WHEN THE WELL RUNS DRY

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1 ABSTRACT

While new rainwater harvesting (RWH) products and systems are evolving beyond the simplistic rain barrel, the reasons for their implementation and adoption remain less defined. With hopes of better understanding these influences, a study was initiated to examine the relationship between RWH system incorporation in new projects and owners' reasons for inclusion.

Projects under construction or previously built that include above or below ground water capture and storage systems were targeted in Oklahoma, Texas and New Mexico due to typical arid climates between eight and forty-eight inches of annual rainfall. Factors influencing integration of RWH were determined from literature review and included in an online cross-sectional survey. Project owners were invited to complete a five level Likert scale to be used to rank the strength of influence of these factors: initial cost, perceived return on investment, government dollar incentives, geographical factors, product availability, available design and installation expertise, aesthetics, maintenance, education, social reluctance, legislation and regulations, marketing, storm water management, LEED and environmental concern.

The results show that rain water harvesting practitioners believe that implementation is due to an environmental ethic, rather than economic incentive or environmental regulation. Further discussed is the strength of influence for any type of building project (office buildings, schools) and building feature (rain water harvesting, LEED credit categories). This study contributes to a greater understanding of the influences associated with water conservation through integration of rainwater harvesting and reuses systems in new building construction projects.

1.1 Keywords

Rainwater harvesting (RWH), LEED, water conservation, water reuse

2 INTRODUCTION

Water could be viewed as the new oil. It is a natural resource and while once plentiful, it has become the focus of tension and competition as demand continues to increase. Benjamin Franklin said "When the well runs dry, we will know the worth of water." While we haven't run dry yet, many would agree that we are wasting, contaminating, and mismanaging our water resources. Like oil, a defining resource of the twentieth century, for most of human history, water has been a crucial resource. In coming years it will reassume its natural dominion placing water on high as the defining resource of the twenty-first century (Pru'd Homme 2011). While cities continue to grow, ground water is increasingly threatened, even depleted, and reservoirs are built for municipal water supply. In order to adapt we must acknowledge this reality, and unlike oil, the good news is water is renewable by means of reuse practices.

With population growth and urban sprawl surging, commercial property owners are turning towards on-site rainwater harvesting or RWH, the practice of capturing and reusing site rainfall, as a form of environmentalism and security for an increasingly limited resource. Understanding why these management decisions are made is critical to the sustainable future of the earth's water supply. While humans may pollute, overuse, and waste it, we cannot destroy the water sources. The challenge for humanity here is to focus on management and education. Using RWH systems may contribute to environmental awareness and education (Winterbottom 2002).

Recognition of this challenge is the major motivation for this research that uses quantitative data to measure the strength of influences on owners to integrate rainwater catchment systems into new construction projects. The importance of the findings lies in how they can be further used to adjust current sustainable construction practices. Initial research began with determining influences and defining through interviews and literature review. Using a survey, influences are weighted by frequency of selection by participants in order to establish means. These means determine the strongest influencing factors such as initial costs or product availability.

Despite available research, the answer to what the strongest influences are on project owners to install RWH systems has seemingly yet to be determined. Based on previous work however, there is evidence of factors that influence inclusion. David Crawford of Rainwater Management Solutions and expert in the field of RWH has defined several roadblocks that he feels effects adoption of RWH systems. He found that RWH is new to many clients, designers, and contractors, therefore resulting in high bids due to unfamiliarity. Crawford also theorizes that consistency in design would result in simplifying installation and therefore result in utilization of such systems by more builders and developers in new projects. He also explains there are regulatory hurdles, such as multiple agencies involved in the regulation of rainwater. Crawford lists the following agencies as being involved in regulation: EPA, Department of Health, Department of Conservation and Recreation, State Water Control Board, Department of Environmental Quality, local plumbing inspectors, and the USDA. "The big picture here is that RWH is still new to a lot of people, builders and developers. Consistently designing, installing, and selling systems that actually work is the best thing we can do to remove the roadblocks. Bad systems will just validate people's fears." (Crawford, 2011).

