

THESIS

CURRENT INDUSTRY PERCEPTIONS OF THE ROLE OF THE CONTRACTOR IN
THE LEED CERTIFICATION PROCESS

Submitted by

Stephen Wesley Loppnow

Department of Construction Management

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Master's Committee:

Advisor: Mary Nobe

Co-Advisor: Brian Dunbar

James Folkestad

ABSTRACT

CURRENT INDUSTRY PERCEPTIONS OF THE ROLE OF THE CONTRACTOR IN THE LEED CERTIFICATION PROCESS

LEED certification has been rapidly adopted on the Front Range of Colorado as the primary green building rating system. LEED has required project teams and contractors to adopt new tasks and management activities in order to meet LEED requirements and owner expectations. It is understood that contractors are critical to successful implementation of the LEED process and ultimately meeting the LEED goals of a project.

This research was designed to help determine what opportunities exist for contractors to better add value to the LEED process on future projects, and to identify differences among architects and designers, green building consultants and contractors in their perception of the contractor's role in LEED.

A survey was distributed to building professionals with LEED experience on the Front Range of Colorado asking for feedback about the contractor's role, opportunities to add value and factors that may limit contractor success in LEED. Findings confirm that contractors have significant impact on the LEED process, and that there is opportunity for contractors to further add value to the process in the future. Also, that difference in perception of the contractor's role and contractor opportunity to add value does vary

among the three main research groups: architects and designers, green building consultants and contractors.

Key opportunities for contractors to better add value to the LEED process include: engagement in an integrated design process, taking on leadership in the LEED process, better LEED related cost estimating and management, better or expanded use of technology, better tracking tools and LEED management processes, and continuing education and LEED credentialing. Contractors and green building consultants often have closely aligned perception of the contractor's role in LEED, however each group showed variation in their perception of the contractor's role that was specific to their area of professional practice.

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This project is for two people. First, for my dad, Don Loppnow, Ph.D., who has dedicated his life and career to excellence in higher education. You informed me sometime in 2002 or 2003 that a master's degree would be your final requirement of me as your son. I took it to heart. Thank you. And most of all, thank you Erica. For helping inspire me to apply to graduate school in the first place, and for all of your support and encouragement along the way. For your understanding, for your cheerleading, for the quality time sacrificed and most of all, for your patience, thank you so much. This is for you! I love you. Thank you.

TABLE OF CONTENTS

ABSTRACT OF THESIS	ii
ACKNOWLEDGEMENTS	iv
TABLE OF CONTENTS	v
LIST OF TABLES	vi
LIST OF FIGURES	vii
CHAPTER 1: INTRODUCTION	1
Sustainability, Resource Consumption and the Built Environment.....	2
The USGBC and LEED	3
The Front Range of Colorado and LEED	5
The Role of the Contractor in LEED	5
Problem Statement.....	9
Purpose.....	10
Research Questions	11
Definition of Terms.....	12
CHAPTER 2: LITERATURE REVIEW	15
Research on the current Role of the Contractor and Impacts of LEED	15
Recent Trends in Project Delivery	20
The Role of the Contractor and Value-Added	22
The Diffusion of Innovations and Change Management.....	23
CHAPTER 3: METHODOLOGY	25
Sample Selection.....	25
Survey Development.....	27
Delimitations.....	30
CHAPTER 4: RESULTS	32
Data Analysis	35
Written Response, questions 8,9,11,12	35
Likert Scale questions, 13-32.....	43
CHAPTER 5: DISCUSSION	48
Research question 1	48
Research question 2	55
Analysis of select non-statistically significant survey questions	62
Limitations and Future Research	64
Conclusion	66
References.....	70
Appendix A	73
Appendix B	75
Appendix C	77
Appendix D	78

LIST OF TABLES

Table 1 <i>Summary of Contractor related LEED-NC credits.....</i>	7
Table 2 <i>LEED project experience on the Front Range.....</i>	33
Table 3 <i>Front Range LEED experience other than LEED-NC.....</i>	33
Table 4 <i>Coded responses to Question 8.....</i>	37
Table 5 <i>Coded responses to Question 9.....</i>	39
Table 6 <i>Coded responses to Question 11.....</i>	41
Table 7 <i>Coded responses to Question 12.....</i>	42
Table 8 <i>Statistical values of responses to Likert scale questions, questions 13-32.....</i>	46

LIST OF FIGURES

<i>Figure 1</i> Grouping of Major Impact LEED-NC Credits	16
<i>Figure 2</i> Categorization of LEED [®] Credits as Major, Moderate and Some impact	17
<i>Figure 3</i> Number of respondents by area of professional practice.....	35

CHAPTER 1: INTRODUCTION

Adoption of the U.S. Green Building Council's Leadership in Energy and Environmental Design certification program as the primary third party rating system for green building is occurring at a rapid rate. Since its inception in 2000, over 22,000 building projects have registered for LEED certification and over 7,000 have achieved certification (USGBC, 2011). As this framework for green building certification gains acceptance in the marketplace, there is a growing need to better understand the impacts of this process on the building industry and its professional practitioners in order to further integrate and diffuse the LEED process. There is evidence of this need in the growing body of research dedicated to better understanding the LEED certification process.

Despite growth in educational opportunities and research related to LEED, little research has been focused directly on the role of the contractor in the LEED process. With the introduction of this rating system that directs variations on conventional process and practice come new tasks and responsibilities for project team members. LEED certification mandates a new set of design, documentation, construction and performance requirements, in addition to those required by conventional design and construction. This is driving a shift that has led building professionals from all backgrounds involved in a project seeking LEED certification to adopt new variations on conventional tasks to satisfy LEED requirements. Due to this adjustment, it has become apparent that early and sustained participation of contractors throughout the process is valued on green building projects and can be an important element of any green building project, including those seeking LEED certification (Betterbricks, 2008, GVRD et al., 2004). This is apparent in the growing trend of contractor involvement in an integrated design approach and

process, often utilized during the design development phase of LEED projects. Accurate cost estimating of green technologies, participation in value-engineering and life-cycle cost assessment exercises, new site management and materials tracking tasks and LEED documentation are just some of the LEED related tasks that contractors may be expected to perform.

In consideration of new LEED related tasks for contractors, this research was designed to shed light on what differing perceptions exist of the contractor's role on LEED projects and what opportunities exist for contractors to better add value to the LEED process. This was accomplished by surveying LEED practitioners (architects and designers, green building consultants and contractors) on the contractor's role on LEED projects to identify how contractors can better add value to the LEED process.

Sustainability, Resource Consumption and the Built Environment

Due to growing world population and desire for a high standard of living, incredible demands are placed on the natural resources that sustain modern life. Currently, the world's natural resources are being consumed at an unsustainable rate. Furthermore, the rate of this consumption is not even and equitable across societies and cultures. A commonly cited figure is that the United States represents roughly 5% of the world's population while consuming roughly 26% of the world's resources (Solar Energy International, 2008). The threat of climate change, speculation over peak oil, rising energy costs and decades of environmental degradation have forced the necessity of adopting sustainable practices into the mainstream. This is leading to significant shifts in

industry and popular culture, as the need to both reduce resource consumption and use resources more efficiently and effectively becomes apparent.

The need to curb excessive resource consumption is particularly relevant in the building industry. In the U.S., construction and operation of the built environment accounts for 70% of electricity consumption, 39% of energy use, 39% of all carbon dioxide (CO₂) emissions, 40% of raw material use, 30% of waste output and 12% of potable water consumption (USGBC, 2008). Due to the resource intensive nature of building construction and operations, there is significant opportunity for positive environmental impact by employing practices that reduce the consumption of resources required to build and operate buildings.

The USGBC and LEED

The U. S. Green Building Council is a non-profit organization, “Committed to expanding sustainable building practices. USGBC is composed of more than 13,500 organizations from across the building industry, working to advance structures that are environmentally responsible, profitable, and healthy places to live and work” (USGBC, 2008). The mission of the USGBC is, “To transform the way buildings and communities are designed, built and operated, enabling an environmentally and socially responsible, healthy, and prosperous environment that improves the quality of life” (USGBC, 2008). The USGBC offers LEED certification as a tool to quantify the comprehensive nature of a green building project. LEED was introduced in 2000. Several LEED rating systems exist for different building and project types. The USGBC has consistently revised and updated existing rating systems while actively pursuing the development of new rating

systems to offer certification for a broader scope of building projects. Recent additions include LEED for Neighborhood Development in 2009, LEED for Retail in 2010, and the introduction of LEED for Homes in 2007. This research will focus on the role of the contractor in the LEED for New Construction and Major Renovation certification process (LEED-NC). Since the time this research was developed, the LEED 2009 rating system has been launched. New projects pursuing LEED must register and certify under the 2009 rating system, while many projects registered under LEED-NCv2.2 are still undergoing certification under that rating system. While the results of this research will be based on the experience of research participants using previous iterations of the LEED-NC rating system (v1-v2.2) there have been minimal procedural changes in the updated 2009 rating system and the role of the contractor in implementing the new rating system is effectively unchanged. The versions of the LEED-NC rating system that survey respondents will be providing feedback on are organized into 6 credit categories, with credits to be pursued depending on the building type, programming and sustainability goals of the project. These categories are (1) Sustainable Sites, (2) Water Efficiency, (3) Energy and Atmosphere, (4) Materials and Resources, (5) Indoor Environmental Quality and (6) Innovation and Design. In LEED-NCv2.2, four levels of certification may be achieved based on number of points earned within each credit. These certification levels are (1) LEED Certified (26-32 points), (2) LEED Silver (33-38 points), (3) LEED Gold (39-51 points) and (4) LEED Platinum (52-69 points). Of the 241 LEED certified projects in the state, 214 are located on the Front Range of Colorado. Of these, 87 have achieved some level of LEED-NC certification (USGBC, 2011).

The Front Range of Colorado and LEED

The state of Colorado and particularly the Front Range region has an exceptionally high number of LEED registered and certified projects. As of March 2011, Colorado ranks 9th overall in the nation in LEED certified square footage per capita (USGBC, 2011). There are over 240 LEED certified projects in the state with over 200 of those located on the Front Range. (USGBC, Colorado Chapter, 2011). Several projects located on the Front Range represent national firsts related to the use of LEED and certification of unique project types. Some highlights include: the first LEED certified state capitol (Colorado State Capitol, Denver, CO), the first LEED EB:OM certified project (Colorado State Capitol, Denver, CO), the first LEED certified high school (Poudre Valley High School, Fort Collins, CO), the first LEED certified Hospital (Boulder Community Hospital, Boulder, CO), the first LEED certified law school (University of Denver, Sturm College of Law, Denver, CO), the first LEED certified museum of contemporary art (MCA Denver, Denver, CO), and most recently, the first LEED-NC platinum certified building in the country under the updated LEED 2009 rating system (Group 14 offices, Denver, CO) (USGBC, Colorado Chapter, 2011). This makes the Front Range an ideal region to study the adoption and use of LEED.

The Role of the Contractor in LEED

LEED certification can be achieved by implementing a variety of different strategies and technologies. The USGBC does not offer a single prescriptive path for achieving certification in terms of delegating responsibility, defining roles or mandating credit achievement beyond its prerequisites and minimum point achievement for

certification. There is flexibility built into LEED rating systems intended to provide opportunity for projects to seek the best and most appropriate solutions for the building program it is applied to. The process of applying appropriate solutions to building projects requires consideration of design, construction and operation phases of a building program and requires involvement of all project team members. To successfully incorporate green building technologies and strategies, it is important to include contractors in the process as early as possible (GVRD et al., 2004). This inclusive and inter-disciplinary approach is known as integrated design.

The USGBC does make general indications of probable role responsibility based on the nature of a particular credit. These general indications of probable roles and responsibilities are presented in a table before each new credit category in the LEED-NC v2.2 Reference Guide (3rd Edition, 2007). The researcher has summarized contractor related credits in Table 1. In the Reference Guide tables, there is a column for credits that are impacted by contractor decision making and another for credits that are submitted as part of the construction LEED submittal, which is regularly supported by contractor documentation (USGBC, 2007). This information is summarized below in Table 1, by credit category and by credits impacted by contractor decisions and then submitted to the USGBC as part of a Construction Submittal. Credits impacted by contractor decision making represent 32% of all LEED credits while Construction Submittal credits represent 22% of all LEED credits.

Table 1 *Summary of Contractor related LEED-NC credits* (adapted from USGBC, 2007).

Credit Category and Number	Credit Title	CDM	CS
SSp1	Construction Activity Pollution Prevention	x	x
SSc5.1	Site Development: Protect or Restore Habitat	x	x
SSc7.1	Heat-Island Effect: Non-Roof	x	x
SSc7.2	Heat-Island Effect: Roof	x	
EAp1	Fundamental Commissioning of the Building Energy Systems	x	x
EAc3	Enhanced Commissioning	x	
EAc5	Measurement and Verification	x	x
EAc6	Green Power		x
MRc1.1	Building Reuse: Maintain 75% of Existing Walls, Floors & Roof		x
MRc1.2	Building Reuse: Maintain 95% of Existing Walls, Floors & Roof		x
MRc1.3	Building Reuse: Maintain 50% of Interior Non-Structural Elements		x
MRc2	Construction Waste Management	x	
MRc3	Materials Reuse	x	
MRc4	Recycled Content	x	
MRc5	Regional Materials	x	
MRc6	Rapidly Renewable Materials	x	
MRc7	Certified Wood	x	
EQc3.1	Construction IAQ Management Plan: During Construction	x	x
EQc3.2	Construction IAQ Management Plan: Before Occupancy	x	x
EQc4.1	Low-Emitting Materials: Adhesives & Sealants	x	x
EQc4.2	Low-Emitting Materials: Paints and Coatings	x	x
EQc4.3	Low-Emitting Materials: Carpet Systems		x
EQc4.4	Low-Emitting Materials: Composite Wood & Agrifiber Products	x	x

Table 1, con't. *Summary of Contractor related LEED-NC credits* (adapted from USGBC, 2007).

IDc1.1	Innovation in Design	x	
IDc1.2	Innovation in Design	x	
IDc1.3	Innovation in Design	x	
IDc1.4	Innovation in Design	x	
IDc2	LEED Accredited Professional	x	

KEY CDM = Contractor Decision Making
 CS = Construction Submittal

While the USGBC does identify the credits that contractor decision making may have an impact on, the degree to which the contractor is critical to achieving these points is not defined by the USGBC. Further, the potential role that the contractor might have in contributing to and achieving points is ignored in these tables. So while the role of the contractor is recognized as significant to successful LEED certification by the USGBC, the extent to which it is critical, or the extent to which contractors can add-value to the process beyond performing tasks specific to targeted contractor credits is not known.

What is understood is that LEED certification requirements do impact the role of the contractor and vice versa. Within the contractor's scope, there are new inputs for estimating and value-engineering, new documentation requirements and construction systems and a new metric by which to measure success (GVRD et al., 2004). The potential also exists for earlier involvement in project design and development as well as new tasks related to project close-out. The introduction and steady adoption of the LEED certification process has generated demand for the contractor to adopt these new tasks, and potentially new roles within the building process. In the interest of better

understanding how to improve the LEED certification process in practice it is important to understand what current perceptions exist in industry of the contractor's role, where differences of opinion and experience occur among building professionals, and to identify opportunities for contractors to better add value to the LEED process moving forward.

Problem Statement

As demand and market share for LEED certification has grown in the building industry, the roles of project team members have been impacted. While a variety of project delivery structures have been noted to be effective in delivering LEED there is no definitive prescribed project team or project delivery structure to ensure certification. General trends and accounts of the role of the contractor have been recorded in the form of project case studies, best practices and some scholarly research. However, the impacts associated with the introduction of LEED certification and how those impacts are changing the dynamics of project team structure, project delivery and role responsibility among contractors, architects and consultants is not fully known.

This leaves unanswered questions about how contractors can best add value to the certification process. To begin to answer these questions, this research has been designed to identify current perceptions of the contractor's role in the LEED certification process among building professionals typically at the center of project teams seeking LEED certification. These building professionals include architects and designers, green building consultants, and contractors. This study brings into focus how contractors can best add value to the LEED process and identifies discrepancies and trends in current perceptions of the role of the contractor on LEED projects among team members.

A common approach to addressing the needs of a green building program is implementation of integrated design (WBDG, 2008). The shift toward use of an integrated design approach and process, along with introduction of contractor related LEED credits, puts the contractor in a unique position to influence decision making traditionally reserved for designers. Integrated design ideally involves construction professionals as part of the decision-making team. To be most effective, contractors should provide input, experience and perspective on design solutions, in addition to taking on the new responsibilities associated with LEED certification (Betterbricks, 2008, GVRD et al., 2004). This shift in building team structure and dynamics suggests that the traditional role of the contractor is being impacted by the introduction of LEED. While academia and industry have begun an effort to better understand the paradigm shift that the LEED process represents, much research is left to be done to better understand the associated impacts. Related research has been conducted by Riley, Pexton, and Drilling, (2003) and Syal, Mago, and Moody (2007). This research focused on opportunities for contractors to add value to the LEED process and the impact of specific LEED credits on the contractor, respectively. However no research to date has focused specifically on industry perceptions of the contractor's role on projects seeking LEED certification on the Front Range of Colorado.

Purpose

In response to the growing demand for LEED certification nationally and on the Front Range of Colorado, the purpose of this research is to answer two questions, (1) how can contractors better add value to the LEED process and (2) what differing perceptions

exist of the contractor's role in LEED among building professionals on the Front Range of Colorado?

A basic assumption of the research is that it is important for contractors to add value to their scope of work. Based on this assumption, it can be understood that it is important to better understand how contractors are responding to the introduction of the LEED process and how they can better add value to it.

