2018-04-21

Analyzing the Restoration of the Oklahoma State Capitol from the Perspective of the Design Build Process:a Descriptive Case Study

Lloyd Scott
Technological University Dublin, lloyd.scott@tudublin.ie

J.E. Dunne

Recommended Citation

Scott, L., Boyse, L. (2018) Analyzing the Restoration of the Oklahoma State Capitol from the Perspective of the Design Build Process - A Descriptive Case Study 54th ASC annual conference Minneapolis, MN. doi:10.21427/76vn-ey49

Analyzing the Restoration of the Oklahoma State Capitol from the Perspective of the Design Build Process - A Descriptive Case Study

Lloyd Scott, PhD
School of Surveying and Construction Management
Dublin Institute of Technology
Dublin, Ireland

Lynnsee Boyse , BSc.
JE Dunn
Oklahoma City, Oklahoma

Design Build projects in the built environment are moving towards more collaborative practices. The intent behind this collaborative approach is to encourage those associated with the built environment to consider how retrofit design and construction can contribute positively to addressing elements of climate change and the design build process. The opportunity to share the rich nature of the design build process in a unique environmentally and heritage focused project excited the authors. Secondly concerns about the way such projects are captured historically, and specifically the disciplinary knowledge and skills employed in the restoration of such a significant landmark building could be lost if not afforded some place in the research annals. This paper presents a Restoration Design-Build (RDB) process employed in the realignment of a state building adopting this novel initiative. The authors adopted a descriptive case study method to enhance the capabilities of understanding and generate constructive reflections and analysis. The intention was to empower the reader to explore new horizons by 'clarifying and negotiating' ideas and concerns around the RDB process. The authors evaluated the usefulness of the RDB approach based on direct and indirect measures. The framework approach presented is a part of an ongoing initiative between state and project stakeholders that have shown positive results based on the teams' performance in the presented case study as well as affirmative feedback from some stakeholder participants.

Key Words: Collaboration, design build, restoration, case study

Introduction

Preserving the past is now considered as an important factor for society Cultural and natural heritage must evolve in order to survive. Working with other disciplines and engaging stakeholders, historic preservation specialists manage change in the physical environment. Recognizing the dynamic and multifaceted nature of the field of historic preservation will help prepare the next generation of change agents. This mission is met through forward thinking, multidisciplinary teamwork, hands-on learning opportunities, and partnerships with experts, public agencies, and private organizations across the US and globally. New construction is not always the answer to a clients' building needs. Often, the renovation of commercial and residential property can just as effectively provide expanded space and fresh architecture. Society needs to recognize the value of an existing structure, especially if the location of the property is desirable. In many cases, clients may simply need to update their properties in order to meet building codes and comply with insurance standards. However, some clients have the vision to set about preserving the past and make that contribution to humanity.
What sets restoration apart from other construction projects is the fact that the project team are taking an already designed, engineered and constructed, often historic, building to a new place where it takes time to do the work properly. Being very sensitive and conscious to maintain the integrity of historic homes and buildings in order to preserve them is the key to the success of this type of work. The setting of high standards to ensure that the protection of the original materials and features, like masonry units (brick, limestone, granite, terracotta, etc.), is the important focus. There are specialist companies who are proud of high rates of being able to salvage even the most worn masonry units to ensure preservation of the original building material.

Trends in the Delivery of U.S. AEC Projects

In the US, the infrastructure sector has experienced a number of changes in preferred project delivery approach over the last century or so. Until the end of the nineteenth century, concurrent delivery of design, construction, and long-term operations was mandated and facilitated largely by state statutes. In particular, the fact that design professionals were not organized in strong professional organizations allowed for an environment in which designers were subordinates to constructors and not collaborators (Pietroforte and Miller 2002). These factors, including others, have led to a wide application of integrated delivery methods. By the end of the Century, however, certain historical developments produced a push to segregate design and construction activities. First, design-oriented professionals organized themselves into professional societies, such as the American Institute of Architects (AIA) and the American Society of Civil Engineers (ASCE). The interests of these groups was supported by growing public concern over the quality of construction-directed design activities. As a result, segmenting the procurement of design and construction services was first allowed by the U.S. Congress in 1893; however, the infrastructure sector's use of this split delivery method was not fully assumed until passage of the Federal Aid Road Act in 1916 (Pietroforte and Miller 2002; Rein et al. 2004). Following 10 years of development, the preparation and launch of Public Buildings Act, the federal government required for the first time that design and construction services be procured separately, a landmark occasion.

