least a bachelor's degree and knowledge and experience in a variety of computer systems and technologies (Bureau of Labor Statistics, 2007). Positions in software engineering generally require baccalaureate degrees in computer science or software engineering. Systems software engineers often study computer science or computer information systems. Graduate degrees are preferred for some of the more complex jobs. In 2006, about 80 percent of computer software engineers had a baccalaureate degree or higher.

Due to the wide range of skills required, there are many entry paths to a job as a computer support specialist or systems administrator (Bureau of Labor Statistics, 2007). Although the training requirements for these positions may vary, most employers prefer applicants with some formal college education. Some jobs may require a baccalaureate degree in computer science or information systems. Other positions may only require a computer-related associate degree. For some jobs, employers may accept relevant computer experience and certifications as a substitute for a formal college education. Systems administrator jobs generally require a baccalaureate degree, although not necessarily in a computer-related field.

While many IT jobs require high skill levels, IT occupations are not necessarily inaccessible to workers with low skill levels. There has been a rise in entry-level IT occupations, including computer support specialists, computer repairers, broadcast technicians, and network and computer systems administrators. These entry-level IT occupations accounted for about 33 percent of all computer-related jobs in 2003, or 1.2 million jobs (U.S. Department of Commerce, 2003 as cited in Chapple, 2006). According to Chapple (2006), their experience in hiring

workers without degrees during the dot-com era showed managers that a degree is no longer necessary for some IT jobs, which created more opportunities in IT for workers without them. The down skilling of IT occupations and the rising importance of soft skills created an opportunity for short-term training programs to prepare less-educated students for IT jobs. (Chapple, 2006).

Salary Ranges and Opportunities for Advancement

According to the Bureau of Labor Statistics (2007), the median annual earnings of computer and information scientists involved in research were $93,950 in May 2006. Salaries ranged from $53,590 to $144,880, with the middle 50 percent earning between $71,930 and $118,100. The median annual earnings of computer and information scientists employed in computer systems design and related services were $95,340 in May 2006. For database administrators, the median annual earnings were $64,670. The salaries ranged from $37,350 to $103,010, with the middle 50 percent earning between $48,560 and $84,830. With a median income of $67,680, database administrators in management of companies and enterprises earned slightly more, while database administrators employed in computer systems design and related services had higher salaries, with median annual earnings of $72,510.

For network systems and data communication analysts, salaries ranged from $38,410 to $101,740 in May 2006, with median annual incomes equal to $64,600 (Bureau of Labor Statistics, 2007). Median annual earnings of all other computer specialists were $68,570 in May 2006. Median annual earnings of all other computer specialists employed in computer systems design and related services were $67,370, and, for those in management of companies and enterprises, earnings were $63,610 in May 2006. The median annual earnings of wage-and-salary computer applications software engineers were $79,780, with salaries ranging from $49,

350 to $119,770. For wage-and-salary computer systems software engineers, the median income was $85,370, with salaries ranging from $53,580 to $125,750. According to the National Association of Colleges and Employers, in 2007 starting salary offers for graduates with a bachelor's degree in computer engineering averaged $56,201 and starting salary offers for graduates with a bachelor's degree in computer science averaged $53,396 (Kelley, 2007).

Prospects for employment for graduates with degrees in computer and information sciences are excellent. According to data collected from bachelor's and master's graduates who received science, engineering, or health degrees between July 1, 2002, and June 30, 2005, 93 percent and 91 percent of recent master's and bachelor's computer and information sciences graduates, respectively, held full-time principal jobs (Proudfoot, 2008). The median salary for those with master's degrees in computer and information sciences was $65,000, the highest median salary among recent science, engineering, and health master's graduates, while recent graduates holding bachelor's degrees in computer and information sciences reported a median salary of $45,000 (Proudfoot, 2008).

This overview of the median salaries, projected job growth, and opportunities for advancement in IT provides attributes that would attract individuals to IT fields. However, as discussed in Chapters 2 and 3 of this thesis, there are factors that influence and affect the extent to which women are able to pursue careers in certain fields. The following section will explore the status of women in IT.

Women in IT Careers

As previously noted, women are underrepresented in IT fields. Although they hold more than half of all professional occupations in the United States, women hold fewer than 26 percent of all computing-related occupations and only 13 percent of Fortune 500 technology companies

have women corporate officers (National Center for Women & Information Technology, 2007). However, despite the fact that the percentage of women corporate officers in IT companies is low, it is greater than the 2 percent of chief executive jobs at the top Fortune 500 companies held by women (Creswell, 2006).

Among those in computer-related positions, women working as computing specialists describe their jobs as challenging and varied with opportunities to meet people, travel, and work at home (Teague, 2002). In a survey of women working in computing, the participants cited jobs with higher pay and prospects for advancement as reasons for seeking careers in computing (Teague, 2002). When asked what they liked about their work, they cited the following attributes: problem solving; always something new to learn; diversity of the work; salary; finding and fixing bugs; the challenge; constant change; and people working in computing. Their dislikes included: people rewarded for originality and innovation rather than getting the job done; convincing people to give them more interesting work to do; hierarchical management structures; expectations of long-work hours; being a minority; discrimination; arrogance and competitiveness of men in the industry; spending long hours at the keyboard; and the lack of female mentors (Teague, 2002). Since originality and innovation play key roles in the development of IT and the technologies that support it, the fact that the women surveyed cited people being rewarded for originality and innovation over getting the job done may point to a reason why they have not done as well as their male colleagues. They misunderstand that in IT originality and innovation is where the value should be. This attitude appears to reflect the tendency among women to assume that the workplace is a meritocracy observed by Seligson (2007, 2008).

As in the non-IT workforce, the wage differentials between men and women in the IT workforce still persist. Fifteen years ago, Truman and Baroudi (1994) found that women were paid lower salaries than men even when job level, age, education, and work experience were controlled (as cited in Wentling & Thomas, 2004). Female computer professionals in the US earned 75-85 percent of their male co-workers' wages for the same work (Zimmerman 1990; US Bureau of Labor Statistics 1995 as cited in Woodward, 2000). In 2009, women with undergraduate degrees in computer science earn a median of $44,000 compared to $46,000 for their male counterparts (Klawe, Whitney & Simard, 2009). In comparison, on average in 2008, a woman working in the United States earned $.77 cents to every $1.00 her male counterpart earned (National Organization of Women, 2008).

Although computer-related occupations will continue to grow (Dohm & Shniper, 2007) and the demand for computer scientists and computer engineers in the United States is expected to increase 37 percent between 2006 and 2016 despite the current economic crisis (Klawe, Whitney & Simard, 2009), women remain underrepresented and underpaid in these fields. However, they remain overrepresented in clerical and service positions (American Association of University Women Educational Foundation, 2003). Job growth in IT fields now exceeds the production of talent (Wentling & Thomas, 2004). The shortage of qualified technology workers may result in as much as four billion dollars per year in lost production for the United States (Valuing Diversity, 2000). To meet the country's current and projected IT workforce needs, more women must be engaged in IT. However, the number of women in IT continues to decline (Woodfield, 2000; CRA, 2009; Information Technology Association of America, 2003, 2005 as cited in Trauth, Quesenberry & Huang, 2006). According to Wentling and Thomas (2004), there are two dominant theoretical perspectives that are used to explain the engagement of women in

IT: essentialism and social construction. The essentialist perspective concentrates on the presumption of inherent differences between women and men to explain the perception of IT as a male domain. The social construction perspective concentrates on the social construction of IT as a male domain, which is understood as problematic with regard to the social construction of female identify.

Subscribers to the essential perspective theory propose that men, as a group, make decisions about applying technology based upon different criteria than women, as a group. According to the social construction theory, "the social shaping of IT as masculine interacts with the social construction of femininity in such a way as to place IT outside the domain of women." (Wentling & Thomas, 2004, p.4-3) Although theories have been proposed to explain why women are underrepresented in IT, there are no definite answers to the problem (Wentling & Thomas, 2004). Factors that contribute to the underrepresentation of women in IT include: gender bias, lack of role models and mentors, perceptions, stereotyping, difficulty with work/life balance, and lack of corporate commitment (Carver, 2000 as cited in Wentling & Thomas, 2004). These factors are similar to the dislikes reported in a survey of women in IT, including discrimination and lack of female mentors (Teague, 2002).

