

# **SUSTAINABLE BUILDING DELIVERY PRACTICES**

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Today's clients both public and private have additional expectations from builders. Full cycle services capability that includes financing, planning, building, and facilities management started to be pronounced in larger projects. These expectations are mainly driven by sustainability requirements of clients. These projects necessitate a comprehensive planning approach. The comprehensive planning scope includes all project activities from design to post-construction services (facilities management) with collaboration of project stakeholders. There is no defined method of project delivery for sustainable projects yet. The majority of top green building contractors in the United States are experienced in Construction Management at Risk (CMR) and Design-Build (DB) delivery methods. This research study aims to explore the project delivery processes currently practiced in the United States' building construction industry. The survey questionnaire was conducted with the selected Top Green Building Contractors (the list of contractors is published in the Engineering News Record Magazine annually). The original list is composed of 100 national construction firms. The San Antonio and Austin firms were invited to participate to the survey questionnaire. The findings reveal the major green building providers' methods and procedures that are used during sustainable projects' delivery. The results indicate that the sustainability is seen as more of a common practice for all projects by most survey participants. There is no specific method for sustainable projects yet. A well-defined sustainable building delivery method should ideally originate from DB and/or CMR.

*Keywords:* Sustainability, Pre-construction, Construction, Post-construction, Design-build, CM at risk.

## **1 INTRODUCTION**

Today's clients both public and private have additional expectations from builders. Full cycle services capability that includes financing, planning, building, and facilities management started to be pronounced in larger projects. These expectations are mainly driven by sustainability requirements of projects. These projects necessitate a comprehensive planning approach. The comprehensive planning scope includes all project activities from design to post-construction services, with collaboration of project stakeholders. There is no defined method of project delivery for sustainable projects. It is more complex and requires more communication among stakeholders (Klotz and Horman 2009). Architecture-engineering-construction (AEC) industry is highly fragmented and this situation creates silo effect (Robichaud and Anantula 2011). However, sustainable project delivery process requires a holistic approach where all stakeholders including subcontractors interact with each other in an intense manner starting from early design (Robichaud and Anantula 2011). The necessity and

importance of intense communication have been highlighted by many scholars (Lapinski *et al.* 2006; Klotz and Horman 2010). The majority of top green building contractors in the United States are experienced in Construction Management at Risk (CMR) and Design-Build (DB) delivery methods (Tulacz 2014). These methods are well recognized with their processes which allow collaboration among stakeholders. The study by Korkmaz *et al.* (2010a) also revealed that design-bid-build is used in green office-building projects' delivery. The aim of this study is to explore major characteristics of sustainable building delivery process and understand how it differs from the delivery of conventional building projects. The study is also expected to provide a base for developing a detailed process map for sustainable building project delivery.

## **2 THE RESEARCH METHODOLOGY**

The research study has explored the project delivery practices for sustainable projects by major construction companies' South Texas offices. Ten companies were identified in San Antonio and Austin to be included in this study. The survey questionnaire was conducted with the selected Top Green Building Contractors (the list of contractors is published in the Engineering News Record Magazine annually). The list is composed of 100 national construction firms. Their total revenue from green projects in 2012 was \$44.67 billion (Tulacz 2012). The top 37 companies' revenue makes up to \$35.72 billion which roughly corresponds to 80% of all the top 100 green contractors. Among the top 37 companies 10 companies (their total revenues constitute 44% of the top 37 companies), have been identified with local offices in San Antonio or Austin. The 10 companies were invited to participate in the survey questionnaire. Nine companies accepted to be part of the survey. The research study was reviewed and approved by the Internal Review Board. The questions were sent to the participants via e-mail. All participants were at executive levels with busy travel schedules therefore phone interviews took place instead of face to face interviews. The survey questionnaire has explored the preferred delivery methods used in sustainable building projects, and if they are modified for sustainable building delivery. In order to reveal the differentiating aspects, participants were specifically asked about pre-construction and planning phases' characteristics. Following pre-construction phase questions, the participants were also asked how construction and post-construction phases of sustainable building project delivery differed from the conventional buildings' delivery process.