Subsequently, the Great Depression "eclipsed the private funding of public projects and the use of the combined project delivery methods" (Pietroforte and Miller 2002; pp.428). So from that the government preference for using segmented approaches to delivering projects increased through World War II. This shift was later reaffirmed in both the 1956 Federal Aid Highway Act (Rein et al. 2004) and in 1972 the Brook Act, each furthering the separation of design and construction procurement activities (Pietroforte and Miller 2002). Thus, the result of this sequence of events, governmental agencies developed their project delivery strategies around the low-bid procurement approach of a single delivery method, the Design-Bid-Build (DBB) method as we know it today. In the transportation sector most particularly, after decades of continuous use, this method became the institutionalized standard for the delivery of projects.

The infrastructure sector is currently reencountering the issues surrounding delivery strategy change; the sector-wide standard for delivering projects, the DBB method, is experiencing a deinstitutionalization. According to Oliver (1992), "deinstitutionalization refers to the de-legitimation of an established organizational practice [...] as a result of organizational challenges to or the failure of organizations to reproduce previously legitimated or taken-for- granted organizational actions" (pp.564). In response to both an increasing demand for new capacity and for minimizing the impact of construction to motorists, the transportation sector is questioning the ability of a project delivery strategy that is based solely on one delivery method; several studies have shown the poor performance of this method in terms of schedule (i.e., overall duration and schedule certainty) when compared with other methods (FHWA 2006; Ibbs et al. 2003; Sanvido and Konchar 1997). Over recent years, these concerns have generated a reduction of legal, regulatory, and practical impediments to integrated delivery methods for delivering new infrastructure projects across all sectors of the AEC (Kennedy et al. 2006; Papernik and Davis 2006), including smaller type design build projects (Nyström et. al. ,2017 and Minchin et. al., 2013).

As a result of this deregulation, the transportation project sector is observing an increased usage of integrated project delivery methods. Among the many emerging delivery method options, the Design-Build (DB) approach has become one of the most popular alternatives. In 1990, the Federal Highway Administration (FHWA) initiated a special experimental program (SEP-14— Innovative Contracting) to enable DOTs to test and evaluate this delivery method along with a few others. The purpose of this program was to identify alternatives to the DBB delivery method that "provided the potential to expedite highway projects in a more cost-effective manner, without jeopardizing product quality or contractor profitability" (FHWA 2006). In the recent past, the FHWA published a report summarizing the findings and lessons learned from the SEP-14 program. This report not only acknowledged the effectiveness of the DB method in shortening project time delivery, but it also concluded that agencies could pursue alternative financing paths as a direct result of this schedule benefit (FHWA 2006).

Potential Problems Associated with Changing Project Delivery Strategy

As the decades-long use of the segmented DBB method has so fundamentally shaped employee perceptions and organizational structures and practices, implementing a combined procurement approach constitutes a paradigm shift for the state agencies adopting it (Miller et al. 2000). Studies have identified that "as agencies attempt design-build for the first time, they are constrained by the low-bid culture in their organizations" (Molenaar and Gransberg 2001). In the report to Congress on Public Private Partnerships (PPP), the U.S. Department of Transportation acknowledged these difficulties, reporting that "states not accustomed to this method of

