Potential Roles and Responsibilities of a Green Building Contractor

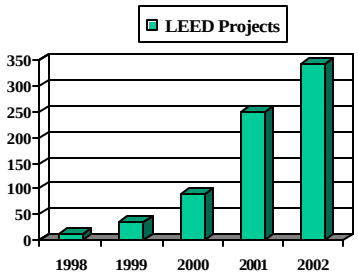
Why should we care?

In recent years, our society has become aware of the environmental changes happening to the earth such as ozone depletion, loss of natural resources, pollution of air and ground water, overabundance of waste, the spread of disease, over populated cities…..…. It has become clear that the characteristics of our earth (ecosystems and regions) are in turmoil, leading to a future for humanity that is indefinite and controlled by the decisions we as a society make today.

Why go green with construction?

The Construction Industry makes up 8% of the economy's Gross Domestic Product, and while economic activity pursues on, it has become clear that construction plays a significant role in the degradation to our earth. It is for this reason that many members in the construction industry and society have sought to influence and change the mentally of the way we are building now is the most effective and cost beneficial. Building environmentally friendly has become the wave of the future. Just over the past few years, the green design and construction approach has had significant impacts of increased occupant's health and worker productivity due to comfortable environments, reduced operations and maintenance costs, reduced energy rates, high return on investments, less wasted solids and water generated, and the increased protection of valuable/endangered ecosystems such as wetlands.

Literature Review:



In 1998, there were a total of 12 buildings registered for the Leadership in Energy and Environmental Design (LEED) Program in the United States. By 2002, there were approximately 340 buildings (See table to right). Green construction has taken a prominent presence in the U.S. just in the last four years, providing a chance for a company to be a differentiator. The challenge construction companies most often face when opting to enter the new market of green construction is the learning curve of green design and procurement. Many contractors of the industry find themselves unsure of what their role even incorporates. They are fed with the notion that there will be

more work leading to more expensive overhead and general conditions. Contractors also assume that they may play the same role as other construction projects, providing a significant role in construction services, and avoiding the design/engineering aspect of the building process.

After extensively exploring search engines on the internet, journal articles, and green building design workshop material from the LEED Accreditation class, it became evident that there was little educational material available for the roles and responsibilities a contractor would likely face on a green or LEED project as a whole.

During my search, I encountered what seemed to be the same material all presented in a different ways. This material focused on the design phase of construction. Research produced by Finland, Sweden, Canada, Australia, and professional societies such as ASHRAE, had created papers written on the development of a green team and the integrated design strategies that came along with this idea. Many others included Case Studies to support the issues addressed. While developing support towards green teams were tackled, issues the contractor may directly face in this pre-planning and pre-construction area of a project would not thoroughly stated in any one source. By far, the best information provided for a contractor addressing the entirety of a green project, design through construction, was encountered in a book written by an architecture firm, Hellmuth, Obata, + Kassabaum (HOK) in Kansas. While this information can be extremely helpful for a contractor, it lacks full content of the construction roles themselves, and once again addresses more pre-planning to a project.

My greatest success to finding the responsibilities a contractor might likely face on a green project did not come from one source, but from a myriad of checklists and guidelines, many not even specifically written for a sustainable project. The most prominent of these guidelines include ways to handle construction waste recycling or indoor air quality during construction. My search iterates the assumption that contractors can provide only these limited services on a sustainable project. There was limited research to show that contractors can have a significant role in training, site development and conservation, energy conservation, building material use, and pollution prevention. These areas during a project are assumed to be limited to the services provided by a designer or engineering role and do not explore the opportunity of getting the contractor involved.