Awareness of general trends related to perceptions of the contractor's role may provide insight into how building professionals can more effectively integrate and manage LEED certification in the future. Understanding of how contractors can better add value to the LEED process will help identify how contractors can better contribute to meeting LEED project goals, which could benefit projects and contractors alike. This research will identify opportunities for better coordination among project team members and opportunities for contractors to better add value to their LEED projects.

Research Questions

As evidenced by the growing number of LEED registered projects, a predominant trend in the building industry has been toward adoption of the LEED certification process. In an effort to better understand the impacts of the LEED certification process on contractors, and how contractors are responding to the introduction of LEED, this research was designed to address the following questions:

1. How can contractors better add value to the LEED process?
2. What differing perceptions exist of the contractor's role in LEED certification process among building professionals on the Front Range of Colorado?

Definitions of terms

Definitions are provided to clarify how the following terms are used in this research. Unless cited, these terms are defined by the researcher to clarify their use.

Added Value (syn. Value Added) - (1) An increase in the attractiveness to customers of a product or a service achieved by adding something to it (BNET, 2009). (2) Additional benefits of a company's products or services in comparison to competing products (Webster's, 2009). (3) Adding value can be interpreted as maximizing efficiency; non-value adding can be described as inefficiency.

Contractor- Refers to the group of individuals that represent the construction organization responsible for estimating, constructing and delivering a completed building project. These individuals may include Project Executives, Pre-construction Managers, Project Managers, Project Engineers, Superintendents, Assistant Superintendents and Field Engineers.

Design-build - A project delivery structure in which construction commences before the building design is complete. This often includes greater collaboration among project team members and a fast-tracked schedule. Designers and construction professionals often work for the same organization.

Design-Bid-Build - A project delivery structure in which the building design is completed, sent out to bid and then constructed. This type of project delivery often

segregates project team members by specific scope of work and positions the design team as project leaders.

Front Range of Colorado- The geographical region that extends from Colorado Springs, Colorado, north to Fort Collins, Colorado. This region is generally understood to extend east, roughly 30 miles from the eastern foothills of the Rocky Mountains. This region incorporates the cities of Colorado Springs, Denver, Boulder and Fort Collins.

Green Building- The practice of designing and constructing buildings with the intention of reducing environmental impact and increasing building and occupant performance.

Integrated Design- An inclusive design process in which building professionals traditionally not included in the design decision-making process are consulted early in project development. This is synonymous Whole Building Design, whose elements are integrated design approach and integrated team process.

LEED Certification- The U.S. Green Building Council's Leadership in Energy and Environmental Design certification. This certification measures the comprehensive nature of a building's green design, construction and operation.

Perception- quick, acute, and intuitive cognition (Merriam-Webster, 2008).

Project Team- The group of building professionals that develops and manages a building program from design through construction to operations and maintenance. This group includes owners, developers, architects, engineers, consultants, general contractors, sub-contractors and building managers.

CHAPTER 2: REVIEW OF LITERATURE:

This literature review covers the following areas; the role of the contractor and the impacts of LEED, recent trends in project delivery structure, and the diffusion of innovations and change management.

Research on the current Role of the Contractor and Impacts of LEED

A primary focus of the research previously conducted on the role of the contractor in the LEED certification process has concentrated on the contractor's role in relation to the implementation of specific prerequisites and credits. *Impact of LEED-NC Projects on Constructors* (Syal, Mago, Moody, 2007) focused research on identifying the LEED credits that have most significantly impacted the practices of construction management. The research consisted of assembling an Industry Advisory Committee and building a database query system based on the impacted role of the contractor. LEED credits that impacted the contractor were organized by the level of impact those LEED credits have had on construction management practices. Impact levels are categorized as 'major', 'moderate' and 'some'. Of 41 potential LEED prerequisites and credits, 12 were identified as having a 'major' impact on construction management practices, 7 were identified as having 'moderate' impact, and the remaining 22 credits were identified as having 'some' impact on construction management practices. 'Major' impact credits are identified as being *construction intensive* credits. 'Moderate' credits are those that are related to both design and construction. These credits can be positively influenced by the contractor being engaged in credit achievement. 'Some' credits are those that are generally design related but that may at some point benefit from contractor input. The

'major' impact credits are related to a number of construction processes and require new practices, decision-making and documentation. Impacted construction practices include site development and management, commissioning, construction waste management, material selection, sourcing and on-site materials management. These 'major' impact credits are organized and referred to specifically in Figure 1.

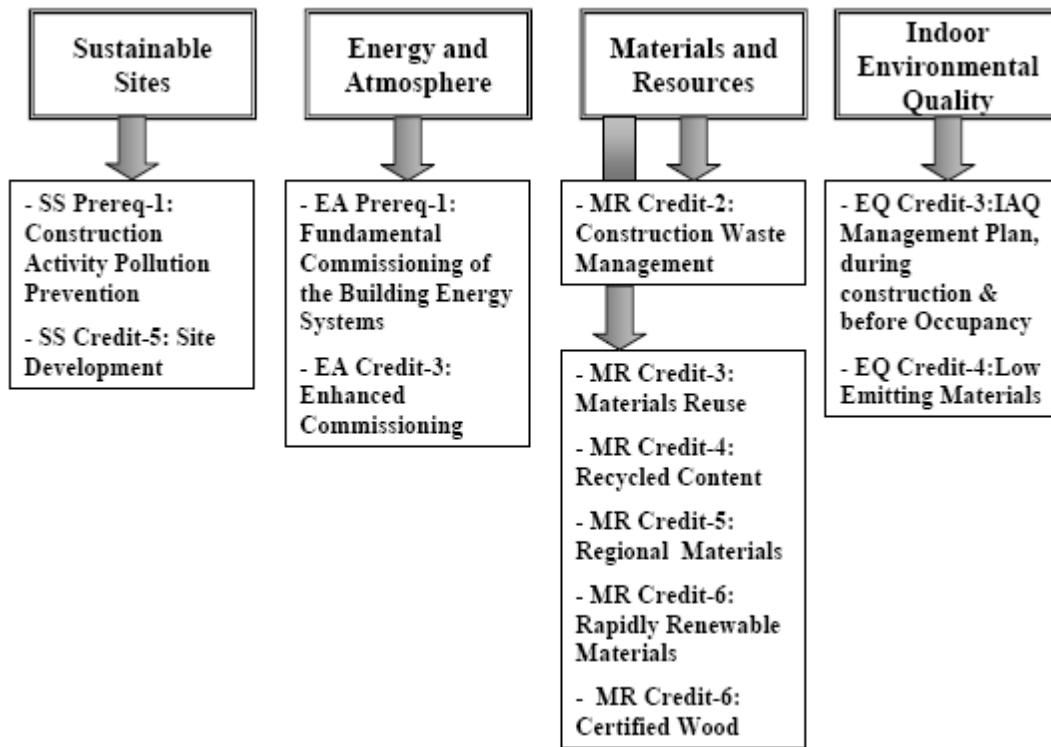


Figure 1 Grouping of Major Impact LEED-NC Credits (Syal, et. al., 2007)

The remaining distribution of credits and their identification as Moderate or Some level of impact on the role of the contractor are reported in Figure 2.

IMPACT OF LEED®-NC PROJECTS ON CONSTRUCTION MANAGEMENT PRACTICES

SUSTAINABLE SITES	MATERIAL & RESOURCES
SS Prereq 1 Construction Activity Pollution Prevention	MR Prereq 1 Storage & Collection of Recyclables
SS Credit 1 Site Selection	MR Credit 1 Building Reuse
SS Credit 2 Development Density & Community Connectivity	MR Credit 2 Construction Waste Management
SS Credit 3 Brownfield Redevelopment	MR Credit 3 Materials Reuse
SS Credit 4 Alternative Transportation	MR Credit 4 Recycled Content
SS Credit 5 Site Development	MR Credit 5 Regional Materials
SS Credit 6 Stormwater Design	MR Credit 6 Rapidly Renewable Materials
SS Credit 7 Heat Island Effect	MR Credit 7 Certified Wood
SS Credit 8 Light Pollution Reduction	
WATER EFFICIENCY	INDOOR ENVIRONMENTAL QUALITY
WE Credit 1 Water Efficient Landscaping	EQ Prereq 1 Minimum IAQ Performance
WE Credit 2 Innovative Wastewater Technologies	EQ Prereq 2 Environmental Tobacco Smoke (ETS) Control
WE Credit 3 Water Use Reduction	EQ Credit 1 Outdoor Air Delivery Monitoring
ENERGY & ATMOSPHERE	EQ Credit 2 Increased Ventilation
EA Prereq 1 Fundamental Commissioning of the Building Energy Systems	EQ Credit 3 Construction IAQ Management Plan
EA Prereq 2 Minimum Energy Performance	EQ Credit 4 Low-Emitting Materials
EA Prereq 3 Fundamental Refrigerant Management	EQ Credit 5 Indoor Chemical & Pollutant Source Control
EA Credit 1 Optimize Energy Performance	EQ Credit 6 Controllability of Systems
EA Credit 2 On-Site Renewable Energy	EQ Credit 7 Thermal Comfort
EA Credit 3 Enhanced Commissioning	EQ Credit 8 Daylight & Views
EA Credit 4 Enhanced Refrigerant Management	
EA Credit 5 Measurement & Verification	INNOVATION & DESIGN PROCESS
EA Credit 6 Green Power	ID Credit 1 Innovation in Design
	ID Credit 2 LEED® Accredited Professional

4

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Major Impact

Moderate Impact

Some Impact

[®]
Figure 2 Categorization of LEED® Credits as Major, Moderate and Some impact

(Syal, et. al., 2007) Confirmed for reproduction via email, May 22, 2008.

Several important pieces of information were established by this research. Beyond the identification of which credits impact the role of the contractor most, it is important to note that no category was established for LEED credits that do not impact the role of the contractor. While this omission could be a research flaw, this is interpreted as a clear signal that on all levels, the contractor is impacted by the requirements of LEED certification and that there is opportunity for contractor involvement across credits. ‘Major’ credits that impact the role of the contractor necessitate an adjustment or change

in the role of the contractor to adequately perform what is required for successful achievement of the credit. ‘Moderate’ and ‘some’ impact credits also are those that are construction and design related, or that may benefit from contractor input. As a result, whether the credit is based on construction activities or design, the role of the contractor may be impacted. The reality of the contractor being impacted by design-based credits denotes early involvement of the contractor and expectation of an integrated design approach for LEED projects. In turn, this means that the contractor has the potential to influence the success of credit achievement in areas outside of their traditional scope. The cited research is important because it begins to provide a quantifiable way to understand the degree to which the role of the contractor is impacted by the LEED process, to anticipate the scope of that impact and how it may define the future role of the contractor.

The comprehensive scope of the impacts of LEED on the contractor, and the challenges of adoption are laid out by Riley, Paxton and Drilling’s 2003 paper: *The Procurement of Sustainable Construction Services, The Role of the Contractor in Green Buildings*. Contractors have traditionally been considered to be little more than, “brokers of construction services,” (p.1), whose primary value has been in management of scheduling, materials and assembly and not as design decision makers. This perception is prevalent among designers as well as contractors. The litigious nature of the construction process only reinforces these roles. Furthermore, the construction industry is one that many consider to be slow to adopt change; however the impacts of the LEED process necessitate a shift from conventional roles and processes toward an integrated process and management of new LEED related tasks. The necessity of green building is driving a paradigm shift that not only impacts the conventional role of the contractor but every

building profession, delivery structure and how successful building projects are defined.

The following is a summary of the relevant findings of Riley's and his colleagues' research:

1. Green building projects...involve more complex interdependencies between building systems and project organizations than traditional projects. They are thus best serviced by **inclusive** and **integrated** project teams.
2. The **LEED™** rating system has been rapidly accepted...What began however, as an assessment mechanism for the final product...has resulted in significant process implications for designers and builders. These processes – **how** to best make green buildings - are still largely undefined.
3. In the US, the leading owners seeking green buildings are...moving toward the use of **design-build** delivery systems in which construction organizations are highly involved during project design.
4. Most owners and professionals hold the opinion that green buildings cost more than traditional buildings...we must face the reality that the industry will be slow to move away from a short-sighted **first cost perspective** (Riley, et. al., p.4, 2003).

Considering these points it can be understood that current perceptions of the role of the contractor in the LEED certification process must be understood within the greater context of the trends that influence them. These include the emerging prominence of design-build delivery and integrated design, and adoption of new contractor roles.

Recent Trends in Project Delivery: Design-build, Integrated Design and the Charrette.

With the establishment of the American Institute of Architects came an effort by architects to establish themselves as project leaders. This led to the segregation of the design and construction processes that was prominent throughout the 20th century (AIA, p.1-2, 2003). The AIA Code of Ethics and Professional Conduct mandated that architects not participate in the construction process. This ethical prohibition was not repealed until 1978 (AIA, p. 1-2, 2003). Throughout the 1980's and 1990's, design-build delivery grew in response to this segregation, as it often offered the benefits of a higher quality product, cost and time savings due to a streamlined process and reduced risk by way of better communication among project team members and early knowledge of cost (Beard, Loulakis, Wundram, p.2-4, 2001).

An aspect of the design-build process that has increasingly been adopted outside of the design-build structure is the concept of an early exchange of ideas among designers, construction managers and other project team members. This type of early integration of project team members is understood to be part of an integrated design approach and process. Integrated design is characterized by early participation of project team members and may include use of charrettes, value engineering and other cross-disciplinary exercises. The Whole Building Design Guide (2008) describes Whole

Building Design as having two elements: integrated design approach and integrated team process. The integrated design approach refers to application of cross-disciplinary design solutions to meet the goals of the project. The integrated team process refers to early and sustained inclusion of project team members with the intention of adding value while controlling cost, schedule and goals of the project (WBDG, 2008). The principles of this integrated design approach and team process, namely the early inclusion of construction managers in project development, has been adopted as a process that can be utilized on projects that are not structured as design-build. An integrated design influenced approach can provide some of the same benefits as design-build delivery, without being limited to design-build firms and practices for project development and delivery. Integrated design is a practice that is applicable unilaterally.

Charrettes are another tool that can be utilized to facilitate the input of all building team members early in the design process. These meetings are inclusive by nature and can take the form of multiple hour to week long brainstorming sessions (Pettit, 2003). The intention being to gain valuable input from all building team members that will influence design related decision-making. Charrettes are commonly utilized as part of an integrated team process (WBDG, 2008). Charrettes can be a first step in forming integrated design solutions. Within the context of the charrette, team members are encouraged to address issues outside of their area of expertise and to apply the perspective of their discipline to design concerns beyond their traditional scope. Contractors are typically encouraged to participate in the charrette process. The expertise of contractors in cost control, constructability, material selection, scheduling and code issues are important for successful delivery of any project. The requirements of LEED

certification can impact all of these tasks, making integrated design invaluable to successful delivery of LEED projects. Early involvement of contractors in the design process can prevent unnecessary and costly changes and delays and increase success of LEED projects by providing input into the design process, future building program and contractor related LEED credits, early in the project.

Whether by way of either a design-build or a design-bid-build process that employs an integrated design or “whole building design” approach, contractors have increasing potential to impact the success of projects, including those seeking LEED certification. The emergence of design-build project delivery and the challenges of adopting green building have generated a movement away from the traditional role of the contractor as a process manager to that of a complete team member that can influence project success on multiple levels, throughout the various stages of a project.

The Role of the Contractor and Value-Added

Contractors add value to the construction process by effectively managing budget, schedule and quality of work. In this research, Value-Added is defined in three ways: (1) An increase in the attractiveness to customers of a product or a service achieved by adding something to it; (2) Additional benefits of a company's products or services in comparison to competing products; and/or (3) Maximizing efficiency, non-value adding can be described as inefficiency. It can be understood that elements of the LEED process must be managed well in relation to budget, schedule and quality of work for contractors to be adding value. For contractors to be competitive with other firms that offer similar products and services, they must add-value to their projects.

The Diffusion of Innovations and Change Management

Since its inception, the USGBC and its founders have worked as agents of change in the building industry (Gottfried, 2003). The USGBC has provided structure for the adoption of green building practices. While this research does not attempt to control for all variables that may influence perceptions related to the adoption and management of change, it is important to understand the research questions and results within the greater context of the diffusion and adoption of innovation and change management.

The diffusion of innovations and adoption of change is fundamentally a social event. The diffusion process has four main elements: (1) introduction of an *innovation*, (2) *communication* of the innovation through *channels*, (3) over *time*, and (4) within a *social system* (Rogers, 2003). Within each of these elements are numerous variables that can impact the rate and success of diffusion, adoption or rejection of the innovation. These include the type of innovation, communication channels employed, the timing of introduction, the amount of time for which an individual or organization has been exposed to an innovation, and the structure of the social systems to which an innovation has been introduced (Rogers, 2003).

Rogers goes on to outline five stages of the *innovation-decision process*, by which an individual or group, “passes from gaining initial knowledge of an innovation, to forming an attitude toward the innovation, to making a decision to adopt or reject, to implementation of the new idea, and confirmation of this decision.” These five stages are categorized as 1) Knowledge 2) Persuasion 3) Decision 4) Implementation and 5) Confirmation. Finally, “*re-invention* is the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation” (Rogers, p.217). In

the context of this research, it can be understood that research participants with LEED project experience have been through the five stages of the *innovation-decision process* with LEED. This research is focused on getting feedback on the *implementation* phase of this process and is asking research participants to engage in a *re-invention* process by identifying how the LEED process can be optimized. The *re-invention* is not of the LEED system per se, but of the standard practices used to implement LEED.

