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FROM CLASSROOM TO EXECUTIVE MANAGEMENT - GENDER DIVERSITY IN THE INFORMATION TECHNOLOGY FIELD

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ABSTRACT

Although women earn a greater number of college degrees (58% in 2010) than men, they comprise a smaller proportion of all employees who work in the Information Technology (IT) industry. Moreover, among the top four consumer electronics categories - LCD TVs, tablets, laptops, and smartphones, women score higher than men in their likelihood of purchasing the latter three. Women also spend more time on social networking sites and conduct more internet searches than men do. Even though, the positive impacts of having more women in top management positions are well documented, they are still under-represented in the middle and upper management positions. The goal of this exploratory research is to investigate the representation of women in the IT field based on two independent and objective data sets. The first data set shows the number of women graduating with IT degrees from 1971-2009 and the second data set shows the number of women who were hired as IT leaders from 2000-2010. The results reveal that the number of women graduating with IT degrees is declining. However, the IT field seems to be doing better when comparing the number of female IT executives to female CFOs and female CEOs who were employed by the 2010 Fortune 100 firms.

Keywords: women in Information Systems (IS), Information Technology (IT), graduation rates, hiring trends, Top Management Team (TMT)

INTRODUCTION

In the U.S., women make 85% of household purchasing decisions, are more likely than men to buy laptops, tablets, and smartphones, and use more Information Technology resources compared to men - use social media more than men and conduct more searches on the internet than men do.

[38, 44]

Given the apparent dominance of women in making purchasing decisions and their propensity to use In-

formation Technology (IT) resources more than men, it would be prudent that firms incorporate more women in the design and marketing of IT and related resources (we hereafter use the generic term IT to refer to IS-Information Systems, MIS-Management IS, and CIS-Computer IS). However, anecdotal and existing research data indicates that women account for very small proportions of the IT workforce and marketing departments' personnel headcounts in general. This sharply contrasts with to the significant increases in the number of women earning college degrees and subsequently participating in the U.S. labor workforce. For instance, in 2010, women accounted for 47% of the U.S. labor force and this figure has been increasing in the last couple of decades signifying that women are increasingly entering the labor market [61]. Additionally, women accounted for 58% of all the undergraduate degrees awarded in the U.S. in 2010 [57]. Although women are the majority of the workers in some industries - financial services, health, and education - they are under-represented in some other industries such as engineering, information, and computer related services. As women gain a foothold in the use of IT resources and continue to dominate household purchasing decisions, firms in the industries in which women are under-represented will be anxious and keen to incorporate more women in the design, production, and devising of marketing strategies for the products targeted at this apparently powerful demographic. Thus, harmonizing the workplace through gender diversification continues to elicit a lot of debate both in academia and the industry.

Diversity may be broadly defined as the harmonious co-existence of individuals in spite of their gender, race, age, color, ethnicity, nationality, or socio-cultural differences [30, 64]. For quite some time now, researchers have been exploring various dimensions related to diversity issues either at the societal and/or corporate level. Prior research studies have generally reported that there are many benefits accruing to a firm and society from a diverse workforce. For example, firms that have more women in top leadership positions have been found to be more innovative and better performers when compared to their less diverse industry counterparts [3, 41, 47]. Firms seek to capitalize these and other positive benefits of gender diversity by having a diverse workforce.

More firms seek to capitalize on the positive aspects associated with diversity by devising strategies that support a diverse workforce. One of the major dimensions of diversity, gender, continues to elicit a lot of discussion, both in academia and the industry. Thus, research that explores gender issues at the corporate level is usually part of the value-in-diversity narrative [30]. It is premised on two main overarching themes. First, improving corporate governance by making better use of all the available human capital/talent pool [31] and second, building up ethical and inclusive institutions that are a better reflection of the current generation of all the associated stakeholders [49]. As women continue to graduate at higher rates, enter the workforce in large numbers, and account for major purchases and purchasing decisions of IT resources, firms will have to reflect these changes in their workforce demographics by formulating appropriate business strategies.

The American workforce is becoming increasingly heterogeneous partly due to the globalization phenomenon which has facilitated workforce mobility and also due to the entry of more women in the labor force. As shown in Table 1, in the U.S., women accounted for 50.8% of the population in 2010 [56] and, on average, 58% of the undergraduate enrollments and graduates within the last five years [57]. In general, women accounted for 47.1% and 46.7% of the U.S. labor force in 2010 and 2011 respectively; moreover, in the Management, Professional, and Related Occupations women had a higher representation at 51.5% and 51.4% respectively. However, considering only Management positions, women are significantly under-represented at 38.1% and 38.2% respectively [18, 59]. Among the top ten jobs for women with the highest median weekly earnings, three are in the computers and related industries. These are computer software engineers ($1,445), computer and information systems managers ($1,415), and computer programmers ($1,177) [58, 61].

Table 1: Gender Diversity Data Based on Population, Graduation and Labor Force Participation

Category	**Women (%)**	**Men (%)**
U.S. Population (2010)	50.8	49.2
Undergraduate Enrollments & Graduation (2006-2010)	58.0	42.0
Undergraduate IT degree recipients (2010)	18.0	82.0
Undergraduate IT degree recipients (1985)	37.0	63.0
Labor Market Participation (2011)	46.9	53.1
Professional computing occupations (2011)	25.0	75.0
Management, Professional, and Related Occupations (2011)	51.4	48.6
Management Positions	38.2	61.8
Chief Executives (General)	25.5	74.5
Corporate Boards (Fortune 500)	16.1	83.9
Chief Executive Positions (CEOs of Fortune 500-2011)	02.4	97.6

Table 1 shows that, the number of women in Top Management Teams (TMTs) is very small as demonstrated by their representation in the corporate hierarchy. For instance, in the 2011 Fortune 500 executive ranks [26], there were 12 (2.4%) female Chief Executive Officers (CEOs), which is a 20% drop from the 2009-2010 period when the number of female CEOs was 15. For all the executive positions, women accounted for 25.5% in 2011 and 16.1% of all the seats on the boards of Fortune 500 companies [17]. While these latest numbers are encouraging, the gender gap between men and women in TMTs remains vast and women only account for 7.6% of the top earnings in comparison to 92.4% for men [19]. Additionally, although women account for 51.5% of employees in Management, Professional and Related Occupations, men's median weekly earnings are $1,342 while women earn $945, which is 70% of what men earn [60]. Also, to compound the gender disparity, out of the Fortune 500 companies, 27.4% and 39.4% had no female executive officers in their boards in 2010 and 2011 respectively [17].