procurement can find it difficult to oversee these types of projects" (FHWA 2004). In addition, although combined procurement of services is expected to reduce transactional costs for delivering a project (Pietroforte and Miller 2002), this new type of procurement usually results in state personnel spending considerable time experimenting and developing new organizational routines to support the procurement change (FHWA 2004). These time excesses are often justified by a wider concern that traditional safeguards embedded in traditional procurement and financing approaches can be lost in the change process (FHWA 2004).
Therefore, especially in the restoration area, an effective implementation of this paradigm shift requires owners to correctly identify the dimensions of change in the delivery cycle in order to establish new work relationships with contractors, suppliers, and consultants. These challenges to changing a project's delivery strategy are summarized below in the problem statement of this research effort. Since the adoption of, what might be referred to a Design Build in Restoration approach is a response to changes in the AEC environment, owner organizations are compelled to seek ways to adapt their organization to the new approach. This adaptation requires the development of new work processes along the delivery cycle, and involves the implementation of these processes within new organizational structures. This research effort will share some of the lessons learnt from the process captured from the implementation of a novel restoration design build (RDB) project.

Solving a Distinct Historical Restoration imperative

The rationale behind this research is two-fold. The first motivation arose from reflection on the type of project delivery strategy communicated by the state of Oklahoma for the restoration of the State capital. The opportunity to share the rich nature of the design build process in a unique environmentally and heritage focused project excited the authors. Secondly concerns about the way such projects are captured historically, and specifically the disciplinary knowledge and skills employed in the restoration of such a significant landmark building could be lost if not afforded some place in the research annals.
It is the coincidence of the changing design build focus in restoration projects, and complex disciplinary challenges that coalesce to provide the rationale for this research.

Case Study approach

The use of case study research within built environment research and development initiatives explicitly recognizes that an attempted to explore the field of study, as defined in the title, and gather information on it is the basis for an appropriate. In order to do this exploration, data was collected and assimilated from formal and informal observation, field notes, vignettes and reference to (researcher-written) profiles and reports, and individualized educational programs. Case study designs and applications can vary widely: They may be used for either exploratory, descriptive or explanatory purposes, and may take either typical, critical or deviant approaches. To further compound the situation, they may be prepared by a wide variety of processes and so cause complexity.

Descriptive case studies may be exploratory, if relatively little research has been done in the area, or they may be illustrative of aspects thought to be representative or typical: Both exploratory and illustrative aspects may be included in a single case study, with accent being on the typical. Hakim (1987) has classified descriptive case studies as typical, or selective: The typical, we have already introduced above. The selective case study may focus on a particular issue or aspect of behavior with the objective of refining knowledge in a particular area, to provide a better understanding of causal processes. The selective case study may lead to questions about 'how' and 'why' issues or behavior conspired to produce the resulting outcomes: This leads into explanatory evaluation.

Case studies may either focus on a single case or use a number of cases: A single case may form the basis of research on typical, critical or deviant cases, while multiple cases may be used to achieve replication of a single type of incident in different settings, or to compare and contrast different cases. Multiple-subject case studies are especially useful if topics are too complex or involve too many actors to be addressed using a simple interview survey. Single case studies are analogous to single experiments, and as such are justified using the same arguments as the single experiment. This single case study provides the context for capturing a historically significant building's redevelopment and offering a reflective paper to share those elements that may contribute to a better understanding for future built environment professionals to advance with some level of clarity and direction.

The Design Build Process

Project Delivery is a comprehensive process in today's AEC sector and includes planning, design and construction along with the post construction requirements to complete a building facility or project. Adopting the most appropriate delivery method is one of the fundamental decisions owners make while developing the acquisition strategy. In the traditional design-build project delivery method, the DB is responsible for both the design and construction stages of the project. Table 1 identifies different Project Delivery Systems, Procurement Methods and Contract Format for different types of Construction Projects in the Built Environment.