Although not included in the analysis provided in Chapter 5 (beyond area of professional practice), the recorded demographic variables could be used in future projects to help further contextualize the research findings. The recorded demographic variables are based on elements of the diffusion process identified by Rogers (2003). The LEED certification process can be considered an *innovation* that is being adopted over *time* (LEED experience). Perceptions related to the role of the contractor in the LEED process are influenced by *communication channels* and *social systems*. The source of education related to LEED represents a *communication channel* while the profession of the research participant and the structure of the project team (project delivery structure and integrated design) represent *social systems*. The amount of past LEED experience may reflect how LEED is being adopted over time and how that effects current perceptions. The researcher has recorded variables that could be analyzed in relation to these diffusion elements in future research projects. In the meantime, understanding the research questions and the results of the research in relation to Roger's theory helps to contextualize the findings and increase the validity of the research.

CHAPTER 3: RESEARCH METHODOLOGY

To measure current perceptions of the role of the contractor in the LEED certification process on the Front Range of Colorado, a survey was developed and administered to qualified building professionals. Survey development was structured around current and potential opportunities for contractor involvement in the LEED process, addressing demographics of respondents and key value add opportunities for contractors. Two rounds of piloting were completed to increase instrument reliability and validity. The survey was administered using Survey Monkey, a web-based survey administration service. An invitation to participate in the survey was sent to 47 potential participants, with 82 (via snowball sampling) providing some responses to the survey and 58 participants completing the survey. The population for this study is defined as architects, green building consultants and contractors in the Front Range of Colorado with project experience on at least one LEED-NC project. Contractors are further defined as preconstruction managers or project managers, due to their different roles and responsibilities within construction organizations, however analysis looked at the contractor response group only.

Sample Selection

Convenience, purposive and snowball sampling was utilized. The researcher drew upon his personal network of qualified building professionals to participate in the survey. This network included colleagues of the researcher that are known through Colorado State University, USGBC chapter affiliation and professional practice. These participants were contacted by email or phone, after which all correspondence with these survey

participants followed the methodology defined for correspondence and interaction below.

There was some potential for bias in survey response as the researcher was known to some of the survey participants. This is a limitation of the research approach.

The sequence of contact with survey candidates generally followed the framework of an introduction and request to complete the survey, survey contact and follow-up thank you contact. Initial recruitment occurred via phone, email, or in person. The purpose of this was to introduce the researcher, the research topic and goals of the research, to confirm contact information and that the building professional is a qualified candidate and willing to participate in the research. A script developed for this conversation appears in Appendix A. Following this, survey contact was made. Survey contact was distributed via e-mail. The purpose of this contact was to confirm the introductory contact, present the research cover letter and notify the participant of the open invitation to participate in the research, clarifying the timeframe for taking the survey and providing a link to the survey. The survey was self-administered via Survey Monkey and was anonymous. Participants were contacted not more than two additional times via email, being reminded of the opportunity to participate in the research. All survey participants received at least one reminder email. Participants were also encouraged to forward the invitation to other colleagues who may have been qualified and interested in the research. Finally, when the survey period was closed, thank you contact was made via e-mail to all participants. Thank you contact was made to thank survey participants for their time and participation in the research. All of the sample population received a thank you email, regardless of whether or not they completed the survey. The researcher had targeted a sample of 60

qualified participants with 20 from each discipline respectively and projected a response rate of 25-35%.

Survey Development

The survey instrument utilized both quantitative and qualitative question structure. The quantitative items used both dichotomous and Likert scale responses. The Likert scale was utilized to gauge the degree to which building professionals agreed or disagreed with statements related to the role of the contractor on LEED projects. The qualitative items required written answer responses. To increase reliability and validity, the survey was piloted twice. In the first round, a paper survey was piloted by six qualified building professionals. During this phase, participants were asked to take the survey and indicate any confusion or questions they had related to the survey items. The feedback received from this pilot was used to revise the research instrument and then a second pilot was conducted. In the second round, the survey was set up on Survey Monkey. Two of the original six qualified building professionals re-piloted the survey on-line to ensure that the on-line administration of the survey was effective and user-friendly. After the second round of piloting, final revisions were made.

In the pilot phase, face validity of the survey instrument was enhanced through the use of industry professionals familiar with the topic of the survey. They were able to not only comment on the format of the instrument but also on the content. While research validity was addressed in the literature review and through sample selection methodology, survey instrument reliability was addressed through the piloting process. Upon completion of piloting, the survey was administered to the sample population.

The research questions were addressed by survey questions organized into categories based on the elements of contractor involvement related to LEED. The researcher developed categories to measure contractor involvement by considering contractor roles, opportunities for contractor engagement and for contractors to add value. These categories include:

- 1) Opportunities for Contractors to add-value to the LEED process: These questions give survey respondents an opportunity to state what best practices are for contractor engagement in the LEED process in their own words.
- 2) Contractor roles and opportunity to add-value: This question gives survey respondents an opportunity to state opportunity for contractors to add-value to the LEED process by taking on new roles in their own words.
- 3) Tools or methods that could help contractors add value: This question gives survey respondents an opportunity to state what skills could help contractors to add-value in their own words.
- 4) Leadership and Initiative: The intent of these questions is to identify how contractors can provide leadership in the LEED process.
- 5) The significance of the contractor's role in LEED: The intent of these questions is to identify how critical the contractor's role is in the LEED process.
- 6) Appropriate point of contractor involvement: The intent of this question is to determine if the timing of contractor involvement in the LEED process is critical.

- 7) The importance of LEED accreditation and LEED administration knowledge for contractors: The intent of these questions is to determine how important LEED accreditation and understanding of the LEED administrative process is for contractors.
- 8) The contractors LEED role and value added: The intent of these questions is to begin to identify how contractors can add value to the LEED process by asking respondents to rank the importance of 9 ways in which contractors could potentially add value to the LEED process.
- 9) Willingness and rate of adoption of LEED by contractors: The intent of these questions is to determine if contractors are willingly adopting LEED at a rate that is consistent with other, non-contractor industry professionals, or if contractors are resisting this change.
- 10) Looking forward: The intent of this question is to identify a future opportunity for contractors to add-value to the LEED process by offering LEED consulting services.
- 11) Limiting factors: The intent of these questions is to identify what limits successful participation of contractors.

One qualifying question appeared at the beginning of the survey along with one demographic variable question. The qualifying question confirms whether the survey respondent has past LEED experience in the Front Range of Colorado. The demographic question confirms whether the building profession of the survey respondent is architecture, green building consulting or construction. The remaining demographic

questions appeared at the end of the survey and identified additional demographic information of each survey participant including: educational experience, amount of past LEED project experience and the project delivery structure used on past LEED projects. Survey results were grouped and analyzed by area of professional practice only. Appendix B outlines the survey categories and related survey questions that were developed to help answer the research questions. Appendix C outlines the demographic variables that were recorded to help inform this and future research. All raw data, including results of the other demographic information is aggregated and provided in Appendix D, however results of the other demographic information (beyond confirming LEED experience and area of professional practice) are not considered in the analysis due to limited and inconsistent response.

Compiled, responses to the survey questions structured by these categories shed light on what opportunities exist for contractors to better add-value to LEED projects in the future and what differing perceptions exist among building professionals. Organization of survey questions by these categories helped the researcher structure the research instrument around anticipated key variables based on the Literature Review and understanding of the contractor's role in LEED.

Delimitations

This study is delimited to (1) the Front Range of Colorado, (2) LEED rating systems, (3) architects and designers, contractors and green building consultants. Due to regional variation in the adoption and use of the LEED program and the high concentration of LEED projects within the geographic region from which the sample was

selected, this research is specific to the Front Range only and is not intended to be generalized to any other region or population. Regional and state incentives, opportunity for education, local demand and regional culture are all variables that make the results of this research specific to the Front Range.

The focus of this study is delimited to the LEED certification process. LEED has emerged as the predominant green building rating system nationally and on the Front Range of Colorado. This research does not seek to incorporate other, non-LEED green building rating systems.

This research surveyed architects and designers, contractors and green building consultants to focus the research on project team members who are central to LEED implementation and who interact directly with contractors throughout the LEED process. The exclusion of other potential project team members is another delimitation of the research.

CHAPTER 4: RESULTS

The purpose of this research is to shed light on two questions, (1) how can contractors better add value to the LEED process and (2) what differing perceptions exist of the contractor's role in LEED among building professionals on the Front Range of Colorado? To help answer these questions a survey was administered to building professionals on the Front Range of Colorado. Results of the survey are presented below. Survey questions were designed to gather information about the contractor's role on LEED projects and to identify variations in responses among three main groups: contractors, architects & designers and green building consultants. All raw data is aggregated and provided in Appendix D. Descriptive statistics for each question are reported in this section, organized by the three main respondent groups. The overall response frequency and/or mean and standard deviation for each question are provided for the whole sample and each participant group.

The survey and recruitment materials were sent out to 47 participants. Participants were encouraged to forward the survey to others that fit the targeted population demographics, consistent with snowball sampling methodology (Heckathorn, D., 1997). As a result, 83 participants started the survey and 70% (n=58) completed the survey. Of those, 76% (n=44) indicated that they had experience working on a LEED-NC registered project on the Front Range of Colorado, while 24% (n=14) indicated that they did not. Of those who indicated they did have experience working on LEED-NC registered projects on the Front Range, several indicated additional Front Range experience with other LEED rating systems (see Table 2). The majority of these had additional experience with

LEED-CS and LEED-EB rating systems, or had no additional LEED experience on the Front Range.

Table 2

<i>LEED project experience on the Front Range</i>	
<u>LEED rating system</u>	<u>Frequency</u>
LEED-NC	44
LEED-CS	19
LEED-EB	12
LEED for Schools	9
LEED-CI	9
LEED-ND	3
LEED for Homes	2
No LEED-NC project experience on the Front Range	14
No additional LEED experience on the Front Range, beyond LEED-NC	12

Of those who indicated they did not have experience working on LEED-NC registered projects on the Front Range, 5 indicated they had experience with other LEED rating systems on the Front Range, while 11 indicated that they did not (see Table 3).

Table 3

<i>Front Range LEED experience other than LEED-NC</i>	
<u>LEED rating system</u>	<u>Frequency</u>
LEED-CS	2
LEED for Schools	2
LEED-CI	1
LEED-ND	1
LEED-EB	1
No Front Range LEED experience	11

Twenty percent (n=12) of surveys were completed by Architects, 28% by Green Building Consultants (n=16) and 41% by Contractors (n=24). Within the Construction Management category, 14% (n=8) specialize in Pre-construction, 10% (n=6) were Construction Managers specializing in Project Management, 5% (n=3) specialize in Field Management and 12% (n=7) had equal emphasis in all areas of construction management. Ten percent (n=6) of surveys were completed by participants who selected “Other” when indicating their area of expertise. These included 2 structural engineers, 1 mechanical engineer, 1 landscape architect, 1 commissioning agent and 1 who indicated no project experience. The engineers and landscape architect were grouped with architects to make up the “Architects and Designers” group. The data collected from the commissioning agent and “no project experience” respondent were not included in the any of the 3 response groups due to the specialized role and scope of commissioning agents and the lack of relevance of the respondent with no project experience, thus a total or 56 completed surveys are included in the analysis (see Figure 3).

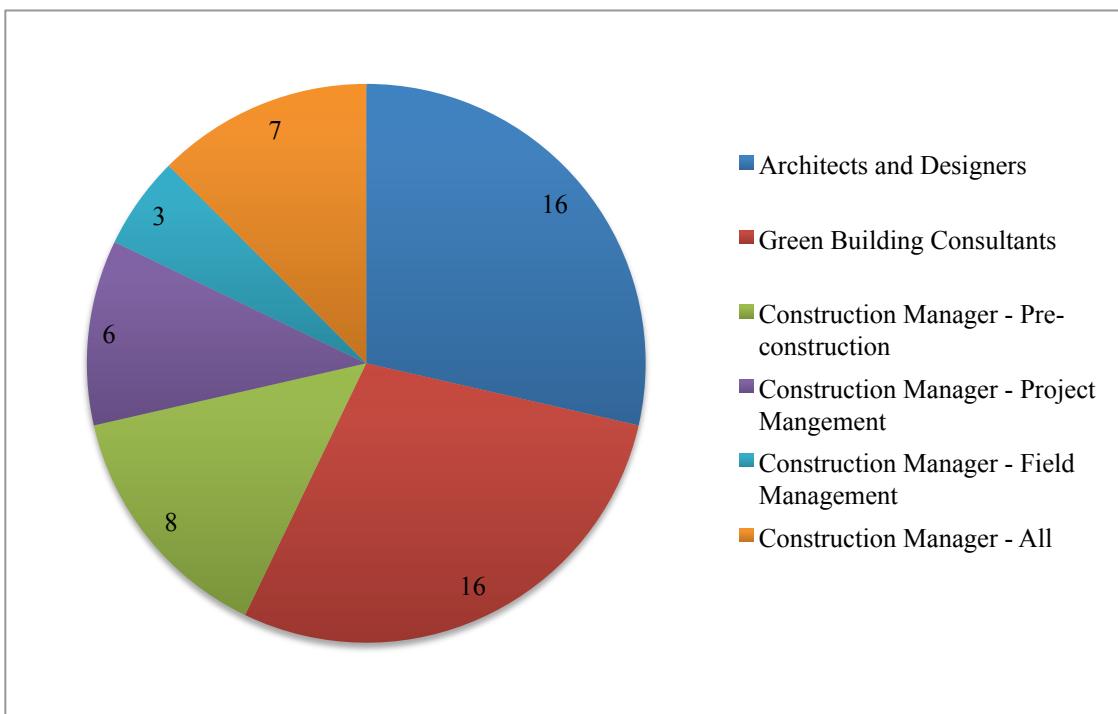


Figure 3. Number of respondents by area of professional practice

Data Analysis

The results of completed surveys were compiled using Survey Monkey and analyzed using Excel. Descriptive statistics and frequencies are provided for each survey item and are reported according to the identified building profession of each respondent. Written answer questions are coded and reported in a summary narrative. All raw data is aggregated and appears in Appendix D.

Written response, questions 8, 9, 11 and 12

Coding categories for responses to questions 8, 9, 11 and 12 were developed using keywords and referential units (Cooper, D., Schindler, P., 2000). The broad scope of written responses were grouped into 6-11 response categorizes for each question. An

example of the range of responses received can be seen in the following two comments from architects and designers in response to question 8. “*I have not seen many contractors excited about the LEED process. Some are beginning to develop tools such as spreadsheets to help track their LEED documentation, but I have not experienced any bringing new ideas to the table to gain LEED credits or boost LEED ratings*” A counterpoint to this comment from another architect, “*In a traditional delivery method, contractors can be proactive with their LEED project requirements. Proactive can mean a lot of things, including certification (accreditation) for staff and sub-contractors, having a robust set of standards used for LEED compliance and documentation, having a QA/QC plan for LEED compliance, requiring sub-contractors to have well grounded LEED knowledge and experience, and a desire to build green projects.*” From these types of responses, coding categories such as *Lack of value add* (first comment), *Applying past experience, Materials and constructability, Leadership and buy-in* and *LEED process management* (second comment) were established. Response frequencies are reported for each category and are organized by area of expertise in order to identify trends among different research groups. Overall response rates were somewhat lower for the open-ended questions, which is likely due to the extra effort and time required to complete this portion of the survey.

Question 8 asked research participants how contractors add value to LEED projects. Fifty two (93%) of the 56 respondents provided an answer. Response frequencies for the coding categories for question 8 are reported in Table 4. The response categories established are: Materials and constructability (23 responses), LEED process management (22 responses), Cost management (19 responses), Applying past experience

(17 responses), Leadership and buy-in (13 responses), Goal setting /integrated design (13 responses) Site management (8 responses), and Lack of value-add (3 responses).

Table 4

Coded responses to Question 8: *How do contractors add value to LEED projects?*

<u>Architects and Designers</u>	<u>Frequency</u>
Applying past experience	7
Materials and constructability	6
Leadership and buy-In	6
LEED process management	4
Site management	4
Cost management	3
Goal setting/integrated design	2
Lack of value-add	1
<u>Green Building Consultants</u>	
Materials and constructability	9
LEED process management	8
Cost management	7
Applying past experience	6
Leadership and buy-in	6
Goal setting/integrated design	4
Site management	2
Lack of value-add	0
<u>Contractors</u>	
LEED process management	10
Cost management	9
Materials and constructability	8
Goal setting/integrated Design	7
Applying past experience	4
Site management	2
Lack of value-add	2
Leadership and buy-In	1

Forty-four (79%) of the 56 respondents provided an answer for question 9.

Response frequencies for question 9 are reported in Table 5. Question 9 asked research participants to describe opportunities for contractors to better add value on future LEED

projects. The response categories established are: LEED Knowledge/continuing education and credentialing (19 responses), Cost (16 responses), Buy-in/early integration (14 responses), Leadership/exceed owner's expectations (13 responses), Better tracking tools and processes/software or databases (7 responses), Materials management (6 responses), Energy conservation measures (5 responses), Site management (4 responses), Experienced sub-contractors (3 responses), Single point of contact/LEED champion (3 responses) and Regional knowledge of LEED (3 responses).