Billy Kniffen of Texas A&M University, an Education and Development Specialist with the American Rainwater Catchment Systems Association, has produced much RWH research over the last decade. Through his studies he formulated the following factors that currently affect adoption of rainwater harvesting system installation and use (Kniffen, 2011).

Crisis - Defined as the fear of a lack of water i.e. drought in arid regions.
Fear - A fear of aquifer drainage, contamination, and salinization of water affects population, growth and economic conditions. This is one of the most significant factors affecting adoption.
Catastrophic Events - Events like floods and earthquakes causing the public to become more interested in water control methodology.
Education – Better educating the public and decision makers.
Leaders Paving the Way - The "early adopters" as Kniffen labels them, are those whose efforts, passions, and driving knowledge pave the road to RWH becoming a way of life leading others to follow suit.
Right Products - RWH tools that are effective, low maintenance, and accessible.

Peer Pressure - Kniffen refers to this as a “keeping up with the Joneses” scenario where a failure to participate will end in losing ground and a failure to act can leave constructors permanently disadvantaged as other companies trudge forward with a sustainable mindset.
Do Our Part - At the heart of the matter lies a healthy planet. This can be as simplistic as the fact that people hold a legitimate concern for the environment and the ecosystem in which it lies. Influenced by the internal need to participate in the game of resource reuse, this element may be one of the most simplistic influences, however research shows it to be increasing.

The importance of the study findings lies in the knowledge gained about the motivating factors effecting RWH system adoption. The study concludes by proposing further research based on the relationships discovered with the sample population and influential factors.

3 THE STUDY AND METHODOLOGY

The guiding assumption of the study is that perceived return on investment would have the strongest influence on owners to RWH systems in new construction projects. In The Wealth of Nations, Adam Smith describes what he labels the “diamond-water paradox.” Smith points out that while water is essential for survival, diamonds, which have merely aesthetic value, commence and interestingly and quite substantially higher market value. Galeleo Galilei supports Smith’s theory hundreds of years prior when he said “it is scarcity and plenty that makes the vulgar take things to be precious or worthless; they call a diamond very beautiful because it is pure like water, and they would not exchange one for ten barrels of water.”

Current research shows to support both views concerning water and monetary correlation as well as propose how costs of RWH can affect installation of such systems. In Arlington County, Virginia, a cost-benefit analysis at commercial facilities considered the feasibility of meeting water demands in modern commercial buildings using rainwater harvested on site as well as the economic viability of the harvested water versus municipal water supplies. The study determined that regardless of whether municipal water is readily available, private developers are most apt to incorporate these systems into commercial development designs if the benefits justify the costs (Hicks, 2008).

3.1 Intent and Significance

Water conservation practices have become a major issue of concern for U.S. communities in recent years. Particularly in the study’s focus region, Oklahoma passed House Bill 3135 that made $35,000 available for the implementation of water conservation projects. This ‘Dust Bowl’ state remains acutely aware of the need for water reserve and reuse based on historical misfortunes. After a visit from storms in May 1935, the St. Petersburg Times reported that the Nation’s Dust Bowl has become a rain barrel, even though some areas only received less than an inch. This article described the region as powder dry as the welcomed drops patterned steadily and became music to the ears of residents and life itself, as crops and pastures suffered alongside. Rain barrels were used in this era to account for such difficult times the nation was enduring. It was out of obvious solution to severe necessity. While there are new technologies, products, and systems emerging derived from the simplistic rain barrels used many years ago, these systems and methods are taking time for unrelenting adoption in spite of what history forewarns us.

The problem is that the influences associated with the implementation of such systems are neither determined nor defined to even begin to address actual system integration into projects. The majority of research reviewed for purpose of this study was nested under significance of system optimization and performance. One study examined, by the Texas Water Development Board in January 2011, focused testing and analysis on the effects of roofing materials on water quality. Another study, prompted by severe drought, was conducted by a computer-simulated model in order to evaluate the use of RWH systems in the Southeast region of the U.S. Three cisterns in North Carolina were used where the model simulated system performances of 2,081 larger rain barrels and cisterns in order to use historical data and anticipated usage. The results showed the RWH systems to be underutilized.

