PRELIMINARY STUDY OF GREEN DESIGN AND PROJECT DELIVERY METHODS IN THE PUBLIC SECTOR

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ABSTRACT
The selection of the project delivery method (PDM) for any project is critical—it establishes the communication, coordination, and contractual interfaces between the owner, contractor, and designer. With an increase in the number of green design projects, understanding the relationship between the PDM and green design is paramount to project and contract management. While it is reasonable to assume that a relationship between green design and design-build (DB) exists since both theoretically are intended to foster an integrated, holistic, team-based collaborative project; it is also appropriate to understand the relationship between green design and other PDMs. This preliminary research examined possible relationships between design-bid-build (DBB), construction management (CM), and DB PDMs and green design with the goal of beginning to identify potential positive correspondence between them. To develop an initial understanding, two main tasks were completed. First, existing published research was evaluated to reveal aspects of projects and PDMs independent of green design. Second, the research collected primarily qualitative information by conducting structured interviews with approximately twenty-five individuals, including owners, contractors, and designers involved in completed green design projects, mainly in the public sector. Upon completion of the structured interviews, responses from the interviews were reviewed for green design project characteristics. Additionally, the interviews provided insight on the initial understanding of the current state of knowledge and experience in green design and PDMs. After the two main tasks were completed, both were evaluated for commonalities. Preliminary results found that seven green design project characteristics emerged that in some cases related to a specific PDM, but in other cases were independent of a PDM. Future research will quantitatively investigate the relationship between green design projects, PDMs, and success factors.

KEYWORDS
green design, project delivery methods, project characteristics

INTRODUCTION
Communication, coordination, and contracts between the owner, contractor, and designer are important for project success. Selection of the PDM should be based on many factors, including the owner’s experience; administrative constraints; funding restrictions; schedule and completion requirements; and legal limitations. Another criterion for selection of a PDM can be its relative success in implementing the project’s green design and sustainability goals. With the increasing number of sustainable and green projects as evidenced by the growing use of the United States Green Building Council’s (USGBC) Leadership in Energy and Environmental Design (LEED) green building rating system, it is important that the relationship between the PDM and green design goals is better understood by designers, owners, and the construction industry.

Given the definitions of green design and the design-build PDM, it is reasonable to consider a complementary relationship between the two: both green design and design-build are intended to create an integrated, holistic, team-based collaborative project. Additionally, it is also possible that relationships exist between green design and other PDMs, namely design-bid-build (DBB) and construction management (CM). A preliminary investigation between selected PDMs and green design is explored in this re-

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search with a focus on public sector projects. The study was limited to public sector projects to narrow the initial research scope and respond to the increasing number of federal, state, and local agencies mandating green buildings.

Preliminary research focused on two areas—completing a literature review that focused on PDMs and project success factors, independent of green design; and conducting a qualitative, structured interview of owners, contractors, and designers with experience in both public sector projects and green buildings. Upon completion of the interviews, the responses were reviewed for green design project characteristics and the relationship to the PDM used in the project. Next, the correspondence between existing research on critical project success factors reported in the literature and the survey responses were made to develop initial insights into possible unique aspects related to green design projects. Quantitative analysis was not conducted in this phase of research, but is anticipated in future work.

The article begins with a brief description of some project delivery methods, then continues with a description of research approach, the literature review, the preliminary findings, and concludes with future research directions.

**PROJECT DELIVERY METHODS**

While several types of project delivery methods (PDMs) and their respective variations exist, this article focuses on three methods: design-bid-build (DBB), design-build (DB), and construction management (CM). The three PDMs were selected because they were the methods used in the projects associated with the structured interviews.

**Design-Bid-Build**

DBB is a traditional project delivery method commonly used in public projects. With this method, the owner contracts separately with the designer and the contractor. A direct contractual relationship between the designer and contractor does not exist, although a working relationship is typically established. The schedule progression is typically linear; that is, the designer completes the design, the owner solicits bids for the project, and then the contractor builds the project. Perceived advantages of this approach are typically clearly defined roles; the owner has significant control over the process; and the checks and balances between the three parties lead to a higher quality project.