Table 5

Coded responses to Question 9: *Based on your experience, please describe any opportunities that exist for contractors to better add value on future LEED projects*

<u>Architects and Designers</u>	<u>Frequency</u>
Leadership/Exceed owner's expectations	5
LEED knowledge/continuing ed. and credentialing	4
Site management	2
Experienced sub-contractors	2
Cost management (includes: systems thinking, life-cycle approach to cost and reduction in change orders)	2
Buy-in/early integration	1
Single point of contact/LEED champion	1
Regional knowledge of LEED	1
Energy conservation measures and building performance	0
Better tracking tools and processes/software or databases	0
Material management	0
<u>Green Building Consultants</u>	
LEED knowledge/continuing ed. and credentialing	10
Cost management (includes: systems thinking, life-cycle approach to cost and reduction in change orders)	9
Buy-in/early integration	7
Better tracking tools and processes/software or databases	6
Leadership/exceed owner's expectations	4
Site management	2
Material management	2
Energy conservation measures and building performance	2
Single point of contact/LEED champion	2
Experienced sub-contractors	0
Regional knowledge of LEED	0
<u>Contractors</u>	
Buy-in/early integration	6
LEED knowledge/continuing ed. and credentialing	5
Cost management (includes: systems thinking, life-cycle approach to cost and reduction in change orders)	5
Material management	4
Leadership/exceed owner's expectations	4
Energy conservation measures and building performance	3
Regional knowledge of LEED	2
Better tracking tools and processes/software or databases	1
Experienced sub-contractors	1
Site management	0
Single point of contact/LEED champion	0

Thirty-seven (66%) of the 56 respondents provided an answer to question 11. Response frequencies for question 11 are reported in Table 6. Question 11 asked research participants to describe any tools or methods that contractors could utilize to better add-value to the LEED process on future projects. The response categories established are: Software/databases/online resources (17 responses), Better tracking tools and processes (13 responses), Better cost control/real time cost estimating (6 responses), Integrated construction process (6 responses), Modeling/BIM (6 responses), Guidebook/best practice guide (5 responses), Buy-in/early integration (4 responses), LEED knowledge/continuing education and credentialing (2 responses) and Better site management protocols (1 response).

Table 6

Coded responses to Question 11: *Please describe any tools or methods that contractors could utilize to better add-value to the LEED process on future projects*

<u>Architects and Designers</u>	<u>Frequency</u>
Software/databases/online resources (LEED-Online, etc.)	4
Better tracking tools and processes	3
Better cost control/real time cost estimating	1
Buy-in/early integration	1
Guidebook/best practice guide	1
Modeling/BIM	0
LEED knowledge/continuing ed. and credentialing	0
Better site management protocols	0
Integrated construction process	0
<u>Green Building Consultants</u>	
Software/databases/online resources (LEED-Online, etc.)	9
Better tracking tools and processes	7
Guidebook/best practice guide	4
Modeling/BIM	3
Integrated construction process	3
Better cost control/real time cost estimating	3
Better site management protocols	0
LEED knowledge/continuing ed. and credentialing	0
Buy-in/early integration	0
<u>Contractors</u>	
Software/databases/online resources (LEED-Online, etc.)	4
Better tracking tools and processes	3
Modeling/BIM	3
Buy-in/early integration	3
Integrated construction process	3
LEED knowledge/continuing ed. and credentialing	2
Better cost control/real time cost estimating	2
Better site management protocols	1
Guidebook/Best practice guide	0

Thirty-seven (66%) of the 56 respondents provided an answer to question 12.

Response frequencies for question 12 are reported in Table 7. Question 12 asked research participants to describe any variation in role responsibility or team approach that could help contractors better add-value to the LEED process. Response categories identified

are: Buy-in/early integration (28 responses), LEED leadership/more responsibility (13 responses), LEED knowledge/continuing education and credentialing (7 responses), Better definition of roles (6 responses), Incentive based contracts/restructuring of contracts (4 responses) and Modeling/software or databases (2 responses).

Table 7

Coded responses to Question 12: *Please describe any variation in role responsibility or team approach that could help contractors better add-value to the LEED process*

<u>Architects and Designers</u>	<u>Frequency</u>
Buy-in/early integration	6
LEED leadership/more responsibility	3
Incentive based contracts/restructuring of contracts	2
Modeling/software or databases	1
LEED knowledge/continuing ed. and credentialing	1
Better definition of roles	0
<u>Green Building Consultants</u>	
Buy-in/early integration	10
Better definition of roles	6
LEED leadership/more responsibility	6
LEED knowledge/continuing ed. and credentialing	4
Modeling/software or databases	1
Incentive based contracts/restructuring of contracts	0
<u>Contractors</u>	
Buy-in/early integration	12
LEED Leadership/more responsibility	4
LEED knowledge/continuing ed. and credentialing	2
Incentive based contracts/restructuring of contracts	2
Better definition of roles	0
Modeling/software or databases	0

The written responses begin to bring into focus activities and opportunities for contractors to add-value to the LEED process, and indicate what of those activities and opportunities are most significant and important to LEED practitioners. The written

responses help confirm the dynamic role that the contractor plays in the LEED process as outlined in the Literature Review. In addition to the coded results, the written responses (see Appendix D) yield interesting anecdotal feedback that helps to paint a qualitative picture of what issues and opportunities related to the contractors role are most important and significant to LEED practitioners. For example, in response to question 9, a green building consultant offered the following comment related to contractors being able to provide cost estimates based on whole building performance instead of just the cost premium for a given component. “*Too often, energy conservation measures are looked at in single discipline silos. For example, the pricing of a better building envelope component may add cost to one contractors bid, but it can reduce another contractor’s (mechanical, for example) bid. Rather than looking at the offsets, sometimes the feedback only represents the increase.*” A contractor offered a similar comment, “*Focus on a wholistic approach to sustainability with a focus on long term building performance particularly with respect to energy consumption. Don’t focus primarily on getting certification during early design phases.*”

Likert Scale section, questions 13-32

The research instrument employed 20 Likert scale questions. Answer options were strongly agree, agree, remain neutral, disagree or strongly disagree. Results are coded so that 1=Strongly Agree, 2=Agree, 3=Neutral, 4=Disagree and 5=Strongly Disagree. Statistical analysis was performed using an ANOVA test, comparing the mean responses between the three main response groups, *architects and designers, green building consultants and contractors*. Statistical results for all Likert scale questions are

reported in Table 8, which is organized by area of professional discipline and by question number. Mean (M), standard deviation (SD), F-value (F) and p -value (p) are reported for each question. Of the 20 Likert scale questions asked, the results of 5 were statistically significant with a p -value (p) of equal or less than 0.10 indicating accuracy within 10%. This is notable considering the relatively small sample size. Question 26 was just above this threshold, with a p -value of 0.13. The differences between the mean responses to question 17, 19, 20, 21 and 31 were found to be statistically significant with a p -value ranging from 0.01 to 0.08. These results suggest that an actual difference in opinion exists among these response groups, although their answers on average appeared similar.

When asked whether or not a contractor should be involved in the design phase of a project seeking LEED certification (Q17) contractors had the strongest affirmative response, $M=1.31$, $SD=0.47$ followed by green building consultants, $M=1.50$, $SD=0.81$ and architects and designers, $M=1.83$, $SD=0.77$. The F-value for Q17 is 3.89 and the p -value is 0.02. All groups had affirmative response in the Strongly Agree range from $M=1.31$ to 1.83, with contractors strongly agreeing most often. Contractors also had the least amount of variability in their responses, suggesting that this perception is most strongly held within this population.

When asked whether contractors could better add value to LEED projects by serving as the project administrator for the LEED process (i.e. managing LEED-Online) (Q19), contractors again had the strongest affirmative response, $M=2.60$, $SD=1.03$ followed by architects and designers, $M=2.67$, $SD=0.95$ and green building consultants, $M=3.31$, $SD=1.07$. The F-value for Q19 is 2.62 and the p -value is 0.08. Contractors and architects and designers had affirmative response in the “Agree” range, however the

affirmative response was low, with a range from $M=2.6$ to 2.67 while green building consultants tended to remain neutral. Variation in response was nearly equal among the three groups, ranging from 0.95 to 1.07 .

When asked whether contractors could better add-value to LEED projects by better understanding the LEED requirements for Indoor Air Quality and implementing Indoor Air Quality management plans (Q20) green building consultants had the strongest affirmative response and least variation, $M=1.25$, $SD=0.44$ followed by architects and designers, $M=1.72$, $SD=0.56$ and contractors, $M=1.82$, $SD=0.57$. The F-value for Q20 is 6.26 and the p -value is 0.01 . All groups responded in the Strongly Agree range, from a high of 1.25 to a low of 1.82 .

When asked whether contractors could better add-value to LEED projects by better understanding the LEED requirements for tracking of green materials (Q21) green building consultants had the strongest affirmative response, $M=1.18$, $SD=0.40$ followed by architects and designers, $M=1.63$, $SD=0.49$ and contractors, $M=1.69$, $SD=0.63$. The F-value for Q21 is 4.62 and the p -value is 0.01 . All groups responded in the Strongly Agree range, with mean responses from $M=1.18$ to 1.69 . The relatively low response and high variation of contractors indicates that contractors may undervalue their own contribution to the materials tracking process when compared to other team members.

When asked whether the contractor's ability to implement LEED is limited by what designers and consultants write into the specifications (Q31) contractors had the strongest affirmative response, $M=2.43$, $SD=1.12$, followed by green building consultants, $M=3.25$, $SD=0.93$ and architects and designers, $M=3.41$, $SD=1.19$. The F-

value for Q31 is 4.02 and the *p*-value is 0.02. Contractors averaged an Agree response while architects and designers and green building consultants remained neutral.

Table 8

	Statistical values of responses to Likert scale questions, questions 13-32							
	Architects and Designers*		Green Building Consultants*		Contractors*		Statistical Significance	
	Mean	SD	Mean	SD	Mean	SD	F-value	<i>p</i> -value <i>p</i> <= .1
Q13	2.19	0.98	2.00	1.03	2.30	1.14	0.38	0.68
Q14	1.67	0.81	1.43	0.62	1.52	0.59	0.14	0.86
Q15	1.08	0.77	1.56	0.81	1.26	0.45	1.18	0.31
Q16	1.16	0.57	1.12	0.34	1.43	0.72	1.33	0.27
Q17	1.83	0.77	1.50	0.81	1.31	0.47	3.89	0.02
Q18	1.91	0.89	2.06	0.85	1.82	0.83	0.40	0.66
Q19	2.67	0.95	3.31	1.07	2.60	1.03	2.62	0.08
Q20	1.72	0.56	1.25	0.44	1.82	0.57	6.26	0.01
Q21	1.63	0.49	1.18	0.40	1.69	0.63	4.62	0.01
Q22	1.81	0.79	1.50	0.81	1.73	0.68	0.54	0.58
Q23	1.63	0.72	1.40	0.73	1.52	0.59	0.80	0.45
Q24	1.6	0.75	1.37	0.61	1.52	0.60	0.85	0.42
Q25	1.90	0.66	1.50	0.63	1.77	0.68	1.24	0.29
Q26	1.67	0.89	1.18	0.40	1.43	0.58	2.11	0.13
Q27	1.90	0.77	1.75	0.85	1.52	0.73	0.89	0.41
Q28	2.91	1.06	2.56	0.96	3.04	1.06	1.26	0.29
Q29	2.75	0.63	2.81	1.04	2.34	0.77	1.49	0.23
Q30	2.16	0.88	2.56	1.09	2.26	0.91	0.87	0.42
Q31	3.41	1.19	3.25	0.93	2.43	1.12	4.02	0.02
Q32	3.58	0.79	3.81	0.98	3.43	1.23	0.65	0.52

*1=Strongly Agree, 2=Agree, 3=Neutral, 4=Disagree and 5=Strongly Disagree

There were very few negative responses across the 3 response groups. By and large, the responses are overwhelmingly positive and in agreement with the statements

made about the contractor's role and opportunities in LEED. This supports the previous research reviewed in the Literature Review and the premise of the research - that contractors are vital to the LEED process, that their impact is broad and diverse, and that there is significant opportunity for contractors to expand their role and have positive impact on the LEED process in the future.

CHAPTER 5: DISCUSSION

Research Question 1

Research question 1 asked, “How can contractors better add value to the LEED process?” Answers to the written response questions helped to answer research question 1 by confirming how contractors currently add-value to LEED projects, shedding light on how they can better add value in the future, and what tools and methods, and variations in role responsibility could help contractors in this progression.

Responses to question 8 helped identify and establish the broad scope of ways in which contractors currently add value to the LEED process. Consistent with the Literature Review, responses indicate that contractors have positive impact on the LEED process in a comprehensive way ranging from conventional contractor activities like managing project costs, materials and project site to offering leadership in the LEED process through buy-in to LEED, aggressive goal setting and active participation in an integrated design and construction process.

Response to question 9 helped bring into focus specifically how contractors can better add value to LEED projects in the future. Overall, the highest response frequency to question 9 was *LEED knowledge/continuing education and credentialing* (coding category). This indicates that there is opportunity not only for contractors to be better practitioners of LEED but also to have deeper knowledge of LEED rating systems and their implementation. Also, that industry places value on contractors who have an on-going commitment to the LEED process, LEED related education, LEED-AP accreditation and credentialing and gaining experience with LEED in practice. *Cost management* was the second highest response frequency for question 9, indicating that

while contractors may be effective in implementing LEED, LEED related estimating and buy-out is an area where contractors can better add value, thus making LEED more accessible and economical. This might be achieved through better estimating tools, use of historical data, or by applying a whole-system approach to estimating by understanding the trade offs between a higher cost, better performing wall system and reduced mechanical system size and operating expenses, for example. *Buy-in/early integration* was the third highest response frequency for question 9, highlighting that early contractor buy-in and integration with designers continues to be of paramount importance to successful LEED implementation and that there remains significant opportunity for contractors and other team members to better implement an integrated design process, (this conclusion is also supported by response to question 12). There was repeated reference to the use of a conventional *design-bid-build* delivery system as limiting the ability of the contractor to have a positive impact on LEED implementation and eventual LEED success. For question 9, research participants identified opportunity for contractors to better provide leadership in the LEED process as a way to better add value; *Leadership/exceed owner's expectations* was the fourth highest response frequency. While reference to contractor leadership was very broad, it's clear that project team members would welcome contractors taking on an expanded role as LEED champions and advocates. Additional opportunities for contractors to better add value to the LEED process identified in response to question 9 include understanding what regional opportunities there are to implement LEED (*Regional knowledge of LEED*), through sourcing regional materials with LEED contribution, use of databases or other software applications to better implement LEED (*Better tracking tools and processes/software or*

databases) and better understanding of energy conservation measures, building efficiency, and building performance generally (Energy conservation measures and building performance).

Question 11 brought into focus what tools contractors could use to better add value to the LEED process. The highest response frequency was for use of technology, specifically software, databases or online tools including more effective use of LEED-Online (*Software/databases/online resources*). Specific references within the *Software/databases/online resources* category included:

- Databases of local and regional material vendors that would catalogue materials with LEED contribution and/or inventories of products that contribute to LEED credits
- Databases of historical cost and performance data to improve contractor cost estimating on LEED projects
- An electronic submittal process to streamline the LEED submittal process
- Better use of LEED-Online
- Use of modeling (noted below).

The second highest response frequency, *better tracking tools and processes* could be partially achieved through the first identified coding category (*software/databases/online resources*) or, as indicated in the written responses, through low-tech solutions like customized material tracking spreadsheets and calculators, paper-based tracking forms, or better coordination and communication among all project team members for LEED related data and activities. Building Information Modeling

(*Modeling/BIM*) was the third most frequent response, referenced here as a tool that can be used as means for contractors to better add value to the LEED process, offering added accuracy and detail to quantity take-offs, cost estimating and any unconventional construction assemblies that might be a part of a LEED project. In addition, several respondents across response groups called for contractors to use BIM not just to enhance their conventional role (noted above; estimating, take-offs, etc.) but as a way for contractors to engage in, impact and optimize building design and performance. Along with *Modeling/BIM*, *Better cost control/real time cost estimating* was the third highest response frequency, reiterating that contractors have opportunity to add value to the LEED process by developing new tools and methods to help bring accuracy and detail to the LEED cost estimating process.

Finally, responses to question 12 reiterate some of the overarching themes identified in the research. Primarily, that contractor buy-in and early integration into the LEED process remains a critical component to project team dynamics and structure, with opportunity for improvement among contractors and project team members alike. Primarily, there was repeated reference to contractor success being limited by a conventional hard bid, *design-bid-build* delivery structure. Even within a design-build or other integrated delivery process, if contractors aren't actively engaged and brought into the conversation around performance and LEED, their ability to fully impact building design, construction, operations and LEED scope may be limited. Consistent with the larger themes outlined above, expanded LEED responsibility for contractors, contractor leadership, continuing education around LEED implementation, contract structure and

use of modeling and other technology solutions were noted as opportunities for an enhanced contractor role in LEED.

