AC 2011-2597: FACTORS THAT INFLUENCE THE USE OF SUSTAINABLE TECHNOLOGY IN STRUCTURAL DESIGN

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Eric Nesbitt

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Factors That Influence the Use of Sustainable Technology in Structural Design

Introduction

The United States is becoming increasingly aware of the implications of overusing natural resources; polluting the air, land, and water; and continuously neglecting the environment. This has spawned a new challenge for engineers, scientists, and businessmen and women. Not only are engineers and scientists expected to research, develop, and implement technology to improve the economy, they are also expected to accomplish this economic growth without compromising the environment for future generations. In addition, businessmen and women will be expected to market these new technologies.

At the time this research paper was written, the price of oil had risen to approximately $127.93 for a barrel. As the cost of energy has increased, Americans are looking for ways to reduce the amount of energy used and become a more sustainable nation. Some Americans have begun purchasing fuel-efficient cars, changing their driving habits, and learning ways to make their homes and workplaces more energy efficient. Although many Americans are participating in these actions, there are still many more Americans who have not embraced this trend. The aim of this research was to examine various factors, including social and demographic variables, that might influence the use of sustainable technologies.

This research used the United States Green Building Council’s (USGBC) nationally recognized standard for sustainable building called Leadership in Energy and Environmental Design (LEED). Accordingly, the number of USGBC LEED projects per 100,000 people within each state was chosen to represent the state’s commitment to environmental technologies. The author chose to use USGBC LEED projects as the representative variable because these projects represent a commitment to sustainability and to improving the environment. The USGBC LEED program is a rating system for judging the sustainability of a building. Ratings are based on sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality. USGBC LEED projects are certified at four different levels: certified, silver, gold, and platinum. A project earns points towards certification for implementing sustainable practices established in the USGBC LEED Rating System (USGBC, 2005).

The author used a regression analysis to predict the number of registered LEED projects within a state. Prior to conducting the regression analysis, the author reviewed previous literature related to the LEED program and factors that affect participation in a sustainable activity or program. The author found several articles that suggest various ways to increase participation in the LEED program and other sustainable programs. Some of the literature suggests a need for more research on the LEED program, an increase in the number of governmental incentives supporting sustainable building projects, or more support for conducting lifecycle financial analyses. However, there is little research that statistically analyzes any of these recommendations or examines possible factors that might influence interest in sustainable projects. This research attempts to fill this void by analyzing the statistical significance of factors that may influence the number of registered LEED projects within a state.
Statement of the Problem

The question that this research attempts to answer is: “What factors, if any, may influence the use of sustainable technologies for structural design within individual states?” This includes the use of sustainable technologies by the government, private companies, public organizations, or individual consumers. The factors included in this study are population, median household income, educational level, geographical region, and state and local policies.

Significance of the Problem

Throughout the past decade, the price of a barrel of oil in the United States has risen from an approximate yearly average of 20 dollars per barrel in 1997 to 107 dollars per barrel in 2007, and is continuing to rise exponentially (OPEC, 2008). In 2007, The International Panel of Climate Change (IPCC) concluded that a 1° to 1.7° Fahrenheit increase in the average global surface temperature from 1850 to 2007 is likely the result of human activity (as cited in Environmental Protection Agency [EPA], 2007). An increase in the average global temperature has been linked to large scale melting of snow and ice and rising sea levels (EPA, 2007).

Because of these environmental problems, a variety of industries have responded with technologies to reduce the amount of negative impact to the environment. The automotive industry has responded with fuel-efficient vehicles such as the Toyota Prius which has an average fuel economy of sixty miles per gallon (mpg) for city driving and fifty-one mpg for highway driving (“2007 Model Year Vehicles,” n.d.). The agricultural community has responded by using sustainable farming practices, such as carefully selecting a variety of species of plants and animals that will naturally survive in a specific region (UC Sustainable Agriculture Research and Education Program, n.d.). Finally, the construction industry has responded with the development of the U.S. Green Building Council (USGBC). The USGBC has created the Leadership in Energy and Environmental Design (LEED) program which provides a structured concept for “sustainable site development, water savings, energy efficiency, materials and resources selection, and indoor environmental quality” (USGBC, 2007). LEED projects will be used to represent a sustainable technology in this research.