ORGANIZATIONAL BENEFITS OF HAVING WOMEN IN TOP MANAGEMENT POSITIONS

There is a plethora of research studies that have sought to investigate the benefits of having women in TMTs. Some of these studies have specifically explored the benefits that firms accrue from having women in TMTs such as CEOs, CFOs, and members of corporate boards [13, 15, 24]. As shown in Table 2, some of these studies have pointed out the positive impacts of having more women in these top positions [31] and have consequently called for the inclusion of more women in these top management positions [33, 50]. Various factors have been advanced to support the inclusion of more women in TMTs. For instance, according to a 2009 Catalyst report [16], firms that had three or more female board members enjoyed positive higher returns - a 16.7% return on equity while the average for the analyzed sample was 11.5%. Also, firms with a consistent minority (at least three women) on their Boards were found to be more innovative [54].

Also, the inclusion of women on corporate boards make them more heterogeneous which leads to more high quality decisions on complex tasks due to the interactions and processes associated with the majority-minority collaborations [6, 32]. For instance, in comparing firms with an all-male Board to firms with at least two women on the Boards, Carter, Simkins, &, Simpson [15] used a sample of 638 Fortune 1000 firms and found that firms with at least two women on the Boards performed better on Tobin's Q and Return on Assets. On the other hand, less diverse organizations have been characterized by high levels of cohesion due to group homogeneity which may lead to pressure to conform and thus fosters an environment that hampers innovation [41].

Innovation leads to new products, processes, and/or business models which yield higher returns upon implementation and commercialization. However, as shown in Table 2, there are also a number of researchers who have contradicted the aforementioned findings and argued that the inclusion of women in TMTs yields no significant returns to the subject firms. The measure of the returns has been conceptualized as either accountancy-based or stock-based firm performance measures [2, 28].

In spite of the aforementioned conflicting research findings, there are unexplored research avenues on the roles and effectiveness of women in TMTs [49]. However, there are significant challenges that confront re-

searchers interested in exploring issues on women in the TMTs. For example, in empirical studies, lack of enough sample size that can justifiably generate statistical significance has hampered comparative studies investigating the relationship(s) between the inclusion of women in corporate boards and firm performance.

On a casual glance, some of the studies shown in Table 2 have reasonable sample sizes, but on further review, the results reveal that the number of women in the sample sizes is considerably smaller. (For example, in the 2011 Fortune 500 executive ranks [26], there were 12 (2.4%) female CEOs).

Thus, there are very few women in these TMT positions (CEOs, COOs, Chairmen, CFOs, CIOs) that, in most cases, the sample size is too small to justify empirical comparative studies of, for instance, the performance of the firms led by female executives in relation to other firms in their industries. As such, the results from a number of the studies that have explored these dimensions are inconclusive at best. The aim of this research is to extrapolate the diversity research into the specific field of IT. This research explores the representation of women in the IT field from an academic perspective and its influence on corporate management of IT resources, which is represented by the hiring of IT leaders.

A number of researchers have explored various aspects related to gender representation in the IT field [51, 52]. Since the 1970s, the achievement of women in education has been increasing and anecdotal evidence suggests that their job opportunities should also increase. The objective of this research is to explore the graduation rates of women in the IT field and relate these numbers with those of female IT executives who have been hired by firms from 2000-2010.

Table 2: A Sub-set of Studies Investigating Women Representation in Top Management Teams

Authors	Theses	Sample space	Results
Shrader, Blackburn, & Iles [47]	Examine the effects on firm performance due to participation of women in corporate boards and TMTs.	Sample of 200 large U.S. firms.	Presence of women in TMTs has no significant relationship with firm performance and participation of women on corporate boards negatively impacts performance (ROA, ROS, ROI, ROE).
Adler [3]	Investigate the relationship between women participation in the executive suite and firm performance.	Sample of 25 Fortune 500 firms.	A positive and strong correlation between women-friendly firms and profitability (ROS, ROA and ROE).
Carter, Simkins, &, Simpson [15]	Study the impact of diversified corporate governance (Board) structure on firm value.	638 Fortune 1000 firms.	A positive relationship between Board diversity (a higher percentage of women and minorities) and firm value-Tobin's Q.
Arfken, Bellar, & Helms [7]	Explore major reasons inhibiting women participation in corporate TMTs-glass ceiling effect.	Case study of 102 publicly traded companies in the State of Tennessee.	Women still under-represented in corporate TMTs and results reveal only a modest change from 1995 to 2002.
Singh & Vinnicombe [48]	Identify the factors contributing to the limited number of women in TMTs (Boards).	Survey of women directors in the Financial Times/London Stock Exchange index of the 100 largest listed companies.	Women still lag behind in corporate TMTs participation (lack of ambition, experience, and commitment).
Helfat, Harris, & Wolfson [29]	Investigate the composition of women in TMTs in major U.S. corporations and the likelihood of these women becoming CEOs.	A comprehensive census of top executives in U.S. Fortune 1000 firms.	There are very few women in the TMTs and hence the pipeline for CEOs has less women; however, the future holds some prospects.
Hillman, Shropshire, & Cannella [31]	Investigate the factors that can predict the presence of women on corporate boards.	Panel data from 1000 U.S. firms between 1990-2003.	Women's presence on corporate boards predicted on organizational size, industry type, diversification strategy, and network effects.
Franceur, Labelle, & Sinclair-Desgagne [27]	Examine the influence on firm performance by the presence of women on corporate Boards/TMTs.	Catalyst censuses of female Directors (2001-2003) and female officers in the Financial Post (500 largest Canadian firms, 2002- 2004).	Firms with a higher proportion of women in TMTs and operating in complex environments accrue positive and significant rents.
Haslam & Ryan [28]	Investigate whether the appointments of women into corporate boards is related to the glass cliff phenomenon.	3 experimental studies based on 95 management graduates, 85 high school students, and 83 business leaders.	Women are likely to be appointed into leadership positions of risky (underperforming, crisis prone) companies.
Barsh & Cranston [12]	Develop a leadership model for female IT leaders.	5 year study that includes interviews with successful female IT executives.	Centered and successful leadership based on talent, desire to lead, tolerance for change, collaboration, risk taking, and team player.
Miller & Triana [41]	Identify the mediating relationship between Board diversity and firm performance.	Sample of Fortune 500 firms.	Board diversity and firm performance mediated by firm reputation and innovation (Board racial diversity positively related to firm reputation and innovation).
Sharma & Givens-Skeaton [46]	Investigates gender diversity within the top 100 US firms.	Top executive officers listed in the 10-k or annual reports of the top 100 firms.	Twenty firms have no female officers-overall, there is a concerning lack of gender diversity in the top 100 firms.
Torchia, Calabro, & Huse [54]	Evaluate the economic value of having female corporate directors.	A sample of 317 Norwegian firms.	A firm with at least three women in TMTs – corporate directors has a higher capacity for innovation.

We aim to answer a number of questions namely:

- What is the trend in the women graduating in IT degrees from 1971-2010?
- What are the characteristics of female IT executives hired between 2000-2010?
- What can we infer from answering the two questions above?

The rest of the paper is organized as follows. The following section presents the statistics on the IT graduates from 1971-2010 at the undergraduate, graduate, and doctoral levels with a focus on female graduates. This is followed by a section that investigates the hiring trends of women in the IT field with an emphasis on female IT executives who were hired in the period 2000-2010. The paper concludes with a discussion of the results, limitations of this research, and recommendations for future research.