While DBB is a frequently used method, several drawbacks exist. Since a contractual relationship does not exist between the contractor and designer, a non-productive adversarial relationship between the parties can develop because the individual entities are mainly protecting their respective interests. It is commonly believed that the DBB projects have extended schedules often caused by relatively long procurement processes; for example, most federal, state, and local projects require a minimum three week bidding period. Perhaps the greatest disadvantage of DBB is that the budget, schedule, and ultimately the perceived success of the project rely heavily on the completeness of the contract documents. Design omissions and errors equate to change orders and possibly schedule delays. Often for public projects, the use of DBB is dictated by the funding source, associated legislation, and procurement laws; public agencies may not have a choice regarding the project delivery method. Efforts to improve DBB include an owner’s concerted efforts to ensure accurate contract documents, pre-qualifying bidders, and commitments through partnering (Mulvey 1998).

**Design-Build**

In DB, the owner contracts with a single venture to perform both the design and construction phases of a contract, offering the owner a sole contract with a single point of contact and responsibility. DB use is increasing, especially in the private sector, but also in certain public agencies. DB often appeals to the owner due to a single-source of contact along with responsibility, assumed decrease in contract administration efforts, and often a decrease in the project schedule due to the overlapping design and construction phases.

Some of the perceived disadvantages associated with DB include the owner’s reduced level of control over the final project and quality. DB owners often believe that quality may be compromised because DB lacks the checks and balances typical in DBB. Most DB firms or joint ventures are headed by the contractor, possibly due to bonding capacity, with the designer as the sub-consultant. With the contractor as the lead and ultimately responsible for the bot-
tom line, the designer’s recommendation with respect to quality may be “over-ruled” due to budget issues. Another important issue faced by owners who use DB is the importance of the selection of a capable design-build team.

In an attempt to take advantage of positive elements of both DB and DBB, a hybrid known as “Design-Build Bridging” or “Design-Assist” can be used. In DB Bridging, the owner with a designer establishes a strong set of documents, typically comparable to the design development phase, and then works to award a contract with a DB firm. The frequency of DB Bridging is increasing.

**Construction Management**

Several varieties of construction management (CM) exist with two common variations being CM at risk (CMR) and agency CM. Both methods offer the advantages of engaging a contracting firm at the onset of a project and benefiting from the CM firm’s expertise in scheduling, budgeting, and value engineering. CMR is a method where the owner contracts with both a designer and a construction manager. The CM firm, typically selected on qualifications, functions in a dual role responsible for both construction management services and construction activities. While contracts used with CMR vary, this method typically uses a Guaranteed Maximum Price (GMP). At some point in the design process, which varies according to projects, the CM develops a GMP based on the contract documents. The CM and the owner enter into a contract based on the GMP.

An agency CM functions as an extension of the owner’s staff, and offers advice on budgeting, scheduling, and daily construction activities. While the owner typically holds both the design and construction contracts, the agency CM supports the owner to make educated and practical design and construction decisions. The contract between the owner and agency CM is often either a percentage of the construction contract or based on hourly staffing requirements.

Advantages of the CM methods are flexibility when the project scope and program are not well-developed; control over schedule and budget when several contractors are involved; and professional, single-source liaison with the owner. Some disadvantages are the number of people involved in resolving disputes, and disagreement over legitimate scope changes that may or may not affect the GMP.