According to Wentling and Thomas (2004), many qualified women in the IT workforce find themselves assigned menial tasks, while their male co-workers receive the more choice and challenging assignments. Many women in IT report that they have supervisors assigned to check on their work, but men performing similar tasks are left alone to their own discretion. Harassment is also prevalent as women are still often viewed as inferior to men (Wentling & Thomas, 2004). There are also stereotypes that affect the hiring and promotion of women, including the belief that women are not proficient in mathematics, technology, and science

(Margolis & Fisher, 2002). Employers place value on characteristics perceived as masculine traits, such as assertiveness, confidence, and achievement, when seeking to fill positions in IT (Leever, Dunigan, & Turner, 2002 as cited in Wentling & Thomas, 2004). The IT environment consists of long, irregular work hours that discourage women with spouses and children, since women remain primarily responsible for family and home care (Rosenbloom et al., 2005; Powell, 1999 as cited in Wentling & Thomas, 2004). Given the work environment and salary differentials, it should not be surprising that women are nearly three times as likely as men to leave the IT workforce (Wardell, Sawyer, Reagor, & Mitory, 2005 as cited in Quesenberry, 2006).

To ascertain whether there are female-friendly opportunities in new IT career paths, Myers, Woszczynski and Shade (2005) researched the emerging field of IT security. Previous research suggests that women are more drawn to fields with social impact and they are more likely to be interested in computers as tools rather than as entertainment. For these reasons, Myers et al. (2005) believe that the IT security field presents a viable career path in IT for women since the work incorporates applying computer technology to protect people and industries. They cite the fact that women are the leaders in the IT security industry today and, although they are still a minority in this field, they are establishing networks and critical mass through initiatives that focus on best practices in IT security. Myers et al. (2005) report that IT security offers a broad array of job titles including: chief security officer; business development; network security systems engineer; director of IT; and vice president. Job responsibilities included training and education, antivirus activities, loss prevention, network maintenance, management of engineers and other technical professionals, as well as development of security and privacy standards. According to the Bureau of Labor Statistics (2007), demand for computer

security specialists will increase as businesses and government continue to invest heavily in protecting vital computer networks and electronic infrastructures from hackers and attack. The Bureau of Labor Statistics expects the information security field to generate many new system administrator jobs over the next decade as organizations and companies across all industries place a high priority on safeguarding their data and systems. However, starting salaries for systems administrators currently range from $50,000 to $75,750, which is less than the $54,750 to $81,500 salary range for Web developers (Bureau of Labor Statistics, 2007).

Through this examination of IT careers, the following factors have emerged with regard to the current status of women in IT.

- Although there is an identified need for more IT workers (Klawe, Whitney & Simard, 2009; Wentling & Thomas, 2004; Valuing Diversity, 2000), and the salaries ranges generally are above the $50,740 median household income in the United States (Bishaw & Semega, 2008; Bureau of Labor Statistics, 2007), the number of women in the IT workforce continues to decline (Woodfield, 2000; CRA, 2009; Information Technology Association of America, 2003, 2005 as cited in Trauth, Quesenberry & Huang, 2006).
- The retention rate for female IT workers is poor. Women are nearly three times as likely as men to leave the IT workforce (Wardell, Sawyer, Reagor, & Mitory, 2005 as cited in Quesenberry, 2006).
- Although theories have been advanced to explain why women are under-represented in IT, there are no definite answers to the problem (Wentling & Thomas, 2004). However, the following issues have been cited as factors that contribute to the underrepresentation of women in IT: gender bias, lack of role

models and mentors, perceptions, stereotyping, difficulty with work/life balance, and lack of corporate commitment (Carver, 2000 as cited in Wentling & Thomas, 2004).

- Many qualified women in the IT workforce find themselves assigned to menial tasks and under constant supervision, while their male counterparts are given more challenging assignments and left to their own discretion (Wentling & Thomas, 2004).
- Since women still bear the primary responsibility for family and home care, the long, irregular hours associated with the IT work environment is difficult for women with spouses and children to manage (Rosenbloom et al., 2005; Powell, 1999 as cited in Wentling & Thomas, 2004).
- The emerging field of IT security may present new career paths in IT for women, but the salary range is approximately $5,000 less per year than the salary range for Web developers.

The next chapter explores the evolution of Web design as a career, the salary ranges and advancement opportunities within the field, women working in the field, the disadvantages and advantages Web design presents as a career option for women, and whether there are biological factors that make women better suited for careers in Web design.

Chapter 5: Web Design

As mentioned in Chapter 3 of this thesis, Tim Berners-Lee invented the World Wide Web in 1989 as an Internet-based hypermedia initiative to support global information sharing while working at Conseil Européen pour la Recherche Nucléaire (CERN) (Berners-Lee, 2008). According to Isler (2004), Web design evolved because Berners-Lee wanted to create a system of links to texts and other documents or files to help workers at CERN in accessing information more efficiently. Due to increased Internet usage and home computer ownership in Europe and the United States, the Web spread beyond CERN by 1991. The usage of hypertext among computer programmers led to a proliferation of Web sites that ranged greatly in form and content. An intern who had worked with Berners-Lee began a Web design consultant firm, giving birth to the profession of Web design. This chapter explores the evolution of Web design; the educational background, training, and job skills required to work in this field; the work environment and status of women currently working in Web design; the advantages and disadvantages that Web design presents as a career option for women; and whether there are any biological factors that give women an edge in this field.

Evolution of Web Design as a Career

Web design first emerged as a skill set in the mid-1990s with the commercial growth of the Internet (Kotamraju, 1999). Due to the Internet's relationship with computer science and technology, employers initially sought individuals with backgrounds and training in these fields. Job postings advertised for Internet designers, online specialists, or programmers. Even the United States Department of Labor found it difficult to define the job position since the duties and responsibilities varied by employer (Steinberg, 1997, as cited by Kotamraju, 1999). The term "Web design" to describe the skills set did not come into use until 1997 (Kotamraju, 2002).

At first, Web sites and pages were simple and basic and the process involved in their development was regarded as a technical exercise and extension of computer science skills (Kotamraju, 2002). Although Web sites were clearly a communication medium, graphic design trade publications initially denigrated Web design as inferior to genuine visual design due to its reliance on technology rather than artistic skill. There also were issues regarding training and skills in programming, which most graphic designers did not have at the time. As Web technology multiplied and its capacity increased, Web sites became more elaborate and interactive. The tasks needed to create a Web site diversified and became more specialized. The division between abstract design skills and precise technical skills grew more pronounced (Kotamraju, 2002). Sensing an encroachment in their field, the graphic design community began accentuating the division between art and code in Web site creation through their trade publications. They argued that though HTML code and database programming skills were useful, the most important component of the Web design skill-set was a theoretical understanding of how to communicate information to the user—what they defined as design. They made their case. In its *Occupational Outlook Handbook, 2004-2005 Edition*, the Bureau of Labor Statistics (2004) listed art and graphic design skills as desirable for Webmasters or Web developers.

According to Isler (2004), the cultural chasm between the two groups—graphic designers working with non-electronic media and technical "geeks" working in software development and computer programming—came together as a team in Web design. The creativity of a graphic designer and the technical know-how of a programmer were needed to design an attractive Web sites that drew attention and users, and "those who could simultaneously operate the right and left sides of their brain were in highest demand" (Isler, 2004, p. 5). Those with skills in one but not all aspects of Web design sought out a partner with skills they lacked, leading to a sudden

increase in Web development teams split into the two camps. In the late 1990s, the introduction of user-friendly software that allowed anyone with a personal computer to design a simple Web site led to what Isler (2004) called the "deskilling" of the industry. In 2000, Challenger published an article entitled *The Web is a Great Equalizer for Women: Part I* encouraging women with little to no background or education in computer science or technology to pursue careers in Web design as a pathway to job opportunities in IT. In his article, Challenger (2000) noted that HTML, the computer language used to design Web pages, was easy to learn and all one needed to be a Web designer was creativity, an eye for design, and the ability to think through problems. This appears to reflect the "deskilling" of the industry to which Isler (2004) refers.