THE ROLE OF WOMEN IN THE INFORMATION TECHNOLOGY FIELD

In the US labor force, the education attainment of women continues to rise. The latest data from the U.S. Department of Labor, Bureau of Labor Statistics [59] shows that in 2010, 36% of women between the ages 25-64 had acquired a graduate degree, which is a significant increase from 1970 when only 11% of women had earned a graduate degree. Additionally, of all the job positions, women accounted for 29.9% in the computer and IT management discipline. Thus, although many more women are acquiring college degrees, they are persistently underrepresented in the IT related fields.

IT programs are experiencing a widening gender gap which is impacting many firms that are under pressure to hire more women and minorities in order to obtain and maintain U.S. government contracts [35]. For example, although the workforce of the top ten companies in the Silicon Valley grew by 16 percent between 1999 and 2005, the percentage of minorities and women has been declining, and these companies employed a smaller percentage of minorities (Hispanics, African-Americans, and women) in 2005 than they did a decade ago [53]. This under-representation is daunting, given the fact that women have traditionally played important roles in the IT field. For example, women played significant roles as programmers in the development of the first electronic computer, the ENIAC [37].

As shown in Table 3, a number of researchers have sought to investigate the reasons associated with this phenomenon of under-representation [5, 55] and offered some recommendations to alleviate this problem [39, 45] by recommending strategies for attracting women and minorities in the field.

Baroudi and Igbaria [11] surveyed 348 IT employees in U.S. firms, and after controlling for age, education, experience, and job tenure, reported that women tend to be employed at lower levels in the organizations, earn less than men, and are more likely to switch jobs than men.

On the other hand, Von Hellens, Neilsen, and Beekhuyzen [63] interviewed a group of 32 female IT professionals and found that many women have a poor understanding of IT education, IT work, and they perceive IT to be a difficult and male dominated field. However, they add that mentoring and constant interaction between female IT students and IT professionals may help demystify the mystery of IT and attract more women into the field.

Finally, Dawson and Kauffman [22] analyzed data on the length of the job tenure of CIOs and reported that, in general, CIOs have short tenures. Furthermore, female CIOs have shorter tenures than their male counterparts. Table 3, gives a summary of some studies that have addressed issues related to women in the IT field.

The studies shown in Table 3 indicate that under representation of women is an inherent phenomenon in the STEM (Science, Technology, Engineering, and Mathematics) disciplines. This study seeks to find out if there are any correlations between the low number of women in the IT discipline and the representation of the hiring trends of female IT executives.

Table 3: A Summary of Some Studies That Have Addressed Issues Related to Women in the IT Field

Authors	Theses	Sample space	Results
Baroudi & Igbaria [11]	Examine the effects of gender-based human capital (age, education, organization, job tenure, and experience in IT field) on the career success of IT employees.	Survey of 348 IT employees in various U.S. firms.	After controlling for differences in human capital, results reveal that in the IT field women are employed at lower levels, earn less, and have a higher likelihood to leave the organization than men.
Ahuja [5]	Provide a synopsis of current literature and future research agenda for studying different aspects of women in the IT workforce.	Extensive literature review based on synthesis of past studies.	A research agenda is identified to study how social and structural factors impact women turnover in IT.
Von Hellens, Neilsen, & Beekhuyzen [63]	Investigate how women in the IT field perceive and talk about their work.	Interviews with 32 female IT professionals.	Many female IT personnel have a poor understanding of IT education, IT work, and perceive IT to be a male dominated field. However, mentoring and interactions between students and IT professionals can minimize this bias.
Adya & Kaiser [4]	Develop a model for women's career choices by evaluating the early determinants of why women choose careers in IT.	Review of literature from education, psychology, computer science, IT, and business disciplines.	Father figures and early access to IT plays a significant role in a girl's choice for IT career while influence of teachers and counselors is minimal.
Adams et al. [1]	Explore the relationship between gender and IT technical skills and investigate their influence on gender identity conceptions.	Semi-structured interviews with 11 women in the IT industry and a web-based questionnaire with 37 respondents.	In addition to problematic and frustrating experiences, IT field (which is male dominated) influences women behaviors and perceptions of self.
Armstrong et al. [8]	Identify the factors that hinder advancements and contribute to voluntary turnover in the IT field for women.	6 focus groups comprising 39 IT professionals in a Fortune 500 firm.	In the IT field, women's advancement and voluntary turnover is influenced by family responsibilities, work stress, work schedule flexibility, and job quality.
McKinney et al. [40]	Examine the influence of gender differences on career choices in IT, socialization, types of experiences, types of attitudes, and desirability of the IT profession.	Survey of 815 male and female IT professionals working in multiple organizations across the U.S.	Women choice of career in IT field is based on opportunity for job autonomy, advancement, task variety, professional prestige, income, using state-of-the-art equipment, gratifying work, and other job-related factors (flexible hours, job security, and ease of entry).
Rosenbloom et al. [45]	Evaluate and understand the factors that drive women to choose careers in IT.	Survey of professionals in IT and other fields from major U.S. firms.	There are systemic differences in how men and women make their choices and this may explain the gender gap in the IT field.
Kvasny, Trauth, & Morgan [36]	Investigate the effects of social exclusion (gender) on IT workforce diversity.	Interviews with female African-American IT professionals and students.	Race and class interact with gender to shape women access, experiences, and perception of IT.
Nezlek & DeHondt [43]	Examine the gender wage gap in the IT field while paying close attention to the Internet 'bubble' period.	March Annual Demographic Supplements (ADS) of the Current Population Survey for the years from 1991 to 2008.	Gender earnings gap in the IT field still persists but might have shrunk after the Internet 'bubble' of the 1990s but unsure if the 21st century 'bust' is erasing the gains.
Dawson & Kauffman [22]	Investigate the job duration tenure of CIOs and other top executives.	Survey of 1,594 executives from private and public corporations between 1994-2009.	Only a quarter of CIOs are members of the TMTs and CIOs in general have shorter tenures. Moreover, female CIOs are very few and have shorter tenures than male CIOs.

Women Earning Undergraduate Degrees in the IT Field

In the first part of this study, the authors investigate the academic achievement of women in the IT field using data from the National Center for Education Statistics [57] from 1971 to 2009. Although IT emerged in the 1960's as a distinct academic discipline that combined concepts from computer science, management, organizational theory, operations research, and accounting [21], the first official graduate IT curriculum was not available until 1972 [9] while the first curriculum for an undergraduate IT degree was not published until 1973 [20].

Figure 1 shows that in 1971, women accounted for 13.6% of all undergraduate IT degrees. These numbers continued to grow and the IT field experienced the peak graduation rates of approximately 36% for women between 1983 and 1986. Figure 1 also shows that between 1971 and 2009, there were two time periods, 1985-1986 and the 2003-2004, that are associated with the highest percentage of graduation rates for all graduates, including women.