Statement of the Purpose

Although numerous sustainable technologies have been developed, many individuals, organizations, and communities have failed to implement these technologies. On the other hand, some communities and organizations are known for their implementation of sustainable technologies. For example, the city of Chicago, Illinois has become known as a leader in sustainability by implementing sustainable technologies such as developing a rooftop garden above their city hall (City of Chicago, n.d.). After the inception of LEED in 2001, there were numerous articles published regarding the current trends of LEED projects and recommendations for strengthening the sustainable building market. However, in the past few years there has been little research to reexamine these trends or to evaluate the impact of the recommendations set forth by the previous research. To better understand the current trends that influence the use of sustainable technologies across states, a research question was developed and answered, “What social factors, if any, may influence a state’s willingness to implement a sustainable
technology?” By understanding how these factors influence a state, businesses and organizations will have a better understanding of where to market environmental technologies and what kinds of environmental technologies should be researched and developed.

Definitions/Exclusions

Only registered LEED projects within the United States were included. The USGBC LEED website was used to collect information regarding the amount of registered LEED projects within each state. LEED was created by the USGBC in 2001. All projects dating from 2001 to the time of data collection, April 9, 2008, were included in this study.

Assumptions

The author assumed that the number of USGBC LEED projects within a state represents a commitment of that state’s people to implement and utilize environmentally friendly technologies.

Delimitations

The author only researched states within the United States. Other countries were not studied due to the availability of data required to complete this research.

Limitations

There are various other factors that may reflect a state’s commitment to environmentally-friendly technologies that are not measurable and cannot be included in this study. For example, a state may have created an initiative to increase the amount of LEED-certified buildings in their state by a certain percentage. However, there is no way to accurately measure the importance or effectiveness of such initiatives as a result of wide variations in scope and size. In addition, there is no practical way to measure a state’s level of commitment to the initiative.

Review of Literature/Background

A literature review of the United States Green Building Council’s (USGBC) Leadership in Energy and Environmental Design (LEED) program was performed. In addition, an evaluation of different variables that could affect a state’s willingness to initiate environmentally-friendly policies and technologies was researched. This research was limited to sustainable building projects due to the subject of the chosen representative variable, LEED registered projects. The following provides general information about the USGBC LEED program and examines available research regarding the selected social factors for this project.

USGBC LEED Research

The LEED program was created by the USGBC to establish an expanding set of sustainability guidelines for various types of construction (Clark, 2008). USGBC is a nonprofit organization that supports advancements in “structures that are environmentally responsible, profitable, and
healthier places to live and work” (USGBC, 2007). The organization members are a collection of building owners, real estate developers, facility managers, architects, designers, engineers, general contractors, subcontractors, product and building system manufactures, government agencies, and other nonprofit organizations. Their mission is “to transform the way buildings and communities are designed, built and operated, enabling an environmentally and socially responsible, healthy, and prosperous environment that improves the quality of life” (USGBC, 2007). The organization’s vision is: “Buildings and communities will regenerate and sustain the health and vitality of all life with a generation” (USGBC, 2007).

The LEED program is based on a system of credits. By meeting a specific performance guideline a project earns credits towards certification. Although some of the guidelines are required for certification, other guidelines are flexible and credits can be earned in various ways. Based upon the percentage of credits achieved, a LEED project will earn different levels of certification. To become a certified project, the project must have forty percent of the total available credits. Fifty percent is required to achieve a silver certification, sixty percent to achieve a gold certification, and eighty percent to achieve a platinum certification. The credits are divided into five different categories. The categories include sustainable sites, energy and atmosphere, materials and resources, indoor environmental quality, and innovation and design. Each category has both required guidelines and flexible guidelines. For example, a project can earn credits under the sustainable sites category for providing workers with changing rooms and bicycle storage. In the indoor environmental quality category, a project can earn credits by increasing outdoor air ventilation thirty percent above the minimum standard (Clark, 2008).

Because there are many different kinds of building types, the USGBC has created different sets of guidelines for commercial interiors, core and shell, existing buildings (operation and maintenance), homes, new construction, and new developments (Clark, 2008). In addition, USGBC has separate guidelines for schools, health care, and neighborhood development. For example, the additional guidelines for schools address classroom acoustics, mold prevention, and site assessment. The additional guidelines for healthcare facilities address sensitivity to chemicals and pollutants and traveling distances from parking facilities.

