The Green Building Technology Model: An Approach to Understanding the Adoption of Green Office Buildings

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Abstract This article investigates the economic and non-economic factors that influence the willingness of building professionals to adopt green office building technology. We developed a model that analyzes the impact of four variables on the intention to adopt green building technology, as measured by the adoption of LEED and ENERGY STAR certifications. Applying our Green Building Technology Model (GBTM) to a sample of Washington, D.C.-area building professionals, we found that both economic and non-economic factors are important in the intention to adopt LEED and ENERGY STAR building technologies. The GBTM allows us to understand the factors that lead to the adoption of green office buildings, with the intended result being wider adoption of LEED and ENERGY STAR buildings.

There is a growing awareness of the need to conserve energy due to general concerns about climate change, dependence on foreign oil, and the prospect of rising energy costs. As a result, a great deal of interest in energy efficiency and social consciousness has been evidenced, as indicated by an ever-increasing number of energy-efficient buildings being constructed in the United States and most other developed nations. In fact, there are many energy efficiency, water conservation, and environmental protection efforts that are currently underway. Examples of these endeavors can be found all around the planet and include the achievement of better automobile manufacturing with increased mileage, higher use of mass transit, increased weatherization of residential units, and improvement in air quality, to name a few. The use of green building technology is another example of these efforts. With buildings estimated to account for approximately half of all annual energy and greenhouse gas emissions (U.S. Department of Energy, 2008), a contributing solution to the nation's environmental and energy concerns is to ensure that the design, construction, operation, and maintenance of buildings are environmentally sustainable.

Although there is substantial evidence of the benefits that green building technology can provide (Yudelson, 2008), the percentage of green buildings is low and is increasing at a very slow rate. Despite the economic value of certified green buildings is generally found to be positive in terms of rental rates and sales prices (Miller, Spivey, and Florance, 2008; Eichholtz, Kok, and Quigley, 2010, 2013;

Wiley, Benefield, and Johnson, 2010; Fuerst and McAllister, 2011). Decision makers involved in the construction of commercial office buildings continue to develop or maintain buildings with little or no green building technology. If more green technology is to be integrated into building projects, the gap between the benefits of green building technology and the low adoption of green building technology needs to be understood. This study was conducted to help researchers, practitioners, and society better understand the connection between the perceived benefits of and the intention to use green building technology.

To accomplish this goal, the study identifies the factors that influence office building professionals to adopt Leadership in Energy and Environmental Design (LEED) and ENERGY STAR certifications. Although many studies have focused on the economics of green buildings (Miller, Spivey, and Florance, 2008; Eichholtz, Kok, and Quigley, 2010, 2013; Wiley, Benefield, and Johnson, 2010; Fuerst and McAllister, 2011), the present study is unique in that it examines both economic and non-economic factors that compel office building professionals to adopt LEED and ENERGY STAR certifications. With an enhanced understanding of what motivates key decision makers in building projects, it is likely that the number of green buildings can be increased, as interventions such as awareness, education, and promotion campaigns can be developed and implemented to achieve that implementation goal.

In order to identify factors that lead to the adoption of LEED and ENERGY STAR rated buildings, we utilized an integrated theory of technology adoption, the Unified Theory of Acceptance and Use of Technology (UTAUT). Our study extends the existing literature on technology management by providing a comprehensive examination of the factors that lead to the adoption of green building technology. The UTAUT posits that four motivational factors collectively provide an assessment of an individual's attitude toward adopting technology: (1) perceptions of performance expectation (i.e., how well the technology performs in the environment); (2) perceptions of effort expectation (i.e., how easily the technology is adopted); (3) perceptions of social influence (i.e., how people important to the individual are believed to view the adoption of the technology); and (4) perceptions of facilitating conditions (i.e., how ready the individual's organization is to adopt the technology) (Venkatesh, Morris, Davis, and Davis, 2003). We employ and modify these factors to act as variables for research in our development of a Green Building Technology Model (GBTM). This model is used to determine the factors that lead to an individual's willingness to adopt green building technology.