The intent of this study is to explore the relationship that exists between rainwater harvesting systems, and influences on project owners to integrate them when building new structures. This research was designed to create awareness of the influences associated with water conservation through integration of rainwater reuse systems in new construction projects. The strength of influence will be

determined for factors affecting adoption and implementation of rainwater harvesting systems in new building projects in order to explore the relationships that exist.

3.2 Limitations

The parameters of this research include owners of construction projects currently under construction or previously built and still fully operating, that include above or below ground water capture and storage systems in a region with annual rainfall between 8 and 48 inches per year. Given those limitations, the states of Oklahoma, Texas, and New Mexico were selected due to the statistical similarities such as typical arid climate and range of annual rainfall. There are roughly 3 different ranges: Low (8”-16” or below), Medium (16”-32”), and High (32”-48”) (National Oceanic and Atmospheric Administration, 2011).

3.3 Methodology

In an effort to delineate between the influences and their individual strengths, an online survey was chosen for data collection. It was considered to be the most appropriate method for this particular study, because it was a true way of obtaining information directly from the selected population. The design consists of an online cross-sectional survey of project owners who installed RWH systems in their buildings or projects under construction or recently constructed.

A 5-Level Likert scale is used in order for the participants to rank the influences of each factor identified. Inferences were developed by research and literature review. When responding to a specific item, respondents specify their level of agreement or disagreement using the scale. Weakest, Low, Medium, High, and Strongest influence ratings indicate the strength of influence for each survey question based on the owners’ decision to include of a RWH system in a new construction project.

3.4 Data Collection

Projects were initially targeted based on known inclusion of rainwater harvesting, project type, the owner, and cost. After contact was made and an appropriate responsible party identified, each owner was sent a link to an approximate 30 minute maximum online one-time non-experimental quantitative data collection survey through www.surveymonkey.com. Notification of the survey link was delivered via email to each targeted participant.

3.5 Survey Questions

The survey consisted of two parts with the first part to qualify the participants and the second identified influences for inclusion of RWH systems in the project as factors. Qualified respondents were to rank the level of perceived strength of influence on a scale of 1 to 5; 1 being the weakest and 5 being the strongest. The following instructions were given to respondents for question 5a through 5o to rate the Influences in their decision to include the RWH system in their project. The categorical areas included:

1. **Initial Cost** - Cost of products and installation.
2. **Perceived Return on Investment -** Current knowledge of financial loss/gain.
3. **Government Dollar Incentives** - Grant monies or tax reliefs.
4. **Geographical Factors** - Drought, flooding, earthquakes.
5. **Product Availability** - Proper and effective manufactured products, techniques and systems to meet intended need.
6. **Available Design and Installation Expertise** - Inconsistency in design creating a lack of standard procedure or higher costs for labor at installation.
7. **Aesthetics** - Visibility aspects of cisterns, catchment systems, or retention ponds.
8. **Maintenance** - Need of maintenance or availability of parts and customer service or discrepancies for who facilitates maintenance after installation.
9. **Education** - Informed public and key decision makers.
10. **Social Reluctance** - Reluctance to accept change by the public, laborers or municipalities.
11. **Legislation & Regulations** - Codes & standards, local officials and water authorities.

12. **Marketing** - Tool for gaining eco-conscious praise/recognition or incentive for owners to follow "green" trend.
13. **Stormwater Management** - Runoff management and benefits.
14. **LEED** - RWH used for Water Efficiency credit.
15. **Environmental Concern** - Legitimate concern for environment and need for sustainable building practices.