Social Factors Research

On April 22, 2002, the USGBC held a monumental meeting with the United States Congress on the topic of green building. The conclusions from this meeting are described in a report entitled “Building Momentum: National Trends and Prospects for High-Performance Green Buildings” (USGBC, 2003). The meeting included representatives from the private, public, and non-profit sectors. The goal of the meeting was to educate the participating members on the sustainable building trends in the United States. Subjects discussed during the meeting included the economic and health benefits of green building, the barriers facing its progress, and the opportunities available to promote sustainable spaces. The meeting had a tremendous effect on USGBC membership, as membership rose from 1,500 companies at the time of the meeting to 2,600 companies just nine months later (USGBC, 2003). The publicity of the meeting and the education of Congressional members seemed to cause an increased interest in the green building market.
Many recommendations for strengthening the green building market were generated from the congressional meeting. Specifically the recommendations were to continue to promote federal agency projects, conduct extensive research, encourage state and local economic incentives and data collection for green building projects, and increase the number of green building projects in the school system. During the meeting, the federal government was applauded as a leader in green building. From 1985 to 2002, federal government building-related energy costs dropped 23% per square foot. This resulted in a savings of $1.4 billion during that period of time. Therefore, the USGBC recommended that the federal government continue its green building projects and further promote the projects. In addition, New York, Maryland, and Oregon were recognized as leaders in creating tax credits for green building projects. Santa Barbara, California and Scottsdale, Arizona were also recognized for offering expedited permit reviews for green building projects (USGBC, 2003).

The meeting also recognized issues surrounding the green building market that would hinder the efforts of increasing interest in green building. The disincentives noted were a lack of life-cycle cost analysis, initial high performance costs, the perception that security and sustainability are trade-offs, insufficient research, and lack of awareness (USGBC, 2003). Many of these same disincentives exist today. However, due to the rapid increase in the cost of energy, the awareness of the sustainable technology marketing is increasing.

Following the meeting between Congress and the USGBC, the editors of Building Construction and Design published a report on the green building movement entitled “White Paper on Sustainability” (Cassidy, Wright, Flynn, Barista, & Zissman, 2003). The paper gave a historical overview of green building, presented a survey of readers’ interests in sustainability, analyses of trends in green building, and a set of recommendations for moving forward. Although this research was conducted almost a year and half after the USGBC congressional meeting, many of the recommendations for improving the green building market mirrored the recommendations made as a result of the congressional meeting. The editors proposed to conduct more research on the benefits of green buildings, conduct research on the economic and business case aspects of green buildings, establish a federal green building council, establish an institute for sustainable development research, and create guidelines for states, countries, and municipalities to implement incentives for green building (Cassidy, Wright, Flynn, Barista, & Zissman, 2003).

The sets of recommendations from the USGBC Congressional meeting and the “White Paper on Sustainability” both contained three common features. These features were education, economics, and public leadership. Education was addressed in the form of conducting research to further knowledge about green building. The economic recommendations for green building addressed the initial cost of green buildings and life-cycle analyses. Public leadership was addressed in the form of federal, state, and local incentives for the green building market.

Matthiessen and Morris (2004) challenged the idea or perception that green buildings were more expensive than traditional buildings. The authors worked for the cost consulting company Davis Langdon. Their research examined only construction costs and not the cost of a holistic green project. Taken from the existing database, cost information from 138 similar buildings was used. Of the 138 buildings, 45 of the buildings were seeking LEED certification and the
remaining 94 buildings were not seeking LEED certification. The projects were normalized for time and location in order to more fairly compare the projects. Ultimately, the authors compared the cost per square foot of all of the buildings. The variations were statistically analyzed using a t-test. The result of the analysis concluded that no statistical difference existed between the projects. However, the authors concluded that the average cost per square foot for a building compared to another is not a meaningful analysis. The study reasoned that cost variations between buildings are extremely large, and as a result, averages are not helpful in analyzing building cost (Matthiessen & Morris, 2004).

The authors then conducted an additional study comparing the cost of green buildings to non-green buildings (Morris & Matthiessen, 2007). The results of this study were essentially the same as the study conducted in 2004. The authors found no statistical difference between the average cost for green buildings when compared to the cost of buildings that are not considered green. The biggest difference found between the two studies was the contracting community’s perception of green building. Previously, the contractors had viewed green building as burdensome and would sometimes charge additional costs for green building projects. Since 2004, the contracting community has begun to embrace green building projects; additional charges for green building are no longer as prominent in the industry (Morris & Matthiessen, 2007).