The article consists of five sections. This first section provides information about the objectives of the study and background information about green building technology. The second section provides a literature review on existing research pertaining to green buildings, the UTAUT, and its relevance and applicability to the research question. The third section contains our GBTM and its methodology, including a description of the associated survey instrument, the demographic composition of the sample and its size, and the dependent and independent variables and the moderators. The fourth section provides the results, including descriptive statistics and reliability and validity tests. The final section provides an analysis and summary of the relevant findings and includes the implications, limitations, and conclusions of the study.

Literature Review

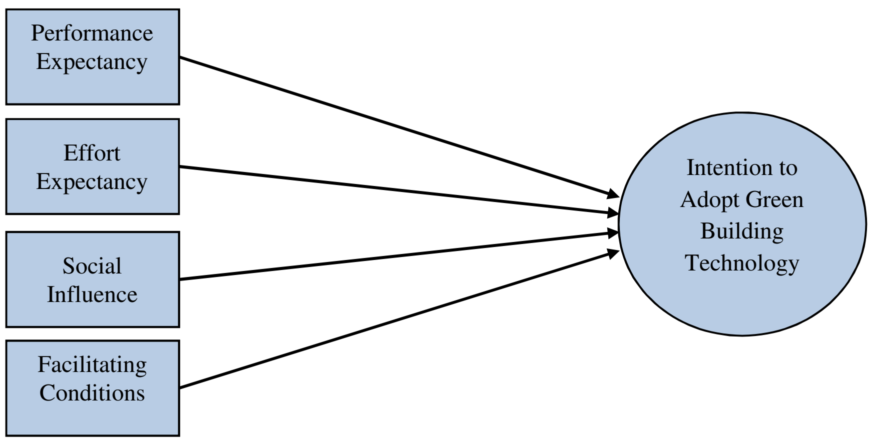
Buildings use approximately 70% of the electricity in the U.S. (U.S. Department of Energy, 2010), so a study of the factors that lead to the adoption of green building technology is potentially an important one for energy efficiency advocates. Research shows that so-called green buildings have been found to be associated with lifecycle cost savings, improvement in human performance (including productivity gains and better employee/occupant health), and an increase in prestige (Nalewaik and Venters, 2009). Although a significant amount of research has been conducted on the financial benefit of adopting green building technologies (Miller, Spivey, and Florance, 2008; Eichholtz, Kok, and Quigley, 2010, 2013; Wiley, Benefield, and Johnson, 2010; Fuerst and McAllister, 2011), little is known about the comprehensive set of factors that influence the adoption of green building technology.

We attempted to fill this research gap by gaining an understanding of building decision-makers' attitudes toward the adoption of green building technology as measured by the intention to adopt LEED or ENERGY STAR certifications for office buildings. Traditional models of technology acceptance suggest that positive attitudes about a technology result in a positive intention toward the use of that technology (Taylor and Todd, 1995), and this same assumption underpins this study. The UTAUT, as previously described, suggests that four factors (performance expectancy, effort expectancy, social influence, and facilitating conditions) contribute to an individual's attitude toward the use of green technology, as measured by the adoption of LEED and ENERGY STAR certifications in office buildings.

Although no single theory provides a definitive model for individual acceptance and use of technology (Halawi and McCarthy, 2006), the UTAUT currently holds the most promise due to its integration of eight competing models widely accepted by technology management researchers (Venkatesh, Morris, Davis, and Davis, 2003). Venkatesh, Morris, Davis, and Davis formulated the UTAUT based on the conceptual similarities between competing theories. These theories include the Theory of Reasoned Action (TRA), Technology Acceptance Model (TAM), the Motivational Model (MM), Theory of Planned Behavior (TPB), Combined TAM and TPB (C-TAM-TPB), Model of PC Utilization (MPCU), Innovation Diffusion Theory (IDT), and Social Cognitive Theory (SCT). The UTAUT consolidates numerous user acceptance models to create an integrated model that boasts an adjusted R^2 of 70% (Venkatesh, Morris, Davis, and Davis, 2003; Li and Kishore, 2006; Marchewka, Liu, and Kostiwa, 2007; Alrawashdeh, 2013), indicating that UTAUT is a dependable model for user acceptance of technology.

