

## **Geographic Information Systems (GIS) Modeling: Women's Leadership Visualization Study**

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### **Abstract**

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*The study applied Geographic Information Systems (GIS) modeling to the variables which have been identified in the research as barriers to women's advancement at the highest levels of corporate leadership. The data show women exit high level leadership roles at greater rates than their male counterparts and fail to advance on par with male counterparts (Carter & Silva, 2010; Catalyst, 2011; U.S. Census Bureau, 2009). Labor statistics show women represent 57% of the overall workforce and approximately 46% of management, professional, and related occupations in the United States but only 13% of Fortune 500 executive officers, 7.5% of top earners, and 3.6% of CEOs. This study utilized GIS modeling to analyze corporate women's outcomes by company, state and city related to work-life-balance and diversity initiatives, percentage of women executives, highest paid women's salaries and the gender pay gap. The maps resulting provide visual representation of correlations between variables identified in the literature as women's advancement barriers layered with women's actual representation and advancement outcomes. Data was collected utilizing both Fortune and Forbes "best of the best" rankings which included 58 questions surveying 128,000 women and 70,000 minorities at 630 companies. Initial mapping showed highly clustered success data in terms of women's workforce success with the lowest pay gaps and highest mean salaries clustered in few geographic areas (mainly northeast and southwest) with New York and California as top state outliers. GIS Mapping showed few cities nationally representing strong advancement opportunities for women. Pay and work-life-balance were not shown to be correlated.*

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**Keywords:** GIS, gender pay gap, work-life-balance, and women's leadership

### **Introduction**

Although census data shows women's share of the United States labor force to be just under 50%, which is on par with male participation, the numbers plummet at the highest levels with women representing only 14% of executive positions in Fortune 500 companies. Likewise, a clear gender pay gap remains particularly at the highest levels with women representing less than 7% of top earners in the United States. The drop off of women at the highest levels of management has serious economic consequences for the organization and the women themselves. Reducing the gap in advancement of women is shown to be positively correlated with corporate outcomes. Adler's (2009) study found that Fortune 500 companies with the best records of promoting women outperform their counterparts anywhere from 50 to 100%; whereas companies that have poorer records lag behind the Fortune 500 companies with the most women in leadership roles in terms of both higher financial returns and overall earnings.

Understanding women's workforce inequities geographically, at the state and city level will allow for advocacy initiatives and resource allocation in the areas with the greatest variance. In addition, it will provide a more accurate assessment of the reality of most women's workforce experiences versus current statistics which fail to highlight the limited geographic nature of highly publicized improvements. GIS mapping shows that advancement is highly limited and clustered geographically.

Geographic information systems (GIS) has been shown to have a wide range of research applicability including urban planning, environmental impact analysis, crime analysis, business analysis and resource allocation (Important GIS Applications, 2015). This study explores the intersection of GIS and feminist research. Kwan (2002) explains that GIS is increasingly being used to influence public decision making processes and as such, it is “an important area in which it can play a role in feminist research is empowering women’s activists groups in local politics” (p. 652). As Kwan (2002) asserts there are numerous ways in which GIS methods may be used to “enrich feminist geographic research” (p. 645) whereby feminist visualization becomes a critical practice in feminist research. Kwan argues that that GIS can be re-envisioned and used in feminist geography in ways that are “congenial to feminist epistemologies and politics” (p. 645).