## **3 THE SURVEY FINDINGS**

The common project delivery practices for sustainable building projects take place with DB and CMR methods. Even though most participants indicated that they do not modify the delivery methods, timing and extension of major services change. Five out of nine companies indicated that their preferred method is DB. Three companies indicated that their preferred method is CMR. One company indicated that they equally prefer DB and CMR.

Six out of nine firms reported that they do not modify DB or CMR delivery methods due to sustainability requirements. Rather, most firms embrace sustainability requirements as a common practice.

The involvement intensity of construction firms in sustainable projects relative to conventional projects during the design process has been analyzed. The participants were asked if the timing and extent of constructability analysis, value engineering, and involvement of mechanical/electrical contractors' differ. In addition, they were also asked if the use of energy and building simulations are commonly used, the intensity of team communication, the differences in commissioning planning and agency involvement, and if they provide life cycle analysis services. The U.S. Green Building Council (USGBC) recognized the importance of commissioning and required its inclusion if the buildings provide required green performance (Elzarka 2009). Green building by definition is expected to enhance life cycle costs (Low and Wu 2010). Energy modeling contributes to life cycle cost savings and has a greatest impact on building energy use (Korkmaz *et al.* 2010b).

The answers to specific questions revealed the following findings: In general all firms reported that sustainable projects require more intense communication. The responses indicate that sustainable building projects require an additional level of early communication in order to collectively work to meet the sustainability goals and strategies for the project. The schedule is affected by additional documentation, meetings, submittals, and commissioning. Additional costs also occur due to staff to prepare the documentation, post documentation to the LEED online website (if the project is expected to be LEED certified).

There is mainly a minimal difference when it comes to extent and timing of constructability analysis and value engineering. Conducting constructability analysis and value engineering may take 10% longer in some projects. When it comes to timing and extent of mechanical and electrical contractors' involvement, the findings indicated that there is quite a bit difference. Their involvement is more extensive than conventional projects due to the selection of the type of energy saving equipment; coordination and selection of material and preparation of submittals; review by the commissioning agent, etc. All contractors reported that the timing is much earlier for commissioning planning and the level involvement is more intense compared to conventional projects. The process is especially more extensive for the mechanical engineer since coordination meetings are required between them as well as the commissioning agent and the Testing Adjustment & Balance (TAB) subcontractor. Meetings are also coordinated between the electrical engineer and the respective subcontractor regarding lighting; selection of equipment and so forth.

Technology applications diffuse into firms' practices when there are tangible benefits. Building Information Modeling (BIM) is a perfect example. In a majority of CMR and DB projects companies use BIM that is integrated into the project. It has been well accepted by the construction industry especially in sustainable projects. Its acceptance by both contractors and designers should be considered as an opportunity for collaboration in such a fragmented industry.

The findings indicate that contractors are not leading energy and lighting applications nor life cycle cost analysis. The contractors' responses indicated that use of energy and lighting simulations are usually handled by design consultants.

Several contractors reported that they provide life cycle cost analysis. Some reported that it is provided mainly by design teams. The responses were mix. Contractors could take more active role in leading life cycle cost analysis practices.

They initiate life cycle costs with first investment costs (building construction costs). There is an opportunity for them to develop cost expertise for post-construction phase of building projects.

The construction phase change dramatically, depending on the size of the project, and especially due to waste disposal/coordination, commissioning, and material tracking/invoicing. It also differs in the team interaction point of view. With hard bid work it is much regimented, and there is little interaction. It is much more interactive and team oriented with DB. The significant difference would be the time and effort that is put into place to properly document the construction activities that affect the project's ability to achieve prerequisites and credits to meet the sustainability goal. Segregation of construction waste is also a factor, co-mingled dumpsters allows basic construction processes to remain consistent whether or not the project has sustainable goals or requirements. The process differs since more items are required for submittal which increases that effort; more items have to be incorporated into the schedule such as commissioning which must take place after TAB. This requires more steps before achieving Substantial Completion or on federal projects in achieving Building Occupancy Date (BOD). Also, there is a tremendous increase in preparation and documentation of the sustainable process. There are greater quantities of materials that have to be tracked and stored under the sustainable process as well. If the project is LEED certified, submittal documentation collection adds more time.