According to Isler (2004), the people involved in Web design in the early 1990s were professional computer programmers and graphic artists. Due to the increase in casual Web use in the mid-1990s, more people began exploring Web design, either as a hobby or as a career path in IT. The emergence of affordable, user-friendly Web design software packages and online tutorials made it possible for even the casual computer user to create a basic Web page (*The Boston Globe*, February 25, 2001; *The New York Times*, December 6, 2001, as cited in Isler, 2004). Web design was no longer the exclusive domain of computer "techies" and Webmasters (*The Wall Street Journal*, December 8, 1997, as cited in Isler, 2004). Public universities, trade schools, and community colleges across the United States began offering certificate programs that provided training in software applications to create more dynamic and interactive Websites, and the relatively short time of completion drew thousands of people seeking entry to the field (*Boston Herald*, June 13, 1999; *The Wall Street Journal*, December 10, 2002 as cited in Isler, 2004). The training classes enabled people from all walks of life, even those without training or skills in basic computer usage, to transition into a Web designer in a couple of months (Isler,

2004; Melymuka, 2000). The marketing of Web design as an IT career opportunity to those with little to no prior experience or training in computer science or technology is reflected in Challenger's article (2000). However, due to their lack of experience and knowledge, these newcomers' ability to create Web sites was limited by the capacities of the new Web design software packages and their entry into Web design created a dual labor market and wage structure (Isler, 2004). Companies that required comprehensive and more complex Web sites sought Web designers with years of experience and training in programming or graphic design. Businesses seeking more basic Web sites hired the less experienced newcomers for less money. Although Challenger's assertion that Web design opened up job opportunities for women in IT (2000) has merit, these positions were at a lower end of the pay scale.

According to Isler (2004), many of those who entered the field of Web design through certification programs or self-instruction were women who had developed computer skills through previous clerical employment. This appears to contradict the assertion in Challenger's article that an aspiring Web designer needed little to no experience on the computer (Kevin Kennedy, as cited in Challenger, 2000). Isler (2004) reports that the "deskilling" and labor market segmentation that occurred in Web design as a result of self-instruction and the certification programs led to a technical and gendered division of labor. Many male IT workers viewed the certification programs as further evidence that women were unable to develop the technical skills necessary to write complicated computer programs and could only design Web sites with store-bought software packages. This viewpoint is ironic because women played a key role in developing programming for ENIAC, the first electronic computer, and programming was a field with a high percentage of women during the early days of computing (Gürer, 2002).

Based on Isler (2004), women who sought careers in IT via the path recommended by Challenger (2000) encountered a negative and hostile reception from their male co-workers.

When the Internet bubble burst in 2000 and the United States entered an economic recession, companies returned to more traditional methods of marketing and Web designers became expendable (Isler, 2004). Companies cut all or most of their Web spending, which put many Web consultant and design firms out of businesses (*The New York Times*, May 4, 2001, as cited in Isler, 2004). As an industry, Web design experienced significant job losses (*Wired*, April, 1996, *Boston Herald*, October 25, 2000, as cited in Isler, 2004). Many of those who had worked in Web design from the early to late 1990s either returned to their previous careers or remained unemployed. According to Isler (2004), many of the Web consultant firms that survived the dot.com bust in 2000 relocated to areas with lower labor costs and cut back on their wages, benefits, and stock options. These changes created a new labor market structure in which locally-based networking associations and software and operating system users' groups play a significant role in helping unemployed workers and contractors find Web consulting work. Isler (2004) found that these organizations rely on preconceived ideas about the ideal IT worker, and these ideas are segregated by sex based on gendered notions of technical skill. Based on Isler's findings, it would appear that, contradictory to Challenger's recommendation (2000), this was not a good point in time for women to pursue Web design as a career opportunity in IT, especially those with little to no education or training in computer science or technology.

Education/Skill Set Requirements

Web designers play a critical role in the diffusion of Internet-based applications and e-business (Sgobbi, 2002). In fact, the skill sets and desired characteristics/abilities for Web designers are similar to those for computer scientists (Bureau of Labor Statistics, 2004). The

knowledge domains of Web designers expand beyond the technical area to include organizational and managerial issues. According to the Bureau of Labor Statistics (2002, 2007), in addition to skills in art or design, a Web designer must have the ability to conceptualize, a theoretical understanding of how to communicate information, thorough knowledge of HTML and a wide variety of software specifically developed to support Web development, familiarity with computer networking and equipment, and willingness to continually retrain and adjust to new technologies. They are responsible for day-to-day site design and creation, as well as managing the technical aspects and performance issues of a Web site, such as speed of access and the quality and consistency of the site's content. The requirements for a position in Web design as outlined by the Bureau of Labor Statistics (2002, 2007) contradict Challenger's assertion that little to no experience or training was required to enter this field (Challenger, 2000). The difference in the job qualifications and requirements reflects the quick expansion in the use of the Internet and its technologies.

Kotamraju (2002) found that the demands of the job require a college education. Through her research, she found that the design employees at one Web design firm had at least bachelor's degrees in a variety of fields, such as English, film, and fine arts. When asked what he seeks in a Web designer, the firm's chief executive officer told Kotamraju the following:

> You tend to look for people who are college educated or highly motivated. It is not easy to do this (Web design), it requires a certain amount of conceptual thinking ability because all the networks, and all the images we [are] talking about are just bits and bytes off disks, so you have to have...a head around the way things are connected. I think people need good conceptual abilities to be able to do this. (Kotamraju, 2002, p. 17)

In addition, the rapidly changing technology requires Web designers to continually readjust and keep their skills up to date (Kotamraju, 2002; Bureau of Labor Statistics, 2007).

Given the requirements and skills associated with Web design outlined by several sources, it appears that Challenger (2000) did not accurately present them in his article.

According to the Bureau of Labor Statistics (2004), Web designers normally work a 40-hour week, but these types of jobs occasionally require evening and weekend work to meet deadlines or solve specific problems. Due to the length of time they spend sitting in front of computer terminals and typing on keyboards, Web designers are susceptible to eyestrain, back discomfort, and hand and wrist problems such as carpel tunnel syndrome and cumulative trauma disorder.

Current Job Market

Approximately 1.5 billion people around the world use the Internet (Richman, 2008). In September 2008, there were 182 million Web sites on the Internet. This is a phenomenal growth when one considers that the first Web site was published in August 1991 (Richman, 2008). According to a recent survey conducted by The Nielsen Company, the long-term prospects for the global online medium continue to be bright (Buchwalter, 2009). Packaged goods manufacturers, pharmaceutical companies and telecommunications firms are moving online at a rapid pace despite the current economic recession. The usage of mobile phones to access the Internet has tripled (Buchwalter, 2009). According to a study conducted by comScore, the number of health information Web sites increased 21 percent between 2007 and 2008 (Kumar, 2008). Nielsen Online reported a 16 percent growth in traffic at the top ten newspaper Web sites in 2008 (Bausch & McGiboney, 2009). This growth in usage of newspaper Web sites reflects a prediction made in 1998 by Dr. Jakob Neilsen, a noted expert in Web usability, who stated that an integrated Web medium would replace most current media formats within five to ten years and all computer users will prefer using the Web over reading printed pages by 2008 (Neilsen,

1998). Combined with the growing popularity of purchasing goods over the Internet (Dohm & Shniper, 2007), these trends create a need for appealing and user-friendly Web sites. Despite the current downturn in the economy, there appears to be an ongoing need for Web designers to support the continuing growth in Internet usage and marketing.

As the Internet and Web technology have evolved, so too have the roles and responsibilities of those who work within these mediums. Web technology has spawned several new jobs (Guenther, 2005). In addition to Web designer, career opportunities in Web design and development now include the following:

- Web programmer, responsible for translating system requirements into code and for developing, testing, analyzing, troubleshooting, and maintaining complex Web-based applications;
- Quality-assurance (QA) Web developer, responsible for developing programming standards and procedures to ensure adherence to standards and workflow to facilitate usage, documentation, QA testing, and debugging procedures;
- Web services/integration engineer or architect, responsible for technical oversight of a Web site's overall IT integration strategy;
- Usability engineer or analyst, responsible for performing usability tests, such as test scripts, surveys, and scenarios, and establishing the test environment; and
- Information analyst, responsible for specifying site structures based on human cognition and making complex content accessible and comprehensive (Guenther, 2005).

However, the rapid evolution of Web design makes it difficult to fully assess the skill set and its potential social and economic ramifications. Kotamraju (1999) found that the process by

which the Web is produced is understudied. She reported difficulty in establishing how many people work in Web site design in any capacity, for what amount of time, how much they were paid, whether they are women or men, and what kind of training they receive. Challenger (2000) and Zeldman (2007) also reported a lack of data on women in Web design. Therefore, more research on women in Web design is required in order to fully assess the occupation's impacts on their lives.