Generally speaking, the UTAUT has been considered a prominent and useful model in information systems adoption research and has proven to be a robust

Exhibit 1 | The Green Building Technology Model



and reliable measure of the key constructs. Validation of UTAUT in a longitudinal study found it to account for 70% of the variance in usage intention (Venkatesh, Morris, Davis, and Davis, 2003). The UTAUT has been applied to different types of technology, such as mobile services and devices (Park, Yang, and Lehto, 2007; Rao and Troshani, 2007), short message services (Baron, Patterson, and Harris, 2006), tablet PCs (Garfield, 2005; Anderson, Schwager, and Kerns, 2006), and web-based course management software (Marchewka, Liu, and Kostiwa, 2007). This study is the first to apply UTAUT to commercial real estate and green building technology. In this study, we measure the intention to adopt green building technology as the intention to adopt either of two well-known green building certifications (LEED or ENERGY STAR certifications) in the U.S.

Methodology

Our Green Building Technology Model (GBTM) is based on the UTAUT, with modifications to accommodate for green building technology (Exhibit 1). The UTAUT model includes four main constructs: performance expectancy (PE), effort expectancy (EE), social influence (SI), and facilitating conditions (FC), each of which has been described above. The theory "posits that individual expectations of performance and effort, as well as influences of both social and facilitating conditions, determine behavioral intention and use behavior," (Bray and Konsynski, 2007).

Four hypotheses derived from the research question are presented to reflect the relevant antecedents of technology adoption theoretically linked to the use of green building technology: performance expectancy, effort expectancy, social influence, and facilitating conditions. After conducting a literature review, we developed the following hypotheses:

H_1: Performance expectancy positively influences behavioral intention to adopt green building technology.

H_2: Effort expectancy positively influences behavioral intention to adopt green building technology.

H_3: Social influence positively influences behavioral intention to adopt green building technology.

H_4: Facilitating conditions positively influence behavioral intention to adopt green building technology.

The predictor variables in this study include performance expectancy, effort expectancy, social influence, and facilitating conditions. These factors are theoretically expected to affect the dependent variable: the behavioral intention to adopt green building technology. The survey items or questions used to measure the predictor and dependent variables were adapted from Venkatesh, Morris, Davis, and Davis (2003).

The four constructs are modified for the context of commercial real estate. Performance expectancy measures the decision-maker's financial performance and company's financial performance on the adoption of LEED or ENERGY STAR certifications. See questions 2–5 of the survey instrument in Appendix A. Effort expectancy measures the decision maker's view of the level of ease (or difficulty) to adopt a LEED or ENERGY STAR certification. Will the adoption of LEED or ENERGY STAR certifications require a minimum (or maximum) amount of effort? See questions 6–11 of the survey instrument found in Appendix A. Social influence measures the level of support provided by peers, family, and business associates for the adoption of LEED or ENERGY STAR certifications. See questions 12–16 of the survey instrument in Appendix A. Facilitating conditions measure whether the decision maker has the components in place to make the decision to easily adopt LEED or ENERGY STAR certifications. For example, resources availability, industry group information availability, the overall condition of the building, etc. See questions 17–20 of the survey instrument in Appendix A.

The Washington, D.C. area was selected for this study because it is a large metropolitan area that allowed us to select appropriate individuals in the commercial office real estate sector. Given that Washington, D.C. (that is, the District of Columbia) at the time of the study required certain new buildings to be LEED certified, respondents from the District of Columbia were removed from the study.

Measurement

The 28-item GBTM survey design was based on the original UTAUT survey instrument (Venkatesh, Morris, Davis, and Davis, 2003) to identify participants' perceptions of performance expectancy, effort expectancy, social influence, and facilitating conditions as they related to adopting green building technology for office buildings. Although the concept and the constructs were retained from the original UTAUT model, some changes were made to the survey to adapt to the

Exhibit 2 | Internal Consistency Reliability Coefficients

Construct	Number of Items	Cronbach's Alpha
Performance Expectancy	5	0.76*
Effort Expectancy	5	0.74*
Social Influence	5	0.75*
Facilitating Conditions	4	0.64

Note: The number of observations is 39.
*Significant at $\alpha > .70$.

study's context. The GBTM survey used a Likert-type scale to assess perceptions of the four major constructs identified in the UTAUT model. Exhibit 2 gives the coding and scaling for each question.