The results indicate that more firms preferred using DB or modified version of DB vs. CMR or modified version of CMR while delivering sustainable building projects. When the Top 100 Green Contractors list has been analyzed, more firms are identified with leadership in CMR, even though it does not mean that they must be using CMR in sustainable project delivery. This is a pilot study and obviously more firms at the national level must be included in order to see if DB or CMR is more preferred.

According to the results, post-construction services do not dramatically differ from conventional projects. One firm reported that it provides facility management or maintenance for only very strategic clients. It is not yet a common practice for construction firms to provide facilities management services. However, it is highly important service area in the age of energy conservation.

#### **4 CONCLUSIONS**

Conducting more inclusive research at the national level is expected to reveal more detailed results. It is not possible to make universal recommendations based on the interviews conducted with nine firms. The concluding remarks can be summarized as follows:

- Sustainability is seen as more of a common practice for all projects by most survey participants.
- There is no specific method for sustainable projects yet.
- DB and CMR continue as the leading delivery methods for sustainable building projects.
- BIM is heavily used as the technology tool during sustainable buildings' delivery process.

- Design firms lead energy and lighting simulations.
- Contractors do not offer any specific services to sustainable building projects' post-construction phase. In fact there is a big potential in facilities management area.
- A well-defined sustainable building delivery method should ideally originate from DB and/or CMR.

This study comprises the first step of designing a process map for sustainable building projects delivery. Defining more precise sustainable building delivery principles will make a significant impact in the building construction industry.

Providing effective solutions to sustainable building construction processes is critical. The AEC industry is fragmented in nature but there is an immediate need for collaborative work solutions. This is especially true for sustainable project processes. This research study has explored the initial facts to design a roadmap for sustainable building delivery. The results provide a clearer image for the next phase which is conducting the research study at the national level.

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### **References**

- Elzarka, H., Best Practices for Procuring Commissioning Services, *Journal of management in Engineering*, ASCE, 25(3), 155-164, 2009.
- Klotz, L. and Horman, M., Counterfactual Analysis of Sustainable Project Delivery Processes, *Journal of Construction Engineering and Management*, ASCE, 136(5), 595-605, 2010.
- Korkmaz, S., Riley, D., and Horman, M., Piloting Evaluation Metrics for Sustainable High-Performance Building Project Delivery, *Journal of Construction Engineering and Management*, ASCE, 136(8), 877-885, 2010.
- Korkmaz, S., Swarup, L., Horman, M., Riley, D., Molenaar, K., Sobin, N., and Gransberg, D., *Influence of Project Delivery Methods on Achieving Sustainable High Performance Buildings*, Report on Case Studies, Charles Pankow Foundation, 2010.
- Lapinski, A., Horman, M., and Riley, D., Lean Processes for Sustainable Project Delivery, *Journal of Construction Engineering and Management*, ASCE, 132(10), 1083-1091, 2006.
- Robichaud, L. B., and Anantatmula, V. S., Greening Project Management Practices for Sustainable Construction, *Journal of Management in Engineering*, ASCE, 27(1), 48-57, 2011.
- Tulacz, G. J., The Top Green Contractors, *Engineering News Record*, September 17, 1-6, 2012.
- Tulacz, G. J., The Top Green Contractors, *Engineering News Record*, August 11/18, 85-90, 2014.
- Wu, P., and Low, S., P., Project Management and Green Buildings: Lessons from the Rating Systems, *Journal of Professional Issues in Engineering Education and Practice*, ASCE, 136(2), 64-70, 2010.