### **Intersection of GIS and Feminist Research**

While GIS is gaining popularity as a pragmatic research tool, some feminist scholars argue that GIS and related geospatial fields generally tend to lack female professionals and consequently perpetuate a discourse of GIS that “associates them with a masculinist positivist science” (Pavlovskaya & St. Martin, 2007, p. 601). Pavlovskaya and St. Martin (2007) explain that too often the digital divide continues to exclude marginalized groups such as the poor, women, minorities, and the elderly from full access to digital information, resources and technologies. The intersection of GIS and feminist research provides opportunities to resolve this divide by encouraging researchers to engage in GIS research that “not only analyzes gendered experiences but also is informed by feminist scholarship” (Pavlovskaya & St. Martin, 2007, p. 602). The GIS model utilized in this study proposed in this study is aimed at addressing the variables which have been identified in the research as barriers to women’s advancement and retention at the highest levels of corporate leadership. The intersection of GIS feminist geographic research will enable researchers to “understand the gendered experience” (Kwan, 2002, p. 650) in order to show the broad contours of difference and similarities that vary with gender. McLafferty (2005) explored the emerging intersections between feminism and GIS in relation to changes in GIS technologies and the impacts of such technologies in terms of “the development of feminist visualization as a research tool” ( p. 37). Feminist visualization can be utilized to create powerful, persuasive visual representations of the many barriers to women’s advancement.

### **Research Problem**

Research and census data show that women exit high level leadership positions at greater rates than their male counterparts (Carter & Silva, 2010; Catalyst, 2011, Soares, Lebow, Wojnas, & Regis, 2011; U.S. Census Bureau, 2009). According to Bureau of Labor Statistics data (2009) and U.S. Census Bureau data (2013) women represent 57% of the overall workforce and approximately 46% of management, professional, and related occupations in the United States. Despite women’s equal representation in the overall corporate workplace they are underrepresented in the upper echelons of organizations with women representing only 13% of Fortune 500 executive officers, 16% occupying board seats, 7.5% representing corporate top earners, and 3.6% in the role of CEO (Catalyst, 2011).

The data suggest an unhealthy professional pipeline in the United States with too many highly qualified women and minorities failing to advance in their career paths to executive-level positions (Cabrera, 2009; Carter & Silva, 2010; Catalyst, 2011; Wolfinger, Mason, & Goulden, 2008). Creating a visual representation mapping the most common variables combined with varying geographic variables will, as Kwan (2002) asserts, GIS can enrich and enhance the research and create a more influential representation better empowering activist groups and political leaders who support women’s advancement initiatives through the presentation of data that visually expresses the magnitude of the problem and the overall importance of addressing women’s workforce advancement issues.

Likewise, GIS modeling can be utilized to test and challenge existing leadership philosophies associated with advancing women in leadership at the highest levels in corporate organizations. Creswell (2013) explains that “feminist researchers see gender as a basic organizing principle that shapes the conditions of their lives” (p. 29). Fox-Keller (1985) describes gender as “a lens that brings into focus particular questions” (p. 6). Lather (1991) as cited in Creswell (2013) asserts the objective of feminist research ideology to “correct both the invisibility and distortion of the female experience in ways relevant to ending women’s unequal social position (Lather, 1991, p. 71). GIS can create visual representations that may assist in correcting a potentially distorted view of the female corporate workforce experience.

## **Literature Review**

### **Gender Pay Gap**

Many researchers have sought to better understand the sources of the inequities in men's and women's earnings in the both public and private sectors. Anderson, Binder, and Krause (2003) assert numerous stereotypes and misperceptions with regard to women and motherhood which frequently hinder progress in the area of leadership. Anderson et al., argue that longstanding beliefs about women have created an environment where skepticism and suspicion of the ability of women to do the job are the norm rather than the exception. Research shows a clear and quantifiable motherhood penalty for women, estimated at around 5% per child.

Mandel and Semyonov (2014) have identified a number of components: the portion of the gap attributed to gender differences in human-capital resources; labor supply; socio-demographic attributes; occupational segregation; and the unexplained portion of the gap. The author's findings reveal a substantial reduction in the overall gender earnings gap in both private and public sectors of the economy that is explained by human capital attributes. While many researchers argue work-life-balance initiatives have a positive impact on women's employment outcomes, Grönlund and Magnusson (2016) found there to be a trade-off between the 'family-friendliness' of jobs, occupations and women's relative wages. In particular, Grönlund and Magnusson assert that extensive family policies were found to harm highly educated women by affecting occupational segregation and workplace skill development. Geographic mapping will allow for better understanding the relationship between work-life-balance initiatives and the gender pay gap.