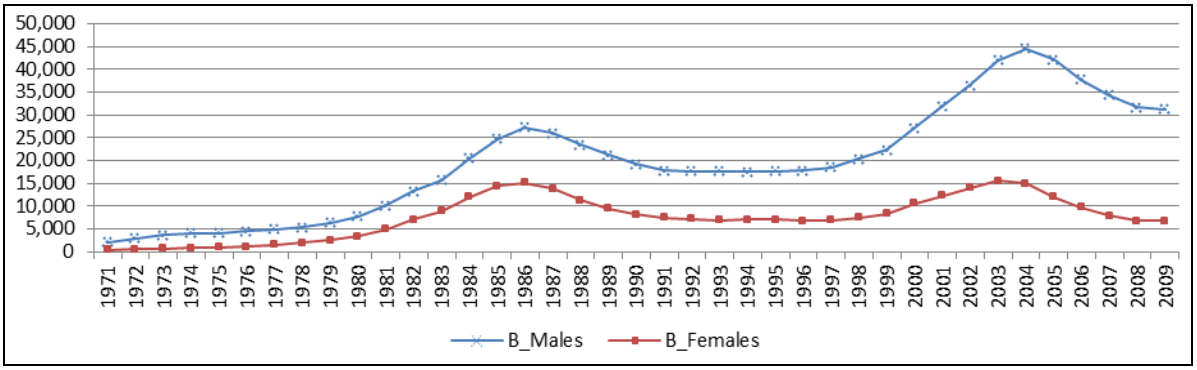

Figure 1: Trend of the Number of Undergraduate IT Degrees Conferred To Men and Women in the U.S. between 1971 and 2009

The first peak occurred during the 1985-1986 period which was preceded by major changes in the IT industry that included the introduction of the PC by IBM in 1981 that revolutionized computing. Before then, most of the computing was based on the mainframe architecture and limited individualized access to the IT resources. The result of the introduction of the PC and the proliferation of networking capabilities brought about by the Internet led to a sharp rise in the demand for IT skilled personnel and increased enrollments (1980-1981) as indicated by the higher graduation rates 4-5 years later (1985-1986). Thus, there are very few women in these TMT positions (CEOs, COOs, Chairmen, CFOs, CIOs) that, in most cases, the sample size is too small to justify empirical comparative studies of, for instance, the performance of the firms led by female executives in relation to other firms in their industries. As such, the results from a number of the studies that have explored these dimensions are inconclusive at best.

Table 4: Undergraduate IT Degrees Conferred To Men and Women in the U.S. between 1971 and 2009

Year	1970-73	1973-76	1976-79	1979-82	1982-85	1985-88	1988-91	1991-94	1994-97	1997-00	2000-03	2003-06	2006-09
Men	86.00	81.63	74.11	67.49	63.28	65.71	69.96	71.51	72.28	72.69	72.59	77.40	81.99
Women	14.00	18.37	25.89	32.51	36.72	34.29	30.04	28.49	27.72	27.31	27.41	22.60	18.01

The second peak period, 2003-04, is associated with the dot com boom and the Y2K phenomenon which drove the demand for IT personnel skilled at, for instance, dealing with the millennium bug. However, this growth was not sustained and the numbers have been declining since. A number of factors have been associated with this decline such as the dot com bubble bust, IT outsourcing and off-shoring, and a general decline in the U.S. economy which have made potential students shy away from choosing IT as an academic major [4, 34]. The latest data for the period 2008-2009 shows that 6,779 women graduated with IT degrees signifying a 56% decline from the

2002-2003 peak. The percentage graduation rates for women who graduated with IT degrees during the 2008-2009 is 17.8% which is close to the values observed in early 1980's or mid 1990's and considerably less than the average rate of 36% for the 1983-86 period. These latest figures depict a widening and alarming gender gap whereby for every six IT degrees awarded to males, there is only one female receiving an IT degree (6:1) at the undergraduate level.

Women Earning Graduate Degrees in the IT Field

Similar to the undergraduate IT Degrees where the number of men exceeds the number of women, Figure 2 depicts an identical trend for graduate degrees. Although there is an upward trend from 1971, both graphs peaked in 2004, declined slightly up to 2007 and are currently showing an upward trend. Unlike the IT undergraduate degrees, after 1986, when the number of female IT undergraduate degrees declined, the trend for the IT graduate degrees shows an upward trend implying that more and more women continued to pursue graduate degrees in IT. This may be due to the fact that many schools started offering graduate courses in IT and hence expanded the pool of IT graduates. However, after the 2004 period, both the numbers for undergraduate and graduate IT graduates showed a downward trend, although the figure for the graduate degree displays a slight upward trend after 2007. Further analysis shows that, unlike the undergraduate IT level where women are poorly represented (1:6), at the graduate level women have a higher representation of 1 for every 3 IT graduate degrees earned by men (1:3).

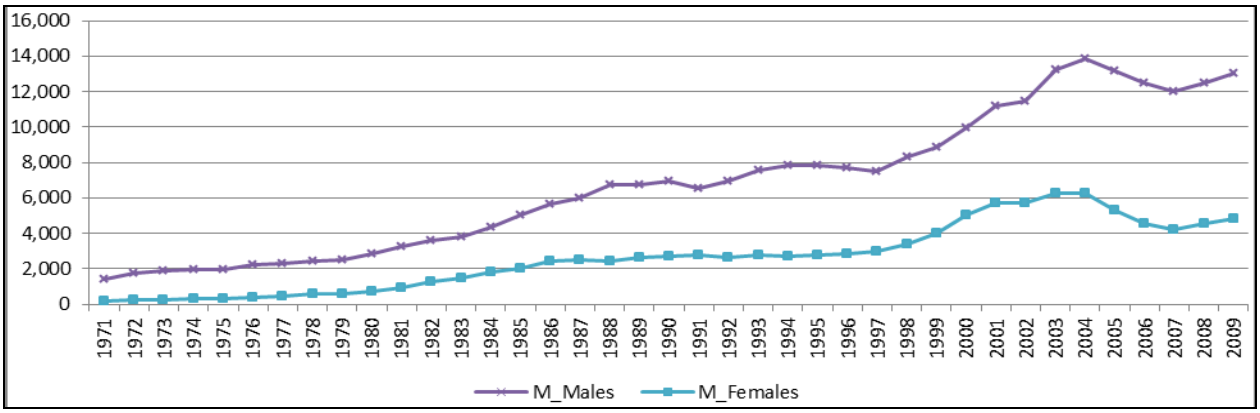

Figure 2: Trend for the Graduate Degrees in IT that Were Awarded to Men and Women Between 1971-2009

Table 5: Graduate Degrees in IT that Were Awarded to Men and Women Between 1971-2009

Year	1970-73	1973-76	1976-79	1979-82	1982-85	1985-88	1988-91	1991-94	1994-97	1997-00	2000-03	2003-06	2006-09
Men	89.21	85.98	81.95	76.50	71.24	71.27	71.43	73.15	72.77	68.82	66.95	71.10	73.34
Women	10.79	14.02	18.05	23.50	28.76	28.73	28.57	26.85	27.23	31.18	33.05	28.90	26.66

Women Earning Postgraduate Degrees in the IT Field

As shown in Figure 3, there were only 3 (2.3%) women who earned an IT doctoral degree during the 1970-1971 periods. However, these figures have been growing steadily and peaked in 2001-2002 where of all the IT doctoral degrees that were awarded, 22.7% (171) were awarded to women. Although this number declined slightly in the subsequent years, it has stayed above the 20% mark. These numbers are encouraging and signify a significant growth (> 20%) compared to the numbers in the 1970's. However, they also illustrate the underrepresentation of women – only 1 female, in comparison to every 5 males, earned an IT doctoral degree (1:5).