**PRELIMINARY RESEARCH APPROACH**

The preliminary research involved two components: a structured qualitative survey and a literature review focused on PDMs. The research approach is to some extent a simplified version of that used by Songer and Molenaar (1997) in developing project characteristics. This section mainly focuses on the survey. The first step in the survey was developing a database of contacts. The four main sources that comprised the database were the USGBC’s (2006) website, Design Build Institute of America’s (2006) website, contact with the Associated General Contractors (AGC), and web searches. Only completed projects were included in the database. The DBIA’s website lists all DBIA registered projects which used DB as a PDM. All public sector building related projects were extracted and included in the database. The AGC was contacted and subsequently sent an email to selected members. A list of the interested members was forwarded and included in the database. Finally, web searches were not only used to obtain information on contacts within government agencies, but also to provide additional knowledge on specific projects. For example, if an architect was contacted about Project X, then a web search was done on Project X to determine the owner and contractor so additional information could be obtained. The database, not including web results, includes about 250 contacts.

The initial approach included a two-step process of data collection. Two sets of questions were developed, one for contacts developed from the USGBC’s website and one for contacts from the DBIA. Two different sets of questions were needed because the USGBC projects were known to be green, but the PDM was not known; conversely, it was known that the DBIA projects used DB, but it was not known if the project was green. Web searches and AGC contacts used a combination of the two sets of questions. Flowcharts of question sequences were used to ensure
the interviews were conducted in a structured and consistent manner. Next, a questionnaire was developed that focused on quantitative aspects and quality. The interview covered both green project characteristics as well as PDMs. The questions included:

- What project delivery method was used?
- Was the project successful, why or why not?
- Do you think the PDM had an effect, either positive or negative, on the project? How?
- What PDM do you think should be used for green projects?
- Can you recommend some best practices for PDM on green projects?

The intent of the phone interviews was the structured interview, but it was also used to determine if the questionnaire should be sent. If the project was appropriate, then the questionnaire was sent to the interviewee via the preferred method of email, fax, or mail. Finally, the interviewee was to return the questionnaire. For the phone interview process, approximately 75 contacts were called. During the initial phase of the phone interviews, the majority of the interviewees was not interested in the questionnaire portion and indicated that decision during the phone interview or did not return the questionnaire. Due to the low response rate on the questionnaire, it was not possible to conduct analysis of the responses.

In total, 88 individuals were contacted either via telephone or email, and 21 interviews were conducted. During the 21 interviews, several individuals discussed more than one project, so 26 projects are included in the study. The response rate was 24% on an actual interview basis, and 30% on a project basis. Owners represented about one-half of the respondents; DB projects were about one-half (14); DBB were about one-third (8); and the remainder (4) were CM. The information presented in the preliminary findings section was not normalized or adjusted based on the respondent or PDM type. Six respondents completed the questionnaire. Since only a small number of questionnaires were completed, the results are not reported here. The majority of the projects were commercial buildings. After the interviews were completed, responses were tabulated, evaluated, and organized into common project characteristics and the associated PDM.

### LITERATURE REVIEW

The goal of the literature review was to understand the current state of knowledge on PDMs, looking more specifically at DB, and develop a comprehensive list of successful project features. There has been a relatively large amount of research on PDMs in projects in general compared to research on PDMs with green design projects. Therefore, a literature review was conducted of project delivery methods irrespective of the relationship with green design. The literature review focuses on the following aspects with emphasis on DB:

- Quantitative studies related to PDMs to report advantages and disadvantages of the associated method;
- Project characteristics that complement DB;
- Owner’s role in DB projects;
- Public sector’s perspective on DB; and
- Characteristics of successful projects.

Quantitative studies on PDMs report positive, negative, and neutral findings on DB. Konchar and Sanvido (1998) collected project specific data from 351 U.S. building projects to empirically compare cost, schedule, and quality with respect to CMR, DB, and DBB. Univariate results indicated that DB projects performed equally or better than DBB and CMR.