This survey includes one important filter question, which permitted identification of appropriate respondents. This question identifies people who make decisions for office buildings: Do you have a major influence on decisions to renovate (or develop) an office building? Only people who answered the filter question in the affirmative were included in the data analysis. In addition to the filter question, this survey instrument also included several demographic questions.

Because the original instrument was altered in this study, the reliability of the instrument was re-assessed using Cronbach alpha reliability coefficients and the scores were found to be within the ranges obtained from previous studies deemed acceptable in the relevant literature.

Results

The respondents indicated that both economic and non-economic factors were important to the adoption of LEED and ENERGY STAR buildings. Further, social influence, a non-economic factor, was found to be a direct determinant of the adoption of green building technology.

The adapted UTAUT model, social influence, and facilitating conditions were all found to have a statistically significant correlation with the intention to adopt green building technology.

Descriptive statistics were computed for the demographic variables; then, a reliability analysis was conducted for each hypothesis and the assumptions of the multiple regression were evaluated. Finally, multiple regression was used to derive the inferential statistics from which the study's conclusions were drawn.

The adapted UTAUT model was evaluated using the multiple R and multiple R^2 statistics from the multiple regression. The hypotheses corresponding to each predictor were also evaluated using non-standardized regression coefficients,

Exhibit 3 | Descriptive Statistics for Study Variables

Variable	Range	Min.	Max.	Mean	Std. Dev.
Performance Expectancy	3.60	2.20	5.80	4.48	0.80
Effort Expectancy	2.80	2.00	4.80	3.77	0.64
Social Influence	2.60	3.40	6.00	4.75	0.58
Facilitating Conditions	2.75	3.25	6.00	4.67	0.66
Intention to Adopt (DV)	3.00	3.00	6.00	5.05	0.97

Note: DV = dependent variable.

standardized regression coefficients, zero-order correlations, and semi-partial correlations.

Participants who reported that they have a major influence on the decision to renovate (or develop) an office building were included in the analysis. Of the n = 69 individuals who completed a survey, only n = 40 reported they had a major influence.

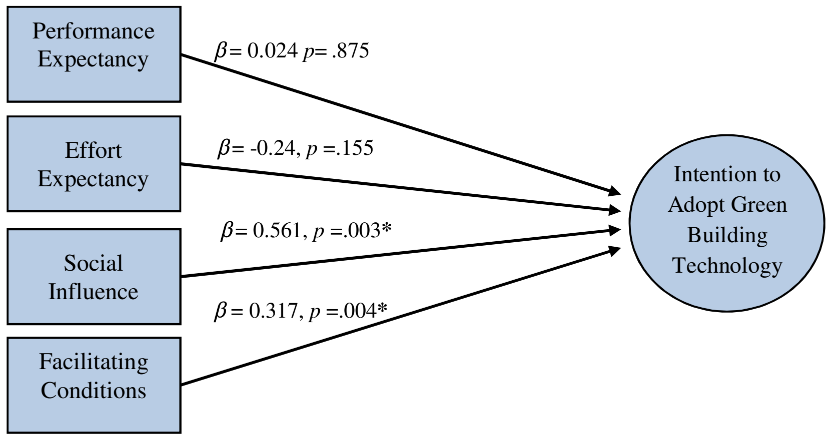
Demographics

It is also important to note that the respondents were knowledgeable about LEED and ENERGY STAR rated buildings. One contributing factor regarding their knowledge is that the respondents were all NAIOP conference attendees. As advertised, NAIOP ''provides strong advocacy, education and business opportunities... for... commercial real estate developers, owners and investors of office, industrial, retail and mixed-use properties,'' (www.naiop.com). Additionally, feedback received during the field research activity indicated that the participants were knowledgeable about the LEED and ENERGY STAR certification systems.

Construct

To assess reliability, Cronbach's alpha coefficient was computed for each construct. Cronbach's alpha is defined as a measure of the internal consistency of the items in a scale. Alpha levels above 0.70 are considered adequate (Barnett, 2002). The Cronbach's alpha coefficients for performance expectancy, effort expectancy, and social influence were all above 0.70. Further, none of the item-total correlations were negative, indicating the scales were sufficiently reliable. The Cronbach's alpha coefficient for the facilitating conditions scale was 0.64, which is less than the generally accepted level of 0.70. This value, however, is not so low as to be problematic, given the number of items in the scale (Huizingh, 2007). Descriptive statistics for the independent variables and the dependent variable are provided in Exhibit 3.