Biological Factors: Are Women Better Suited for Web Design?

To fully assess Web design as an IT career pathway for women, it is necessary to examine whether there are any biological factors that may contribute to women's success in this particular field. For example, Jane Austin, a founding member of a female-run digital design company, has found that women are particularly good in the usability aspects of Web design (Deans, 2002). She noted that when women design a Web page, they tend to be concerned with how it works as well as how it looks, whereas men focus more on what they have designed and less on whether the Web site is user-friendly.

Another area where women may be particularly well suited for Web design is color perception. According to Flory (2005), color is an important component in Web design. As a powerful form of communication, color can stimulate, depress, persuade, soothe, create anxiety, increase appetite, and evoke feelings of warmth or coolness. Therefore, selecting a color palette in Web design is a challenging task (Flory, 2005). To complicate matters, the same color can elicit vastly different reactions between gender groups. A study conducted by a Swedish researcher found that males and females have different emotional and cognitive responses to different kinds of light (Weil, 2008). Exploring the meaning of color, its perception by gender, and how it can be used in design is crucial to building an effective Web site. Women are able to

perceive more color (A Moment of Science, 2005). Approximately 40 percent of women possess two types of red cones, a key gene involved in enabling one to see the color red. This gene is located on the X chromosome. Men have only one X chromosome, whereas women have two. This distinction is the reason why there is a discrepancy in how men and women see color. Women are better able to differentiate colors in the red-orange range of the color spectrum. Some women may be able to see 100 million colors, and only women have the potential for super color vision (Roth, 2006). Given the importance of color to Web design, this ability may give women an advantage over men as Web designers.

According to Hunt (2009), the most important skill for a Web designer is the ability to use words effectively. As the head of a prominent Web design firm, Hunt believes that an effective Web designer is more skilled in writing and editing copy than in designing graphics. This is another area where women as Web designer may have an advantage over male Web designers since research shows that women perform better than men on tests related to verbal ability (Hyde, 1981; Hyde & Linn, 1988; as cited in Lippa, 2002), as well as spelling and verbal fluency (Halpern, 1992, 1997, 2000, as cited in Lippa, 2002)

Since there are aspects of Web design that are artistic, it may fall into a range of occupations that women prefer. According to Lippa (2002), "a growing body of evidence suggests that biological factors contribute, sometimes strongly, to many of the phenomena described by the term *gender* [author's italics]" (p.129). Based on his meta-analysis of six studies that collected occupational preferences, Lippa (2002) determined that men prefer realistic occupations (such as jobs that involve work with machines, tools and equipment), while women prefer social and artistic occupations. According to Browne (2002), studies have found that women rate opportunities to help others or to help society higher than men do. Myers et al.

(2005) stated that women's interest in helping others and society made them well suited to careers in IT security. Web design offers women the opportunity to help others. For example, Web sites that provide health information are beneficial and there has been a significant increase in these types of Web sites (Kumar, 2008).

Having children also impacts women and their career paths more than men. Many women take extended maternity leaves and many do not return to work afterwards (Browne, 2002). For example, the Liz Claiborne Company found that one-third of its employees who went on maternity leave did not return to work. When they do return, many women cut back on their hours and some begin to decline assignments that would require travel (Browne, 2002). Web design may present the flexibility that working mothers require in a career. Due to advances in technology, telecommuting is an option for Web design. Increasingly, the type of work that Web designers perform can be done from remote locations through modems, laptops, electronic mail, and the Internet. Therefore, telecommuting may enable Web designers who are working mothers to more easily manage job and family responsibilities.

To a certain extent, it is difficult to fully assess the status of women in Web design because of the lack of data. Challenger (2000) found no statistical data on the percentage of Web site designers who were women. In 2007, An Event Apart, an organization that sponsors conferences for Web designers, hired researchers at The New York Public Library to investigate all that is actually known about women in Web design and their positions relative to their male colleagues (Zeldman, 2007). The only data the researchers found concerned women and minorities in the IT workforce. They were unable to find data specific to women and men working in Web design.

Web design does appear to have opened up opportunities for women in IT. In an article on bridging the gender gap in IT, Melymuka (2000) supports Challenger's assertion that Web design offers women a career path in IT. She highlights a few women who advanced themselves by completing a four-month, intensive, hands-on training program in Web design. Sponsored by a nonprofit media arts center in San Francisco, the program was developed to address the digital divide by providing free training. According to Melymuka (2000), half of the graduates from the program are women and they have moved into careers as interactive designers, graphic artists, Webmasters, Web designers, and HTML and Java coders. One graduate increased her annual income from $16,000 to $38,000 after completing the program. Another female graduate who made $5,000 annually prior to completing the program increased her salary to $50,000 annually as a Web developer. However, it is worth noting that several of the women highlighted in the article already had college degrees in areas that blended well with Web design, such as fine arts, art history, or mathematics.

Although women have increased their income by pursuing careers in Web design and development, the median salary for Web designers in 2002 was approximately $23,000 less than the median salary for computer scientists (Bureau of Labor Statistics, 2002). The pay is considerably less than in software engineering and the work has less influence on how computers are used (Stross, 2008). As with many jobs, recruitment is often done by word of mouth and women have just begun to set up their own networking in Web design (Deans, 2002).

Through a review of Web design as a profession and a potential IT career opportunity for women, the following factors were established:

- As a profession, Web design has evolved very rapidly since it first emerged in the mid-1990s (Isler, 2004; Kotamraju, 1999). Due to the rapid evolution of the field

and the technologies that it employs, the available data and research on Web design as a career option are very limited (Kotamraju, 1999; Challenger, 2000; Zeldman, 2007).

- Initially, the structure of Web sites was simple and basic. Their development was viewed as a technical exercise that fell under the purview of computer programmers. Since women comprised only 29 percent of the IT workforce in 1999 (Chamberlain, 2001), one can assume that the majority of the computer programmers involved in developing Web sites in the 1990s were male.
- The development of user-friendly Web design software at the end of the 1990s made it possible for people without knowledge or experience in computer programming to develop Web sites. This led to a proliferation of self-training and certification training programs in Web design that attracted people with little to no training or experience in computer or information technologies, especially women, because they were promoted as a pathway to a career in IT (Isler, 2004; Melymuka, 2000).
- Male IT workers viewed those who completed self-training or certification programs in applications of user-friendly Web design software with contempt. Since the majority of people pursuing careers in Web design through these types of training programs were women, male IT workers saw this as further evidence that women were incapable of learning computer programming (Isler, 2004). Therefore, women who sought careers in IT via self-instruction or training certification programs in Web design encountered a negative and hostile reception from their male coworkers.

- The "deskilling" and labor market segmentation that occurred in Web design as a result of self-instruction and certification training programs led to a technical and gendered division of labor within the field (Isler, 2004). The new labor market structure that emerged relies on a networking system comprised of organizations and groups with preconceived ideas about the ideal IT worker, and these ideas are segregated by sex based on gendered notions of technical skills (Isler, 2004).
- Establishing a career in Web design is more complex than Challenger indicated in his article *The Web is a Great Equalizer for Women: Part I* (Challenger, 2000). Web designers must have the ability to conceptualize, a theoretical understanding of how information is communicated, a thorough knowledge of HTML and a wide variety of software applications, familiarity with computer networking and equipment, and the willingness to continually retrain and upgrade their skills to accommodate new technologies (Sgobbi, 2002; Bureau of Labor Statistics, 2002, 2007).
- Despite the current economic downturn, the long-term prospects for the Internet continue to be bright (Buchwalter, 2009). More manufacturers, pharmaceutical companies and telecommunication firms are moving online. Combined with the growing popularity of purchasing goods over the Internet (Dohm & Shniper, 2007), these trends create a need for workers who can design and maintain appealing and user-friendly Web sites. In addition, the evolution of Web technology has spawned several new jobs in the field (Guenther, 2005).
- Due to their ability to differentiate colors better than men, their verbal ability, and their interest in social and artistic occupations, women may be better suited for

careers in Web design than men. The time demands of deadline driven projects and the need to continually upgrade one's technical knowledge and skills may be difficult for women with families to maintain. However, the ability to telecommute may make it easier for female Web designers to manage job and family responsibilities,

- Web design does appear to have opened up opportunities for women in IT. Several of the women who completed a training program in Web design in San Francisco secured positions in the field that increased their income. However, many of them already had college degrees in areas that blended well with Web design.
- Annually, Web designers earn approximately $23,000 less than computer scientists (Bureau of Labor Statistics, 2002), although the skill sets and characteristics required are similar (Bureau of Labor Statistics, 2004).