Project Delivery Systems	Procurement Methods	Contract Format
Construction Management at Risk (CMR) also known as CM/GC Design-Bid-Build (DBB) Design-Build (DB) Multi-Prime (MP)	Best Value (BVS) Low Bid Negotiated Qualifications-Based (QBS) Sole Source (or Direct Select)	Cost Plus Fee Guaranteed Maximum Price (GMP) Lump Sum (or Fixed Price) Target Price Unit Price

Table 1: Project Delivery Systems, Procurement Methods and Contract Format for Construction Projects

Table 2: Planning, Design and Construction processes

Through well-developed relationships with trade partners, Restoration Design-Build (RDB) can provide a cohesive team for every step of the project process. By utilizing this team approach throughout the design and construction phases, like Design Build, the restoration DB approach is able to minimize project risk, control project cost, and reduce the delivery schedule. The design-build process allows the project to be owner driven as the construction program maximizes the owner's value at the completion of the project. There is one firm, one contract, one integrated flow of work from design inception to project completion.

Overview of RDB Process:

Design Process:

- •Initial Consultation
- •Preliminary Design and Project Cost Range
- •Design Partnership Agreement
- •Development of Existing Conditions and Project Design Alternatives
- •Design Revisions and Materials Selection
- •Final Design Approval
- •Construction Contract

Build Process:

- •Scheduling and Materials Ordering
- •Project Initiation – including health and safety protocols
- •Ongoing Construction planning and updates
- •Project Completion

•Completed Project Consultation (important phase of the project)

The advantages associated with the RDB process include:

Reduced Financial Risk:

Eliminates the risk of paying for complete drawings that do not fit within your budget once construction costs are determined.

The project is designed to fit within the client investment comfort range.

Problem solving is completed during the design phase, not during construction when they can become more costly.

Efficiency:

Allows for a shorter, smoother construction process.

Accountability:

Design-Build maintains complete accountability of your project at all times.

Background of the Project and the Stakeholders

> "The State Capitol Building represents who we are as a people. It resonates with the spirit of the people who have walked through its hallways or sat in its chambers for the past 100 years. The State Capitol of Oklahoma is a functioning historic and irreplaceable treasure, serving the people of our great state, as a building, a museum, and a repository of our government's past, while simultaneously, the constantly evolving headquarters of its future, in both its daily use and governmental guidance." (Oklahoma Capitol Restoration CAP Solicitation No. 15151DB Report, 2014)

It took three years and $1.5 million to build Oklahoma's Capitol building a century ago. It will take at least six years and as much as $245 million to prepare the building for its next 100 years. Plans and design work to repair and renovate the 452,000-square-foot building were completed based on the historic data archived.
The work schedule identified that the building's exterior restoration would begin in July 2016 and the interior in September of that year. Trait Thompson, the Capitol project manager for the Oklahoma Office of Management and Enterprise Services, reported that the project would involve every square inch of the capitol building. Details of the project include:

COST: Estimated at $245 million; $120 million in bonds authorized by Oklahoma Legislature and another $125 million bond issue pending.

DURATION: Exterior work to take an estimated 3.5 years; while the interior work to take an estimated six years.

EXTERIOR REPAIRS:

- •Eleven levels of scaffolding to be erected.
- •Repair 21 miles of mortar joints.
- •Repair 240 cracked or damaged stones.
- •Restore 477 windows.
- •Restore 43,000 pounds of cast iron.
- •Expand exterior loading dock
- •Replace exterior doors
- •Partial roof replacement
- •Repair exterior stairs, plazas, sidewalks and battlements.
- •Repair east tunnel.

Reflections on the use of Design Build Process in Restoration

Existing buildings and legacy project systems can offer distinctive challenges which are technical (e.g. access to archived data, capturing & maintaining accurate as-built data, lack of interoperability, high data volumes), organizational (e.g. public representation, stakeholder collaboration, new workflows) and cultural (e.g. learning curve, learning on the job, increased effort) in nature (Volk, Stengel, & Schultmann, 2014). In some cases, sections of the restoration facility may remain operational during upgrades, adding another particular layer of

operational complexity. Despite these challenges, the construction trades face increasing pressure to; (a) maintain a high level of performance to ensure a faster time to market for the manufactured products and (b) optimize construction labor headcount to alleviate the congestion on site.