Exhibit 4 | Survey Findings by Individual Construct



Note:
* Significant at $p < .05$.

Assumptions

Univariate outliers were evaluated by comparing the z-scores to a criterion of ±3.29 (Huizingh, 2007). No univariate outliers were detected. Multivariate outliers were also evaluated. No multivariate outliers were detected.

Next, the assumptions of normality, linearity, and homoscedasticity and multicollinearity were evaluated using residual scatterplots. The analysis revealed that the assumptions for multiple regression were all met. Multicollinearity was also evaluated using bivariate scatterplots. None of the correlations between pairs of predictor variables exceeded 0.70; thus, multicollinearity was not an issue (Huizingh, 2007).

Hypothesis Findings

The hypotheses assert that the four variables when combined (performance expectancy, effort expectancy, social influence, and facilitating conditions) would predict the intention to adopt green building technology. The multiple regression of performance expectancy, effort expectancy, social influence, and facilitating conditions on the intention to adopt green building technology was significant ($R = .623$, $R^2 = .388$, $F\ (4, 34) = 5.399$, $p = .002$). The combined independent variables were strongly correlated with the intent to implement green building technology ($R = .623$) (Huizingh, 2007). Approximately 39% of the variance in intention to adopt green building technology was explained by the combined predictors ($R^2 = .388$). For illustration purposes, Exhibit 4 provides the standardized betas for each individual construct found in the sub-hypotheses. The model and construct summaries for the multiple regression are provided in Exhibits 5 and 6 in Appendix 2.

The overall UTAUT model, the social influence construct, and the facilitating conditions construct are validated. The direct constructs of performance expectancy and effort expectancy were non-significant as individual determinants.

Conclusion

The Green Building Technology Model (GBTM) explained over 39% of the behavioral intention to adopt LEED or ENERGY STAR office building technologies. Further, the non-economic factors of social influence and facilitating conditions appeared to be more important than the economic factors of performance expectancy and effort expectancy as independent determinants of the intention to adopt green buildings.

The population for this study consisted of commercial real estate decision makers in the Washington, D.C. area. The sample consisted of 39 qualified respondents. The small sample size was considered sufficient as the power was calculated at 0.84. The survey questions were adapted from the UTAUT survey instrument used by Venkatesh, Morris, Davis, and Davis (2003). The major changes from the original UTAUT survey were: (1) modifications to the questions to account for the context of the green technology artifact; and (2) a change of the facilitating conditions construct to measure behavioral intention in lieu of actual use.

SPSS version 20 was used for the statistical analysis. The response rate was about 14% ($N = 69$) out of an estimated population of 500 conference attendees. Multiple regression analysis was utilized to analyze the relationship between both the predictor variables with the dependent variable.

The four predictors when combined were strongly correlated with intent to implement green building technology ($R = .623$) (Huizingh, 2007). Approximately 39% of the variance in intention to adopt green building technology scores was explained by the combined predictors ($R^2 = .388$). It suggests that commercial real estate professionals can expect that these constructs, when combined, correlate with green building adoption.

The results indicate that performance expectancy was not a statistically significant unique predictor of the intention ($\beta = 0.024$, $t = .158$, $p = .875$) to adopt green building technology. This finding was not consistent with previous UTAUT studies (Marchewka, Liu, and Kostiwa, 2007; Gupte, Dasgupta, and Gupta, 2008; Alrawashdeh, 2013). It suggests that commercial real estate professionals do not expect the adoption of LEED and ENERGY STAR buildings to increase their performance; i.e., their personal compensation.

The results also indicate that effort expectancy was not a statistically significant unique predictor of the intention ($\beta = -.244$, $t = -1.453$, $p = .155$) to adopt green building technology. This finding was not consistent with previous UTAUT studies (Marchewka, Liu, and Kostiwa, 2007; Gupte, Dasgupta, and Gupta, 2008; Alrawashdeh, 2013). It suggests that real estate professionals do not expect that lower effort directly correlates with the adoption of LEED and ENERGY STAR building technologies.