Similar to the development of computer programming for ENIAC, Web design developed as it went along. The job and its qualifications and responsibilities evolved along with the concepts and technologies that support it. The required skill sets changed in pace with the rapid manner in which the field and the technologies developed. As Web design evolved, it became a hybrid field that combines computer technology with communication theories and techniques. Although its origins are within the field of computer programming, the emergence of Web sites as a format for communicating information to a broader audience required the integration of graphic design concepts. Communicating information to the user is now considered the primary function of a Web site. Skills in writing and editing copy may now be of greater importance than skills in graphic design.

As a hybrid, Web design should have been an effective bridge for women to careers in IT. There are aspects of the field that align with women's interests in helping others, preference for social and artistic occupations, ability to perceive more colors, and their verbal skills. Although there is a lack of data on women in Web design, the overall low percentage of women in IT indicates that as a career option Web design has not increased their numbers in IT. Due to the lack of data, more research is necessary in order to say with any certainty that Web design is a great equalizer for women.

Chapter 6: Summary and Conclusions

Since it first emerged in the early 1990s, Web design has evolved very rapidly as a profession. Consequently, the data and research on Web design as a career option are very limited, making it difficult to fully assess the pros and cons of the profession as a job opportunity for women in the male-dominated world of IT. There may be biological factors that make women better suited to careers in Web design, but the field does not appear to be "a great equalizer for women" in IT. IT is still dominated by men and reflects their perspective, values, and characteristics. Women who pursue careers in Web design may earn more than they did in their previous jobs, but similar to the non-IT workforce, they are still paid less than their male counterparts. Throughout the IT workforce, women still encounter bias, hostility and a lack of respect.

The exponential growth of computer and information technology has generated a need for more skilled workers in these fields. Yet, despite the demand for more workers, women continue to be underrepresented in IT fields. Women are poorly represented in IT management and the majority of female IT workers are employed in low paying positions. Although there has been an increase in the employment of computer scientists and systems analysts, women are still under employed in these areas.

Ironically, women played a key role in computing and the development of computer technology during the industry's infancy. When computer technology first emerged, the new industry was envisioned as a model that offered a bright, new future for women in scientific or technology-oriented occupations. The second wave of the women's movement during the 1960s and 1970s brought equality for women to the forefront. Despite expectations and the advances women made overall in the workplace, computer technology did not evolve as a gender-neutral

activity. In a relatively short period of time, a male hierarchy was established within the IT industry. By 1986, the presence of women in IT had begun to decline. Until recently, women's contributions to computer technology were largely ignored. Rather than offering a new future for women, IT evolved into a male-dominated work environment that in many respects is more hostile to female workers than the non-IT workforce. Now the growth in computer usage and advances in computer technology has shifted the computer science paradigm just enough to realign the field in favor of women. This is similar to other points in history when traditionally male occupations opened up to women due to a shortage of male workers as a result of war, a rapid increase in market demand, or a decline in the status of the occupation. Women are needed to meet the shortage of professional IT workers, so job opportunities in IT fields are being promoted to them.

However, despite the shortage of IT workers, studies on women in IT and ways to increase their number and retain them, and programs to engage more young girls in IT, women's presence in IT fields remains low. In an effort to understand and address the issue, several theories ranging from nature to nurture have been posited to explain the low percentage of female IT professionals. Factors frequently cited for contributing to the underrepresentation of women in IT include gender bias, lack of role models and mentors, perceptions, stereotyping, and difficulty with work/life balance. The research is ongoing, but there are no clear answers on how to address the issues, several of which are deeply rooted in historic gender roles and rules.

The hostility that women encounter in IT may be due to a fear among male IT workers that the presence of women in higher-level IT jobs may alter Society's perceptions of the qualifications required for these occupations. This would negatively impact the prestige associated with these positions and the pay scales would subsequently be lower. This appears to

have been the case in the late 1990s when people without educational backgrounds and experience in computer science or technology attempted to pursue careers in IT as Web designers through self-instruction and training certification programs. The majority of those who pursued this pathway to a career in IT were women; the population that Challenger (2000) targeted in his article *The Web is a Great Equalizer for Women: Part I.* Some women did increase their income by successfully completing these training courses and securing positions as Web designers. However, male IT workers viewed the application of user-friendly Web design software as another indicator of how women lacked the necessary skills and ability to work in IT. The user-friendly Web design software simplified a process that previously required knowledge and experience in computer programming, undermining a prestigious skill set of male IT professionals. In addition, the entry of Web designers with only training in user-friendly software created a dual market and pay scale within the field. Women who sought positions as Web designers after completing self-instructional or certification programs found themselves on the low end of the pay scale, similar to other women in IT. Currently, Web designers seeking work rely on locally-based networking associations and software and operating system users' groups to find jobs in Web design and these organizations still rely on preconceived ideas about IT workers that are based on gendered notions of technical skills. Given the bias, this approach to job placement in Web design does not bode well for female graduates of self-instructional or certificate programs in Web design software applications.

Although supply and demand may open up more IT fields to women, historical and current evidence suggests that women seeking careers in these fields will continue to encounter obstacles and difficulties in a work environment dominated by a male management stratum. Many qualified women in the IT workforce report that they find themselves assigned to menial

tasks and under constant supervision, while their male counterparts are given more challenging assignments and left to their own discretion. There are no indications that the situation is any different for women in the IT workforce who are employed as Web designers.

Since women still bear the primary responsibility for family and home care, the long, irregular hours associated with the IT work environment can be difficult for women with spouses and children to manage. Although Web designers generally work a 40-hour week, they are occasionally required to work evenings and weekends to meet deadlines or solve specific problems. This type of work schedule may be hard for Web designers who are mothers to maintain. The option of telecommuting within IT fields, such as Web design, may provide the flexibility women need to manage job and family responsibilities. However, with limited available research, it is difficult to assess the extent to which telecommuting is permitted in these fields and how the ability to telecommute affects workingwomen. Some of the working mothers that I know have told me that they would find it difficult to complete their work assignments at home because they would continuously be interrupted or distracted by family members and home care responsibilities. Currently, women are nearly three times as likely as men to leave the IT workforce and one of the primary reasons cited is the long work hours.

Establishing a career in Web design is more complex than learning HTML programming. Web designers must have the ability to conceptualize, a theoretical understanding of how information is communicated, a thorough knowledge of HTML and a wide variety of software applications, familiarity with computer networking and equipment, and the willingness to continually retrain and upgrade their skills to accommodate new technologies. They also must be able to address organizational and managerial issues. This is significantly more than the job requirements that Challenger (2000) presented in his article. However, since the field has

expanded so quickly over a relatively short period of time it is difficult to determine the required skills sets at the time Challenger's (2000) article was published. As previously stated, the initial Web sites were basic and employed only HTML programming language. As they became more complex, Web sites required more extensive knowledge and experience in a wider range of computer hardware, software programs, and technologies. Increasingly, employers are looking for Web designers with at least a baccalaureate degree and management and organizational skills.

Despite the current economic downturn, the long-term prospects for the Internet continue to be bright. More manufacturers, pharmaceutical companies and telecommunication firms are moving online. Combined with the growing popularity of purchasing goods over the Internet, these trends create a need for workers who can design and maintain appealing and user-friendly Web sites. In addition, the evolution of Web technology has spawned several new jobs in the field. The emerging field of IT security may present new career paths in IT for women, but the salary range is approximately $5,000 less per year than the salary range for Web developers. Although Web design positions may pay slightly more than positions in IT security, Web design is not one of the highest paying fields in IT. Within computer-related occupations, Web design pay scales fall on the lower end of the spectrum. Annually, Web designers earn approximately $23,000 less than computer scientists. However, the number of women earning baccalaureate degrees in computer science continues to decline.

Outsourcing and traditional practices in IT, along with beliefs regarding the value of women's labor, will likely keep women at lower salary levels than their male counterparts. As with other fields, including medicine, research, and government, women will be allowed to work in IT jobs to the extent that the socially dominant male hierarchy finds it economically

beneficial. Based on history, there is no reason to believe that the need for more IT specialists or Web designers will generate higher or equal salaries for women. The issues affecting women in all IT positions, similar to gender issues pertaining to risk taking and household responsibilities, are deeply rooted in perceptions regarding female and male characteristics and roles. Expectations that computer technology would create a gender-neutral activity did not factor in how deeply entrenched these perceptions and beliefs are.