### **Work-Life-Balance**

The lack of progress in developing work-life balance among women in the workplace in general and into the upper echelons within organizations in particular, has been cited by researchers as a prominent factor hindering women's advancement at the highest levels (Catalyst, 2010). Fain (2011) suggested that the slow progress towards equity reported by Catalyst is to be expected and will probably continue in spite of efforts by organizations to eliminate the glass ceiling or the exclusion of women from informal networks. Necessary changes are taking far too long because of some institutionalized practices that prevent women from advancing on pace with their male counterparts, who enjoy a head start from the outset (Catalyst, 2010). Carter and Silva (2010) reported that after 10 years of striving to create opportunities for female managers, inequality still exists, so companies must admit their failures and advocate for improved programs to help talented women succeed. GIS will better enable the visualization of work-life-balance initiatives geographically and the influence on women's workforce outcomes.

### **Diversity**

Understanding the complexities of why women leave requires epistemology which questions truth claims and the power structure. With half of middle management being women and only 13% of top level management being women in Fortune 500 companies, as Hatch and Cunliffe (2013) explain the relationship between knowledge and power, organizations have to a degree regulated "what will be perceived as normal" (p. 43). In spite of widespread diversity initiatives, the pipeline for women from middle management to leadership at the highest levels remains broken. Challenging the current processes not only increases the likeliness of change, it sends a message that women are valued in the hierarchy and that women in power can be part of the cultural norm. GIS will better enable the visualization of diversity initiatives geographically and the influence on women's workforce outcomes.

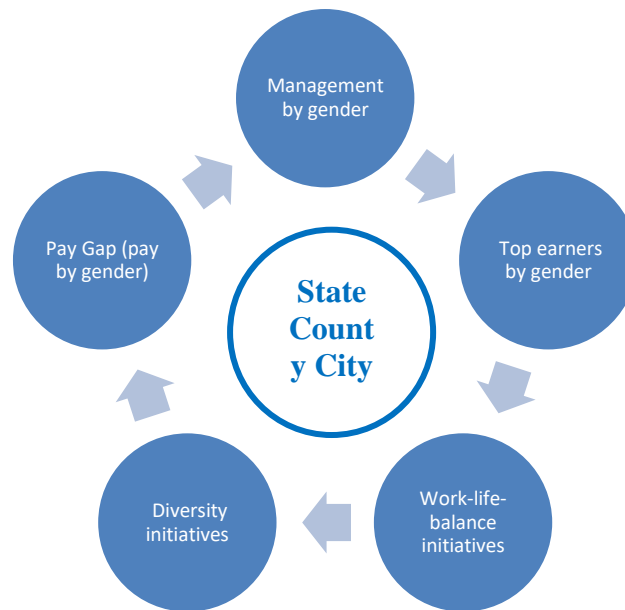
### **Leadership Advice**

Research shows that best practice leadership advice, when taken by men, will often have different outcomes than when the same advice is taken by women. This is an essential point as it relates to a distorted perspective in terms of how to women in corporate positions can overcome workforce barriers. The advice given to women leaders often perpetuates the fallacy that if women do all the right things, they can level the corporate leadership playing field. Research shows this to be largely a myth. Carter and Silva's (2011) study of 3,345 high potentials professionals on traditional career paths following graduation from full time MBA programs, of which both women and men had adopted the full range of advancement strategies attributed to an ideal worker, there were distinct gender differences in the benefits of adopting the same advancement strategies. Carter and Silva found that men benefitted more than women when they adopted the proactive strategies of the proverbial "ideal worker" (Carter & Silva, 2011, p. 2). The study showed that even when women used the same career advancement strategies to help them get ahead, they advanced less than their male counterparts and had slower pay growth. GIS Modeling illustrates visually the quantitative outcomes of many of the push variables that truncate the success of these strategies for women.