Table 6: Doctoral Degrees Awarded to Men and Women from 1971-2009

Year	1970-73	1973-76	1976-79	1979-82	1982-85	1985-88	1988-91	1991-94	1994-97	1997-00	2000-03	2003-06	2006-09
Men	94.27	93.15	90.28	90.15	88.86	87.27	85.38	85.61	83.83	82.67	79.65	79.06	78.32
Women	5.73	6.85	9.72	9.85	11.14	12.73	14.62	14.39	16.17	17.33	20.35	20.94	21.68

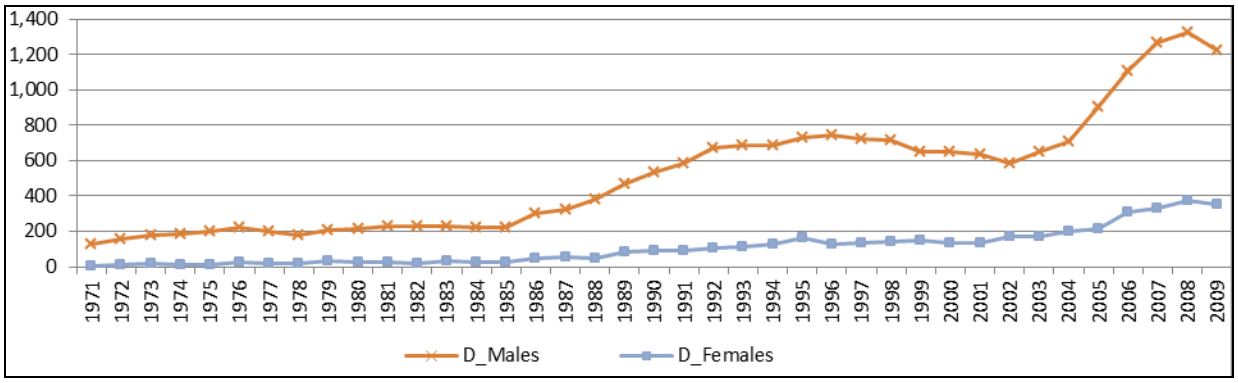

Figure 3: IT Doctoral Degrees Awarded to Men and Women from 1971-2009

Table 7 shows the summary for the academic achievement of women in comparison to men.

Table 7: Comparison of Academic Achievement of Women and men

	Undergraduate	Graduate	Doctoral
Women	1	1	1
Men	6	3	5

A testament to the increasing number of IT doctoral degrees is the fact that the number of female IT faculty has been steadily increasing. For instance, the latest data from Computing Research Association Archives [62] shows that the percentage of newly hired female Computer Science and Computer Engineering faculty was 12% in 2000 in comparison to 24% in 2008. Furthermore, the numbers for Assistant, Associate, and Full Professors have also been increasing. These values were 9%, 9%, and 3% in 1991 and by 2008; they were 20%, 13%, and 11% of the hired faculty respectively. The rise in these values may be a contributing factor to the rise in female graduation rates. The female faculty may be perceived as role models and mentors who motivate female students.

From Academia to Executive Management - Women in IT

Upon graduation, IT graduates seek jobs either in academia, private, or public sectors and hold various positions [34, 42]. Some of these positions are entry level while others are middle or top level management positions. At the top level, female managers make decisions that have potential to impact various dimensions of IT either at the societal and/or academic levels. The following section explores the hiring trend in the industry and specifically investigates the characteristics of female IT executives who were hired between 2000-2010 by firms in the U.S. With the exception of Helfat, Harris, and Wolfson [29], the literature review reveals that very few studies have investigated issues related to other members of TMTs, apart from CEOs, and members of the Board. The goal of this research is to narrow this gap and to investigate issues of IT leadership by analyzing the data on female IT leaders.

The study sample for the second part of this research was the female IT executives that were hired between 2000-2010 either to replace an IT executive who had retired, left the firm, got fired, resigned, or as a result of the creation of a new top IT executive position. The focus was to collect data on the hiring trend, educational background, age, years of experience, tenure, and reporting relationship of these female IT executives. Since firms

usually put out a press release when they hire a top IT executive, the researchers used the event of the hire as a unit of analysis and collected data from Lexis-Nexis Academic wire index (http://www.lexisnexis.com/us/ln-academic/home/). The researchers gathered additional data from the corresponding firms' websites, Google financials, Reuters, and Hoovers. This secondary search process provided additional validation, by applying the data triangulation technique, to the collected data.

After a pilot study, the authors developed and agreed on a classification rubric and completed the data extraction procedure. The authors reviewed each announcement separately and compared the results later. Where disagreements arose, the authors reviewed the specific announcements together and came to a consensus. The data was eventually merged into one document to facilitate further analysis.

Between 2000 and 2010, there were 104 announcements (press releases) that were made by the firms following the hiring of a senior female IT executive. However, 12 announcements were eliminated because the hired executive was not the highest IT executive in the firm (for example, VP of IT who reports to a CTO or to a CIO), giving a sample size of 92 unique firm announcements showing the hire of a highest female IT executive. Firms used different titles to designate the various IT executives. The maximum number of female IT executives had the title CIO which accounted for 78.26% of total positions, only 10 (10.87%) had the title CTO, while the rest had other designations like Director of IT, Senior VP of IT, and others.

The Popular Educational Disciplines/Fields of Female IT Executives

The researchers collected data about the education backgrounds of the female IT executives to analyze their academic credentials. They were able to obtain data on undergraduate degrees for 62 (71%) of the 92 IT executives. The undergraduate degrees were classified into 8 main categories namely Bachelor of Arts (BA), Bachelor of Science (BS), Business Administration, Accounting, Mathematics, Engineering, Computer Science, and IT. A majority of the female IT executives had an undergraduate degree in Business Administration, followed by Mathematics and Engineering. However, further analysis revealed that among the CIOs, the most dominant major was Business Administration followed by Mathematics while for the CTOs, the most dominant major was Engineering.