Response to the statistically significant survey questions also help answer research question 1, “How can contractors better add value to the LEED process?” Responses to question 17 reiterate that contractor integration into the project team during the design phase of LEED projects is a core component of a contractor’s ability to add value. Overall, 91% either ‘strongly agreed’ or ‘agreed’ when asked whether contractors should be involved in the design phase of projects seeking LEED certification. Contractors had the strongest affirmative response to this question, followed by green building consultants and architects. Contractors had significantly less variability in their responses (contractors, $SD=0.47$, architects and designers, $SD=0.77$, green building consultants, $SD=0.81$) suggesting that this perception is most strongly held within this group and that contractors want to be involved in the design phase of LEED projects. It is noteworthy that despite the prevalence of integrated design, contractors are still asking for and emphasizing the importance of being included in the design phase of projects. Question 19 asked whether contractors could add more value by serving as the LEED project administrator (managing LEED-Online) for LEED projects. Overall the highest response was neutral (41%), followed by those who disagreed (24%). Contractors had the strongest affirmative response to this question, followed by architects. Green building consultants, who often serve as the LEED project administrator tended to be neutral or disagree with this question. There was no notable difference in variation in response across groups, SD ranged from 0.95 to 1.07. This indicates that while some contractors see opportunity to better add value to their LEED projects by serving as Project

Administrator, on the whole this view is not maintained across all 3 groups. Question 20 and 21 confirm that contractors have opportunity to better add value to two of their current core areas of LEED implementation: (1) indoor air quality management during construction and (2) sourcing and tracking of green materials. For both questions 20 and 21, green building consultants had the strongest affirmative response to whether or not contractors could add value here, followed by architects and contractors. Green building consultants also had the least variation in response ($SD=0.44$ and 0.40 respectively), followed by architects and designers ($SD=0.56$ and 0.49 respectively), and contractors ($SD=0.57$ and 0.63 respectively). As LEED champions, it makes sense that green building consultants would have the strongest response to a question about whether contractors can add more value to a scope of the LEED process that they are already responsible for, and that contractors, in their self assessment would have a lesser affirmative response. These results indicate that contractors undervalue their own contribution to indoor air quality management during construction and sourcing and tracking of green materials, or are unaware of the opportunity to better add value to these areas. It is important to note that contractors have opportunity to better add value to tasks that are already in their court and are part of their core contribution to LEED implementation. Finally, question 31 indicates that contractors may feel limited in their ability to successfully implement LEED by what is written in the project specifications, potentially inhibiting their ability to add-value. Green building consultants and architects tended to be neutral or disagree with this, while contractors tended to agree. As contractors are legally bound by specification language it makes sense that they would feel limited in this regard, while architects, who write specifications, might feel that there

is significant flexibility despite legally binding language. Again, as LEED champions it's predictable that green building consultants would support the notion that contractor success is not limited externally. Overall, the most frequent responses to this question were 'agree' (37.9%) or 'disagree' (36.2%), with 15 contractors (65%) agreeing or strongly agreeing and 18 non-contractors (56%) disagreeing or strongly disagreeing. This is important because it indicates a clear discrepancy among the 3 groups, indicating that contractors perceive project specifications as potentially limiting success in implementing LEED while the other two groups do not.

While the results of question 26 were just outside of the statistically significant range, responses to this question suggest that across response groups LEED practitioners believe that there is opportunity for contractors to better add value to LEED projects by providing accurate cost estimating and constructability reviews. All response groups had an affirmative response to this question, led by green building consultants ($M=1.18$, $SD=0.40$), contractors ($M=1.43$, $SD=0.58$), then architects and designers ($M=1.67$, $SD=0.89$). This is consistent with responses provided to the written answer questions as an area of opportunity for contractors. The standard deviations show that architect and designer response is not as uniform as the other two groups, indicating that while architects and designers understand this is an area of opportunity, they may not hold that belief as strongly as the other two groups.

Overall, the research indicates a consensus among the respondent groups that while contractors currently play a vital role on LEED projects, there is significant opportunity for contractors to better add-value to the LEED process. These results are broad, indicating that opportunity for contractors to better add value isn't limited to a

single task or activity. Instead, opportunity exists for contractors to better add value from pre-design through project build-out by:

- Early and active involvement in the design phase
- Assuming more leadership in the LEED process early on and assuming responsibility for success
- Better management of cost attributed to LEED implementation
- Better management of site (specifically IAQ management during construction) and materials tracking
- Development of more effective tools with which to manage all facets of LEED implementation.

There is also opportunity for contractors to better prepare themselves to add value to LEED projects by:

- Pursuing on-going education in green building
- Acquiring LEED credentialing
- Better understanding the principles and benefits of green building generally.

Research question 2

Results for research question 2 were mixed. Overall, the responses of the 3 groups tended to be similar. In both the written response and multiple-choice questions, the three groups did not have dramatically different responses to survey questions. For example, at no point did one group have a mean response in the strongly agree range while another group had a mean response in the strongly disagree range. In the most dramatic cases, groups had a mean response in the agree range while another was in the neutral range.

However, there were clear differences among the 3 groups, but the differences are more subtle and nuanced than the type of obvious discrepancy noted above.

Research question 2 asked, “What differing perceptions exist of the contractor’s role in LEED among building professionals on the Front Range of Colorado?” The intent of the question was to identify if notable similarities or differences exist among the three participant groups in their understanding of the contractor’s role in LEED based on their area of professional practice. The results of the written response questions offer qualitative feedback that helps to answer research question 2. Based on the established coding categories, responses to question 8 and 9 begin to indicate that contractors and green building consultants have similar perceptions and understanding of the contractor’s role in LEED. Contractors and green building consultants had the same top 3 response categories for question 8: *Materials and constructability, LEED process management* and *Cost management*. Only *Materials and constructability* were in the top three response categories for all response groups. The other top response categories for architects and designers were *applying past experience* and *leadership and buy-in*. This is repeated in responses to question 9. Contractors and green building consultants again had the same top 3 response categories. In this case the top responses were: *LEED knowledge/continuing education and credentialing, Cost management, and Buy-in and early integration*. Architects and designers also identified *LEED knowledge/continuing education and credentialing* and *Cost management* in their top three responses. However, only 1 architect identified *Buy-in/early integration* as an opportunity for contractors to better add value.

It is worth noting that contractors and green building consultants may have a similar perspective on the contractor's role in LEED. This makes sense since contractors and green building consultants work more closely together on LEED related tasks through the construction phase than contractors and architects.

The consistency with which green building consultants and contractors responded to the written answer questions shifted somewhat for question 11. Here, the differences among the groups begin to come forward. All three response groups had the same top two response categories (1) *Software/databases/online resources* and (2) *Better tracking tools and processes*; however, there were variations in the third response category for each group. For architects *Cost control/real time cost estimating* was the third highest response; for green building consultants, *Guidebook/best practice guide*, and for contractors, *Modeling/BIM* was the 3rd highest response. Green building consultants and contractors both had the same response frequency of *Modeling/BIM* and *Integrated construction process*. Four green building consultants and one architect identified a *Guidebook/best practice guide* as a tool that could help contractors add value, however none of the contractors mentioned this tool. These results suggest that there is consensus among LEED practitioners regardless of discipline, that expanded use of technology and improved tracking tools and processes are immediate value-add opportunities for contractors. However, this also begins to show that in some cases, each group's perceptions of the contractor's role in LEED is specific to their area of expertise and their own role in the LEED process.

For question 12, *Buy-in/early integration* was the most frequent response for all groups, with *LEED leadership/more responsibility* ranking second for architects and

contractors and third for green building consultants. The second most frequent reference for green building consultants was better *Definition of roles*, which wasn't referenced by either contractors or architects. Both contractors and architects referenced *Incentive based contracts/restructuring of contracts*, while green building consultants did not. The high frequency reference to *buy-in/early integration* is consistent with the content of the Literature Review and has emerged as a consistent theme throughout this research. While the importance of an early and integrated contractor involvement with the project team is known, reference to it here suggests that there is on-going and continued opportunity to better implement an integrated design process and for contractors to contribute more within that team structure. Inversely, contractors may be limited in their opportunity for success when a conventional *design-bid-build* delivery structure is implemented.

There is early indication of green building consultants and contractors having similar perception of the contractor's role in the LEED process, specifically, of how contractors add value and how they can better add value. This may be due to the fact that green building consultants and contractors often work closely together through the LEED process, particularly during the construction phase, when the LEED credits in the contractor's court are being implemented. While responses of architects and designers don't represent a huge departure from the other response groups, they didn't follow with the same consistency in response to questions 8 and 9.

Additionally, each research group (architects and designers, green building consultants and contractors) provided answers to questions that appeared to be unique to their response group, or related directly to the role and relationship of the given response group's scope of work to that of the contractor. For example, when asked what variation

in role responsibility or team approach might help contractors better add value to the LEED process (question 12), there was some reference from both contractors and architects to contract structure, but none from green building consultants. This is likely because green building consultants are rarely involved in structuring of the prime contract for a project and are most often sub-contractors of the owner/developer, architect or contractor.

It is important to be aware that all groups may perceive the role of the contractor through the lens of their own discipline. It's worth noting because architects and designers aren't as closely involved in construction phase LEED implementation to the same degree as green building consultants and contractors. Thus consultants and contractors may be able to offer insights into optimizing the LEED construction process that architects and designers cannot. Furthermore, this supports the need for on-going integration of these three groups, enabling an enhanced design process, knowledge sharing and better understanding of the similarities and differences of the three main groups in their perception of the contractor's role in LEED.

In the responses to the quantitative survey questions there is continuation of the trend of each response group providing answers that reflect their own relationship to the LEED process and the building process generally. For question 17, contractors had the strongest affirmative response when asked whether they should be involved in the design phase of projects, followed by green building consultants and architects and designers, who traditionally have led the early design phases of projects and have relied on contractors only for early cost estimates and other pre-construction consultation. This indicates that contractors want to be involved early in a project's development and seek

opportunity to have an impact on the project early on. This is also important because it indicates opportunity for architects and designers and green building consultants to further support and implement an integrated design process that includes the contractor, and that differences in perception exist among the three groups.

Contractors again had the strongest affirmative response to question 19. When asked whether it would add value for contractors to serve as project administrator on LEED projects, contractors tended to agree, as did architects and designers with slightly less frequency. Green building consultants, who typically serve as project administrator on LEED projects, tended to remain neutral or disagree with this question. This suggests that contractors see opportunity in the role of project administrator, while green building consultants may be resistant to having contractors assume what is currently one of their core tasks: managing LEED-Online and the LEED administration process. Despite this potential resistance from green building consultants, if there is perceived opportunity for contractors then it would be worth pursuing. On the other hand, the sentiment of green building consultants being resistant to this shift in role responsibility may be based on the desire of green building consultants to have contractors remain focused on successfully implementing the LEED credits and scope that is already in their court, instead of managing the LEED process on the whole. Regardless, it is worth noting gaps such as these both as an example of how the different response groups interpret opportunities for contractors to better add value through the lens of their own scope of work, and as an example of some of the dynamics that may come in to play as contractors pursue opportunities to better add value in the future, and as the differences in perception of the contractor's role in LEED among the three groups are understood and reconciled.

Questions 20 and 21 asked whether contractors could better add value to specific LEED related activities that occur during the construction phase of LEED projects (indoor air quality management during construction and materials tracking, respectively). All groups had affirmative response to questions 20 and 21, indicating that there is opportunity for contractors to better add value to both of these areas and consensus among groups. For both questions, green building consultants, who are often champions of these LEED related activities had the highest affirmative response and lowest variation, followed by architects and designers and finally contractors. These results tie back into the need for more contractor education and the value added of contractors who have past experience with LEED. It also indicates that contractors may undervalue their own contributions to LEED. Ultimately, subtle difference in opinion is realized here; contractors lag behind green building consultants and architects and designers in their self-assessment of their opportunity to add-value and their LEED contributions on the whole.

Finally, when asked whether contractor success in LEED was limited by what designers write into project specifications, contractors, who are legally bound to execute the project specifications, had the strongest affirmative response, followed by architects and designers (who write specifications) and green building consultants (who are LEED champions but generally not contractually obligated to comply with specification language) who both tended to remain neutral in their response. Responses reflect that each group has a different relationship with project specifications and supports the idea that each response group at times will have different perceptions of the contractor's role (and factors that limit or enhance opportunity for success) based on their own role in

LEED. Moving forward this indicates that there may be opportunity to write specifications that enhance the contractor's role and provide greater opportunity for contractor success. Performance based specifications; referenced in the written responses, may be one way in which this shift could be made.

Analysis of select non-statistically significant survey questions

Green building consultants had the most affirmative responses to questions about the significance of the contractors role in LEED projects and opportunity for contractors to better add value (Q13, 14, 16, 22-26, 28), followed by contractors (18, 27, 29, 32) and architects and designers (Q15 and Q30).

Responses to questions 28, 29 and 32 support the findings for research question 2. Question 28 asked if contractors tend to be resistant to adopting the additional tasks associated with LEED certification. While overall the mean responses to these questions were in the agree to neutral range ($M=2.56$ to 3.04), green building consultants and architects and designers tended to agree with this statement ($M=2.56$ and $M=2.91$, respectively) while contractors tended to remain neutral ($M=3.04$). The following question (Q29) asked whether or not contractors are adequately responding to the introduction of LEED in industry. All groups had affirmative response in the “agree” range ($M=2.34$ to 2.81). Consistent with Q28, Contractors had the strongest affirmative response to this question, followed by architects and designers and green building consultants, indicating that there may be some discrepancy in the perception of contractor responsiveness and willingness to adopt LEED.

Question 32 asked if contractors may be limited by lack of opportunity to accurately estimate LEED related costs. All responses were in the neutral range ($M=3.43$ to 3.81). Contractors had the strongest affirmative response to these questions, followed by architects and designers and green building consultants. This follows the logic of contractors responding most favorably to the idea that their opportunity for success may be limited by factors that are external to them. Architects ($M=3.58$) and green building consultants ($M=3.81$) tended to be neutral or disagree with this concept, suggesting than non-contractors are more likely to reject the notion that contractors are limited in their ability to estimate LEED projects. Ultimately, all responses were in the neutral range, which suggests that LEED should not be considered a limiting factor when estimating project costs. It's important for project teams to be aware that it may not be necessary for project budgets to hold large allowances or contingencies specifically for LEED.

Response to question 30 supports the findings of both research question 1 and 2. Question 30 asked whether in the future, construction organizations could add value to LEED projects by offering LEED consulting and project management as a professional service, along with estimating, preconstruction and construction services. In this case, all groups had affirmative response ($M=2.16$ to 2.56) lead by architects and followed by contractors and green building consultants. Architects are often responsible for structuring contracts and managing the overall project budget. Thus, if there were opportunity for contractors to take on part or all of the role of green building consultants there may be some opportunity to reduce the overall fees associated with LEED implementation, which would be attractive to architects and designers. This expanded role for contractors would present opportunity for increased revenue, scope and value add

so would also be attractive to contractors. Despite the potential loss of scope to green building consultants, they too saw this as an opportunity for contractors, however had a higher frequency of responses in the neutral range than the other two groups and had the greatest variation in response ($SD=1.09$).

Limitations and Future Research

The research sought to take a broad comprehensive view of industry perceptions of the contractor's role in LEED and differences in perception among response groups. The open-ended questions were intended to capture perspective of respondents in their own words. However, the open-ended questions did not ask respondents to identify and address specific issues related to the role of the contractor but instead gave respondents opportunity to comment on any aspect of 1) how contractors currently add value to LEED 2) how they can better add value to LEED in the future 3) what tools and technology could be employed to help contractors better add value and 4) what variation in role or project team structure could help contractors better add value. As a result, the responses ranged widely in all categories which made establishing coding categories that reflected the diversity in response difficult. Subsequently, some of the detail and nuance of the individual responses are not fully reflected in the research analysis (but are presented in Appendix D). In future studies, it would be ideal to hone in on specific aspects of how contractors can better add value to the LEED process based on those established here, and develop a research instrument and methodology that provides a greater level of detail on how those opportunities can be leveraged to increase the value-add of contractors on LEED projects. For example, within the broad response categories of *leadership/exceed*

owner's expectations and *buy-in/early integration* for question 9, future research might focus on the specifics of what leadership roles would be appropriate for contractors to assume in the LEED process and how to assume those roles, or what specific activity or contribution contractors can make to better add value through early integration into the process and how to initiate those.

A related limitation of the open-ended questions is that the methodology did not allow for follow-up with research participants to further confirm or clarify their written responses. Follow-up with respondents might have helped support the establishment of the coding categories and provided better understanding of the context and content provided in the written responses. Lack of this detail and opportunity for follow-up limits the research results to some degree.

Finally, there was some potential for bias in survey response, as the researcher was known to some of the survey participants. Whether or not this has limited the results is unknown, but there is potential for research participants to have altered their responses based on their relationship with the researcher.

Opportunities to expand and improve this research include revising and improving the research instrument to target more specific information about the opportunities for contractors to add value within the established coding categories and the known roles and tasks that contractors are responsible for. It may be valuable to develop a methodology that would allow for follow-up and/or on-going dialogue with research participants in order to bring a greater level of detail to the content of the written response questions.

Conclusion

Research results offer insightful feedback about current perceptions of the contractor's role on LEED projects and opportunities for contractors to better add value to the LEED process on the Front Range of Colorado. These results reflect the diverse scope of contractor related LEED activities and highlight the importance of contractor involvement in the LEED process. In the design phase, it's clear that an active and integrated design process that includes a contractor is critical to the success of LEED projects, and that there is opportunity for contractors to continue to add-value to this phase of project development by serving as LEED champions for contractor-related LEED activities and the process as a whole. Through the design phase and into construction, there is opportunity for contractors to better add value to their projects by providing accurate estimating and constructability reviews for LEED related scope. During construction, contractors can better add value to LEED by proactively tracking LEED credits and managing LEED related activities in real time, on a daily and weekly basis. Working closely with sub-contractors and the rest of the project team through the construction phase also supports success of the LEED construction scope. There were many strategies and tools identified as opportunities for contractors to better add value to LEED. These strategies and tools were wide ranging and include the following:

- Early commitment and buy-in to use of LEED as a tool for building optimization.
- Designating a single point of contact on the construction team to manage and delegate LEED related tasks from design through construction.
- Applying systems thinking and life-cycle cost analysis to LEED estimating.

- Developing historical data of LEED cost premiums and applying that information to current and future projects.
- Developing knowledge of best practices for applying LEED on a regional basis.
- Developing tracking tools that are customized for the LEED scope of a given project.
- Better management of the project site (specifically IAQ management during construction) and materials tracking.
- Use of BIM software to manage materials, cost, constructability and schedule on LEED projects.
- Contracting with LEED experienced sub-contractors.
- Providing training and support to sub-contractors who have limited LEED experience.
- Pursuing on-going training, education and LEED credentialing.