Goal and Objective of Research:

The goal of this thesis research is to define the potential roles and responsibilities a contractor may perform on green building construction projects during the phases of pre-construction and construction. The objectives include the following:

- To develop guidelines of valued added activities a contractor may perform during a green project.
- To identify the various roles a contractor may have the most and least significant impact on during the pre-construction and construction phase
- To identify the different perceptions and the ability of the contractor through different professionals in the construction industry.
- To establish industry knowledge of contractor misconceptions or consistent thinking, in addition to future areas of research for this area

Methods of Research:

I established a network around the United States of experienced contractors, engineers, architects, consultants, and owners who had been involved and understand the green building process. I chose to have my study incorporate a wide variety of professions to grasp a concept of the role of the contractor from all members within the industry. I allowed for less experienced and more experienced individuals. Some of the professionals were LEED (Leadership in Energy and Environmental Design) accredited and some were not. Due to the LEED Accreditation being fairly new, I choose to not make this a major factor as many could have more years of sustainable experience and may not have the label to their name. I also focused on establishing people from areas around the top rated LEED states in the nation (California, Pennsylvania, Oregon, New York, Texas, and Washington D.C.) where there might be more of a reputable presence of professionals.

While establishing a network of individuals to ask to participate in my research, I produced a guideline of potential roles of a contractor, developing my criteria around the LEED areas of Site Planning, Energy and Atmosphere, Water Conservation, Waste Management, Indoor Air Quality, and Building Materials. I addressed these areas in two phases of a construction project, pre-construction and construction. Other information was gained through contacts, and elaborated more through research of existing literature. I choose to additionally add the topic areas of General, Education, and Air Pollution Prevention.

I used the roles I had devised to create a questionnaire to send to my research contacts. The questionnaire (Appendix E) consisted of 5 pages and asked the participants to respond by the following ways:

(1) Rank each of the 94 roles listed on a 1-4 scale.

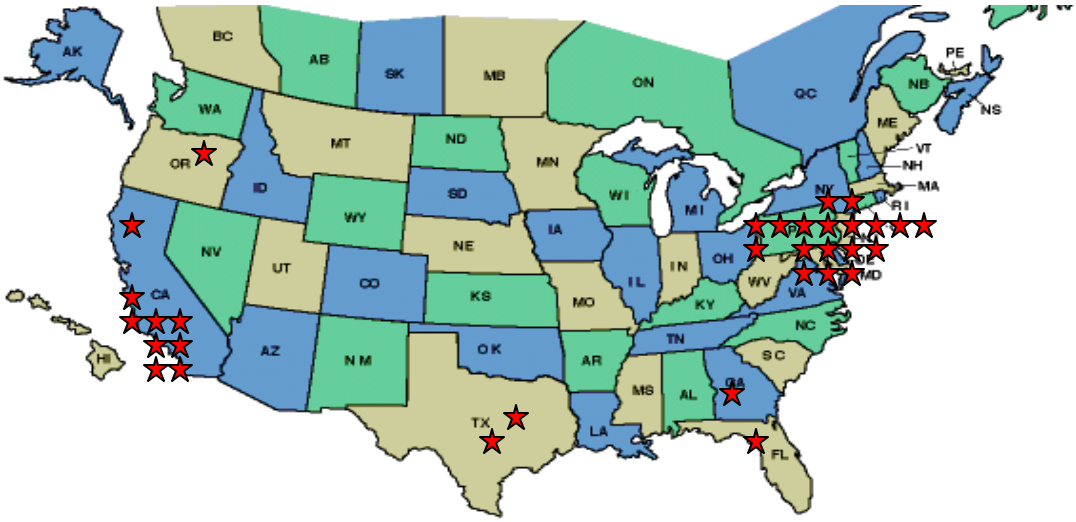
- 1= Contractors have no impact on the role
- 4= Contractors have significant impact on the role

(2) Respond with comments throughout the survey at the areas provided.

I also found it critical to my research to acquire their name, company, position, role, years of experience, and contact information. I felt that this was not a survey that was meant to be anonymous, and their credibility would be a factor in the results.

Results:

Thirty-two of seventy surveys were returned. The diversity of experienced opinions over the United States was successful. The stars on the graph represent each questionnaire respondent.



Part 1- Data:

To organize my results, I first grouped the respondents into their different areas of work (designers, contractors, etc.). This produced the following:

- 16 Contractors
- 3 Design-Builders
- 5 Architects
- 3 Consultants
- 4 A/E Managers
- 1 Owner

In addition to tabulating all 32 responses, I narrowed down the groups to well experienced people only, and retabulated the results. This included 24 of the 32 people. I tried to get a sense of how experienced each person was by personal conversations with the individual, their position and high authority roles (such as a member of the United State Green Building Council), the sureness and diversity of their rankings (using the entire scale of numbers 1-4), and a more involved concept and development of their answers on the questionnaire. The questionnaire group rankings were averaged into the three parts each for all the participants and the more experienced selected participants.