We found that social influence was a statistically significant unique predictor of the intention (β = .561, t = 3.219, p = .003) to adopt green building technology. This finding was consistent with previous UTAUT studies (Marchewka, Liu, and Kostiwa, 2007; Gupte, Dasgupta, and Gupta, 2008; Alrawashdeh, 2013). It suggests that real estate professionals that receive positive social influence to adopt green building technology have a stronger intention to adopt LEED and ENERGY STAR building technologies.

We also found that the variable facilitating conditions was a statistically significant unique predictor of the intention (β = .317, t = 2.100, p = 0.043) to adopt green building technology. This finding was consistent with previous UTAUT studies (Marchewka, Liu, and Kostiwa, 2007; Gupte, Dasgupta, and Gupta, 2008; Alrawashdeh, 2013). It suggests that real estate professionals that experience positive facilitating conditions to adopt green building technology have a stronger intention to adopt LEED and ENERGY STAR building technologies than those who do not experience those conditions.

Of the four UTAUT independent variables, social influence provides the most significant contribution to commercial real estate professionals' behavioral intention (β = .561, p = .003) to adopt green building technology, followed by facilitating conditions (β = .317, p = 0.043).

Research has shown that favorable economics drive real estate decision-makers to "go green" (Miller, Spivey, and Florance, 2008; Eichholtz, Kok, and Quigley, 2010, 2013; Wiley, Benefield, and Johnson, 2010; Fuerst and McAllister, 2011). This study suggests that real estate decision-makers are motivated by both economic and non-economic factors to adopt green office buildings. Performance expectancy, effort expectancy, social influence, and facilitating conditions collectively correlate with the intention of real estate professionals to adopt green building technology. Social influence and facilitating conditions were found to be direct and strong determinants of the intention to "go green" in the office building sector.

While neither of the constructs of performance expectancy nor effort expectancy was found to be independently correlated with the intention to adopt green building technology, the combined model explains 39% of the intention for such an adoption.

It is also important to note that the GBTM developed for this study was adapted from the UTAUT model. The specific changes to the UTAUT model may have contributed to the outcome differences between UTAUT and GBTM. Hypotheses 1 and 2 were not statistically supported, due possibly to the changes to the questions made in these constructs to accommodate for the green building context. It is noted that there were more changes to the questions for the performance expectancy and effort expectancy constructs than to the social influence and facilitating conditions constructs, so rather than the number of changes being a potential confounding factor for the first two variables, we surmise that it was the nature of the changes themselves that may have been responsible for our partial non-verifying results. Appendix 1 provides all survey questionnaire items for reference.

Given that the majority of green building research is based on real estate economics and sustainability literature, this study provides a unique perspective. It posits that real estate professionals intend to adopt green building technologies due to both economic and non-economic factors. As a result, researchers may consider using a more comprehensive approach in studying the motivations of more sustainable behaviors.

Based on the findings of this study's analysis, we recommend that in order to increase the relative and absolute number of adoptions of green buildings, an effort should be made to increase the awareness by commercial real estate professionals of non-economic factors, particularly social influence and facilitating conditions. Specific interventions may need to be developed and used, based on the factors of social influence and facilitating conditions. For example, businesses, governments, and other organizations could include social influence factors in their marketing initiatives (i.e., websites and printed publications) that reinforce the notion that the adoption of green building technology is perceived by some stakeholders, as ''the right thing to do,'' or ''the smart thing to do.''

The UTAUT model explained over 70% of behavioral intention of the adoption of information system technology, while the GBTM explained over 39% of the behavioral intention of LEED and ENERGY STAR rated office building adoption. The findings suggest that the combined factors of performance expectancy, effort expectancy, social influence, and facilitating conditions are important to the adoption process of green building technology in commercial office buildings. As a result, emphasis should be placed on these combined factors with added weight on the social influence and facilitating conditions in order to increase the adoption rates of green building technologies. In summary, governments, industry, and other organizations should consider interventions that can positively alter the adoption of green building technology by incorporating this new understanding of non-economic factors presented by this research.