3.6 Study Sample

Twenty projects were discovered in the sample area through various public or trade resources such as U.S. Green Building Council case studies. Eleven projects were targeted from New Mexico, Oklahoma and Texas that qualified based on project type, owner, cost and completion date between 2005 and 2010. Of those eleven, eight participants allowed direct communication with the owner or owner's representative to obtain further information and agreed to complete the survey. These projects are listed in Table 1.

Table 1. Demographic and Basic Project Information

Demographic and Basic Project Information				
Participant	Name/Location	Project completed	LEED Certified	Total Cost
3	Sandia Prep School Field House Addition Project	2005-2010	NO	Cistern $125/ Total construction $4.5 million
4	Marc Heitz Chevorlet -	2005-2010	NO	$22,000
6	Bishops Building,	2005-2010	Yes, Gold	$20+ million
7	Agriculture Resources Center, OSU-OKC campus	2005-2010	NO	Donated - approx value $60000
8	Jefferson Elementary	2005-2010	NO	$7,000
9	Skyline Elementary,	2005-2010	NO	$10,000
10	Shangri La Botanical Gardens and Nature Center	2005-2010	Yes, Platinum	$30 million
11	Denton Fire Station #7	2005-2010	Yes, Gold	$3.2 million

4 DATA AND ANALYSIS

As part of the analysis a mean score is calculated for each response to determine the strongest degree of influence that explains how the factors rank against each other. The mean scores are the calculated average across all eight participants for each of the factors tested. The averages give a rank order to the influences. For example, environmental concern had the most 'highest influence' numbers. The higher the number on the ranked means (averages) reflects a stronger influence. The lower the number, 1.87 Government Dollar Incentives for example, means the least amount of participants responding to that factor as a strong influence. Table 2 lists the mean responses to the factors using the following measurement indicators: 5- Strongest Influence; 4- High Influence; 3- Medium Influence; 2- Low Influence, 1- Weakest Influence.

Environmental Concern weighted the strongest influence among participants with the highest mean score of 4.38. See Figure 1. Government Dollar Incentives proved to be the weakest influence, with an average of 1.87 indicating grant monies or tax reliefs ranked low on determining an owners' decision to install rainwater harvesting systems. According to the mean scores reported in the study it appears owners of projects hold a concern for the environment and see a need for sustainable building practices more than any of the other factors effecting influence on their decision to integrate the systems. Marketing, calculated at 4.25 ranked just below Environmental Concern. It's worth noting that other factors pertaining to the environment such as LEED, a sustainable building ranking system based on

weighted credits by the Leadership in Energy and Environmental Design, and Geographic Factors were ranked considerably lower at 2.38 and 2.25 respectively.

Table 2 Mean scores of participant responses across all influential factors

Influencing Factors	Mean Score
Environmental Concern	4.38
Marketing	4.25
Education	4.13
Stormwater Management	3.25
Product Availability	2.75
Available Designs & Installation Expertise	2.5
Maintenance	2.5
Social Reluctance	2.5
Aesthetics	2.38
LEED	2.38
Geographical Factors	2.25
Initial Cost	1.88
Perceived Return on Investment	1.88
Legislation & Regulation	1.88
Government Dollar Incentives	1.87