Some of the fundamental points that provide a depth of learning for all stakeholders include:

Allow the members of the team to share their knowledge and gain confidence - allow and schedule time for this as this will require more time than you might expect
Encourage them to schedule meetings outside of the designated time
Encourage the team members to challenge assumptions
Ensure that project team members, especially those who will have to travel to meetings acquire as much background knowledge as possible
Embrace the stakeholder -led collaborative efforts that lead to team success and look for ways to foster it
Make any expectations clear to all project team members.

This kind of truly collaborative approach demands a major time commitment and agreed/ shared goals. One cannot assume that the team members know what it is they are going to say and roll with it as easily. Be prepared to have situations that will take more time than you might have scheduled for, especially as time will be gained in the execution of work when clarity around objectives is achieved. The time spent will allowed team members to deepen their understanding of the requirements to be successful, improve interactions with each other, develop a capacity to embrace differences, and work toward a more collaborative approach to solving the project.

Discussion and Future Direction

The authors reflected on a number of advantages in the collaborative RBD projects - social benefits, learning benefits, and development of skills, knowledge and competences of the participants for their future careers. The early stage meetings be embedded to reduce the social anxiety of students by providing an instant group of peers with whom they would not feel exposed. Instead they would feel a sense of community through engaging in the common task of grappling with and understanding the competition structure and the material associated with it. Secondly, it was hoped that the method would help to promote deeper understanding, especially for the international audiences as their knowledge and experience in the US construction processes is very limited. Due to the historic nature of the building, those associated with the project often do not know what they are getting into until the disassembling of components has commenced. More specifically, the windows on the Oklahoma Capitol project are specific to this building and through a focused and collaborative investigative process, the design-build delivery method really assists in coming up with resolutions quickly and with little cost. The opportunity to collaborate and discuss matters as they emerge as a shared ownership of the project is clearly observed. On the contrary, if this were a traditional delivery method, for any unforeseen conditions or changes that need to be made, the team would have to follow the traditional protocol of notifying the Owner, contacting the Architect, receiving a stamped set of drawings to denote the changes made, etc. In Design Build, the project team very simply make a decision and implement it immediately – documenting everything in an as-built manner.

One of the primary benefits of design-build is also the shifting of risk from one primary group (i.e. the architect or contractor) to the entire group. This is especially beneficial for this historical project owner, with the large amount of risk that could be involved with restoring a 100-year-old building. When the team run into issues on-site, the design-build team understands that whatever decision is made, everyone on the team shares the same risk if that decision turns out to be incorrect or flawed. This delivery method truly forces everyone on the team to work together for one common goal: to complete a successful project.

The understanding of the complexity of the advanced technology repair methods employed was a major limitation for this study as the expert masons hired for the project were from Poland and communication proved difficult. Also, frequent changes give the construction trades limited time to react, thus lowering their productivity. The retrofit conditions also affected productivity, for example as health and safety was a huge concern on this public facility which remained in use during the restoration period impacted on how the project progressed. The lack of an existing formal method for measuring productivity for the project made it difficult to compare our observations against a baseline, such is the nature of restoration work. The second limitation is in the research method. Nevertheless, despite the limitations of a case study method, the complexity of the construction environment and the integration of the researchers in the field provides a solid foundation for analysis and conclusions. As Glaser &

Strauss (1967) argue; it is the intimate connection with empirical reality which permits the development of a testable, relevant and valid theory.

Many public owner organizations such as state's departments of transportation and Federal Agencies such as the General Services Administration are fundamentally changing the way they procure capital facilities. The emergence of wide-scale infrastructure deficits, aging and failing infrastructure, and the loss of expertise to effectively manage large capital programs have all lead to a movement toward alternative project delivery methods, such as design-build and in this case RDB.

Changing from a low-bid, design-bid-build process to a best value, competitive Design Build process for delivery of a facility is not easy. Information about how this change should be implemented is limited, especially at the organization-wide level.