Real estate sustainability research should go beyond its current boundaries by applying the GBTM and similar models to the green building technology artifact. Many technology theories, such as UTAUT, technology acceptance model II (TAM2), and the innovation diffusion theory (IDT) may also be applicable to green building research. The practice of applying these models to technology artifacts can be worthwhile for the real estate community in order to avoid the danger of a narrowing view of sustainable real estate research. The success of this study helps support this perspective within the commercial real estate research community. Other technology artifacts, such as green technology for retail buildings, for residential real estate, and for hotels, could be tested in the future.

There is additional demand for researchers to develop effective interventions to strengthen green building adoption intentions to increase the actual adoption of green building technology. If society better understands the problem related to green building adoption, then it can take the next natural step to develop effective interventions.

The GBTM could be extended with the use of other predictor variables or moderators. Examples of other predictor variables include personal prestige, corporate philosophy, and keeping pace with others in the industry and relevant communities. Moderators may include building age, building size, and job satisfaction.

Moreover, alternate research designs might strengthen the understanding of the base model. While the current study focused on individuals within the commercial real estate industry, other studies might focus on organizations or on a more focused subset of users (e.g., only real estate developers) in order to better understand adoption behavior.

The GBTM is a new model that can be customized for examining the intention to adopt green building and related technologies. The green building movement could benefit from extending this perspective to include the use of models from other disciplines. Finally, the application of a technology model to a commercial real estate problem is an example of multi-disciplinary research that increases our ability to solve societal and multi-dimensional problems. The greening of buildings is an important process that this study attempts to better understand.

Sustainability research is rapidly growing and expanding. However, to our knowledge, this is the first research study on green adoption using technology acceptance as the theoretical foundation. It also underscores that green building research needs to consider both economic and non-economic factors.

Finally, this study confirms that our model's combined independent variables (performance expectancy, effort expectancy, social influence, and facilitating conditions) strongly correlate with the intention to adopt green building technology. Governments, industry, and other organizations can use this information as a foundation for developing new interventions to increase the number of green buildings. Researchers can use this study as a basis for a new way forward in conducting green building and related technology adoption research.

Appendix 1

Survey Questionnaire

Q1: Do you have a major influence on decisions to renovate (or develop) an office building?
1. Yes
2. No

Q2: Adopting a LEED or ENERGY STAR certification for an office building in my portfolio may increase my chances of increasing my compensation.

Strongly Disagree	Disagree	Disagree more than Agree	Agree more than Disagree	Agree	Strongly Agree
1	2	3	4	5	6

Q3: I would find a LEED or ENERGY STAR certification for an office building that I manage to be useful (in terms of marketing, public relations, or otherwise).

Strongly Disagree	Disagree	Disagree more than Agree	Agree more than Disagree	Agree	Strongly Agree
1	2	3	4	5	6

Q4: My company would financially gain in the short term (i.e., 1–3 years) if it obtained a LEED or ENERGY STAR certification for an office building in its portfolio.

Strongly Disagree	Disagree	Disagree more than Agree	Agree more than Disagree	Agree	Strongly Agree
1	2	3	4	5	6

Q5: My company would financially gain in the medium term (i.e., 4–9 years) if it obtained a LEED or ENERGY STAR certification for an office building in its portfolio.

Strongly Disagree	Disagree	Disagree more than Agree	Agree more than Disagree	Agree	Strongly Agree
1	2	3	4	5	6

Q6: My company would financially gain in the long term (i.e., 10–20 years) if it obtained a LEED or ENERGY STAR certification for an office building in its portfolio.

Strongly Disagree	Disagree	Disagree more than Agree	Agree more than Disagree	Agree	Strongly Agree
1	2	3	4	5	6

Q7: LEED or ENERGY STAR certification requirements are clear and understandable.

Strongly Disagree	Disagree	Disagree more than Agree	Agree more than Disagree	Agree	Strongly Agree
1	2	3	4	5	6

Q8: The process to obtain a LEED or ENERGY STAR certification for an existing building is easy.

Strongly Disagree	Disagree	Disagree more than Agree	Agree more than Disagree	Agree	Strongly Agree
1	2	3	4	5	6

Q9: The process to maintain a LEED or ENERGY STAR certification for an existing building is easy.

Strongly Disagree	Disagree	Disagree more than Agree	Agree more than Disagree	Agree	Strongly Agree
1	2	3	4	5	6

Q10: The time it takes to obtain a LEED or ENERGY STAR certification is worthwhile.