ALL Participants

Pre-Construction	
Group	**Average Ranking**
Owner	3.48
A/E Managers	3.22
Design-Builders	3.13
Contractors	2.87
Architects	2.63
Consultants	2.51

Construction	
Group	**Average Ranking**
Owner	3.66
A/E Managers	3.64
Contractors	3.42
Consultants	3.41
Design-Builders	3.31
Architects	3.24

Total Average	
Group	**Average Ranking**
Owner	3.62
A/E Managers	3.50
Contractors	3.29
Design-Builders	3.28
Consultants	3.21
Architects	3.11

SELECTED Participants

Pre-Construction	
Group	**Average Ranking**
Owner	3.48
Design-Builders	3.13
A/E Managers	2.86
Architects	2.63
Contractors	2.59
Consultants	2.51

Construction	
Group	**Average Ranking**
Owner	3.66
A/E Managers	3.58
Consultants	3.41
Contractors	3.33
Design-Builders	3.31
Architects	3.24

Total Average	
Group	**Average Ranking**
Owner	3.62
A/E Managers	3.43
Design-Builders	3.28
Consultants	3.21
Contractors	3.18
Architects	3.11

Part 1- Observations & Conclusions:

When analyzing the participant response for pre-construction, design-builders feel contractors can play a more significant role in pre-construction than the Contractors themselves. This may attribute to the fact that they are involved in the design process and have a better sense of the importance and potential of their early involvement. Owners and Architectural/Engineer Managers highly value

the contractor's early involvement showing they have high significance, while Architects and Consultants tend to think contractors play less of a significant role and have less influence. This may be due to the fact that Architects feel the Design Development and Pre-Construction phase is under their jurisdiction and decision making. Therefore, they feel less inclined for contractors to suggest their expertise on technical design parts of a project.

When analyzing the participant response for construction, contractors feel very highly of their significance and role on a LEED project, as do consultants, who show that the contractor's role is much more dire during construction as compare to pre-construction. Owners and Architectural/Engineer Managers once again round off the top, showing there opinion that contractors can be doing more than they actually think. Design-Builders rank among the lower end of contractor significance, but are only narrowly behind Contractors and Consultants. Architects show the least amount of potential contractor involvement, but this may be attributed to the fact that they are not always heavily involved with contractors during construction. The architects lack of communication, understanding of the construction process, and the contractor's ability might potential contribute to the lower score. Otherwise, the architect shows that contractors can not always handle the highly technical/or design activities as they think.

After taking out less experienced individuals of sustainable design and construction, the rankings clearly lower, showing less potential for contractor significance. This is most evident for the group of contractors (highlighted in yellow). The selected and more experienced group possibly shows a more realistic perception of what a contractor can actually accomplish and impact on a LEED project. The rankings of the more experienced individuals are well diversified (between the 1-4 scale), therefore, provide a more evolved idea of where a construction manager can be most effective.

Part 2- Data:

The second part of my data analysis focused on the LEED areas of highest and lowest rank, as well as the separate ranked roles among each area that contributed to its exceptionally high or low significance. Once again, I averaged rankings based on all the responses and then the more experienced of the individuals. (See Appendix).

Part 2- Observations & Conclusions:

The most noticeable observation showed an identical ranking of highest and lowest LEED areas between the less and more experienced individuals. It should be noted that the more experienced individuals had scores that were slightly lower, but still concluding in the same rank. About 95% of the individually ranked roles proved to be equally ranked as well. The following charts below summarize the results.