### Shape Map Content/Layers

This study applied GIS modeling to map data related to U.S. corporate women's experiences and the effects of the push, pull, and leadership strategy variables outlined above. This data would be combined with US Census and Labor Force Data by state, county, and city. Major mapping components would include:

- U.S. Census Bureau and Bureau of Labor Statistics data (2009) data on women in management level by state, county, and city
- Gender pay gap data by state, county, and city
- Management turnover and promotion rates by gender, by state, county, and city
- Presence of work-life-balance, workforce flexibility, family-friendly corporate initiatives by company, by state, county, and city (pull variables).
- Parent friendly initiatives (corporate and legislative) by company by state, county, and city (pull variables).
- Presence of diversity initiatives such as networking and mentoring initiatives for women (push variables).



*Figure 1.* Diagram of geographic data and barrier variables for overlay shape map

Utilization of the model allows for visual representation of the correlations between push and pull variables identified in the literature as women's workforce barriers layered with women's actual representation and advancement outcomes. Mentoring initiatives by state, county and city, overlaid with gender of and high-earning women by state, county, and city for example, could provide powerful insights for advocacy groups working towards elevating the significance of gender inequities in the workplace and fighting to allocate meaningful and efficacious resources. As Kwan (2002) asserted, the intersection of feminist research and GIS can result in "research that influences public decision making processes and political discourse" (p. 652) which can play an important role in empowering women's activists groups and politicians locally and on a national level to address the underrepresentation of women in the highest echelons of corporate leadership.

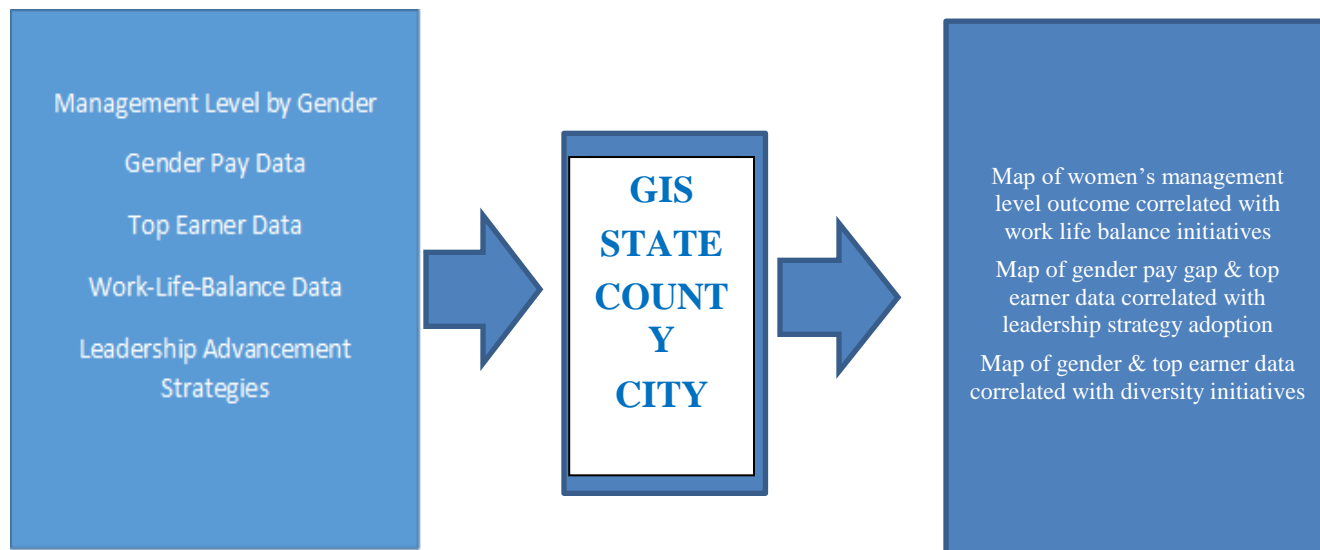
**Study Model: Data Input & Information Output**