Conversely, the researchers were able to obtain 33 (36%) data items out of the 92 IT executives that had specific information on the graduate degrees. The graduate degrees were classified into four major categories namely Engineering, Mathematics, Master of Business Administration (MBA), and Masters in IT. Overall, the most dominant graduate major was MBA among all of the IT executives. Additional analysis showed that MBA remained the most popular major with CIOs while graduate degrees in Engineering and IT were the most popular among CTOs.

The researchers analyzed the ages of the women who were hired to fill the positions of IT executives. Although not all executives had their ages stated in the announcements, for a few IT executives, this information was obtained from the respective firm's websites, Google financial, Reuters, and Hoovers. They obtained age data on 57 of the 92 (62%) IT executives. The data did not reveal any IT executive who was younger than 30 (the youngest was 32) and there were only two IT executives who were older than 55 (the oldest was 77) years. The two most dominant age categories for all the different IT executives designations were 41-45 and 46-50. Additional analysis of the 2010 Fortune 100 firms showed that the average age of the IT executives was 52 years and was comparable to the CFOs' at 51 years while on average, CEOs' were a little bit older at 57 years.

A majority of the announcements explicitly specified the years of experience of the IT executives. The researchers obtained data for 59 (64%) of the 92 female IT executives. The least experienced executive had 10 years of experience while most experienced had 51. Additional analysis showed that CIOs tend to have less experience (16-20 years) while CTOs tend to have more experience (21-25) before ascending to the top IT leadership positions. This may be due to the fact that, as shown by our earlier analysis of educational backgrounds, CIOs, with their MBAs, have a formal business education while the CTOs, with graduate degrees in Engineering, may be acquiring business skills through experience.

A comparative analysis for the undergraduate and graduate majors of these female IT executives and their respective years of experience yielded inconclusive results due to the small sample size. However, on analyzing the reporting relationship of these IT executives, the data revealed that most of these IT executives are reporting to the CEOs in lieu of CFOs or other top management leaders. This may be interpreted as an indicator of the importance placed on their roles by the organizations. Prior research has shown that power and importance in the organizational hierarchy can be inferred from the reporting relationship [10].

RESULTS AND DISCUSSION

The results show that women are under-represented at the undergraduate, graduate, and post graduate levels in the IT field. Although, it is gratifying to note that the ratio of women to men who earn graduate (1:3) and post graduate degrees (1:5) is higher than that at the undergraduate (1:6) level, the under-representation of women earning undergraduate degrees is greatly pronounced and the future trend is not very encouraging. The findings corroborate and are consistent with studies that report that women are under-represented in the IT field and that their numbers are declining further [14, 52]. As such, there is still work to be done in response to the call by Woszczynski & Shade [65] to devote more resources towards attracting and retaining more women in the IT field.

Furthermore, the data indicates that there are very few women who ascend to the top IT leadership positions. However, it is encouraging to note that, the IT field seems to be doing better when the numbers of female IT executives are compared to the number of female CFOs and CEOs who are employed by the Fortune 100 firms. There is a higher proportion of female IT executives when compared with other corresponding positions at the executive level. For instance, of the 92 firms in the 2010 Fortune 100 list from which the researchers were able to obtain information about their IT leaders, 16 (17.4%) of the firms had a female as the highest ranked IT executive. This figure was significantly above the 5.4% for the female CFOs and 6.4% for the female CEOs in the same firms. However, most of the female IT executives in this study earned degrees in Business Administration either at the undergraduate or graduate level and their educational credentials may not be a clear reflection of the progress being made in the IT field. On the other hand, CFOs either have degrees in accounting (CPAs) or finance – disciplines that are more closely and clearly related to their job functions.

The data also revealed that more female IT executives have the title CIO than CTO. Given the fact that CTOs have to be more technology oriented, the relatively smaller number of female CTOs might be explained by the propensity of women to pursue IS rather than the more technically oriented STEM majors. This is corroborated by our earlier results on graduation rates that indicate more women graduated with IS than a STEM major.

Women in TMTs have been shown to create value for their firms when compared to those firms with few or no women in TMTs. Also women have been shown to score higher on a number of traits in comparison with men. For instance, the results of a study by Folkman [25], which evaluated the effectiveness of 7,280 TMTs (64% males), women consistently scored higher than men in such traits as behaviors, honesty, integrity, problem solving, results driven, developing relationships, collaboration and team work, strong communication skills, and champions of change. We propose that it is this value creating proposition that should influence and convince firms to hire more female IT executives.

Additionally, since there are fewer women in the IT field, we recommend that firms hire more female IT executives as a symbol of gender representation in their organization. We argue that these executive level positions are more visible in comparison to middle or lower level positions (database administrators, programmers) and may encourage more women to major in IT and STEM related disciplines.

On the issue of gender representation in the TMTs, there seems to be a glass ceiling [23], although this effect is less salient for the female IT executives when compared to the female CFOs and CEOs. Additionally, there are more IT executives with the designation CIOs compared to the CTOs. Hence, schools should encourage more female students to enroll in both IT and other technically oriented programs so as to increase the representation of female IT executives. Schools should also make efforts to create forums through which these female IT executives can effectively interact with the female IT students. This way, the IT executives can help in demystifying both the technical and business management aspects of IT, in addition to serving as mentors and role models – processes that research has shown have the potential of attracting many more women into the IT discipline. Moreover, having women on board signifies career prospects for potential female recruits.

CONCLUSION

From our analysis of the extant literature in the IT field, this study is the first to concurrently report on the female representation in the classroom to top levels of management. The under-representation of women in corporate America, which is usually, referred to as glass ceiling, diminishes their bargaining power usually yielding lower wages for equal positions, impacts women access to mentors, as well as role models. In the IT field, the number of women working in the Computer and Mathematical occupations - this is the closest occupation categorization that is closely related to the IT as per 2010 BLS Standard Occupational Classification codes (15-1111 to 15-1199) - is 25.9% and 25.1% for the 2010 and 2011 respectively. Although these figures are relatively higher when compared to the current graduation rates, they are more likely

attributed to the higher graduation rates witnessed in the early 2000s.

The occurrence of lower graduation rates which eventually leads to lower labor force participation by women in the IT field can be referred to as a self-propagating phenomenon. As fewer and fewer women work in IT fields, potential female employees cannot identify role models and mentors and hence, fewer and fewer women will tend to pursue IT degrees leading to a vicious cycle of under-representation. The researchers posit that the higher representation of women in the top IT positions will inspire more women to pursue careers in IT and boost their labor market participation in the IT field. One of the aims of this research is to spur more debate and research concerning the roles and representations of women both in the IT academia and the corporate world.

LIMITATIONS AND FUTURE STUDIES

The data on the hiring of female IT executives covers the period 2000-2010 and future studies should extrapolate to cover a more current and wider study period. Also, more studies should investigate the characteristics of those firms that have female IT executives to investigate, for instance, if they have more female IT workers and how these firms perform, on a variety of parameters like financial, innovation and others, when compared to their industry counterparts that have less female IT executives.