Web design may present a pathway to a career in IT for women, but the available research does not support Challenger's (2000) simplistic assertions. Based on the research, Challenger published his article during a period when short-term Web design training certification programs proliferated. People with little to no computer experience or training did flock to these programs, particularly women, in hopes that the programs would provide them with entry to the booming, high-paying world of IT. Although some of those who completed these training programs did find work as Web designers, they were held in contempt by established IT workers and ended up in lower pay scale brackets. For the most part, those who did succeed in obtaining positions in Web design through completion of training certification programs had college degrees and some experience in applying computer technology and software.

Although the growth of the Internet has slowed down, the use of the World Wide Web as a means of communication and marketing continues to expand. Web design does present a career opportunity, but an applicant for a position in this field, whether male or female, will need to have the educational background and training in Web design applications and technologies to secure even an entry level job in this field. The complexity of IT is such that it is no longer possible to gain entry in any of the various fields that support IT without a college degree in a

related field, or a college degree combined with some courses related to IT and hands-on experience in the field. Women who want to pursue careers in IT fields, whether as a Web designer or other type of IT specialist, should identify which field is most appealing to them and acquire the post-secondary degrees that best prepares them for entry into that field. Given the current data on women in IT, we still have quite a way to go before women experience equality with men in IT fields. However, the current shortage of IT workers does provide an opportunity for women to pursue careers in IT fields, including Web design.

Within the next seven years, women will account for more than half of the country's workforce. IT needs to attract more women in order to maintain its growth and evolution, not only to meet the shortage in the workforce, but because women bring different life experiences and perspectives to the innovation process that contributes to the design of products and services that benefits a broader range of people. Women must play a more significant role in building an innovative and technically trained workforce if US companies are to maintain their competitive advantage in IT-related fields. As the industry matures, more IT jobs require business aptitudes, people-oriented skills, and multi-tasking management potential more than just technical ability, and many people believe that women are more likely than men to have these types of attributes. We may finally have reached a point in the evolution of IT where the industry's future depends on creating an overall environment that serves as an equalizer for women in all the various IT fields, opening the way to careers for women in IT that is not limited to one narrow pathway.

As the largest employer in the United States of America, as well as the largest purchaser of products and services in the country, the federal government may need to lead the way, similar to its role in addressing discrimination through integration of the armed forces. For example, the federal government could enact pro-active hiring policies designed to increase the number of

women in management position throughout all of its IT divisions. Priority might be placed on women entering IT in the military and domestic security forces, such as the Federal Bureau of Investigation, through hiring, training, and enlistment incentives. The federal government could also make more efforts to enforce existing laws to ensure that women receive salaries equal to men for the same work and job responsibilities and they have the same opportunities for advancement in their fields as men. In addition, the federal government could require companies seeking federal contracts to ensure that a percentage of IT workers engaged in the project are women, and a portion of them are in management positions. As with its anti-smoking campaign, the federal government might enlist the various components of the media to produce and present positive messages promoting girls and women in IT. Within IT companies and divisions, programs for women employees that include career development and networking components have been successful in increasing the percentages of female workers.

Given that women overall are not pursuing fields of study that will position them for high-end jobs in IT, more efforts should be made to implement the recommendations made by the American Association of University Women in 2003 to promote the benefits of education in technology and create opportunities and incentives for women and girls to pursue careers in IT, such as events designed to get girls excited about IT and opportunities to speak with women who are working in IT and female high school and college students studying IT. Parents and teachers should also be engaged through programming that provides information on ways to encourage girls to embrace technology. More efforts are needed to change women's perceptions of IT, as well as more research on the impacts of the IT working environment on the careers of women. Mentoring programs, flexible work schedules, and the provision of childcare also have been cited as ways to increase the number of women in IT. I believe that one of the keys is to create an

environment within IT that welcomes women's input and assures men that the presence of women does not pollute the field. As this has remained a challenge, more research is necessary to understand and overcome deeply ingrained perceptions about gender

Though it may be easy to become cynical because the bias appears so entrenched, women have made progress in entering fields and jobs that previously had been closed to them, although that progress has been woefully slow. Last year, a woman ran for President of the United States and she almost succeeded, approximately 89 years after the 19th amendment gave women the right to vote, and 137 years after the first woman ran for the office. Now may be the best time to push for a more equal playing field in IT for women since the growth in computer usage and advances in computer technology has shifted the paradigm just enough to realign the field in their favor.

References

Alliance for Telecommunications Industry Solutions. (2007). *Information technology.* ATIS Telecom Glossary. Retrieved May 20, 2007 from http://www.atis.org/glossary/definition.aspx?id=4534

American Association of University Women Educational Foundation. (2004). *Under the microscope: A decade of gender equity projects in the sciences.* Washington, D.C.: Author.

American Association of University Women Educational Foundation. (2003). *Women at work.* Washington, DC: Author.

A Moment of Science. (2005). *Women see more color.* Indiana University, Bloomington. Retrieved January 25, 2009 from http://amos.indiana.edu/library/scripts/womencolor.html

Arnold, D. & Niederman, F. (2001). The global workforce. *Communications of the ACM*, 44(7), 31-33. Retrieved January 19, 2009 from the ACM Digital Library.

Bausch, S. & McGiboney, M. (2009, January 26). *Newspapers grows 16 percent year-over-year in December, according to Nielsen Online* [PDF document]. Retrieved May 8, 2009 from The Nielsen Company Online Web site: http://www.nielsen-online.com/pr/pr_090127.pdf.

Baxandall, R. & Gordon, L. (Eds.). (1995). *America's working women: A documentary history 1600 to the present* (2nd ed.). New York: W. W. Norton and Company, 1995.

Belkin, L. (2008, June 15). When mom and dad share it all. *The New York Times*. Retrieved June 15, 2008 from http://www.nytimes.com/2008/06/15/magazine/15parenting-t.html?scp=1&sq=When+mom+and+dad+share+it+all&st=nyt.

Berners-Lee, T. (2008). *Tim Berners-Lee.* Retrieved February 24, 2008 from the World Wide Web Consortium Web site: http://www.w3.org/People/Berners-Lee/

Bishaw, A. & Semega, J. (2008, August). *Income, earnings, and poverty data from the 2007 American Community Survey* [PDF document]. American Community Survey Reports (ACS-09), U.S. Census Bureau. Washington, DC: U.S. Government Printing Office. Retrieved February 15, 2009 from the U.S. Census Bureau Web site: http://www.census.gov/prod/2008pubs/acs-09.pdf.

Bollier, D. (2005). *Information technology and the new global economy: Tensions, opportunities, and the role of public policy* [PDF document]. Washington, DC: The Aspen Institute. Retrieved February 22, 2009 from http://www.bollier.org/pdf/IT-NewGlobalEconomy.pdf.

Bossé, M., & Hurd, D.A.C. (2002). Women communicating mathematics: The historic role of women. *Mathematics and Computer Education*, 36(3), 218-226. Retrieved April 3, 2007 from H.W. Wilson OmniFile.

Browne, K.R. (2002). *Biology at work: Rethinking sexual equality*. Piscataway, NJ: Rutgers University Press.

Buchwalter, C. (Ed.). (2009). *The global online media landscape: Identifying opportunities in a challenging market* [PDF document]. New York, NY: The Nielsen Company. Retrieved May 8, 2009 from The Nielsen Company Web site: http://en-us.nielsen.com/etc/medialib/nielsen_dotcom/en_us/documents/pdf/white_papers.Par.95384.File.dat/Nielsen_Global_Online_Media_Report_0424.pdf

Bureau of Labor Statistics. (2002). 2002 national occupational employment and wage estimates, computer and mathematical science occupations. *Occupational Employment Statistics.* U.S. Department of Labor. Retrieved April 25, 2004 from http://www.bls.gov/oes/2002/oes_15Co.htm.

Bureau of Labor Statistics. (2004). Computer system analysts, database administrators, and computer scientists. *Occupational Outlook Handbook, 2004-2005 Edition.* U.S. Department of Labor. Retrieved April 27, 2004 from http://www.bls.gov/oco/ococs042.htm.