Figure 2. Diagram of GIS study

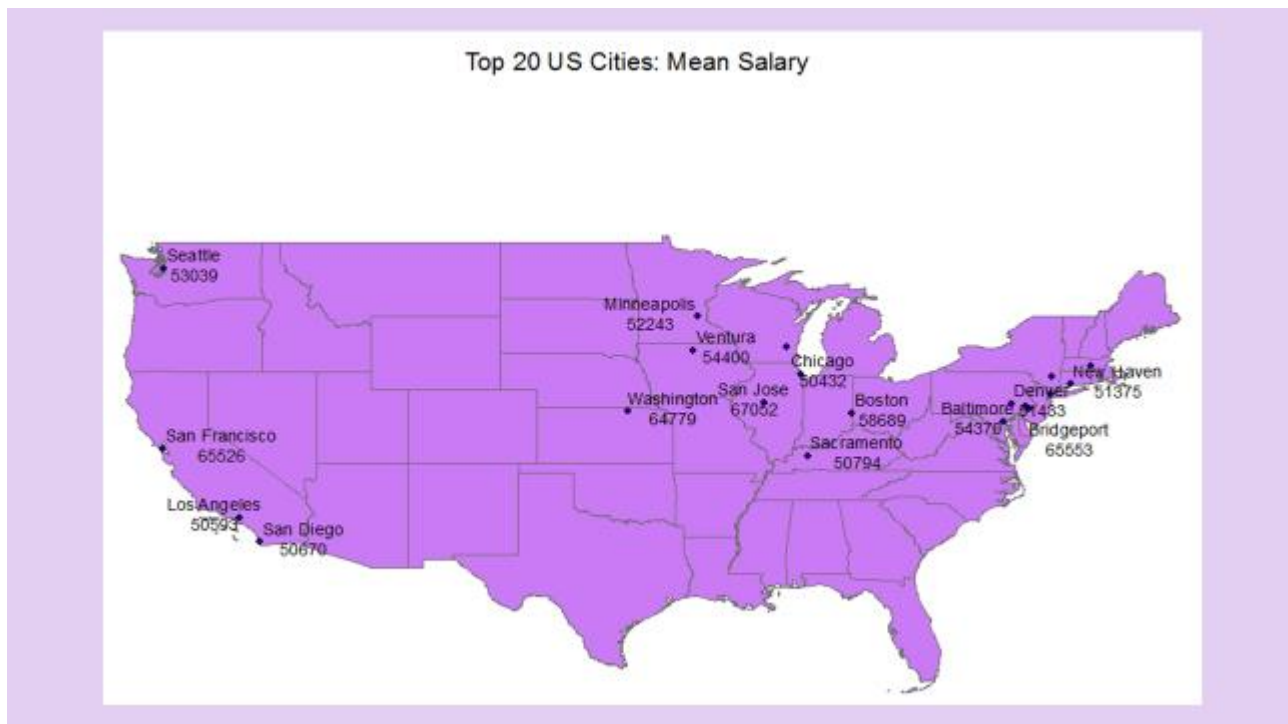
**Strength's & Limitations of the Study**

This research is highly relevant for improving gender equality issues, but also in terms of organizational outcomes. Research shows that companies with the best records of promoting women outperform their counterparts anywhere from 50 to 100%; conversely, companies that have poorer records are lagging behind the companies with the most women in leadership roles in terms of higher financial returns and overall earnings (Adler, 2009). Likewise, as Kwan (2002) explains, GIS is increasingly being used to influence public decision making processes and as such, it is “an important area in which it can play a role in feminist research is empowering women’s activists groups in local politics” (p. 652). There are limitations of the study however. The accuracy of the input data can vary and the output is only as reliable as the input data. While census and labor statistic data tend to be reliable, much of the data related to diversity initiatives, work-life-balance initiatives and leadership development initiatives is reliant upon the collection of data from private organizations. Working Mother Magazine for example, provides much of the data on work-life-balance initiatives (by location and company) and little is known about the reliability of the data collection methodology.