Ibbs et al. (2003) examined the effectiveness of 67 projects related to DB and DBB. The study quantitatively analyzed the impact of different PDMs on changes in cost, changes in schedule, and productivity. This research differs from Konchar and Sanvido (1998) in that Ibbs et al. (2003) also included productivity, which leads to changes in cost and schedule. The authors concluded that the reported cost savings associated with the DB method were not fully substantiated by this set of data with univariate statistical analyses. Relative to schedule, DB projects experienced a 7.7% change whereas DBB were at 8.4%. The authors note that while it is important to understand PDMs in concert with cost and schedule, the significant indicator is productivity. Productivity was analyzed as a function of cost and schedule changes by calculating best fit regression equations. The authors observed that the effects on productivity were difficult to predict and ultimately may depend on the functionality of cost or schedule versus productivity. To summarize, this study found that DB did not perform significantly better than DBB.
The literature review also focused on project success to better understand the potential relationship of green design project success and PDMs. Understanding and defining not only characteristics of successful projects but also key project characteristics with respect to PDMs is critical for selecting the appropriate PDM for a project.

Songer and Molenaar (1997) examined 88 public sector projects to identify project characteristics that are critical for success. Criteria of success are staying on budget, conforming to user’s expectations, and staying on schedule. This study found that the top five DB characteristics for successful DB projects are (1) well-defined scope, (2) shared understanding of the project scope, (3) adequate owner staffing, (4) owner’s construction sophistication, and (5) established budget. With the project characteristics established, Molenaar and Songer (1998) then tested the above characteristics by attempting to predict the relationship between the characteristics and project success for public sector projects using DB. Results indicated that the most critical element to project success is the owner. The owner’s critical roles are developing accurate request for proposals (RFP) and active involvement in the design phase. These results are important because they are contrary to the perceived belief that DB projects have a lower administrative burden.

Several other studies have also attempted to define successful project characteristics. Alkhathami (2004) summarizes several key project success factor studies. For example, Ashley et al. (1987) developed a comprehensive, filtered, and statistically significant list of project success factors:

1. Construction and design planning effort
2. Project manager goal commitment
3. Project team motivation
4. Project manager technical capabilities
5. Scope and work definition
6. Control systems

Additional research on project success factors was done by Sanvido et al. (1992). The researchers found four critical factors that determine project success:

1. A well-organized, cohesive facility team to manage, plan, construct, and operate the facility.
2. A series of contracts that allow and encourage the various specialists to behave as a team without conflict of interests and differing goals.

3. Experience in the management, planning, design, construction, and operations of similar facilities.
4. Timely information from the owner, user, designer, contractor, and operator in the planning and design phase of the facility.

Chua et al. (1999) used analytical hierarchy process (AHP) with subjective expert judgments to identify critical success factors (CSFs) with respect to budget, schedule, quality, and overall performance. A summary of the CSFs based on overall performance includes:

1. Adequacy of plans and specifications
2. Constructability
3. PM commitment and involvement
4. Realistic obligations/clear objectives
5. PM competency
6. Contractual motivation/incentives
7. Site inspections
8. Construction control meetings
9. Formal communication (construction)
10. Economics risks

In summary, while some research has concluded that the hypothesized benefits of DB are not conclusively demonstrated, the majority of research has reported that DB is an effective PDM given a project with appropriate characteristics. Secondly, with respect to the public sector, as the use of DB increases and the owner’s experience with DB increases, some of the reported administrative burden should be reduced. A substantial amount of research exists on project success factors, and a representative sampling was described. The successful project characteristics from these studies are compared to characteristics of green design projects in the subsequent section.

**REVIEW OF PRELIMINARY FINDINGS**

Two major aspects of the preliminary research are summarized in this section. First, green project characteristics as they relate to PDMs are discussed, and then a comparison of those characteristics with existing project success factors was evaluated.