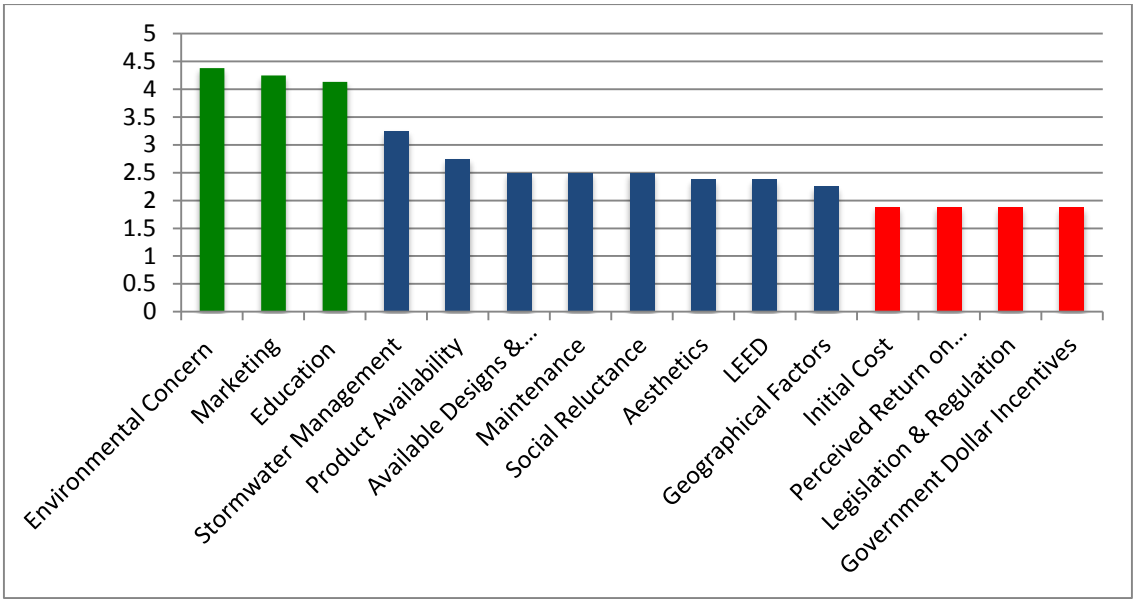

Figure 1. Mean scores of participant responses across all influential factors

Education with a 4.13 average is placed below Marketing indicating still a high level of influence on project owners. Stormwater management with an average response of 3.25 was a medium influence. Product Availability, Available Designs and Installation Expertise, Maintenance, and Social Reluctance had an average means of 2.50 indicating moderate influence.

Initial Cost, Perceived Return on Investment, Legislation and Regulation and Government Dollar Incentive all had similar averages at around 1.88. These factors had the least influence on respondents' decision to integrate. Among these considerably lower influential factors, Perceived Return on Investment disproved the study hypothesis and the average of 1.88 is also quite a low in comparison to the other included influences.

4.1 Study Sample

Table 3 illustrates the frequency and percentages of participants' responses to each influential factor. The data displayed represents how participants viewed each factor separately.

Table 3 Frequency and percentages of participant responses to each influential factor

	Weakest Influence		Low Influence		Medium Influence		High Influence		Strongest Influence	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%
Initial Cost	2	25.0%	5	62.5%	1	12.5%	0	0.0%	0	0.0%
Perceived Return on Investment	2	25.0%	5	62.5%	1	12.5%	0	0.0%	0	0.0%
Govt. Dollar Incentives	6	75.0%	0	0.0%	0	0.0%	1	12.5%	1	12.5%
Geographical Factors	3	37.5%	2	25.0%	2	25.0%	0	0.0%	1	12.5%
Product Availability	1	12.5%	3	37.5%	2	25.0%	1	12.5%	1	12.5%
Available Designs & Installation Expertise	1	12.5%	3	37.5%	3	37.5%	1	12.5%	0	0.0%
Aesthetics	3	37.5%	2	25.0%	1	12.5%	1	12.5%	1	12.5%
Maintenance	0	0.0%	4	50.0%	4	50.0%	0	0.0%	0	0.0%
Education	3	37.5%	0	0.0%	0	0.0%	1	12.5%	4	50.0%
Social Reluctance	2	25.0%	3	37.5%	1	12.5%	1	12.5%	1	12.5%
Legislation and Regulations	3	37.5%	3	37.5%	2	25.0%	0	0.0%	0	0.0%
Marketing	0	0.0%	0	0.0%	2	25.0%	2	25.0%	4	50.0%
Stormwater Mgmt	1	12.5%	2	25.0%	2	25.0%	0	0.0%	3	37.5%
LEED	3	37.5%	2	25.0%	0	0.0%	3	37.5%	0	0.0%
Environmental Concern	0	0.0%	0	0.0%	2	25.0%	1	12.5%	5	62.5%

Initial cost - Cost of products and installation. 62% of participants felt that the initial cost of installing RWH systems along with the cost of all of the different components, equipment, and necessary products was a relatively low influence. One participant reported that initial cost was a medium influence on their decision. Two participants believed that initial cost had little to no influence on their decision and ranked initial cost as the weakest influence.