REFERENCES

[1] Adam, A., Griffiths, M., Keogh, C., Moore, K., Richardson, H., and Tattersall, A., "Being an 'IT' in IT: Gendered Identities in IT Work," *European Journal of Information Systems*, Volume 15, Number 4, 2006, pp. 368-378.

[2] Adams, S. M., Gupta, A., and Leeth, J., "Are Female Executives Over-represented in Precarious Leadership Positions?" *British Journal of Management*, Volume 16, Number 2, 2008, pp. 81–90.

[3] Adler, R. D., "Women in the Executive Suite Correlate to High Profits," *Glass Ceiling Research Center*, http://glass-ceiling.com/InTheNewsFolder/HBRArticlePrintablePage.html, 2001.

[4] Adya, M. and Kaiser, K. M., "Early Determinants of Women in the IT Workforce: A Model of Girls' Career Choices," *Information Technology and People*, Volume 18, Number 3, pp. 230–259.

[5] Ahuja, M. K., "Women in the Information Technology Profession: A Literature Review, Synthesis, and Research Agenda," *European Journal of Information Systems*, Volume 11, Number 1, 2002, pp. 20-34.

[6] Amason, A. C., "Distinguishing the Effects of Functional and Dysfunctional Conflict on Strategic Women Directors on Corporate Boards Decision Making: Resolving a Paradox for Top Management Teams," *Academy of Management Journal*, Volume 39, Number 1, 1996, pp. 123–148.

[7] Arfken, D. E., Bellar, S. L., and Helms, M. M., "The Ultimate Glass Ceiling Revisited: The Presence of Women on Corporate Boards," *Journal of Business Ethics*, Volume 50, 2004, pp. 177–186.

[8] Armstrong, D. J., Riemenschneider, C. K., Reid M., and Allen M., "Advancement, Voluntary Turnover and Women in IT: A Cognitive Study of Work-Family Conflict," *Information and Management*, Volume 44, Number 2, 2007, pp. 142–153.

[9] Ashenhurst, R. L., "Curriculum Recommendations for Graduate Professional Programs in Information Systems," *Communications of the ACM*, Volume 15, Number 5, 1972, pp. 364-398.

[10] Banker, R., Hu, N., Pavlou, P. A., and Luftman, J., "CIO Reporting Structure, Strategic Positioning, and Stock Performance," *MIS Quarterly*, Volume 35, Number 2, 2011, pp. 487-504.

[11] Baroudi, J. and Igbaria, M., "An Examination of Gender Effects on Career Success of Information Systems Employees," *Journal of Management Information Systems*, Volume 11, Number 3, 1995, pp. 181-201.

[12] Barsh, J. and Cranston, S., *How Remarkable Women Lead: The Breakthrough Model for Work and Life*, New York: McKinsey and Company, 2009.

[13] Bilimoria, D., and Piderit, S. K., "Board Committee Membership: Effects of Sex-based Bias," *Academy of Management Journal*, Volume 37, 1994, pp. 1453–1477.

[14] Bowers, T., "Number of Women Entering IT Field Drops," *TechRepublic*, http://www.techrepublic.com/blog/career/number-of-women-entering-it-field-drops/368, 2008.

[15] Carter, D. A., Simkins, B. J., and Simpson, W. G., "Corporate Governance, Board Diversity, and Firm Value," *The Financial Review*, Volume 38, 2003, pp. 33–53.

[16] Catalyst, "2009 Catalyst Census: Fortune 500 Women Board Directors," *Catalyst*, New York, NY, 2009.

[17] Catalyst, "Statistical Overview of Women in the Workplace," *Catalyst*, http://www.catalyst.org/file/672/qt_statistical_overview_of_women_in_the_workplace.pdf, 2012.

[18] Catalyst, "The 2010 Catalyst Census: Fortune 500 Women Executive Officers and Top Earners," *Catalyst*, http://www.catalyst.org/publication/459/2010-catalyst-census-fortune-500-women-executive-officers-and-top-earners, 2010a.

[19] Catalyst, "U.S. Women in Business," *Catalyst*, New York, NY, 2010b.

[20] Couger, J. D., "Curriculum Recommendations for Undergraduate Programs in Information Systems," *Communications of the ACM*, Volume 16, Number 12, 1973, pp. 727-749.

[21] Davis, G. B. and Olson, M. H., *Management Information Systems: Conceptual Foundation, Structure, and Development*, McGraw-Hill, New York, NY, 1985.

[22] Dawson, G. and Kauffman, R., "CIO Survival and the Composition of the Top Management Team," *Proceedings of 2011 International Conference on Information Systems*, December 7, 2011.

[23] Diehl, A. B., "Making Meaning of Barriers and Adversity: Experiences of Women Leaders in Higher Education," *Advancing Women in Leadership*, Volume 34, 2014, pp. 54-63.

[24] Erhardt, N. L., Werbel, J. D., and Shrader, C. B., "Board of Director Diversity and Firm Financial Performance," *Corporate Governance: An International Review*, Volume 11, Number 2, 2003, pp. 102–111.

[25] Folkman, Z., "A Study in Leadership: Women Do it Better Than Men," http://www.zfco.com/media/articles/ZFCo.WP.WomenBetterThanMen.033012.pdf, 2012, pp. 1-4.

[26] Fortune, http://money.cnn.com/magazines/fortune/fortune500/2011/womenceos/ , 2011.

[27] Franceur, C., Labelle, R., and Sinclair-Desgagne, "Gender Diversity in Corporate Governance and Top Management," *Journal of Business Ethics*, Volume 81, 2008, pp. 83–95.

[28] Haslam, S. A. and Ryan, M. K., "The Road to the Glass Cliff: Differences in the Perceived Suitability of Men and Women for Leadership Positions in Succeeding and Failing Organizations," *Leadership Quarterly*, Volume 19, Number 5, 2008, pp. 530–46.

[29] Helfat, C. E., Harris, D. and Wolfson, P. J., "The Pipeline to the Top: Women and Men in the Top Executive Ranks of U.S. Corporations," *Academy of Management Perspectives*, Volume 20, 2006, pp. 42–64.

[30] Herring, C., "Does Diversity Pay? Race, Gender, and the Business Case for Diversity," *American Sociological Review*, Volume 74, Number 2, 2009, pp. 208-224.

[31] Hillman, A. J., Shropshire, C., and Cannella, A. A., Jr., "Organizational Predictors of Women on Corporate Boards," *Academy of Management Journal*, Volume 50, Number 4, 2007, pp. 941–952.

[32] Hoffman, L. R., "Homogeneity of Member Personality and its Effect on Group Problem Solving," *Journal of Abnormal and Social Psychology*, Volume 58, Number 1, 1959, pp. 27–32.

[33] Huse, M., "Accountability and Creating Accountability: A Framework for Exploring Behavioral Perspectives of Corporate Governance," *British Journal of Management*, Volume 16, Number 1, 2005, pp. 65–79.