Pre-Construction:

Highest Ranked Areas

	LEED Area	Role(s) of Highest Rank
1	Waste Management	☑ Locate a recycle facility that can provide the resources to recycle all types of materials
2	General	☑ Help owner and engineer to produce estimates of possible LEED points ☑ Provide suggestions to enable efficient deconstruction
3	Building Materials	☑ Provide value engineering and constructability suggestions which reduce material waste

Lowest Ranked Areas

	LEED Area	Role(s) of Lowest Rank
1	Energy & Atmoshpere	☑ Suggest cogeneration design (the simultaneous production of electricity and useful 'waste' heat) where possible with different systems. This includes reciprocating engines, combustion trubines, steam turbines, microturbines, fuel cells, and the combined cycle of gas and steam ☑ Consider use of photovoltaics for night site lighting
2	Planning & Sitework	☑ Encourage conservation of existing natural features within a site plan ☑ Consider rescuing and transplanting trees
3	Water Conservation	☑ Suggest the use of grey water for landscaping and toilets. Estimate the feasibility of this connection ☑ Suggest the use of low-flow sinks, composting toilets, and waterless urinals

Construction:

Highest Ranked Areas

	LEED Area	Role(s) of Highest Rank
1	Indoor Air Quality	☑ HVAC Protection- Seal all HVAC inlet and outlet units from dust and moisture ☑ Soure Control - Keep building materials dry to avoid the introduction of mositure to building ☑ HVAC Housekeeping- Maintain and minimize dust on the work site, Use vacuum cleaners with high-efficiency particulate (HEPA) filters to clean up, & keep work areas dry
2	General	☑ Assemble and maintain records necessary to document a building's compliance with LEED requirements ☑ Conduct weekly meetings with subcontractors to discuss methods to improve IAQ (Indoor Air Quality) onsite and minimize/manage construction waste activities for all upcoming construction
3	Waste Management	☑ Provide adequate training of construction waste recycling for all workers on site ☑ Encourage recycling by signage and posting measurable percentage goals
4	Education	☑ As CM or GC, effectively educate subcontractors- (1) in identifying vendors and materials that meet requirements and minimize cost, (2) in minimizing risk

Lowest Ranked Areas

	LEED Area	Role(s) of Lowest Rank
1	Energy & Atmoshpere	☑ Full System Building Commissiong- Develop design intent and basis of design documentation, engage a commissioning authority
2	Air Pollution Prevention	☑ Review services provided by outside vendors for potential impact on air quality. Examine pest control practices, cleaners used by janitorial services, and equipment maintenance.
3	Building Materials	☑ Suggest the use of low maintenance and easily replaced materials ☑ Identify indoor air quality concerns that may impact material selection (Select low-toxic alternatives to conventional materials whenever possible).
4	Planning & Sitework	☑ Consider milling wood from land-clearing debris into building materials

Part 3- Comments By Respondents:

(Please see Appendix)

Possible Future Considerations In Addition to Respondants:

- **General, Construction**: Have subcontractors break down all material by divisions and provide the cost data based on divisions
- **Education, Construction:** Provide training to employees to the requirements of the IAQ Program
- **Planning and Site Work Construction:** Provide
    - Erosion and Sedimentation Control Plan,
    - Storm Water Pollution Prevention Plan to help prevent
        - Contamination of city storm water.
        - Prevention of loss soil during construction by storm water runoff and/or wind erosion, including protection topsoil by stockpiling for reuse.
        - Prevent sedimentation of storm water sewer or receiving streams and/or air pollution with dust and practical matter.
- **Building Materials Construction:**
    - Develop a Local/Regional Material Tracking form including the following
        - Ship date, subcontractor, manf., supplier, material, Post- Industrial recycled material content (percentage of waste material available from industrial use incorporated into building material), Post-Consumer recycled material content (percentage of waste material available from consumer use incorporated into a building material), material cost, material purpose, miles of travel to job site
    - For Wood use, prove conformance with the Forest Stewardship Council Guidelines www.certifiedwood.org/CertSuppliers.html.
        - Subcontractor should submit written documentation from manf. In compliance with the FSC
        - Subcontractors should use only composite wood and agrifiber products that have no added urea-formaldehyde, resins
- **Waste Management:**
    - Develop Construction Waste Monthly Reports (by subcontractors) including a breakdown of size amounts (including weight) of
        - Recycling
        - Savage, including reuse on site
        - Hazardous waste disposal
        - Landfill