Perceived return on investment – Current knowledge of financial loss/gain. Contrary to the proposed hypothesis of this study, the majority or 62.5% of participants ranked perceived return as 2 – (low influence) on a scale of 1 to 5 where 5 was the highest influence. Two participants claimed that the consideration of financial loss or gain in fact had the weakest influence in their decision. While no

participants responded to perceived return having a strong or high influence, one participant believed it to be an evenly weighted influential factor and selected 3- medium influence.

Government dollar incentives - Grant monies or tax reliefs. 75% of respondents believe government dollar incentives to be the weakest influence during project design decision-making regarding RWH system integration. Two respondents selected high and strongest on the scale indicating that tax relief or grant money incentives were very influential. Whether these projects took the incentive monies or reliefs was not asked of participants. However, it could be interpreted due to two respondents believing it to be on the opposite end of the scale as a high or strongest that they were able to take advantage of such incentives.

Geographical factors - Drought, flooding, or earthquakes. The frequency of respondents of the survey seemed to be more evenly distributed regarding geographical factors influencing participants. One participant responded as it having the strongest influence. Two participants each felt that geographical factors had medium or low influence. The remaining three participants agreed that geographical factors had the weakest influence.

Product availability – Proper and effective manufactured products, techniques, and systems to meet the intended need of the project. One participant ranked product availability as the strongest influence and one the weakest influence. Remaining respondents ranked influences in between. 37.5% perceived product availability to be a low influence.

Available designs & installation expertise – Inconsistency across designs that in turn creates a lack of standard procedure or even higher costs for labor at the time of installation. One respondent believed expertise to be the weakest influence and contradictorily one chose it to be a high level of influence on decision-making. Three respondents ranked expertise as a low influence and three felt it was a medium influence.

Aesthetics – Visibility aspects of the cisterns, catchment systems, or retention ponds on project sites. 57% of respondents felt that aesthetics was the weakest or low influence. Two respondents, on the opposite end of the scale, ranked aesthetics high and the strongest influence.

Maintenance – Need of maintenance or availability of parts and customer service or discrepancies for who facilitates maintenance after installation. Results for maintenance showed interesting percentage of participant responses. 100% of respondents felt that maintenance was a low or medium influence for RWH integration in the project. Half responded to low and the other responded to medium which shows an equal split, but nevertheless an overall low to medium overall outcome.

Education – Informed public and key decision makers. The issue that RWH is still new to a lot of people leading to misunderstandings and misconceptions that create roadblocks.

Half of the respondents felt that education had strongest level of influence. One respondent scored it as a high influence however the remaining three respondents ranked education as the weakest. The frequency here shows results that are spread throughout the entire ranking scale. Respondents agreed that an educated public or decision makers strongly effect their decision to integrate RWH into their projects, or they don't feel as if it has much of an influence, if any on their decision making. This could possibly be related to location of the respondents and could be further explored in future research**.**

Social reluctance – The reluctance to accept change by the public, laborers or municipalities. While at least one participant responded to each of the five in the rankings, three ranked social reluctance as a low influence. One participant marked it as the strongest influence.

Legislation & regulation – Referring to the codes and standards, local officials and water authorities involvement and regulations. The idea that too many agencies are involved and/or standards are thoughts to be scattered and tend to vary from state to state and city to city (no standard set).

All participants ranked regulatory standards as a medium or less influence.