Strongly Disagree	Disagree	Disagree more than Agree	Agree more than Disagree	Agree	Strongly Agree
1	2	3	4	5	6

Q11: The effort it takes to obtain a LEED or ENERGY STAR certification for an existing building would be worthwhile.

Strongly Disagree	Disagree	Disagree more than Agree	Agree more than Disagree	Agree	Strongly Agree
1	2	3	4	5	6

Q12: People that I respect (other than associates) support LEED or ENERGY STAR initiatives.

Strongly Disagree	Disagree	Disagree more than Agree	Agree more than Disagree	Agree	Strongly Agree
1	2	3	4	5	6

Q13: Generally, the community at large supports LEED or ENERGY STAR initiatives.

Strongly Disagree	Disagree	Disagree more than Agree	Agree more than Disagree	Agree	Strongly Agree
1	2	3	4	5	6

Q14: Professional associates (not connected to my company) that I respect support LEED or ENERGY STAR initiatives.

Strongly Disagree	Disagree	Disagree more than Agree	Agree more than Disagree	Agree	Strongly Agree
1	2	3	4	5	6

Q15: The senior management of my organization supports the use of LEED or ENERGY STAR initiatives.

Strongly Disagree	Disagree	Disagree more than Agree	Agree more than Disagree	Agree	Strongly Agree
1	2	3	4	5	6

Q16: People who are important to me personally think that I should adopt LEED or ENERGY STAR initiatives.

Strongly Disagree	Disagree	Disagree more than Agree	Agree more than Disagree	Agree	Strongly Agree
1	2	3	4	5	6

Q17: My company has the resources necessary to obtain a LEED or ENERGY STAR certification for an existing commercial office building.

Strongly Disagree	Disagree	Disagree more than Agree	Agree more than Disagree	Agree	Strongly Agree
1	2	3	4	5	6

Q18: My company has the knowledge necessary to obtain a LEED or ENERGY STAR certification for an existing office building.

Strongly Disagree	Disagree	Disagree more than Agree	Agree more than Disagree	Agree	Strongly Agree
1	2	3	4	5	6

Q19: Industry groups (profit or non-profit groups) are readily available to assist with the process of obtaining a LEED or ENERGY STAR certification.

Strongly Disagree	Disagree	Disagree more than Agree	Agree more than Disagree	Agree	Strongly Agree
1	2	3	4	5	6

Q20: LEED or ENERGY STAR certification is compatible with the existing office building's condition.

Strongly Disagree	Disagree	Disagree more than Agree	Agree more than Disagree	Agree	Strongly Agree
1	2	3	4	5	6

Q21: I intend to seek LEED or ENERGY STAR certifications(s) sometime in the next three years.

Strongly Disagree	Disagree	Disagree more than Agree	Agree more than Disagree	Agree	Strongly Agree
1	2	3	4	5	6

Appendix 2

Results of Green Building Technology Survey

Exhibit 5 | Multiple Regression Model Summary

R	R^2	Adj. R^2	Std. Error	*F*	*P*
0.623	0.388	0.317	0.804	5.399	0.002*

Note:
*Significant at $p < .05$.

Exhibit 6 | Multiple Regression Construct Summary Table

	Unstandardized Coeff.		Standardized Coeff.			Correlations		
Model	β	Std. Error	β	*T*	*P*	Zero-order	Partial	Semi-partial
Constant	−0.331	1.287	N/A	−0.257	0.799	N/A	N/A	N/A
PE	0.029	0.183	0.024	0.158	0.875	0.224	0.027	0.021
EE	−0.368	0.254	−0.244	−1.453	0.155	0.199	−0.242	−0.195
SI	0.938	0.291	0.561	3.219	0.003	0.545*	0.483	0.432
FC	0.468	0.223	0.317	2.100	0.043	0.396*	0.339	0.282

Note:
*Zero-order correlations significant at $p < .05$.

The relationship strength is based upon the beta value according to the following categories: $\beta \leq 0.2$ is a weak effect, $0.5 \geq \beta > 0.2$ is a moderate effect, and $\beta > 0.5$ is a strong effect (Huizingh, 2007).

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