Bureau of Labor Statistics. (2007). *Occupational Outlook Handbook, 2008-09 Edition.* U.S. Department of Labor. Retrieved February 15, 2009 from http://www.bls.gov/oco/

Burnett, K., & Subramaniam, M.M. (2004). Defining the information technology workforce from educational perspectives: A pilot study. Proceedings from SIGITE '04: *The 5th Conference on Information Technology Education.* Salt Lake City, UT: ACM Press. Retrieved May 20, 2007 from the ACM Digital Library.

Challenger, J.E. (2000, December 20). The web is a great equalizer for women: Part I. *The Buffalo News*, Employment Section, E1.

Chamberlain, C. (2001, November 5). Women still under-represented in information technology, says panel. *Advance on the Web*. Retrieved February 29, 2008 from the University of Connecticut Web site: http://advance.uconn.edu/2001/011105/01110506.htm.

Chapple, K. (2006). Foot in the door, mouse in hand: Low-income women, short-term job training programs, and IT careers. In J. McGrath Cohoon (Ed.), *Women and information technology: Research on under-representation*, pp.439-470. Cambridge, MA: MIT Press. Retrieved April 8, 2009 from http://site.ebrary.com/lib/bridgeport/Doc?id=10173711&ppg=458

Cohen, P. & Bianchi, S. (1999). Marriage, children, and women's employment: What do we know? *Monthly Labor Review*, 22-31. Retrieved November 24, 2008 from http://www.bls.gov/opub/mlr/1999/12/art3full.pdf

Creswell, J. (2006, December 19). How suite it isn't: A dearth of female bosses. *The New York Times*. Retrieved December 19, 2006 from http://nytimes.com.

Croarken, M. (2003). Mary Edwards: Computing for a living in 18th century England. *IEEE Annals of the History of Computing*. Retrieved April 4, 2007 from ABC-CLIO Press Historical Abstracts and America: History & Life.

Dean, C. (2006, December 19). Women in science: The battle moves to the trenches. *The New York Times*. Retrieved December 19, 2006 from http://www.nytimes.com.

START HERE

Deans, J. (2002, August 5). New media: boys, boys: New media, new attitudes? Think again. *The Guardian*. Retrieved April 22, 2006 from ProQuest.

Dohm, A. & Shniper, L. (2007). Occupational employment projections to 2016. *Monthly Labor Review*, 130(11), 86-125. Retrieved February 14, 2008 from http://www.bls.gov/opub/mlr/2007/11/art5full.pdf.

Eisenberg, B. & Ruthdotter, M. (1998). History of the movement. *National Women's History Project.* Retrieved July 29, 2009 from http://www.legacy98.org/move-hist.html.

Erdwins, C., Buffardi, L., Casper, W., & O'Brien, A. (2001). The relationship of women's role strain to social support, role satisfaction, and self-efficacy. *Family Relations*, 50, 230-238. Retrieved November 18, 2008 from EBSCOhost.

Feminism and Women's Studies. (2005). The women's movement – our history. Retrieved July 29, 2009 from http://feminism.eserver.org/theory/feminist/Womens-Movement.html.

Finder, A. (2006, June 14). Women on faculty still lag at Harvard, report finds. *The New York Times*. Retrieved June 14, 2006 from http://www.nytimes.com.

Flory, K.L. (2005). Color inside the lines—Does gender matter in color selection for Web design? In *Karen Lare Flory: Portfolio.* Retrieved April 11, 2009 from https://www.msu.edu/~florykri/Color.pdf

Gabriel, M. (1998). *Notorious Victoria: The Life of Victoria Woodhull, Uncensored.* Chapel Hill, NC: Algonquin Books of Chapel Hill.

Golden, C. (2002). *A pollution theory of discrimination: Male and female differences In occupations and earnings* (NBER Working Paper 8985). Cambridge, MA: National Bureau of Economic Research. Retrieved March 1, 2009 from http://www.economics.harvard.edu/faculty/goldin/files/pollution.pdf

Guenther, K. (2005). Web site management: Where have all the Webmasters gone? *Online*, 29(2). Retrieved July 2, 2006 from ProQuest Research Library.

Gürer, D. (1995). Pioneering women in computer science. *Communications of the ACM*, 38(1), 45-54. Retrieved January 21, 2004 from The ACM Digital Library.

Gürer, D. (2002). Women in computing history. *SIGCSE Bulletin*, 34(2), 116-120. Retrieved April 11, 1007 from The ACM Digital Library.

Handelsman, J., Cantor, N., Carnes, M., Denton, D., et al. (2005). More women in science. *Science*, 309(5738), 1190-1191. Retrieved June 28, 2007 from ProQuest databases.

Hayghe, H. & Bianchi, S. (1994). Married mothers' work patterns: The job-family compromise. *Monthly Labor Review*, 24-30. Retrieved November 18, 2008 from http://scholar.google.com/scholar?hl=en&lr=&q=info:61hcAbvhiH8J:scholar.google.com/&output=viewport&pg=1

Health Physics Society. (2009, May 19). *Pregnancy and radiation exposure*. Retrieved June 10, 2009 from http://hps.org/publicinformation/ate/faqs/pregnancyandradiationexposure.html

Hochschild, A.R. (1989). *The second shift: Working parents and the rRevolution at home.* New York, NY: Viking Penguin, Inc.

Hochschild, A.R. (1997). *The time bind: When work becomes home and home becomes work.* New York, NY: Metropolitan Books.

Hunt, B. (2009, January 17). 10 top skills for Web design, in order of importance. *Web Design from Scratch.* Retrieved May 9, 2009 from http://www.webdesignfromscratch.com/blog/top-10-skills-for-web-design.php.

Institute for Telecommunications Sciences. (1996). Definition: computer. Retrieved January 12, 2009 from http://www.its.bldrdoc.gov/fs-1037/dir-008/_1184.htm.

Isler, J.M. (2004, August 14). *The gendering of Web design job search: Three cases of information technology networking organizations.* Paper presented at the annual meeting of the American Sociological Association, San Francisco, CA. Retrieved February 28, 2009 from http://www.allacademic.com/meta/p109863_index.html.

Johnson, T. D. (2007). Maternity leave and employment patterns: 2001–2003. *Current Population Report, P70-113.* U.S. Census Bureau, Washington, DC. Retrieved August 17, 2008 from http://www.census.gov/prod/2008pubs/p70-113.pdf.

Joy, L. (2006). Occupational differences between recent male and female college graduates. *Economics of Education Review*, 25, 221-231. Retrieved July 9, 2006 from http://www.sciencedirect.com.

Kelley, R. (2007, July 12). Most lucrative college degrees. *CNNMoney.com*. Retrieved March 24, 2009 from http://money.cnn.com/2007/07/11/pf/college/starting_salaries/index.htm.

Klaus, P. (2009). A sisterhood of workplace infighting. *The New York Times,* January 12, 2009. Retrieved January 12, 2009 from http://www.nytimes.com/2009/01/11/jobs/11pre.html?_r=1&ref=jobs

Klawe, M., Whitney, T., & Simard, C. (2009). Women in computing: Take 2. *Communications of the ACM*, 52(2), 68-78. Retrieved March 16, 2009 from the ACM Digital Library.

Kotamraju, N. (1999). The birth of Web site design skills: Making the present history. *American Behavorial Scientist*, 43 (3), 464-474.

Kotamraju, N. (2002). Keeping up: Web design skill and the reinvented worker. *Information, Communication & Society, 5(1)*. Retrieved April 11, 2004 from Communications Institute for Online Scholarship Web site: http://www.cios.org

Koss, A.M. (2003). Programming on the UNIVAC I: A woman's account. *IEEE Annals of the History of Computing*. Retrieved April 4, 2007 from ABC-CLIO Press Historical Abstracts and America: History & Life.

Kumar, R. (2008, September 9). Twenty-one percent growth in health information Web sites. *Silicon Valley Web Guild*. Retrieved May 8, 2009 from http://www.webguild.org/2008/09/twenty-one-percent-growth-in-health-information-sites.php

Laudon, K., Traver, C. G., and Laudon, J. P. (1994). *Information Technology and Society*. Belmont, CA: Wadsworth Publishing Company.

Lippa, R.A. (2002). *Gender, nature, and nurture*. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Margolis, J. & Fisher, A. (2002). *Unlocking the clubhouse: women in computing*. Cambridge, MA: The MIT Press.