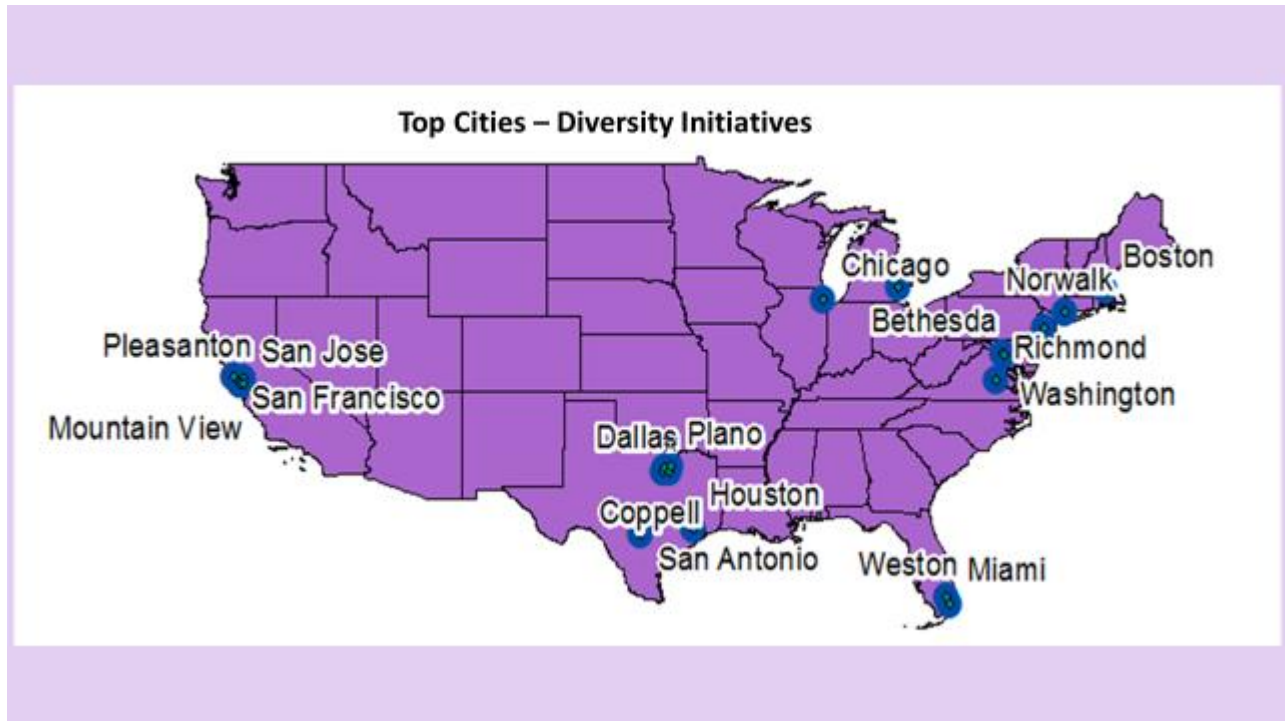
Schuurman and Pratt (2002) critique the intersection GIS and feminist research geographic technologies within the context of the shift in the power dynamics between the state and community. Resources may be allocated differently and community goals reprioritized based in part, on GIS research data presentation. Pavlovskaya and St. Martin (2007) explain that too often the digital divide continues to exclude marginalized groups such as the poor, women, minorities, and the elderly from full access to digital information, resources and technologies. Schuurman and Pratt (2002) support this limitation explain that it can result in “those with greater technological facility to gain more control” (p. 296). Creswell (2013) asserts the objective of feminist research ideology to “correct both the invisibility and distortion of the female experience in ways relevant to ending women’s unequal social position (Lather, 1991, p. 71), feminist researchers must consider the role technology and GIS play in contributing to providing data in which minorities and women may have limited access with maximum consequences to outcomes in terms of resource allocation which may result from the research.