[34] Karanja, E. and Zaveri, J., "IT Leaders: Who are They and Where Do They Come From?" *Journal of Information Systems Education*, Volume 23, Number 2, 2012, pp. 143-163.

[35] Koch, H., Van Slyke, C., Watson, R., Wells, J., and Wilson, R., "Best Practices for Increasing IS Enrollment: A Program Perspective," *Communication of the Association for Information Systems*, Volume 26, Number 22, 2010, pp. 477-492.

[36] Kvasny, L., Trauth, E. M., and Morgan, A. J., "Power Relations in IT Education and Work: The Intersectionality of Gender, Race, and Class," *Journal of Information, Communication and Ethics in Society*, Volume 7, Number 2, 2009, pp. 96 –118.

[37] Light, J. S., "When Computers Were Women," *Technology and Culture*, Volume 40, 1999, pp. 455-483.

[38] Madden, M. and Zickuhr, "65% of Online Adults Use Social Networking Sites - Women Maintain their Foothold on SNS Use and Older Americans are Still Coming Aboard," *Pew Internet Research*, Aug 26, 2012, pp. 1-14.

[39] Martincic, C. J., and Bhatnagar, N. (2012), "Will Computer Engineer Barbie Impact Young Women's Career Choices?" *Information Systems Education Journal*, Volume 10, Number 6, pp. 4-14

[40] McKinney, V.R., Wilson, D. O., Brooks, N., O'Leary-Kelly, A., and Hardgrave, B., "Women and Men in the IT Profession," *Communications of the ACM*, Volume 51, Number 2, 2008, pp. 81-84.

[41] Miller, T. and Triana, M. C., "Demographic Diversity in the Boardroom: Mediators of the Board Diversity–Firm Performance Relationship." *Journal of Management Studies*, Volume 46, Number 5, 2009, pp. 755–786.

[42] Morris, G., Fustos, J., and Haga, W., "Preparing for a Career as a Network Engineer," *Information Systems Education Journal*, Volume 10, Number 1, 2012, pp. 13-20.

[43] Nezlek, G. and DeHondt, G., "An Empirical Investigation of Gender Wage Differences in Information Systems Occupations: 1991-2008," *System Sciences (HICSS), 2010 43rd Hawaii International Conference on Computer Science*, 2010, pp. 1-10.

[44] Parks Associates Research, "Women Dominate Digital Media Usage in the Connected Homes," http://www.parksassociates.com/blog/article/parks-pr2012-cdp-women, 2012.

[45] Rosenbloom, J. L., Ash, R. A, Dupont, B., and Coder, L., "Why are There so Few Women in Information Technology? Assessing the Role of Personality in Career Choices," *Journal of Economic Psychology*, Volume 29, Number 4, 2008, pp. 543-554.

[46] Sharma, R., and Givens-Skeaton S., "Ranking the Top 100 Firms According to Gender Diversity," *Advancing Women in Leadership Journal*, Volume 30, Number 3, 2009.

[47] Shrader, C. B., Blackburn, V. B., and Iles, P., "Women in Management and Firm Financial Performance: An Exploratory Study," *Journal of Managerial Issues*, Volume 9, Number 3, 1997, pp. 355–372.

[48] Singh, V., and Vinnicombe, S., "Why so Few Women Directors in Top UK Boardrooms? Evidence and Theoretical Explanations," *Corporate Governance: An International Review*, Volume 12, 2004, pp. 479–488.

[49] Singh, V., Sealy, R., and Terjesen, S., "Women Directors on Corporate Boards: A Review and Research Agenda," *Corporate Governance. An International Review*, Volume 17, Number 3, 2009, pp. 320–337.

[50] Singh, V., Vinnicombe, S., and Terjesen, V., "Women Advancing onto the Corporate Board," in D. Bilimoria and K. S. Piderit (eds.), *Handbook on Women in Business and Management*, Edward Elgar, Cheltenham, 2006, pp. 304–329.

[51] Soe, L., Guthrie, R., Yakura, E., and Hwang, D., "Designing an Introductory CIS Course to Attract and Retain Female (and Male) Students," *Information Systems Education Journal*, Volume 10, Number 4, 2012, pp. 31-40.

[52] Stross, R., "What has Driven Women out of Computer Science?" *The New York Times*, http://tech.mit.edu/V128/N56/women.html, 2008.

[53] Swift, M., "Blacks, Latinos and Women Lose Ground at Silicon Valley Tech Companies," http://www.mercurynews.com/top-stories/ci_14383730?nclick_check=1, 2010.

[54] Torchia, M., Calabro, A., and Huse, M., "Women Directors on Corporate Boards: From Tokenism to Critical Mass," *Journal of Business Ethics*, Volume 10, Number 2, 2011, pp. 299–317.

[55] Trauth, E. M., Quesenberry, J. L. and Huang, H., "Retaining Women in the U.S. IT Workforce: Theorizing the Influence of Organizational Factors," *European Journal of Information Systems*, Volume 18, 2009, pp. 476-497.

[56] U.S. Census Bureau, "Census Report," http://2010.census.gov/2010census/, 2010.

[57] U.S. Department of Education, "Earned Degrees Conferred, 1992-2007," *National Center for Education Statistics*, http://nces.ed.gov/programs/digest/d08/tables/dt08_300.asp on 09/25/2014, 2011.

[58] U.S. Department of Labor, Bureau of Labor Statistics, "Employment and Earnings: Annual Averages," http://www.bls.gov/opub/ee/empearn201101.pdf, 2011a.

[59] U.S. Department of Labor, Bureau of Labor Statistics, "Projections Overview," *Occupational Outlook Handbook*, 2012-13 Edition, http://www.bls.gov/ooh/about/projections-overview.htm, 2012.

[60] U.S. Department of Labor, Bureau of Labor Statistics, "Usual Weekly Earnings of Wage and Salary Workers: Second Quarter 2012," http://www.bls.gov/news.release/pdf/wkyeng.pdf, 2012.

[61] U.S. Department of Labor, Bureau of Labor Statistics, "Women in the Labor Force: A Databook," http://www.bls.gov/cps/wlf-databook2011.htm, 2011b.

[62] Vegso, J., "CRA Taulbee Trends: Female Students and Faculty," http://archive.cra.org/info/taulbee/women.html, 2012.

[63] Von Hellens L., Neilsen S. H, and Beekhuyzen J., "An Exploration of Dualisms in Female Perceptions of Work," *Journal of Information Technology Education*, Volume 3, 2004, pp. 103–116.

[64] Wentling R. M. and Palma-Rivas N., "Current Status of Diversity Initiatives in Selected Multinational Corporations," *Human Resource Development Quarterly*, Volume 11, Number 1, 2000, pp. 35-60.

[65] Woszczynski, A. B. and Shade, S., "A Call to IS Educators to Respond to the Voices of Women in Information Security," *Journal of Information Systems Education*, Volume 21, Number 2, 2010, pp. 223-231.

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