The interviews were summarized and evaluated in a structured manner and common “green project characteristics” were identified. The “green project characteristics” are often not mutually exclusive. One example is with number 4, Clear definition of scope of work, and number 5, Adequate budget and funding limitations, because an overly ambitious
scope of work can strain a fixed budget. Each of these characteristics have been examined in relation to the survey responses and other related published work to determine if the characteristic is more relevant or associated with a particular PDM, if it is generally regarded as a good practice, or if it is both. The seven important project characteristics that emerged from the structured interviews follow:

1. Collaboration
2. Team experience
3. Leadership
4. Clear definition of scope of work
5. Adequate budget and funding limitations
6. Complexity and flexibility
7. Control and accountability

1. **Collaboration**

Project team collaboration early in the design and construction process is an important aspect of green projects. Several interviewees strongly suggested that one key to project success for green design projects was collaboration. Collaboration is cooperation among the owner, contractor, designer, or design-builder. From the survey results, collaboration early in the project was recommended by six of the respondents; integrated team was recommended by four of the respondents. One respondent emphasized both collaboration and an integrated team.

With respect to this feature and PDMs, collaboration was considered somewhat more important in projects that used DB. Five of fourteen DB projects, three of eight DBB projects, and one of four CMR projects stressed that collaboration was an important feature for project success. Collaboration was a slightly more prevalent feature in DB projects, but also considered important in DBB projects. The conclusion, therefore, is that collaboration is important on all green design projects, and is an important characteristic of green design projects that use DB.

2. **Team Experience**

Team experience is important on all green design projects independent of the PDM. Owners should use a “best value” selection process, which is more prevalent in DB projects, and include team experience as a criterion. The owner’s role is critical with DB. The experience of the designer, contractor, and owner is an important feature of green design projects. From the interviews, six respondents believed that team experience was an important characteristic in a green design project. Of those six, four projects were DB, while two projects were DBB. Experience with the LEED rating system and its credits are important characteristics for all parties. One of the critical characteristics in a successful DB project is the role of owner. The owner’s experience is central early in the project, in particular, the owner’s development of the RFP in the initial design phase (Molenaar and Songer 1998). The experience of the contractor’s project manager was also noted as an important characteristic in this survey, and it is corroborated by existing research.

3. **Leadership and Contractual Incentives**

Leadership is an important characteristic for all contracting parties involved in green design projects and it is a dominant characteristic in DB projects. The importance of leadership was discussed during seven interviews. Six of those interviews were associated with DB projects, and one was associated with a DBB project. Leadership, as discussed during the interview process, was fairly broad and depended on the person’s perspective. For example, a contractor recommended that a contractor should lead the DB team. On the other hand, a designer recommended that the designer should lead the DB team. The contractor believed construction companies remained more focused on budget and schedule. The designer believed that they were able to guide the project to achieve higher LEED ratings and maintain a higher level of quality standards for the projects. One owner mentioned that he was considering a project delivery method that would put the contractor and designer on an equal footing, or have the designer as the lead. This owner explained that with DB, “. . . the contractor typically holds cost first, quality second. Conversely, the A/E firm holds quality first, and cost second. But, because the contractor typically holds the DB contract, cost usually wins.”

The owner’s leadership is critical in setting the tone of the project and setting a clear direction, not only in the scope of work, but also during construction as issues arise. During three of the interviews, the importance of owner’s leadership was discussed in terms of setting and remaining focused on the budget and LEED goals. For green design projects, it is most commonly the owner’s decision that a project
will have green design features, and then often determines the LEED rating range or state that the project will be LEED silver, for example. One interviewee pointed out that one successful characteristic in a DB project was that the owner not only set an attainable LEED rating but also established a good and realistic budget to achieve the LEED goal. Another interviewee thought that the owner’s focus on the budget helped to achieve a successful project.