**Results**

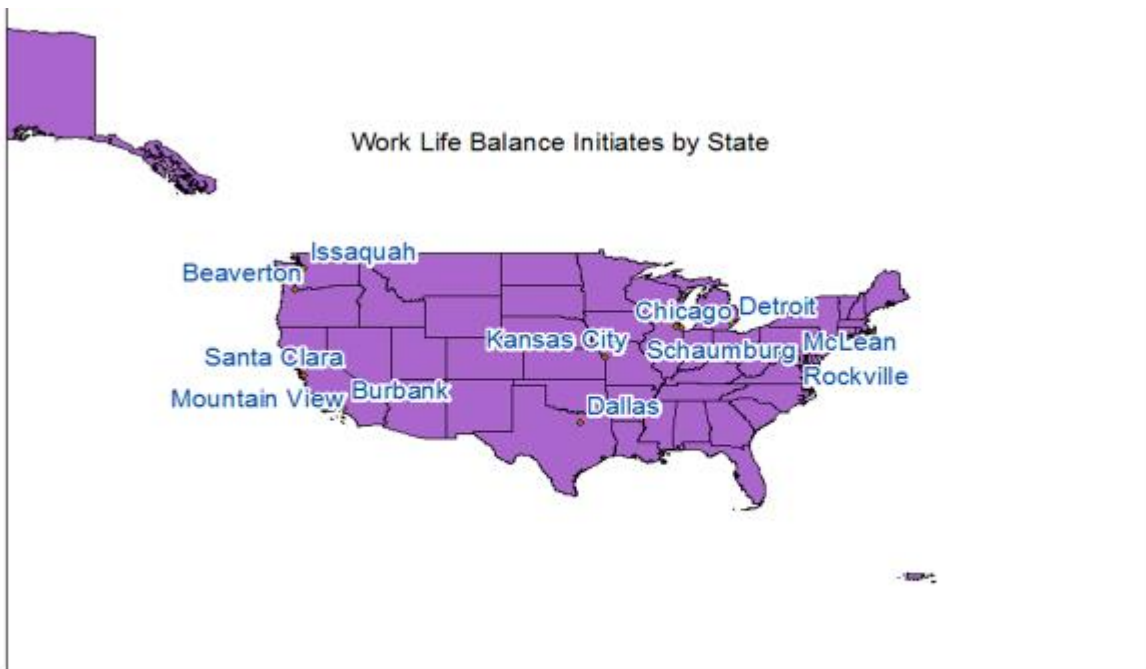
GIS mapping confirms highly clustered geographic data in terms of women’s workforce success with the lowest pay gaps and highest mean salaries clustered in few geographic areas (mainly the northeast and southwest). This is consistent with visual representations of the highest paid women and states with the most women CEO’s. Although the list of women CEOs is small, it is important in addressing gender pay inequity as research shows that companies with women leaders at the helm impact the entire wage distribution within an organization. There is an impact on wages based on the presence of a women CEO. Research shows that the impact of female CEOs is positive on the wages of women, especially at the top of the wage distribution. The impact on men is the opposite: female CEOs lower wages at the top. As a result, female CEOs reduce the gender wage gap at the top.



Diversity GIS mapping shows similar patterns to Gender Pay Gap and Mean Women’s salary mapping with similar clusters in the northeast and southwest, but also showed additional diversity in areas of the south (particularly Texas). The data suggest a higher diversity population in these areas and diversity mapping in the southeastern areas of the country (mainly Texas and Florida) did not correlate with higher women’s salaries and declines in the gender pay gap as was seen with the geographic locations of women CEOs and correlates with women’s mean salaries.



Work-life-balance initiatives don't translate to salary and decreasing the gender pay gap as diversity issues do. GIS mapping shows work-life-balance initiatives are less clustered and include sections of the Midwest which are notably absent in terms of mean salaries and gender pay gap decreases.