Nelson (2007) researched the changing trends in the green building industry and found that the biggest change in the green building market in the past few years is the addition of real estate companies and investors in the green movement. In the past, the leaders of the green building industry were the government and large corporations. The government and large corporations were leaders because they were more likely to be owners of a particular building or space and could capture the benefits of being LEED certified. In addition, corporate leadership in green building has been affected by the effort of corporations to become more accountable for their actions. Nelson (2007) describes this as the “halo” effect. By supporting green building, corporations are able to reap from the benefits of advertising as socially responsible companies. As a result of the growing concern over global warming, this has lead to exponential growth in the green building market. As of mid-2007, 100 million square feet of building space in 800 different buildings were LEED certified. LEED project are expanding at an exponential rate, with a compounding annual increase of 50 to 100%. Nelson (2007) also reported that LEED certified buildings are regionally concentrated in largely populated, politically liberal states. LEED certified buildings are also concentrated in capitol cities with multiple governmental buildings. Another recent trend involves the level of certification being achieved by buildings. Increasingly new projects are achieving platinum and gold certifications rather than the lowest level of being certified. Finally, there is a changing composition trend in the market. As sustainability becomes more popular, developers and small leases have participated more in the green building movement. According to Nelson (2007), the rapid increase in LEED participation can be explained by five driving factors. These factors are tenant demand, government roles, investor demand, industry support, and business case. Like large corporations, tenants have become aware of the goodwill advertisement of being socially responsible and the reduced utility bills associated with a green building. The government’s role as a leader has increased awareness of the LEED program. In addition, the creation of incentives for the green building market has influenced businesses to support
green building. Investors are beginning to see the business case for green buildings and are demanding more. These investors could see the business case based on the "halo" effect as discussed previously, or based on reduced energy consumption or increased corporate responsibility. Lastly, as the building industry has begun to embrace the green building movements, more products are available for use (Nelson, 2007).

The following two articles are not directly related to the green building industry. However, these articles do present possible factors that could influence a state’s commitment to sustainability or improving the environment. Guthrie and Shackleton (2006) studied Arbor Day participation in South African urban and rural communities. Guthrie and Shackleton conducted the research by sending out a survey asking various questions related to the community’s infrastructure, remoteness, and educational practices. Their results indicated that urban communities experienced more Arbor Day participation than rural communities. Guthrie and Shackleton hypothesized that rural communities participated less because of the disparity between education among urban and rural South African communities. Because of their choice to use a survey, their results may be biased based on the questions asked and the communities that received the survey. In addition, the disparities that exist in South African communities may not be the same as in the United States. If a difference exists between rural and urban communities in the United States, geographical area may influence the use of sustainable products or projects.

McLean and Jensen (2004) qualitatively analyzed how a community leader’s knowledge of environmental issues affects the community. Their research was conducted by asking community leaders a series of questions about urban forestry. The results of their research indicated that leaders with a mature understanding of urban forestry were more capable of being agents of change. However, their research was conducted by only asking community leaders in two cities. Many more cities must also be included to really understand the relationship between a leader’s knowledge of urban forestry and the policies he or she chooses to implement. A community leader has political influence as to what initiatives are passed. As such, a community leader’s role in supporting green technologies, like the green building industry, has a significant influence of the initiatives passed to support the sustainable industry.

The recommendations presented in previous research have clear categorical themes. One of the common recommendations was for more research to be conducted on the LEED program. The request for more research is related to education and increases the amount of awareness of the LEED program. There has been recommendations made about the cost or the perceived cost of a LEED project, and there has been research conducted to analyze the cost of LEED projects. Some research suggested that participation in environmentally-friendly activities may be different between rural and urban areas. Finally, previous research has suggested that local and state governments should create incentives increase participation in LEED. However, there is little or no research that quantitatively tests these recommendations. This research attempts to fill this void in the research, by testing different factors that may or may not influence participation in the LEED program.

Methodology/Procedures
In an effort to answer the research question for this study, a regression analysis was performed with the dependent variable being the amount of USGBC LEED projects per 100,000 people within each state and the explanatory or independent variables being population, the percentage of college and high school graduates, median household income, geographical region, and the number of state and local incentives for green building in each state. According to Mendenhall and Sincich (1995), a regression analysis is an important statistical analysis for “estimating the mean value of a response variable \( y \) or predicting some future value of \( y \) based on knowledge of a set of related independent variables” (p. 532).\(^{16}\) The null hypothesis for each independent variable used for this study was \( H_0 : \beta_x = 0 \), and the alternative hypothesis was \( H_a : \beta_x \neq 0 \). All variables were tested for significance at the 0.05 alpha level. The overall significance of the regression analysis was evaluated using the calculated \( R^2 \) and the significance of \( F \) at the 0.05 alpha level.