Tying these results back to Rogers' *innovation-decision process*, the strategies and tools outlined above can be understood to be opportunities to improve the implementation (fourth phase of the *innovation-decision process*) of LEED (the innovation). Having gained experience with LEED, research participants have engaged in a *re-invention* of the standard practice or past approach utilized to implement LEED. Rogers notes that there are benefits of *re-invention*, including a faster rate of adoption, a higher degree of sustainability of an innovation, flexibility in the process of adopting and customization of the innovation to fit more appropriately to a changing and/or local condition (Rogers, p.183-185). Awareness and adoption of the opportunities outlined

above will ideally increase the adoption of LEED on the whole via improved implementation, greater flexibility and customization of the process to fit the needs and goals of project teams.

Indication of trends related to differing perceptions of the contractor's role based on area of expertise began to come into focus through this research, and differences among the 3 groups were identified. Contractors and green building consultants often appeared to have similar perceptions of the contractor's role in LEED, which can likely be attributed to contractors and green building consultants working closely together through the LEED construction process. Stepping back and looking at the results on the whole, the three groups often responded in a similar way, indicating that there is fairly uniform understanding of the contractor's role in LEED and the opportunities that exist for contractors to better add value to the process. However, when results of individual questions were examined in detail, differences came forward that can be attributed to the different roles that the three groups play in the LEED process, their given relationship to the role of the contractor and to project teams on the whole.

It is clear that industry values the contractor's role in the LEED process, and that the contractor's role is critical to the success of LEED. Contractor commitment to LEED, through continuing education and continuous improvement is valuable in and of itself. Additionally, early and sustained integration of the contractor with the project team increases opportunity for contractors to add value to the LEED process. Key next steps for industry may include offering more opportunities for contractors to gain LEED knowledge through access to educational programs, support for pursuing LEED accreditation and credentialing maintenance. Knowledge sharing and the development of

standardized tracking tools and LEED resources may further help contractors implement LEED and diffuse the LEED process on the whole, and to become better aware of the differences that exist among the three groups studied here. Published or shared cost data on LEED premiums for both hard and soft costs and integration of BIM and other software and database tools could help contractors better estimate and implement LEED related tasks from pre-design through close-out. Support for these next steps from industry organizations and associations could promote contractor success across regions and markets, helping to maximize the value-add of contractor involvement in the LEED process and further the evolution of the LEED certification process as a tool for developing high-performance, environmentally responsive buildings.

References

- Added value, (2009). *BNET Business Dictionary* Retrieved March 4, 2009 from
<http://dictionary.bnet.com/definition/added+value.html>
- Added value. (n.d.). *Webster's New Millennium™ Dictionary of English, Preview Edition* (v 0.9.7). Retrieved April 05, 2009, from Dictionary.com website:
<http://dictionary.reference.com/browse/added value>
- American Institute of Architects. (2003). *The Architect's Guide to Design-Build Services*. John Wiley & Sons, Inc.
- Beard, J., Loulakis Sr., M., Wundram, C. (2001). *Design-Build: Planning through Development*. McGraw Hill.
- Betterbricks. (2008). The High Performance Portfolio: *Integrated Design*. Retrieved November 9, 2008 from
http://betterbricks.com/graphics/assets/documents/BB_WinTactics_IntegratedDesign_v6.pdf
- Cooper, D., Schindler, P., (2000). *Business Research Methods*, McGraw-Hill College, 7th Edition.
- Gottfried, D. (2004). *From greed to green*. Berkeley, CA: Worldbuild Publishing.
- Greater Vancouver Regional District, Ledcor Construction, Buildgreen Developments, Keen Engineering Co. Ltd. (2004). *Green Construction: Introducing Green Buildings and LEED to Contractors*. Retrieved February 4, 2009 from
http://www.infrastructure.alberta.ca/Content/docType486/Production/LEED_PD_Appendix_10.pdf
- Heckathorn, D. (1997). *Respondent-Driven Sampling: A New Approach to the Study*

- of Hidden Populations.* Social Problems. Vol. 44, no. 2, pp. 174-199. May 1997
- Merriam-Webster's Online Dictionary. (2008, July 13). *Perception*.
<http://www.merriam-webster.com/dictionary/perception>.
- Pettit, K. (2003). *Investigating the relationship of charrettes and LEED certified buildings*. Retrieved February 12, 2008 from
<http://cmarc.colostate.edu/survey/thesis%20to%20post.doc>.
- Riley, D., Pexton, K., Drilling, J. (2003). *Procurement of sustainable construction services in the United States: the contractor's role in green buildings*. Industry and Environment. Vol. 26, no. 2-3, pp. 66-69. Sept. 2003
- Rogers, E. (2003). *Diffusion of innovations* (5th ed.). New York: Free Press.
- Solar Energy International, (2008). *Energy Facts: Energy Consumption*. Retrieved October 22, 2008 from <http://www.solarenergy.org/resources/energyfacts.html>
- Syal, M., Mago, S., Moody, D. (2007). *Impact of LEED-NC Projects on Constructors*. Michigan State University. Retrieved January 28, 2008 from
www.spdc.msu.edu/cm
- USGBC. (2006). *New Construction and Major Renovation Version 2.2 Reference Guide*. U.S. Green Building Council. Second Edition.
- USGBC. (2008). Retrieved July 23, 2008 from
<http://www.usgbc.org/DisplayPage.aspx?CMSPageID=124>.
- USGBC. (2008). Retrieved July 20, 2008 from
<http://www.usgbc.org>ShowFile.aspx?DocumentID=3340>
- USGBC. (2008). Retrieved July 20, 2008 from
<http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1718>

USGBC. (2009). *LEED Projects and Case Studies Directory* Retrieved April 5, 2009 from <http://www.usgbc.org/LEED/Project/CertifiedProjectList.aspx> and <http://www.usgbc.org/LEED/Project/RegisteredProjectList.aspx>

USGBC. (2011). *LEED Projects and Case Studies Directory* Retrieved March 26, 2011 from <http://www.usgbc.org/LEED/Project/CertifiedProjectList.aspx> and <http://www.usgbc.org/LEED/Project/RegisteredProjectList.aspx>

Whole Building Design Guide Retrieved July 8, 2008 from

http://www.wbdg.org/resources/value_engineering.php)

Whole Building Design Guide Retrieved July 13, 2008 from

http://www.wbdg.org/wbdg_approach.php.

Appendices

Appendix A – Recruitment Materials

Written Invitation:


Colorado
State
University

DATE

To: Construction Industry Professional

Re: An invitation to participate in research on current industry perceptions of the role of the contractor in the LEED certification process.

Department of Construction Management
1364 Campus Delivery
Fort Collins, CO 80523-2944
(970) 491-7333
FAX: (970) 491-2473
www.csuconstruction.com

I am a master's degree student in the Department of Construction Management at Colorado State University. I'm employed as a LEED consultant and have 9 years of experience in the construction industry. As a graduate student and as a professional, I am interested in the role of the contractor in the LEED process. I am conducting research to identify current industry perceptions of the role of the contractor in the LEED process and how contractors can better add value to LEED projects.

The title of my study is "Current Industry Perceptions of the Role of the Contractor in the USGBC LEED-NC Certification Process." I am asking for your assistance in this study to identify ways in which contractors can better add value to LEED-NC and other types of LEED projects in Colorado and to determine variation in response based on several research variables.

The survey is being conducted via a secure website and will take approximately 15 to 30 minutes to complete. Once you submit the survey you will not be able to withdraw from the research, as no tracking of survey respondents will take place.

Your participation in this research would be greatly appreciated but is voluntary. Your confidentiality and anonymity are ensured, your identifiable information contained in the survey will only be used during the data collection phase of this study. During the analysis portion of the study, you will not be individually identified with your responses. All collected data will be aggregated, grouped and coded.

There are no known risks associated with participation in this study. By completing the survey you are agreeing to participate in the study. Your responses may contribute to the improvement of the LEED certification process on projects in the region. If you have any questions or comments concerning this study feel free to contact us using the information provided below. If you have any questions about your rights as a volunteer in this research, contact Janelle Barker, Human Research Administrator, at 970-491-1655. Potential research participants will receive 3 reminder emails to take the survey. If you do not wish to take the survey and participate in this research, please respond to the email with "Remove from Mailing List" as the subject.

Thank you for your interest and participation in this research. The results of this study will be available upon request after the survey period is closed. If you are interested in the results, please email me at loppnow.CSU_thesis@live.com.

To take the survey, select the following link:
https://www.surveymonkey.com/s.aspx?sm=tD7kkdWr25EkvZP5QMaF_2hQ_3d_3d

Stephen Loppnow Graduate Student (303) 803-6542 stephenloppnow@hotmail.com	Advisor: Dr. Mary Nobe (970) 491-5215 mary.nobe@CAHS.Colostate.edu
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Phone Script:

Hello, my name is Steve Loppnow, how are you today? I am a graduate student in the Colorado State University Construction Management Department and I am calling regarding my graduate research paper. I am administering a survey related to the role of the contractor in the LEED certification process.

Q1: Do you have any LEED project experience on the Front Range?

Y: Q2

N: O.K., does anyone else at your firm have LEED project experience that you would be willing to redirect me to?

Y: Great, thanks so much for your help.

N: O.K., thank you for your time today. Take care, goodbye.

Q2: Great, and are you an architect, contractor or green building consultant?

Y: Q3

N: O.K., are there other architects, contractors or green building consultants at your firm with LEED project experience on the Front Range that you would be willing to redirect me to?

Y: Great, thanks so much for your help.

N: O.K., thank you for your time today. Take care, goodbye.

Q3: Great, would you be willing to participate in this research?

Y: O.K., I would like to confirm an email address for you and will follow-up with instructions for taking the survey. Thanks so much for your interest.

N: O.K., thank you for your time today. Take care, goodbye.

Appendix B – Survey categories and related questions

<u>Elements of Contractor Involvement</u>	<u>Survey Question outline</u>
Written Response: Opportunities for contractors to add value to the LEED process	<ul style="list-style-type: none"> • In your opinion, how do contractors add value to LEED projects? • Based on your experience, please describe any opportunities that exist for contractors to better add value on future LEED projects
Written Response: Contractor roles and opportunity to add-value	<ul style="list-style-type: none"> • Please describe any variation in role responsibility or team approach that could help contractors better add-value to the LEED process
Written Response: Tools or methods that could help contractors add add-value	<ul style="list-style-type: none"> • Please describe any tools or methods that contractors could utilize to better add-value to the LEED process on future projects
Leadership and Initiative	<ul style="list-style-type: none"> • Contractors should strongly encourage their project teams to seek LEED certification for their building projects. • Contractors, when included in the design process, have equal opportunity to add-value to LEED process as any other design team member.
The significance of the contractor's role in LEED	<ul style="list-style-type: none"> • It adds value for contractors to have an understanding of all LEED credits. • Contractor commitment to the LEED certification process is very important to successful certification.
Appropriate point of contractor involvement	<ul style="list-style-type: none"> • A contractor should be involved in the design phase of projects seeking LEED certification.
The importance of LEED accreditation and LEED administration knowledge for contractors	<ul style="list-style-type: none"> • Contractors who are LEED-AP's generally add significant value to a LEED project team. • Contractors could better add value to LEED projects by serving as Project Administrator for LEED projects (managing LEED-Online).
The contractors LEED role and value added Contractors can better add value by:	<ul style="list-style-type: none"> • By understanding the LEED requirements for Indoor Air Quality and successfully implementing IAQ management plans • By understanding the LEED requirements for and tracking of green

	<p>materials (recycled content, regionally sourced, FSC wood, etc.)</p> <ul style="list-style-type: none"> • By having knowledge of the use of LEED Online and the LEED documentation process • By understanding the LEED requirements for site management and successfully implementing erosion and sedimentation control • By understanding the LEED requirements for Construction Waste Management and successfully implementing Construction Waste Management plans • By understanding the LEED requirements for and supporting the Commissioning process • By providing accurate cost estimating and constructability reviews for projects seeking LEED certification • By establishing a single point of contact to manage LEED related contractor tasks
Willingness and Rate of LEED Adoption by contractors	<ul style="list-style-type: none"> • Based on your project experience, contractors are resistant to adopting the additional tasks associated with LEED certification. • Contractors are adequately responding to the introduction of LEED in industry.
Looking Forward	<ul style="list-style-type: none"> • In the future, construction organizations could add value to LEED projects by offering LEED consulting and project management as a professional service, along with estimating, preconstruction and construction services.
Limiting factors	<ul style="list-style-type: none"> • The contractor's ability to implement LEED is limited by what designers and consultants write into the specifications. • It is exceptionally difficult to provide accurate construction cost estimating for projects seeking LEED certification.

Appendix C – Demographic variables and related questions

<u>Demographic variable</u>	<u>Survey Question outline</u>
Professional practice or trade	<ul style="list-style-type: none"> • Architect • Green Building Consultant • Construction Manager - Pre-Construction (Includes Estimators and those involved in value engineering, constructability reviews and other pre-construction services) • Construction Manager - Project Management (Includes Project Executives, Project Managers, Project Engineers) • Construction Manager – Field Management (Includes Superintendents, Field Engineers and Foremen) • Construction Manager – ALL (Equal involvement in pre-construction and construction phases of projects) • Other (please specify)
LEED experience	<ul style="list-style-type: none"> • Are you a LEED-AP? • For what length of time have you been involved in LEED projects? • How many LEED projects have you worked on?
Educational experience	<ul style="list-style-type: none"> • Describe your own level of education in relation to the LEED process. Education may refer to courses taken at a college or university level, trainings, workshops, conferences attended or self-study.
Project delivery structure	<ul style="list-style-type: none"> • What type of project delivery best describes the project(s) you have LEED experience on?
Integrated design	<ul style="list-style-type: none"> • Has an integrated design approach that included a contractor been used on the LEED projects you have worked on?

Appendix D – Raw Data

Response Group	Have you worked on a LEED-NC registered project seeking certification on the Front Range of Colorado?								
	If you have experience on the Front Range with LEED rating systems in addition to LEED-NC, please indicate those below.								
	Y	N	CI	CS	Schools	ND	EB	Homes	No other Front Range LEED experience
A&D	9	7	0	3	1	0	2	0	3
GBC	14	2	3	10	7	2	7	0	0
Contractors	20	3	5	5	4	1	3	2	9

Response Group	Have you worked on LEED projects using a rating system other than LEED-NC on the Front Range of Colorado?								
	Please indicate which LEED rating systems you have experience with on the Front Range of Colorado.								
	Y	N	CI	CS	Schools	ND	EB	Homes	
A&D	2	6	0	0	1	1	1	0	
GBC	2	1	1	1	1	0	1	0	
Contractors	1	2	0	1	0	0	0	0	

Response Group	Do you have experience with LEED-NC projects elsewhere in Colorado?								
	If you have LEED experience in Colorado (outside of the Front Range) in addition to or other than LEED-NC, please indicate the rating systems you have experience with.								
	Y	N	CI	CS	Schools	ND	EB	Homes	None
A&D	7	9	0	2	1	2	1	0	11
GBC	11	5	2	2	6	2	3	0	4
Contractors	8	15	1	2	1	0	1	1	16

Response Group	In your opinion, how do contractors add value to LEED projects?
A&D	May provide alternate materials or methods than to the specified approach, but will still comply with LEED goals.
A&D	by identifying more efficient methods
A&D	Involving the contractor early provides a full team buy in of the select targeted points, ensuring the greatest success. Also adds realistic cost figures to the points, to ensure that they will not be cut later.
A&D	Many of the credits available for LEED certification require the cooperation and understanding of the contractor. The contractor can be/should be the LEED leader on the construction site by verifying and overseeing the construction waste sorting, the air filter management during construction, and non-smoking rules to name a few. Contractors who understand and are invested in the LEED process can make a project go much more smoothly and can decrease the possibility of losing LEED credits due to oversight or non-compliance.
A&D	assisting in the design phase with regional and recycled content estimations in the market. They hold a critical role in the execution of the design and the quality assurance of many material and construction phase credits.
A&D	The contractor needs to be proactive in the process and advise owner on best course of action, based on cost and availability, to achieve the certification.
A&D	I have not seen many contractors excited about the LEED process. Some are beginning to develop tools such as spreadsheets to help track their LEED documentation, but I have not experienced any bringing new ideas to the table to gain LEED credits or to boost Leed ratings.
A&D	In a traditional delivery method, contractors can be proactive with their LEED project requirements. Proactive can mean a lot of things, including certification for staff and sub-contractors, having a robust set of standards used for LEED compliance and documentation, having a QA/QC plan for LEED compliance, requiring sub-contractors to have well-grounded LEED knowledge and experience, and a desire to build green projects. In a design-build delivery method, contractors should have additional LEED design experience and knowledge to bring to the table.
A&D	A building is only as good as it is constructed. You can design all you want, but if a contractor is not well educated in LEED and committed to quality construction (LEED or not), that building is not going to perform well across its lifetime.