Almost half the states didn't rank and two states dominated with New York and California showing the best women's workforce condition. Manhattan and the "Sans" in California (San Diego, San Francisco, San Jose) dominate in terms of all variables mapped including work-life-balance initiatives, diversity initiatives, women's mean salaries, closer gender pay gap and overall workforce conditions for working executive women. Conversely, mapping shows that the situation is bleak in smaller cities, even those in California and New York. Much of "Middle America" shows a strong need for improved gender inequity initiatives.

## Discussion

Kwan (2002) asserted that the intersection of feminist research and GIS can result in “research that influences public decision making processes and political discourse” (p. 652) which can play an important role in empowering women’s activists groups and politicians locally and on a national level to address the underrepresentation of women in the highest echelons of corporate leadership. Resources may be allocated differently and community goals reprioritized based in part, on GIS research data presentation. The fields selected in this research correspond with women’s advancement at the executive levels as well as a number of variables identified in the literature as corresponding with women’s lack of representation and the pay gaps associated with women leaders as compared with their male counterparts at the same professional levels.

The literature reveals a complex symphony of variables which influence women’s decisions to remain or exit the workforce. The fields included in the mapping include work-life-balance and diversity initiatives which correlate in the literature as influential variables in women’s decision to remain or exit the workforce and with women’s pay and advancement outcomes. Research shows work-life-balance issues to be a significant barrier to women’s success (Catalyst, 2011). This study confirms that geographically mapping data related to the push and pull variables that are correlated with women’s workforce advancement assist in punctuating the significance of issues that might otherwise be misleading from the research. While census data for example shows increases in women’s mean salaries and the number of women achieving success at the highest echelons of leadership, GIS mapping shows that these advances are only relevant for women geographically located in a few clustered states and cities across the country. This is problematic because the advancement may suggest a lack of a problem, but GIS mapping shows that for most women in most cities and states across America, there is much work to be done and resources needed. While this study showed that the cities and states where companies with the best work-life-balance and diversity initiatives, again this is only in a few geographic locations. GIS modeling assists in creating a visual representation of the areas which can serve as benchmarks for positive change as well as highlighting the many areas with the greatest need for advocacy at the state and local levels. Visual representation by state and city combined with data mapping the gender pay gap and women’s mean salaries provide powerful insights for advocacy groups working towards elevating the significance of gender inequities in the workplace and fighting to allocate meaningful and efficacious resources.

## Conclusion

Research and census data show that women exit high level leadership positions at greater rates than their male counterparts (Carter & Silva, 2010; Catalyst, 2011, Soares, Lebow, Wojnas, & Regis, 2011; U.S. Census Bureau, 2009). According to Bureau of Labor Statistics data (2009) and U.S. Census Bureau data (2013) women represent 57% of the overall workforce and approximately 46% of management, professional, and related occupations in the United States. Despite women’s equal representation in the overall corporate workplace they are underrepresented in the upper echelons of organizations with women representing only 13% of Fortune 500 executive officers, 16% occupying board seats, 7.5% representing corporate top earners, and 3.6% in the role of CEO (Catalyst, 2011). Although things have improved for women in mid-level management, the needle has hardly moved in the highest levels of leadership and top earner positions.

The media often focus on the statistics showing overall positive change which is assumed to be universal. GIS mapping shows that in fact, this is not the case. Rather, there are clusters in few demographic regions where there are ample opportunities for women’s upward mobility, but for the vast majority of women in the United States, the opportunities for advancement professionally and economically are scarce. Moving forward, additional research providing visual representation of the correlations between push and pull variables identified in the literature (such as pay gap and work-life-balance and diversity initiatives merged and layered with women’s actual representation and advancement outcomes will be beneficial. Work-life-balance initiatives by state, county and city for example, overlaid with representation by mean pay by state, county, and city could provide powerful insights for advocacy groups working towards elevating the significance of gender inequities in the workplace and fighting to allocate meaningful and efficacious resources.



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