The USGBC LEED variable included all the projects within a state from the inception of the LEED program until April 9, 2008. The number of USGBC LEED projects within a designated state was obtained from the organization’s website (USGBC, 2008a).\(^{17}\) In order to correct for the difference in the sizes of states, the author determined the number of USGBC LEED projects per 100,000 people by dividing the number of projects within a states by the state’s population and then multiplying by 100,000. To represent the population variable, the author used the population of each state. To represent the education variable, the author used the percentage of the state’s population that has attained a high school diploma and the percentage that has obtained a bachelor’s degree. The author used both high school and college education data to investigate any difference in the significance between the two different educational levels. The state’s median household income was used to represent the economic variable. The population, education, and economic data were obtained from the most recent official statistics provided by the U.S. Census Bureau (U.S. Census Bureau, 2008).\(^{18}\) The population and educational data was obtained from the 2000 U.S. Census. Median household income was reported by the Census Bureau as a three-year average from 2002 to 2004. The geographical region of each state was determined by the U. S. Environmental Protection Agency (EPA) region classifications (EPA, 2008).\(^{19}\) The number of state and local incentives supporting green building were collected from the USGBC website (USGBC, 2008b).\(^{20}\) These include all state and local initiatives up to July 1, 2008. Because the U.S. EPA regions are a qualitative variable, a dummy variable was used in the regression equation. Mendenhall and Sinchich (1995) support the use of a dummy variable in a regression analysis when the independent variable is qualitative.\(^{16}\) All regions were statistically compared to U.S. EPA Region 1. The regression equation was designed as:
\[ E(y) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 + \beta_9 x_9 + \beta_{10} x_{10} + \beta_{11} x_{11} + \beta_{12} x_{12} + \beta_{13} x_{13} + \beta_{14} x_{14} \]

### Variable Definitions

<table>
<thead>
<tr>
<th>Variable</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registered LEED Projects Per 100K</td>
<td>( y )</td>
<td>Amount of registered LEED projects in a state as of April 9, 2008, divided by the states population, and the multiplied by 100,000.</td>
</tr>
<tr>
<td>Median Household Income</td>
<td>( x_1 )</td>
<td>U.S. Census 3 year average from 2002-2004.</td>
</tr>
<tr>
<td>Population</td>
<td>( x_2 )</td>
<td>U.S. Census 2000 population estimates.</td>
</tr>
<tr>
<td>High School Education</td>
<td>( x_3 )</td>
<td>U.S. Census 2000 percentage of high school graduates.</td>
</tr>
<tr>
<td>College Education</td>
<td>( x_4 )</td>
<td>U.S. Census 2000 percentage of college graduates.</td>
</tr>
<tr>
<td>Geographic Region</td>
<td>( x_5 \text{ - } x_{13} )</td>
<td>U.S. EPA defined regions. (See Map in Appendix A)</td>
</tr>
<tr>
<td>Green Building Incentives</td>
<td>( x_{14} )</td>
<td>Amount of green building incentives per state as of July 1, 2008.</td>
</tr>
</tbody>
</table>

### Findings

The overall significance of the regression analysis was evaluated using the calculated \( F \) value and R square value. The \( F \) value was statistically significant at the 0.05 alpha level. The R square value of 0.51 indicates that 51% of the variation of the dependent variable can be explained by the independent variables.

#### Overall Regression Results

| Multiple R | 0.712 |
| R\(^2\)     | 0.507 |
| Adjusted \(R^2\) | 0.310 |
| Standard Error | 1.311 |
| Observations  | 50    |

<table>
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<tr>
<th></th>
<th>( Df )</th>
<th>( SS )</th>
<th>( MS )</th>
<th>( F )</th>
<th>Significance ( F )</th>
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<td>60.157</td>
<td>1.719</td>
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<tr>
<td>Total</td>
<td>49</td>
<td>122.034</td>
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</table>