A&D	They must be willing and able to provide the project leadership during construction needed for the LEED level sought. This includes open and timely communication with owner and design team, documentation of required data, and control of subs and jobsite.
A&D	Contractors are helpful in determining which points are achievable for local materials, recycling, etc. They also bring experience on structural and mechanical systems that provide LEED points, but also have a good idea what the budgets can bear.
A&D	Recycling, oversite of installation.
A&D	Contractors have the knowledge with the means and methods required to provide educated input on how the various building components can come together to create a successful project
GBC	In my experience, the contractor was responsible for complying with and achieving about a third of our project's LEED points. Therefore, contractor buy-in was vital to the projects success. The value added by our contractors was actually achieving the credits by implementing the LEED requirements and specifications as well as offering constructability advice, material and product sourcing, budget assistance early in the project.
GBC	Experience and understanding green building materials and techniques clearly adds value. The ability to learn about how to use new materials and techniques is additionally valuable. The ability and willingness to document materials for recycling, reuse, and landfill diversion is critical (somebody's got to do it).
GBC	By providing accurate pricing (more so than designers) that can be plugged into life cycle cost analyses to determine a realistic return on investment for higher capital measures.
GBC	Contractors are (typically) directly responsible for a number of LEED credits and prerequisites, and therefore can contribute significantly to the project's overall certification and level of certification. Contractors can provide early estimates about the ability to meet credit requirements and then must make sure processes get implemented and that materials are used, tracked, and documented appropriately. If involved early enough in the process, contractors can also add value by participating in project decisions and contributing their perspective with regard to costs, scheduling, and the process of construction.
GBC	By providing cost estimates of different design strategies and building elements.
GBC	They are an integral part of the process and instrumental in certifying a LEED project. They add value by being an integral part of the design process and executing the LEED requirements that have been chosen as being pursued.

GBC	A contractor that knows and understands the intentions and requirements of LEED add value to a project by ensuring that the time consuming and tedious tracking and documentation for many of the construction credits runs smoothly and finish successfully.
GBC	By making developers aware of best practices and rebates and incentives available from the State, Federal governments and local utilities
GBC	They can most add value by understanding the LEED system and their role in the process. This is expressed by how they present their construction estimates, by offering cost effective solutions and by tracking implementation of green strategies and products in the field. LEED and Green Building are most successful when the entire team is willing/eager to work hard toward making the project fit sustainability goals into existing budgets and schedules. For the contractor, this may mean working on the estimate a little harder, thinking more about how to improve constructability and affordability, and by diligently implementing the green/LEED aspects of the project. The value is added when the contractor takes an active role in fulfilling their part of the LEED requirements.
GBC	Contractors can add value to LEED projects by providing insight as to the successful application of green building strategies in the actual construction and operation of a building. They can provide valuable cost information for decision makers considering design alternatives. They can significantly simplify the LEED documentation and construction implementation process if they have knowledgeable and proactive staff working the job. Contractors can add most value by being a proactive participant in the LEED process.
GBC	An experienced contractor can add a lot of value to a project by simply knowing things to look out for, like recycled content in ceiling tiles. Where an unexperienced contractor may struggle to grasp the difference between pre- and post-consumer recycled content and only be able to track "big ticket" items like concrete for recycled content. I think the value add has a lot to do with the LEED experience one has. The contractor works closely with the subs and so not only affects the GC portion but also the subs knowledge and tracking ability.
GBC	Through implementing the IAQ management plan and Construction Waste Management Plan. In addition and organized and experienced contractor can foresee and head off issues that often arise during LEED projects surrounding product requirements such as VOC content, FSC and Formaldehyde content.
GBC	Contractors add value to LEED projects by being involved in the project early, and sharing the goals of the design team. The contractor should be an integral part of the design team to insure that there are no surprises during construction.

GBC	Contractors can add value by proactively pursuing targeted LEED credits on their projects. Contractors add value when they manage their LEED credits early on and effectively throughout the process. When contractors buy-in to the LEED process they best add value.
GBC	Add value by ensuring design is executed and goals follow through to construction. Implement strategies such as CWM, indoor air quality plans, ESC plan, low-VOC products, etc. that can contribute to LEED points and the overall best practices of the project. If they have knowledge of LEED and its framework, they can offer an experienced perspective and share lessons learned and how to anticipate potential issues or problems in design before they have begun construction.
GBC	By controlling and accounting for recycled and re-used content. The hope is that as contractors and sub-contractors gain experience they can be proactive and look for ways to improve material re-use and reduce overall waste. Ultimately, this experience can provide road-map and affect design and material choices in the design phase of design-build projects.
Contractors	Constructability review, payback analysis, systems development, scheduling
Contractors	Knowledge of price helps to determine the best bundle of credits to pursue to meet the building owner/users goals
Contractors	By helping the Owner decide which points are achievable with the least impact to their budget and researching which points can be achieved in the area (recycling not always available in remote locations). Also, experience with previous projects of similar type and their ability to achieve a certain LEED rating.
Contractors	Practicality, constructability, cost input, commissioning and long term maintenance feedback. A LEED certification in itself does not necessarily mean that a building is a model for sustainability. A wholistic approach to sustainability with a focus on long term building performance particularly with respect to energy consumption should be our goal.
Contractors	Providing options for the owner and architects for compliance with LEED goals Providing cost information to help owners evaluate which credits to persue based on their budgets
Contractors	In the projects we do no value is added just more money and that is why most of our clients can not afford LEED. Most are just trying to get the energy savings. We build Leed all the time and have for many years. Concrete, Steel, Wood
Contractors	Current cost and schedule assessment. Another viewpoint of the marketplace and what is available in the marketplace.
Contractors	By giving their valued opinions and ideas of different items related to LEED that may or may not work on the project.

Contractors	Through the waste management and indoor air quality practices.
Contractors	Daily monitoring of construction activities to make sure the project not only says it's LEED, but actually is LEED. Design is carried out properly.
Contractors	Contractors add value to LEED projects by taking more pride in the process and outcomes, leading to more thoughtful input to consideration of materials and systems selection and greater attention to work planning and organization (minimizing waste and energy consumption, maximizing recycling and labor/equipment efficiency).
Contractors	Contractors add another set of eyes and expertise when it comes to the LEED process. We are able to examine each lead point from a feasibility point of view.
Contractors	Early in the process contractors can add value by suggesting ways to accomplish sustainable features. During the construction process, they add value by implementing and documenting LEED credits.
Contractors	We help to divert waste from the landfills by choosing appropriate vendors to recycle waste with. We directly affect and track IEQ 3, IEQ 4, SSP1, MR2, MR4, MR5, MR6 which have a huge effect on points that are rather easy to get.
Contractors	Guarantee that the building is being built to goals set in design. Contribute to the constructability of the project.
Contractors	The have to know many of the LEED rules and regulations and also understand more than the architects the timeframes that it can take to get materials that comply with LEED.
Contractors	In the current state in LEED, the contractors don't have the opportunity to add much value other than following the process that the design team/owner have already put into place when they made their decision to go after what type of LEED Certification. If the contractor is able to get involved w/ the LEED process early on in designing they will be able to add a lot more value.
Contractors	I feel like the contractor's role is to provide cost estimates for different strategies to get LEED points. In a LEED project there are more and less expensive ways to get the same number of points, It's the contractor's job to find the most cost-effective way to get those points
Contractors	Contractors are best able to assign costs to possible ways of getting LEED points
Contractors	By being involved in the beginning of the project to make sure costs are being tracked properly and the design team is staying within budget. During construction contractors carry out the game plan so that all intended credits are achieved and even try to get some credits that weren't expected.

Contractors	I believe that as a CM/GC, we provide valuable insight to the entire LEED process. When becoming part of the team early, it allows for us to provide real time costing of materials and systems, but also allows the team to make decisions early on to reduce the amount of rework. Documents do not get thrown into the dumpster after a milestone deadline is met and the pricing is over or under budget. Also, an experience contractor such as my firm, we can bring lessons learned from previous projects to help project teams that may or may not be adverse in LEED.
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Response Group	Based on your experience, please describe any opportunities that exist for contractors to better add value on future LEED projects:
A&D	In my experience, this is mostly limited by the owner depending on when they contract the contractor and what services they are hired for - a good understanding of systems and prices helps a lot.
A&D	See above.
A&D	na
A&D	Assign a dedicated LEED professional person to the team.
A&D	I think that contractors can do a lot to advance the LEED program. Certainly in areas such as construction waste management, but also when it comes to competitivly bidding a project and choosing the subcontractors who participate in sustainable practices.
A&D	It is counter-intuitive to the competitive environment that a contractor now works in, but it would be nice to work with a contractor who wants to exceed an Owner's expectations for LEED. Most contractors now accept LEED as a requirement and include costs for minimal LEED coordination, but this is more of a minimal response to changing paradigms.
A&D	I would like to see contractors and sub-contractors get more involved in the LEED discussion -- what is working on a job site, and what is not? What opportunities are being missed, and what goals are difficult to implement? To date, LEED has been driven by architects and engineers, with product manufacturers and other industry professionals coming on more recently. I think we need to balance the conversation and get the construction perspective.
A&D	Full understanding of LEED goals and credit opportunities, knowledge of local and regional manufacturers, contractors, vendors and suppliers that may help achieve LEED points.
A&D	As they build more LEED projects they will perhaps see more

	innovative ideas that can be used in more and more projects.
A&D	None.
A&D	Continuing education in the various LEED components such as Core & Shell and Operations and Maintenance.
GBC	The earlier the contractor can get involved with the project the more opportunity they have to add value to the project.
GBC	Each project is better. Experience adds value, until of course the requirements change or evolve. Then experience helps to inform decisions about how to accomplish new goals.
GBC	Too often, energy conservation measures are looked at in single discipline silos. For example, the pricing of a better building envelope component may add cost to one contractors bid, but it can reduce another contractor's (mechanical, for example) bid. Rather than looking at these offsets, sometimes the feedback only represents the increase.
GBC	Often contractors are not involved early enough in the process and therefore miss out on some of the value adding opportunities that exist. Also sometimes contractors do not understand the value that can or should be adding to the project, even if they are brought in early in the process.
GBC	Look at the building as a whole rather than a sum of pieces when evaluating different building systems and their costs.
GBC	They can add value by better understanding the LEED requirements and the cost implications of pursuing LEED credits. This will also help them monitor the site and assure compliance with LEED requirements.
GBC	Designate champions on the construction administration team to be responsible for different components of the LEED tracking process. Superintendent - supervise on-site LEED items, PM assistant - track bid proposals and packages to optimize materials selection, PM assistant - itemize the LEED relevant materials while materials are being selected to ensure all are identified before close-out, PM assistant - begin a database of ideal materials so that contractor can suggest materials and be more efficient on next LEED project
GBC	More energy efficiency measures. Understanding the payback with financial tools to show what escalating utility rates has on the payback.
GBC	Many contractors could start by making sure that their estimators, PM's, Supers, Project Engineers and subs, all understand their respective roles in the LEED process. Then they need to develop the internal documents and tracking systems to manage LEED projects. Contractors should be willing to work with the estimate and their subs to find ways to include LEED goals in a cost effective manner.

GBC	Again, be more proactive. Come to the table during design with answers to questions like, how much recycled content can we expect in our materials based on the construction type? What is the current cost premium for FSC doors? Be more receptive to the process and really take the time to understand what the goals are.
GBC	I think it would be helpful to have a LEED for Contractors training session that was at least a half day, so that you could really get into the details. Then the GC would be able to better explain the process to the subs...I think the subs is where a lot of things can fall through the cracks.
GBC	Contractors can gain training on the LEED process prior to beginning a LEED project. This is highly recommended. Also, have a dedicated individual who is responsible for compiling all LEED information is helpful. Also, having dedicated documentation procedures (LEED tracking spreadsheets) is helpful.
GBC	Contractors should have a broad knowledge of sustainable practices and materials available, as well as the detailed skills to complete the project at hand. Staying informed about green techniques and materials will help bring a project in at a lower cost, and with better quality.
GBC	Contractors can better add value by recognizing that LEED is a mainstay in industry and that their role is important and critical to the success of the LEED process. They could also better add value by proactively managing their credits, meaning including their credits as part of their weekly project management tasks, tacking materials proactively, being well organized in their documentation and in committing to sucessfully implementing LEED early on.
GBC	Contractors can better add value if they are brought on earlier in design to share experience and perspective, reduce need for change orders and costly design changes. Also, knowing LEED process and documentation requirements and expectations can reduce burden on contractor's team / project team / green building consultant to relay these requirements. If they are familiar with processes such as commissioning, this can help project keep on track and enable them to work with ex agents more effectively to meet the requirements.
GBC	By smoothly and timely executing the accounting, tracking, and submittal processes that they are responsible for during the LEED-NC construction phase. On the projects I have been involved with, this often requires much outside help and constant effort to receive the required information to adequately comply with those credits directly attributable to contractors.
Contractors	Earlier involvement than the design development phase. at that point it gets to be almost too late.
Contractors	I note that people who already bring good management and customer skills to projects tend to be successful with LEED and presenting its value to owners/users.

Contractors	I see contractors taking a greater role in helping determine long term energy savings (energy modeling) and payback so that additional consultants aren't required.
Contractors	Focus on a wholistic approach to sustainability with a focus on long term building performance particularly with respect to energy consumption. Don't focus primarily on getting a certification during early design phases.
Contractors	Continual knowledge growth of what is available in the marketplace. Increase knowledge, awareness and application of LEED principles throughout the organization on all projects, not just project pursuing LEED certification.
Contractors	Value would be added by bringing contractors on board earlier in design in a negotiated GMP project delivery system. This allows the GC to select from a pool of more qualified and competent subcontractors who have experience working on LEED projects. Suggestions during design from the subcontractor could impact the selection of products that contribute more to the local/regional credits.
Contractors	They can help with the pre-construction to plan to get realistic construction points for this region.
Contractors	Earlier involvement in the planning process, if coupled with increased awareness of material and systems options (especially their relative costs in terms of energy, time and dollar costs), can optimize LEED strategies and contribute to more cost-effective project sequencing/scheduling. A collateral benefit might be improvement in general contractors' familiarity with and command of a broader range of specialty work, reversing the dominant (and dismaying) trend of the last generation of contractors.
Contractors	Contractors should focus on training. LEED AP's significantly enhance the efficiency of the project.
Contractors	Contractors can add value early in the design process. By including contractors early on, those with trade specific knowledge can assist designers in implementing sustainable features. Ways they can assist include cost savings through finding products, suggesting methods that are least labour intensive, or providing lessons learned from previous projects.
Contractors	Tracking and organizational skills to keep LEED Submittals on track and the spreadsheets organized for whomever is doing the certification process (most likely the architects).
Contractors	Provide insight into costs and ease of assembly of material choices.
Contractors	The biggest thing that contractors can do is explain to architects and owners the importance of a quick decission for which materials will be used on the project.
Contractors	Get the contractor in ealry in design and allow them to give they're insight on how to attempt to reach the certain certification the owner/design team is looking to achieve.
Contractors	There is opportunity to add value in every credit of the LEED project.

	I believe that to better help project teams in the future and allow the contractor to add value on future projects, the design teams need to understand that contractors are responsible for implementing majority of the credits whether design or construction credits. I'm not stating that it's all about the contractor, but design teams need to embrace the collaborative process and understand that contractors don't try to drive the bus with respect to LEED, but our opinions are valuable and need to be heard and discussed. Too many project design teams don't want contractors to discuss items of concern during preconstruction efforts and design and they need to understand that we are advocates for LEED and we have lots of construction experience on projects.
Contractors	

Response Group	Please describe any tools or methods that contractors utilize to add-value to the LEED process (this could include systems to manage documentation or other process management strategies):
A&D	not sure.
A&D	Contractors should be filling out the LEED forms having to do with construction waste and other credits to help the architect or LEED consultant document credits.
A&D	material matrix, checklists, detailed reporting and photographs, accurate scoping and oversite of subcontractors.
A&D	Don't know of certain tools, but proper paper chase is very important.
A&D	To date, the LEED documentation on all my LEED projects has been done through the architect or a LEED consultant, and the contractor simply has used the tools provided to them by the architect or consultant. However, I know of contractors who have a much more progressive approach to LEED and have developed or implemented software not only for managing LEED documentation, but also for modeling systems and products that go into a project to ensure zero (or close to zero) waste, and can track material recycled content and origin.
A&D	I can't think of anything that contractors use to add value, certainly nothing from my experience. Any easy to read standard for documentation might help the team know where we stand on the contractor's LEED responsibilities. Maybe some form of online logging where deliveries or items installed are logged in with the pertinent data for team members to see? Not sure?

A&D	As an architect, we struggle to get the contractor 'on board' with the LEED process. This is about the mindset (there is no recycling in the trailer) to the process (recycled content is not part of the submittal process). At some point, a general contractor has to achieve certain LEED points, and they know that when they are bidding. I'd like to understand how they calculate credits like recycled content or regional materials, and how that translates into a building. A lot of times product reps think the architects 'pick' the products that going into a building, but in the case of public schools, we're only making suggestions... and we can't do all of the research. Ultimately it comes down to the contractor.
A&D	Construction Waste Management - dedicated individual in charge of ALL waste and recycling, with power to educate and direct all site personnel
A&D	NA
A&D	System that manages construction waste and purchasing of local products.
A&D	Various software programs available to model the various components of the project
GBC	We developed a LEED documentation management system with the assistance of our contractors.
GBC	Real-time cost estimating is very intriguing, and I believe will become much more prevalent in the construction industry. Being able to determine these costs in a charrette environment is a very powerful resource.
GBC	Cost estimating at various times during the project is important for some LEED credits. Materials tracking processes, procedures, and paperwork are also very valuable for LEED projects.
GBC	We use Microsoft Project to manage the LEED tasks during construction and will soon be implementing a schedule for all LEED projects that will encompass the entire Design/Construction process. We also have weekly LEED construction meetings to manage the LEED process. Other aids include spreadsheets for tracking resources and materials, VOC cheat sheet, contractor training and a LEED specifications sheet that is attached to all of our contracts.
GBC	see #9.
GBC	BIM and Energy Modeling
GBC	Some contractors have a dedicated position or person that becomes an expert in LEED implementation. This seems to work fairly well. I often see project engineers create a LEED binder for the project to help them keep organized and be able to easily find information.