Melymuka, K. (2000). Bridging a gap for women in IT. *Computerworld*. Retrieved July 16, 2002, from Gale Group database.

Microsoft Corporation. (2000, November 15). Valuing diversity. *On the Issues: Society and Technology*. Retrieved April 4, 2009 from http://www.microsoft.com/issues/essays/2000/11-15diversity.mspx.

Myers, M., Woszczynski, A., & Shade, S. (2005). Opportunities for women in IT security. Proceedings from *SIGMIS-CPR'05*, April 14–16, 2005, Atlanta, Georgia: ACM Press. Retrieved June 25, 2006 from the ACM Digital Library.

National Center for Women & Information Technology. (2007). *By the numbers: Revolutionizing the face of technology*. Retrieved March 22, 2009 from http://www.ncwit.org/pdf/Stat_sheet_2007.pdf.

National Organization of Women. (2008). No excuses: Women deserve fair pay. *Take Action,* July 23, 2008, Retrieved July 26, 2009 from http://www.now.org/lists/now-action-list/msg00341.html.

Neilsen, J. (1998). End of legacy media. *Alertbox*, August 23, 1998. Retrieved January 19, 2009 from http://www.useit.com/alertbox/980823.html.

Pink, D.H. (2005). Why the world is flat. *Wired*, 13.05, May 2005. Retrieved February 22, 2009 from http://www.wired.com/wired/archive/13.05/friedman.html.

Princeton University. (2006) *WordNet 3.0*. Retrieved January 24, 2009 from http://wordnetweb.princeton.edu/perl/webwn?s=information+technology&sub=Search+WordNet&o2=&o0=1&o7=&o5=&o1=1&o6=&o4=&o3=&h=

Proudfoot, S. (2008). An overview of science, engineering, and health graduates: 2006 (NSF 08-304, revised). Retrieved January 11, 2009 from National Science Foundation, SRS Publication: InfoBrief Web site: http://www.nsf.gov/statistics/infbrief/nsf08304/.

Quesenberry, J. (2006). Career anchors and organizational culture: A study of women in the IT workforce. Proceedings from SIGMIS-CPR'06, April 13–15, 2006, Claremont, California: ACM Press. Retrieved March 16, 2009 from the ACM Digital Library.

Richman, L. (2008, October 28). Growth of the Internet. *LDS Media Talk*. Retrieved May 9, 2009 from http://ldsmediatalk.com/2008/10/28/growth-of-the-internet/.

Robinson, H.H. (1883). Early factory labor in New England. In Massachusetts Bureau of Statistics of Labor, *Fourteenth Annual Report* (Boston: Wright & Potter, 1883), pp. 380-82, 38788, 39192. Reprinted Internet Modern History Sourcebook Paul Halsell 1997. Retrieved June 15, 2008 from http://www.fordham.edu/halsall/mod/robinson-lowell.html.

Rosenbloom, J.L., Ash, R.A., Coder, L., & DuPont, B. (2003). ITWF progress report 3: results from March 2002 CPS data – IT characteristics. *Professional Worker Career Experience Survey*. University of Kansas. Retrieved March 14, 2009 from http://www.ipsr.ku.edu/~ipsr/ITWorkforce/pubs/CPS2.shtml

Rosenbloom, J.L., Ash, R.A., Coder, L., and DuPont, B. (2005). IT workforce composition and characteristics. *Professional Worker Career Experience Survey.* University of Kansas. Retrieved February 15, 2009 from http://www.ipsr.ku.edu/~ipsr/ITWorkforce/pubs/ITWorkforceOverview.shtml#auth

Roth, M. (2006, September 13). Some women may see 100 million colors, thanks to their genes. *Pittsburgh Post-Gazette*, September 13, 2006. Retrieved January 25, 2009 from http://www.post-gazette.com/pg/06256/721190-114.stm

Sciammacco, C. (1998). Feminists call for closing of wage gap: Equal Pay Day shows women still behind. *National NOW Times*, Summer, 1998. Retrieved July 26, 2009 from http://www.now.org/nnt/05-98/wagegap.html

Seligson, H. (2007). Ladies, take off your tiara! *The Huffington Post*, February 20, 2007. Retrieved November 16, 2008 from http://www.huffingtonpost.com/hannah-seligson/ladies-take-off-your-tia_b_41649.html.

Seligson, H. (2008). Girl power at school, but not at the office. *The New York Times*, September 7, 2008. Retrieved September 7, 2008 from http://www.nytimes.com/2008/08/31/jobs/31pre.html?ref=jobs.

Schor, J. (2000). *The overworked American*. New York, NY: BasicBooks.

Sgobbi, F. (2002). Web design skills and competencies: An empirical analysis. *Human Systems Management*, 21(2), 115-128. Retrieved January 19, 2009 from EBSCOhost.

Stross, R. (2008). What has driven women out of computer science? *The New York Times*, November 16, 2008. Retrieved November 16, 2008 from http://www.nytimes.com/2008/11/16/business/16digi.html?_r=1&scp=1&sq=What%20Has%20Driven%20Women%20Out%20of%20Computer%20Science?%20&st=cse

Teague, J. (2002). Women in computing: What brings them to it, what keeps them in it? *SIGCSE Bulletin*, 34(2). Retrieved February 8, 2009 from The ACM Digital Library.

Todd, K., Mardis, L., & Wyatt, P. 2005. We've come a long way baby! But where women and technology are concerned, have we really? Proceedings from The 33rd Annual ACM SIGUCCS *Conference on User Services*. New York: ACM Press.

Trauth, E., Quesenberry, J. & Huang, H. (2006). Cross-cultural influences on women in the IT workforce. Proceedings from *SIGMIS-CPR'06*, April 13–15, 2006, Claremont, California, USA. Retrieved June 25, 2006 from the ACM Digital Library.

U.S. Census Bureau. (2008). Facts for features. *Women's History Month: March 2008*. Retrieved August 17, 2008 from http://www.census.gov/Press-Release/www/releases/archives/facts_for_features_special_editions/011179.html

U.S. Department of Labor. (2002). Women in high-tech jobs. *Facts on Working Women,* 2(01). Retrieved April 24, 2004, from http://www.dol.gov/wb/factsheets/hitech02.htm.

Walsh, M. (1989). Working women in the United States. *Bulletin Society for the Study of Labour History*, 54(1), 37-53. Retrieved April 5, 2008 from EBSCOhost.

Weil, E. (2008). Teaching boys and girls separately. *The New York Times*, March 2, 2008. Retrieved March 2, 2008 from http://www.nytimes.com/2008/03/02/magazine/02sex3-t.html?scp=1&sq=Teaching%20boys%20and%20girls%20separately&st=cse.

Weisberg, B. (2004). *Talking to the dead: Kate and Maggie Fox and the rise of spiritualism.* San Francisco, CA: Harpers.

Wentling, R.M., & Thomas, S.P. (2004). Women in information technology. Paper presented at the Academy of Human Resource Development International Conference, Austin, Texas, March 3-7, 2004. Retrieved March 1, 2007 from ERIC.

Wertheimer, B. (1977). *We were there: The story of working women in America.* New York, NY: Pantheon.

Williams, E.P. 2003. A systems analyst's computer watch: 1943-2003. *IEEE Annals of the History of Computing*. Retrieved April 4, 2007 from ABC-CLIO Press Historical Abstracts and America: History & Life.

Risk & Insurance. (2000). Women face greater workplace risks. (2000). The Free Library. Retrieved November 18, 2008 from http://www.thefreelibrary.com/Women+Face+Greater+Workplace+Risks.-a065714496

WordNet. (2006). Princeton University. Retrieved January 21, 2009 from http://wordnetweb.princeton.edu/.

Woodfield, R. (2000). *Women, work and computing*. England: Cambridge University Press.

Wright, R. & Jacobs, J.A. (1994). Male flight from computer work: a new look at occupational resegregation and gettoization. *American Sociological Review*, 59(4). Retrieved November 26, 2008 from ABI/INFORM Global.

Zeldman, L.J. (2007). Women in web design: just the stats. *The Daily Report*, April 19, 2007. Retrieved March 18, 2009 from http://www.zeldman.com/2007/04/19/women-in-web-design/.

Zielbauer, P. (2001). Bell for Connecticut's sleepy students. *The New York Times*, Late Edition - Final, Section B, Page 1, Column 2, February 20, 2001.