The percentage of college graduates within a state was the only independent variable that was found to be statistically significant at the 0.05 alpha level, and the null hypothesis was rejected. The coefficient of 0.21 indicates a small positive relationship between the percentage of college graduates in a state and the amount of LEED projects within a state, holding all other independent variables constant. Population, EPA Region 10 (Washington, Oregon, Idaho, and Alaska), and the number of incentives a state offers were not statistically significant at the 0.05 alpha level criteria set for this research, but would have been statistically significant at a 0.1 alpha level. All variables besides the percentage of college graduates in a state were statistically insignificant, and the null hypothesis could not be rejected.
Conclusions, Discussion and Recommendation

This research has revealed that college education is a statistically significant factor that affects a state’s participation in the LEED program. In addition, several other factors were close to being statistically significant in the research including population, U.S. EPA Region 10, and the amount of incentives within a state that support the LEED program. Additional research should study each of these factors in more detail to determine how these factors influence LEED participation and how they can be used to increase LEED participation.

The statistical significance of college education has led the author to speculate that college graduates are more aware of environmental issues and sustainable programs like LEED. As recommended in previous research by USGBC (2003), Nelson (2007), and Cassidy, Wright, Flynn, Barista, & Zissman (2003), an increase in the awareness of the LEED program will increase the amount of LEED projects. However, further research should be conducted to determine if certain college graduates are more likely to participate in the LEED program. Specific research questions that may be addressed include: 1) Do states with a higher percentage of engineering and science graduates have more participation in the LEED program than states with a higher percentage of liberal arts graduates? 2) Is there a difference in the perception or awareness of sustainable building between college graduates and non-college graduates? If so, why is the perception or awareness of sustainable building different between college graduates and non-college graduates? Answering these questions will help bring more understanding to the emerging sustainable products market.

States with higher populations could possibly have a negative affect upon the amount of LEED projects per 100,000 people. This may be due the equation for the author’s chosen dependent

<table>
<thead>
<tr>
<th>Independent Variable Results</th>
<th>Coefficients</th>
<th>Std. Error</th>
<th>t Stat</th>
<th>P-value</th>
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</table>
variable. Population directly affects the amount of LEED project per 100,000 because population is part of the equation. The negative affect of population could also be an issue of population density. Specific research questions that may be addressed include: 1) Are areas with higher population densities less likely to have as much LEED participation? 2) Does the presence of large buildings in densely populated areas affect the amount of LEED projects within a state? 3) Are LEED projects more expensive in densely populated areas? More research should be conducted to evaluate the relationship between population density and LEED participation.

U.S. EPA Region 10 (Idaho, Washington, and Oregon) was close to being statistically significant in this study. The author believes that something is causing the people in this state to have more awareness of the LEED program. This may be a result of Oregon’s early efforts to create incentives for the LEED program. According to USGBC (2003), Oregon was one of the first states to award businesses with a tax credit for achieving a silver certification for a new construction. As a result, Oregon had an early influence on the amount of registered LEED projects in the state and directly affected the other states by spreading awareness of the program. This issue of awareness should be studied in more detail. Specific research questions that may be addressed include: 1) Are registered LEED projects clustered in certain areas? 2) Does geographical distance from these areas of awareness affect the amount in participation in the LEED program? 3) Is there something else going on in U.S. EPA Region 10 that is affecting the amount of LEED participation? By answering these questions, there will be more understanding of why particular areas are more successful implementing the LEED program.

The last variable that was close to being significant in the study was the number of incentives in a state that support the LEED program. One of the limitations of this study was ability to differentiate the impact of a particular incentive. For example, this study did not distinguish a difference between a state initiative and a local initiative. A state initiative would clearly have a larger impact upon a state as it addresses the state as a whole. However a local initiative in a large city could have just as much impact as a state initiative. The difference between these types of initiatives must be evaluated in future research. In addition, this study did not differentiate between the different types of incentives. Some incentives were tax or financial incentives, and some incentives were aimed to increase the speed the building project review process. Specific research questions that may be addressed include: 1) Does the difference in the type of incentive offered affect the amount of LEED projects within a state? 2) Are state or local incentives more effective? Answering these questions will help governmental legislators create incentives that are the most affective in producing results.

This study is simply a beginning in an ongoing effort to understand what influences participation in the LEED program. Coupled with the previous research in this field, this research supports the recommendations for state and local incentives, education and research, and a continued push to create awareness of the LEED program. Researchers need to continue to ask questions, challenge the aforementioned recommendations and specifically learn more about the detailed interactions between current research and LEED participation.
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