Agencies that are using DB, such as the Pentagon to name just one, have found it effective to include award and incentive fees to the design-builder. An award fee, typically 10% of the contract award, provides the design-builder with an up-front incentive and starts the project in a positive manner. The award fee not only acts as an effective relationship builder, but also assists in paying some of the designer’s fees. With respect to the incentive, if there is a savings, then a split is shared between the DB firm and the owner. If there is an overrun, then an established not to exceed split is also shared between the DB firm and the owner. The Pentagon also uses quarterly progress reports which are associated with incentive fees. Contractual incentives in turn create contracts with complementary goals, all project success factors cited by Chua et al. (1999), Alkhathami (2004), and Sanvido et al. (1992).

4. Clear Definition of Scope of Work

A well-defined scope of work is important on all projects. Having a clear scope of work was mentioned during five interviews. Four of the five interviews were related to DB projects. In the case of DB, bridging helps improve quality and the owner’s control; and using performance specifications to attain a LEED certification has been an effective contract administrative technique. A clear scope of work minimizes change orders and schedule delays in all PDMs. A clear scope of work is a project success factor in Ashley et al. (1987).

In Design-build bridging, the owner produces a set of documents and establishes an RFP based on the bridging documents. The selected design-builder incorporates the bridging document into the final design and project. It should be noted that one interviewee mentioned that a potential problem with bridging is that the architect of record is the architect from the design-build company, which may become an issue when the bridging documents are incorporated from a different architectural firm. Bridging was mentioned during several of the interviews, and several respondents stated that bridging is recommended and used by the United States General Services Administration (GSA). DB bridging is used to maintain the owner’s level of control and meet quality standards, two aspects of DB that are often cited as disadvantages. DB bridging appears to work well with green design because it allows the project team flexibility during the design and construction phases to experiment and meet LEED requirements, and ensures attainment of the owner’s project goals and quality level. Similarly, specifying a LEED rating as a performance specification also gives the project team the same flexibility to work within the LEED framework while achieving the owner’s goals.

Regardless of the PDM, several interviewees mentioned that specifying green design elements as performance specifications, such as the project shall meet or exceed a specified LEED rating, was effective to realizing green design goals. Performance specifications set clear goals and shifted some of the responsibility from the owner and designer to the contractor. Since a significant number of LEED credits are managed or driven by the contractor, this approach assisted in obtaining the owner’s overall green project goals.

Some owners who use DB are using design competitions to assist them in the selection process. The owner gives the short-listed firms design fees or a stipend to compete in the selection process, which is a two-fold advantage because the firms are compensated for their proposals while the owner is given the opportunity to further define and solidify the project’s scope of work before entering into a DB contract.

5. Adequate Budget and Funding Limitations

Having adequate funding and budget for the given scope of work is particularly important in a green design project. Public funding restrictions may not allow the use of certain PDMs, and the nature of public funding streams may make non-traditional PDMs more difficult. Based on observations in this research, the use of non-traditional PDMs seems to decrease as one moves from federal, to state, to local levels. The federal government uses more DB than the local governments with the state’s usage in between. On the other hand, one federal employee noted that the GSA’s program requirements changed

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often, so DB may not work well due to shifts in the program. Also, the funding allocation is often separated between the design and construction phases making the option to pursue DB more administratively difficult. One interviewee noted that DBB must be used due to funding and legal constraints.

Two respondents cited the importance of the owner's expectations in conjunction with the budget and LEED goals. Incorporating green design early in the design process in the Pentagon renovation projects resulted in spending less money on green aspects while achieving a higher LEED certification (Pulaski et al. 2003).

6. Complexity and Flexibility

Project complexity and flexibility is a project characteristic that is more positively associated with DB. Flexibility and complexity are included in the same category because during the interview process the two features were often intertwined; for example, a complex project required flexibility from all team members to produce a successful project. Complexity and flexibility were discussed in six of the interviews; three were associated with DB projects, two with DBB projects, and one interviewee based on experience. These combined characteristics appear to be more prevalent in green design projects, as they are minimally mentioned in existing research reviewed herein, but Molenaar and Songer (1998) do include project complexity as a success factor for DB projects. Interviewees said that they decided to use DB because it allowed them to be more flexible and allowed the team to refine the design without affecting the schedule. DB's flexibility fostered a collaborative effort that resulted in an end-product with many owner or tenant requested features. This aspect is important when the project is being built by a developer with a long-term lease tenant who has specific space requirements. Administratively, it was more difficult with DBB to make changes because the change order process was difficult and time-intensive causing additional costs and schedule delays. However, one interviewee believed that sustainable design was too complex to achieve with a traditional design-build PDM.