GBC	I haven't encountered any specific tools that add value to the LEED process. Often times, contractors will have their own format and templates to monitor LEED related information in the project submittals.
GBC	Materials tracking sheet, to collect information on materials and low-emitting levels.
GBC	Excel spreadsheets and email. In addition Contractors can be sure to highlight specification requirements that relate to LEED at the beginning of the project.
GBC	Project Management software that is used to track the construction process, and manage material delivery to the site. Having on the materials on site that are needed helps to keep materials clean and reduce the chance of contamination before and during installation.
GBC	Most use tracking sheets and other tracking tools provided by their LEED consultants. Rarely do contractors have these developed already. Historical data from past LEED projects, data on sourcing materials, previous waste haulers used that offer recycling and so forth are things that some contractors have and implement in a way that adds value.
GBC	Templates and forms for CWM plans and IAQ plans, tracking forms and material calculators for recording materials and sustainable attributes. BIM software Photo documentation (tends to be standard) to document ESC, CWM, IAQ and SMACNA compliance
GBC	Use of a streamlined / on-line submittal process. Reduces redundant e-mails and some of the disconnects that can occur between architect, contractor, sub-contractor's, and project consultants.
Contractors	Trend logs, payback estimates and systems study forms
Contractors	Open mind. Most contractors tend to think only of their own disciplines and do not help promote LEED understanding between different trades. The most successful LEED projects I have participated in are those in which credits are gained across trades (i.e. gaining energy credits by better insulation rather than substituting expensive but sexy alternative mechanical systems)
Contractors	Spreadsheets that describe the associated additional costs of different LEED points.
Contractors	Involvement in design phase and systems selections. Insist on energy modeling early in the process.
Contractors	Schedule analysis. Early test scenarios for viability of credits based on preliminary cost plans. Communicating ideas and lessons learned from other projects locally, regionally and nationally.
Contractors	Having a detailed policy for documentation and attaching it to subcontracts ensures the cooperation of all parties involved in the project.
Contractors	Use of an integrated, interactive, on-line data-base for accumulating and correlating project planning and progress information, with data reports constantly updated and available to all project team members.

Contractors	In the past, I developed a LEED submittal log that tracked any submittal related to LEED points.
Contractors	Communication through subcontractor meetings, owner meetings, pretasks.
Contractors	excel is amazing! Prolog is great for tracking LEED Submittals as well.
Contractors	Build templates for subs to follow on project to allow the subs to understand what is needed from them.
Contractors	LEED On-line. Excel spreadsheet for the LEED burn-out process.
Contractors	I don't think it's that different than a normal project. A little more paperwork, but not that big of a deal
Contractors	Spreadsheets to log all incoming information. Digital camera's to document what is happening.
Contractors	Our team has in-house construction waste management and indoor air quality management plans that we implement on all LEED projects and other projects that we deem necessary or critical for the success of the project. We also have requirement for subcontractors to fill out material spreadsheets for regional materials, recycled content, FSC wood, etc on a monthly basis with pay applications. We ensure that all subcontractors understand the requirements prior to sending them a contract and this information is an exhibit to all subcontracts.

Response Group	Please describe any tools or methods that contractors could utilize to better add-value to the LEED process on future projects:
A&D	not sure.
A&D	See above.
A&D	na
A&D	See item 10.
A&D	I would like to see modeling being used more cohesively through the design team including the contractor to minimize change orders which produce waste, track materials better, and have a better overall understanding of where a project sits on the LEED spectrum before construction begins.
A&D	See above.
A&D	I think my answer above sort of answers this as well... some contractors have this figured out, and others do not.
A&D	I'm not sure what software is available to them to track all of the points assigned to them, but it seems that a good software program would be

	very helpful.
A&D	?
A&D	Software
GBC	Signage for recycling and other practical LEED credits. Regular meetings with subs to discuss relevant LEED requirements.
GBC	Very few contractors actually implement the real-time cost estimating I mentioned, so it is still a process that is futuristic for most companies.
GBC	More sophisticated or complete tracking processes and tools can be helpful for those who don't have them. Ultimately a BIM platform could help as well.
GBC	I do believe we need a LEED management tool, such as Loraxpro, to better manage the LEED process. This would aid us not only in design but also during the construction process.
GBC	see #9.
GBC	BIM and Energy Modeling
GBC	Contractors should be able to quickly source materials (and associated costs) that will support LEED credits and have an internal database that highlights LEED qualities (like recycled content or VOC compliance). Contractors should be able to provide pre-construction estimates for MR credits. They should have construction waste recycling standards, construction activity pollution protocol, and indoor air quality plan readily available. Contractors should keep a log of lessons learned and work toward improving their effectiveness by reflecting and learning from past projects. One of the things that most contractors really need to improve on is being proactive about the whole process. Being proactive means educating staff, setting up internal processes and documents, and staying on top of documentation during construction.
GBC	A library of all the low VOC adhesives and sealants that have been used on their previous LEED projects. A listing of all the regional materials that are available in given locations. A listing of all the materials that have included recycled content on all of their previous jobs. A listing of all the construction waste haulers in a given location and the cost/benefit of each Standard IAQ during construction policy followed on all projects, not just LEED.
GBC	Don't know.
GBC	Consistent documentation protocols such as LEED spreadsheets. Perhaps a dedicated FTP site folder where contractors can post documentation such as MSDS and product data sheets and approved submittals.

GBC	Local USGBC chapters and resources to learn about best practices in the area and local manufacturers and materials that are available. Also national green building resources, ie. GreenSource.
GBC	Historical data, developing databases of past LEED projects, strategies and results could add value to the LEED construction process. Also, education and diligent monitoring of LEED related site management tasks (IAQ, ESC, etc.) is important. Making LEED 100% part of the weekly routine is a method that could help to add value.
GBC	Further integration or participation using BIM software with project team Cost estimating incorporating anticipated LEED goals / credits that may be out of initial scope
GBC	A clearly defined tracking process with monthly or bi-monthly reporting.
Contractors	Open mind, same as above
Contractors	Energy modeling software, lighting analysis software.
Contractors	Early procurement of Mechanical and Electrical subcontractors for better input on design and systems selection.
Contractors	BIM
Contractors	Make sustainability and LEED a part of all meetings and design reviews. Plan and investigate credit strategies early.
Contractors	Better on-site recycling system with multiple recycling locations throughout the construction site would result in higher percentages of materials diverted from the landfill.
Contractors	1. Full integration of CADD, cost/quantity data-base, and 3-D systems coordination between the architect, consultants, GC, key subcontractors and Owner/user reps. 2. Use of reliable local industry-standard material costs and labor productivity data for planning and evaluating LEED and other project options.
Contractors	I believe that using LEED online as often and early as possible adds value. In addition, documenting electronically adds value as these files are easily accessible for the LEED consultant and can be given to the owner for future information.
Contractors	We need to help educate our trades to collaborate and understand a much bigger picture of project success than a traditional model allows. Installing what is drawn leaves so much opportunity on the table that could improve the overall project.
Contractors	Don't know of any.
Contractors	I believe that our firm is at the leading edge of tools and methods and we continually refine them in-house to make the information easier to get.

Response Group	Please describe any variation in role responsibility or team approach that could help contractors better add-value to the LEED process:
A&D	earlier integration with the team, expanded use of Revit, more detailed specifications
A&D	Having the contractor collaborating on the project early, as in a design-build project, greatly increases the contractor's personal investment in the LEED process. Giving the contractor more responsibility and perhaps incentive to complete LEED credits may help in traditional design-bid-build projects.
A&D	na
A&D	Team approach with the architect and the owner.
A&D	It typically comes down to whether it is a low bid project where the contractor is trying to take out any 'extras' or a CMGC where the contractor is onboard from the beginning and provided a gross maximum price determined by the design. However, even in a CMGC process, the contractor is typically looking to earn money where possible and a lot of time LEED products or practices will be cut without diligent supervision.
A&D	Not sure. Obviously in design build, the contractor takes a lead role (pun intended).
A&D	If you can get a contractor on board early, they can help advise you about more efficient processes or things they have had success with in the past. Even if you do get them on board early, however, they don't always give you that advice.
A&D	I would think that contractors would be moving towards having LEED professionals on staff that would lead the charge on LEED charrettes and following all the way through to the commissioning.
A&D	?
GBC	In our experience, the contractor added much more value to the project when pulled in during design development. They provided constructability advice, building system analysis and material sourcing assistance from a practical, empirical perspective. They helped to take the architects and engineers great ideas and turn them into pragmatic cost-effective strategies.
GBC	Engaging all the key members of the construction team into the charrette process would add value. That would include the estimator, project manager, and site superintendent. The construction process is so complicated, that when all of these people are not engaged during the whole process, we will usually see some disconnect as the project responsibility gets handed from one to the next.

GBC	When contractors understand and are on board with LEED and the motivations behind seeking certification for the project, then they are a very valuable part of the team. When contractors do not have a good understanding and are resistant to change or LEED in general, then that creates conflict within the team. The best solution is probably earlier engagement and more education to bring the contractors into the entire project team.
GBC	Clear role responsibility along with clear expectations should be the basis of any LEED team. Also, a kickoff to gain alignment around the LEED process would also be helpful.
GBC	see #9.
GBC	Contractors should be involved as early as possible. They should embrace a "can do" attitude to LEED and help find ways and ideas to include green features in a project (e.g. finding cost effective ways to include daylight shading). They need to be more open, engaged and creative.
GBC	Be open to the process, be proactive, learn about the intent.
GBC	Having one dedicated LEED manager on the contractor team.
GBC	Dedicated LEED go-to guy on the GC team.
GBC	Contractor should be part of the design team, not just the contractor. Building relationships with the design team early will help the project run smoothly later.
GBC	Contractors should be able to manage LEED documentation without LEED consultants looking over their shoulders. Also, it is always important to have an experienced contractor in the design phase or early project meeting to confirm constructability and sometimes, when accurate, cost.
GBC	Have the contractor join project team early on to ensure integrated design and incorporate perspective and experience into design decisions, budget estimating, etc. Also, have the contractor partner with LEED project manager to work together and help encourage participation in all project phases.
Contractors	Design assist or design build approach in lieu of 'consulting' or, worse yet, reactionary.
Contractors	I observe it is essential to have an independent LEED driver who has the sole responsibility to manage the LEED process and guide the team in coming up with the "scorecard" that best meets the owner/users needs.
Contractors	Contractor hires the LEED Consultant or has them on staff.
Contractors	More Design-Build project delivery project deliveries rather than hard bid.
Contractors	Better collaboration with Architects and designers.

Contractors	Early involvement with the project design and the test fit scorecards.
Contractors	It is good to have them in the planning process - design phases - not just estimators, but operations as well.
Contractors	Find a contract approach/format that offers incentives and rewards to contractors for contributing to enhanced project value from start to finish, rather than the typical lump-sum or cost-plus-fee arrangement.
Contractors	Design and construction team need to meet early and often to discuss attainable points and feasibility of said points.
Contractors	Having one LEED champion and others on the project that have a comprehensive understanding of LEED.
Contractors	Works best if the architect and contractor do weekly updates on LEED Submittals and tracking logs to not let items slip behind or wait until the very end.
Contractors	The silo effect of traditional delivery prevents individual contributors from adding more than is normally their role.
Contractors	It is more important for a contractor to be brought into the team early in the planning phase of the job. The contractor needs to be part of it to give feedback on potential budget impacts for different point strategies
Contractors	It helps if the contractor understands the LEED process and is positive about it.
Contractors	Don't let the architect be the LEED consultant unless they embrace the collaborative process including the contractor and listening to their thoughts and concerns.

Response Group	Contractors should strongly encourage their project teams to seek LEED certification for their building projects.				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
A&D	4	7	3	2	0
GBC	6	6	2	2	0
Contractors	6	8	7	0	2

Response Group	Contractors, when included in the design process, have equal opportunity to add-value to LEED process as any other design team member.				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

A&D	9	6	0	1	0
GBC	10	5	1	0	0
Contractors	12	11	1	0	0

Response Group	It adds value for contractors to have an understanding of all LEED credits.				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
A&D	14	1	0	1	0
GBC	9	6	0	1	0
Contractors	17	7	0	0	0

Response Group	Contractor commitment to the LEED certification process is very important to successful certification.				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
A&D	13	2	1	0	0
GBC	14	2	0	0	0
Contractors	15	8	0	1	0

Response Group	A Contractor should be involved in the design phase of projects seeking LEED certification.				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
A&D	5	7	4	0	0
GBC	10	5	0	1	0
Contractors	15	7	0	0	0

Response Group	Contractors who are LEED-Accredited Professionals generally add significant value to a LEED project team.				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
A&D	5	7	3	1	0
GBC	4	8	3	1	0
Contractors	9	10	3	1	0

Response Group	Contractor's could better add value to LEED projects by serving as Project Administrator for LEED projects (managing LEED-Online).				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
A&D	2	5	6	3	0
GBC	1	2	6	5	2
Contractors	5	3	11	4	0

Response Group	Contractors can better add value by understanding the LEED requirements for Indoor Air Quality and successfully implementing IAQ management plans				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
A&D	4	10	1	0	0
GBC	12	4	0	0	0
Contractors	6	15	2	0	0

Response Group	Contractors can better add value by understanding the LEED requirements for and tracking of green materials (recycled content, regionally sourced, FSC wood, etc.)				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
A&D	5	9	0	0	0

GBC	13	3	0	0	0
Contractors	6	15	2	0	0

Response Group	Contractors can better add value by having knowledge of the use of LEED Online and the LEED documentation process				
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	
A&D	7	5	3	0	0
GBC	10	5	0	1	0
Contractors	9	12	2	0	0

Response Group	Contractors can better add value by understanding the LEED requirements for site management and successfully implementing erosion and sedimentation control				
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	
A&D	6	6	2	0	0
GBC	11	2	2	0	0
Contractors	12	10	1	0	0

Response Group	Contractors can better add value by understanding the LEED requirements for Construction Waste Management and successfully implementing Construction Waste Management plans				
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	
A&D	6	5	2	0	0
GBC	11	4	1	0	0
Contractors	11	9	1	0	0

Response Group	Contractors can better add value by understanding the LEED requirements for and supporting the Commissioning process				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
A&D	4	8	2	0	0
GBC	9	6	1	0	0
Contractors	8	11	3	0	0

Response Group	Contractors can better add value by providing accurate cost estimating and constructability reviews for projects seeking LEED certification				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
A&D	8	5	1	1	0
GBC	13	3	0	0	0
Contractors	14	8	1	0	0

Response Group	Contractors can better add value by establishing a single point of contact to manage LEED related contractor tasks				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
A&D	5	6	3	0	0
GBC	8	4	4	0	0
Contractors	14	6	3	0	0

Response Group	Based on your project experience, contractors are resistant to adopting the additional tasks associated with LEED certification.				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
A&D	1	5	2	8	0
GBC	1	9	2	4	0

Contractors	0	10	4	7	2
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Response Group	Contractors are adequately responding to the introduction of LEED in industry.				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
A&D	0	8	7	1	0
GBC	1	6	5	3	1
Contractors	2	13	6	2	0

Response Group	In the future, construction organizations could add value to LEED projects by offering LEED consulting and project management as a professional service, along with estimating, preconstruction and construction services.				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
A&D	4	7	4	1	0
GBC	3	5	4	4	0
Contractors	4	12	4	3	0

Response Group	The contractor's ability to implement LEED is limited by what designers and consultants write into the specifications.				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
A&D	1	4	2	7	2
GBC	0	5	2	9	0
Contractors	4	11	3	4	1

Response Group	It is exceptionally difficult to provide accurate construction cost estimating for projects seeking LEED certification.				
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
A&D	0	2	2	11	1
GBC	0	2	3	7	4
Contractors	2	4	3	10	4

Response Group	Are you a LEED-AP? For what length of time have you been involved in LEED projects?				
	Y / N	< 1 year	1-2 yrs.	3-5 yrs.	> 5 yrs.
A&D	13 / 3	1	6	5	4
GBC	16 / 0	0	3	10	3
Contractors	18 / 6	2	9	7	6

Response Group	How many Front Range LEED-NC registered projects have you worked on?					
	0	1	2-3	4-6	7-9	10 or more
A&D	7	1	4	2	2	0
GBC	2	1	2	8	0	3
Contractors	3	4	8	5	1	2

Response Group	How many Front Range LEED-NC certified projects have you worked on?					
	0	1	2-3	4-6	7-9	10 or more
A&D	9	2	3	2	0	0
GBC	4	3	4	5	1	0

Contractors	5	9	5	1	1	2
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Response Group	How many LEED projects have you worked on in Colorado?					
	0	1	2-3	4-6	7-9	10 or more
A&D	1	3	6	3	3	0
GBC	1	0	1	5	4	5
Contractors	4	2	8	4	2	2

Response Group	Describe your own level of education in relation to the LEED process. Education may refer to courses taken at a college or university level, trainings, workshops, conferences attended or self study.						
	Highly Educated	Well Educated	Above Average	Average	Below Average	Little Education	No Education
A&D	0	5	5	4	1	0	0
GBC	9	4	3	0	0	0	0
Contractors	2	10	6	3	1	0	1

Response Group	What type of project delivery best describes the project(s) you have LEED experience on?		
	Design-Build	Design-Bid-Build	Equal Emphasis on Both
A&D	6	6	1
GBC	2	4	10
Contractors	6	5	5

Response Group	Has an integrated design approach that included a contractor been used on the LEED projects you have worked on?			
	Yes	No	Sometimes	No Experience with Integrated Design
A&D	9	2	4	1
GBC	8	0	8	0
Contractors	11	3	8	1