Marketing – Marketing used as a tool for gaining eco-conscious praise, recognition, or incentive for owners to follow the green trend. Half of the respondents agreed that marketing played a role when deciding to integrate RWH systems in their projects and ranked it as the highest influence amongst other factors. Marketing also averaged the second highest influence. The remaining participant responses were split as the table above shows 25% ranking it as medium influence and the other 25% as high influence. No survey respondents perceived marketing anything lower than medium, therefore attesting that using RWH system integration in projects as a tool for show is an incentive.

Stormwater management – The benefits of runoff management. Three respondents ranked the influence of beneficial runoff management as the strongest influence. One respondent ranked storm

water management as the weakest influence and the remaining responses were split between low and medium.

LEED – The use of rainwater harvesting system employment in project scope for Water Efficiency credit gain. Three participants found LEED to be the weakest influence; three also found it to be a high influence. A quarter of the respondents however ranked credit achievement as a low influence and either did not pursue LEED certification or did not find it influential in determining credits in pursuit.

Environmental concern – Holding a legitimate concern for the environment and seeing a need for sustainable building practices. Environmental Concern had the highest overall frequency of respondents for a single factor, but those 62% of respondents also ranked it as the strongest influence on the owner's decision to integrate the RWH system. No participants considered environmental concern less than a medium influence.

4.2 Discussion

Decision makers of RWH tend to be influenced more by the aspiration to support the environment rather than the proper economic incentives and return on investment. The responses provided by the sample pool of property owners and project managers did not support the position of Crawford (2011), Kniffen (2011) and the findings of Hicks (2008). Instead, the project managers perceived environmental concern as the most influential factor. It was grouped with marketing and education (score > 4.0) as primary factors influencing adoption of RWH. Furthermore, according to the mean score results, all economic factors (scores < 2.0) ranked as the lowest four of all influential factors. According to the results, owners hold a more legitimate concern for the environment over issues related to economics all other influential factors in relation to RWH.

This raises question to the relationship with the geographical limitations of the arid climate. Are buildings located in arid climates, such as those included in this study, more likely to include RWH systems in their building projects because of legitimate care for the environment or simply a fear of drought? With a mean score of 4.38 Environmental Concern was ranked the strongest influencing factor and the biggest influence which supports the assumption that participants in the studied region have a vested interest in the environment. Geographical factors such as the fear of drought, flooding or earthquakes had a mean score of 2.25, ranking it as a lesser influence.

These findings encourage the idea of rainwater reuse on site. Echols and Pennypacker (2012) show how stormwater is "artfully" displayed across goals of education, recreation, safety, public relations, and aesthetic richness. By deploying a rainwater harvesting system as a designed landscape the site can engage ecological goals as well (Meng, 2009). When clients are influenced by environmental concerns they may be more apt to use RWH solutions that achieve multiple goals.

Marketing closely followed Perceived Return on Investment as half of the respondents ranked marketing as a 4- high influence. With Marketing defined as a tool for gaining the eco-conscious consumers and seeking a label of being green, one could see a closeness to return on investment if translated as a tool for owners to gain profits. However, results show only a 0.13 mean difference between marketing and environmental concern with both holding a high influence on owners to include RWH systems in their projects. If marketing aspects of RWH are interpreted as owners simply desiring to be a part of the green trend and hold desirable eco-conscious attributes, it is related to concern for sustainable building practices.

With interest in the environment ranking higher as an influence one might assume LEED certification would closely follow. Following this assumption it is worth noting LEED credit achievement actually had a mean score of 2.38, placing it somewhere between medium and low influence and seven factors below marketing. This result appears contradictory as owners often proudly display a project's LEED certification for recognition and use it as a marketing tool when the project is intended for owner occupancy. Rarely has a project been LEED certified where certification is not displayed in some way and by definition LEED, "Leadership in Energy and Environmental Design" (USGBC, 2012) it could be assumed that a tool for using LEED as signification of leadership would be advantageous. To further understand how this information might affect sustainable construction, the data was scrutinized more closely to investigate LEED certified projects and respondents' feedback on the remaining influences in a LEED Cross Examination found in section 4.3.