7. Control and Accountability

Control and accountability are related problems and are associated with DB to a greater degree than with DBB. Project controls are instituted to provide for the accountability of the project team. Control and accountability are not specific to green design projects, and as discussed earlier, DB Bridging can be used to offset the lack of control with traditional DB. With the owner's level of project control potentially reduced when using DB, accountability of the DB team to the owner can be lost as well. This issue was discussed in four interviews; two were DBB projects, one was a DB project, and one was speaking based on experience. The two DBB interviewees both believed that DBB was the best option when the owner desired a great deal of project input and control. One architect interviewed believed that DB diminished owner's participation, and that the architect's access to the owner was limited. On the other hand, one interviewee that participated in a DB project thought that DB was the better approach when green design was involved because of the project team's continuity.

SUMMARY

A consistent relationship between green design projects and a particular PDM did not emerge from this preliminary research. However, based on the limited survey data and consistent with other research, it is concluded that, rather than identifying one PDM that should be used for all green design projects, individual project characteristics should be the basis for PDM selection for green design projects. Future research will further investigate the relationship between the identified green design project characteristics and PDMs.

Second, some green design project success factors were identified that may be unique to green design projects. Project success factors from Ashley et al. (1987), Sanvido et al. (1992), and Chua et al. (1999) are shown in Table 1, along with the green design project characteristics identified from this work. Of the seven green design project characteristics, three characteristics—Leadership, budget and funding, and complexity and flexibility—were not identified in previous research as critical project success factors.

CONCLUSION

The intent of this research was to examine the relationship between project delivery methods and green design projects in order to assist the public sector when selecting a PDM appropriate for a green design
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projects. This research is relevant and timely since an increasing number of Federal, State, and local agencies are mandating green buildings.

This preliminary research used qualitative survey analysis and structured interviews. Further, literature reviews were conducted on the effectiveness of PDMs and on project success factors in general, without considering green or sustainable aspects. The most important finding is that the PDM selection decision for green design projects should be based on project characteristics. The green design project characteristics identified in this research are:

1. Early team collaboration is an important aspect of green design projects, and even more significant in DB projects.
2. Not only is the experience of the designer and contractor important, but also the owner’s role and experience is critical. This finding is independent of the PDM.
3. Leadership is an important feature for all contracting parties involved in green design projects, and is particularly important in DB projects.
4. A well-defined scope of work is important on all green design projects. For DB projects, DB Bridging helps improve the owner’s control and quality.
5. Adequate funding and budget for the given scope of work is significant for green design projects. Public funding restrictions may not allow the use of certain PDMs, and the nature of public funding streams may make non-traditional PDMs more difficult.
6. Project complexity and flexibility is a project feature that is more specific to green design projects and DB may handle this characteristic better than other PDMs.
7. Control and accountability is a problem associated with DB more than with DBB. It is not specific to green design projects. As with scope of work, DB Bridging can be used to offset the lack of control with traditional DB.

A relationship between DB and green design did not explicitly emerge, but several broad characteristics related to PDMs and green design did emerge which may assist the owner in making the appropriate PDM decision. Further, when using DB on a green design project, the main recommendations were to use DB Bridging with award and/or incentive fees and performance specifications.

Additional research is needed to further investigate the relationship between green design and PDMs. Future research will further develop the identified green design project characteristics and relate those characteristics to both PDMs and project success. The research approach is anticipated to be a more extensive survey allowing statistical analysis of the results.

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REFERENCES