Speaking to the limited data set applied in this study, it has been mentioned that the 40% response rate could be improved for future study purposes. However it is notable that half of all surveys receive a 26% response rate and the average is 32.42% according to Michael Braun Hamilton, an online survey analyst. Therefore, while the sample size could be improved it still holds validity in the findings due to recorded averages. Another interesting query uncovered is whether or not the sample size had any relevance towards the geographical location of the projects studied. The three factors ranked on the strongest to highest end of the scale (Environmental Concern, Marketing, and Education) could be interpreted as emotional or social influences. The bottom three, (Perceived Return on Investment, Legislation & Regulation, and Government Dollar Incentives) on the other hand, are more rational influences. Geographical location of the sample utilized may be able to explain the results if looked at in future research. Furthermore, what exactly tips the scale from emotional to rational given the factors that lie in between? All of these issues could also be examined in order to advance additional findings.

4.3 LEED Cross Examination

Of the eight projects included, three were LEED certified. Of those two were Gold Certified. One project was Platinum Certified, ranking the highest on a scale of Certified, Silver, Gold and Platinum. Of the three LEED certified respondents, two were commercial buildings and one was municipal. Using these three respondents' data, a LEED certification cross tabulation was created for each survey factor ranking question.

Two of the three LEED project respondents replied with a 5 - strongest influence that environmental concern had on their decision to integrate RWH systems. One respondent regarded LEED credit achievement as a medium influence. The LEED certified respondents did not rate LEED credit achievement as strongly and ranked it as a 4 - high influence. Based on this comparison it can be assumed that LEED certified project respondents' influences concur with the previously theorized assumption that they do in fact hold a legitimate concern for the environment.

As discussed previously LEED certification and marketing appear to be related. One respondent did feel that using RWH for Marketing was highly influential and gave it a score of 4. The remaining two respondents in the cross-examination of Marketing, felt it was of medium influence. Given those results, it is then noticeable that of those LEED certified project respondents, all felt little to no influence perceiving return on investment. Furthermore, all three respondents were in agreement that the incentive of tax breaks or funding aid from the government had the weakest influence upon their decision for RWH in their projects. This supports the assumption that dollar relationships were of little importance. Results in Table 3 show four out of eight projects that were not LEED certified, marketing held the strongest influence. These respondents also ranked marketing higher than those LEED certified project respondents. Recognizing the limited data set, marketing a project as eco-friendly by use of RWH is supported whether a project is LEED certified or not. Owners appear to possess high environmental values as well as a perceived need for sustainable building.

It is also worth noting that this study holds structural value in that it could be employed for further research, particularly aimed at LEED features. If replicated, the methodology could be used to discover strength of influence for each individual LEED credit category and pique interest for further examination in this arena.

5 CONCLUSION

Evaluation of the study data means, frequencies, relationships, and cross tabulations revealed the following conclusions. This study proposed a hypothesis stating that perceived return on investment has the strongest influence on owners to integrate rainwater harvesting systems in new construction projects. This was disproved according to responses to the survey. The findings extracted from the limited data set strongly indicate that the decision to install RWH systems in building projects is influenced by many factors. The strength of influence associated with perceived return on investment was weakest to low according to mean scores of all respondents.

With a mean score of 4.38, Environmental Concern was ranked the strongest influencing factor in relation to the other included factors. It can be concluded based on the findings that environmental concern is the biggest influence on owners to integrate RWH systems included in building projects indicating a vested interest in the environment and sustainable building practices.

Marketing was the second strongest ranked influencing factor among study respondents. It can be concluded that respondents recognized the value of the green trend and were highly influenced by the use of marketing as a tool to gain eco-conscious praise and recognition.

Perceived return on investment had minimal influence on LEED certified and school related projects. Respondents felt that environmental concern was the strongest influence. Again, gain of eco-conscious recognition is assumed.

The authors feel that this study methodology can be replicated focusing on other U.S. climate regions, specific project types, and specific sustainable features within a building rating system to further explore the use of RWH systems.

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