The significance of using well qualified personnel on a project of this nature is that if contracted correctly from the beginning of the projects lifecycle, offers opportunity for the development of high performing facilities through sustainable building construction processes with fewer resources and lower risk than a traditional process. It can be argued that, within the framework of alternative project delivery methods, project management strategies and collaborative work environments, will affect improvements in the construction supply chain. The first objective of this paper was to present a background to the implementation for a retrofit project. It was found that there is limited published research on RBM use for construction projects, with most publications offering research related to sharing project accomplishments. However, there are limited studies which have qualitatively and quantitatively examined the impact of retrofit and its contribution to dealing with old buildings allows us to consider each part of the structure as an individual element that makes up the whole. Such analysis is of concern and should be especially so to owners. To this effect, as part of future research, a RDB framework be developed and proposed which will evaluate the stakeholder expectations driving the decision-making during the planning, implementation and use of appropriate conservation methods and their impact on task-level labor performance. The AEC sector in general can benefit by extending a RDB framework as a methodology for future projects.

References

Federal Highway Administration (FHWA), U.S. Department of Transportation (2004). *Report to Congress on Public-Private Partnerships*, December. Retrieved April 2, 2017, from http://www.fhwa.dot.gov/reports/pppdec2004/pppdec2004.pdf

Federal Highway Administration (FHWA), U.S. Department of Transportation (2006). *United States Department of Transportation—Federal Highway Administration, design-build effectiveness study*, January. Retrieved April 2, 2017, from http://www.fhwa.dot.gov/reports/designbuild/designbuild.htm/

Hakim, Catharine (1987) *Research Design: Strategies and Choices in the Design of Social Research*, 1987: London, Unwin Hyman, pages 61 - 75.

Ibbs, C. W., Kwak, Y. H., Ng, T., and Odabasi, A. M. (2003). "Project Delivery Systems and Project Change: Quantitative Analysis." Journal of Construction Engineering and Management, 129(4), 382.

James, L. R., Demaree, R. G., and Wolf, G. (1984). "Estimating Within-Group Interrater Reliability With and Without Response Bias." Journal of Applied Psychology, 69(1), 85.

Kennedy, M., Hurley, L., and Pritchett, L. (2006). "The Fully Integrated Design-Builder." Design-Build Dateline, 13(4), 34-38.

King, N. (1994). "The Qualitative Research Interview." Qualitative Methods in Organizational Research: A Practical Guide, C. Cassel and G. Symon, eds., Sage Publications, London, 14-36.

Linstone, H. A., and Turoff, M. (2002). "The Delphi method: Techniques and applications." H. A. Linstone and M. Turoff, eds., Murray Turoff and Harold A. Linstone.

Migliaccio, G. C. (2007). "Changing Project Delivery Strategy: An Implementation Framework." Ph.D. Dissertation, The University of Texas at Austin, Austin, TX, Summer.

Migliaccio, G.C., Shrestha, P. P., Clarke, M., O'Connor, J.T., and Gibson, G.E. (2006). R5-2006 Final Report, Report 0-4661-5 to Texas Department of Transportation, Center for Transportation Research (CTR), Austin, TX, October.

Miller, J. B., Garvin, M. J., Ibbs, C. W., and Mahoney, S. E. (2000). "Toward a new paradigm: Simultaneous use of multiple project delivery methods." Journal of Management in Engineering, 16(3), 58.

Minchin, J., Li, X., Issa, R., and Vargas, G (2013) Comparison of Cost and Time Performance of Design-Build and Design-Bid-Build Delivery Systems in Florida *Journal of Construction Engineering and Management* Volume 139 Issue 10

Molenaar, K. R., and Gransberg, D. D. (2001). "Design-builder selection for small highway projects." Journal of Management in Engineering, 17(4), 214.

Nyström, J., Bröchner, J. and Mandell, S., (2017) Design-Build, Innovation, and Competition: The Role of Smaller Contractors, International Conference on Construction and Real Estate Management, Guangzhou, China.

Oliver, C. (1992). "The Antecedents of Deinstitutionalization." Organization Studies (Walter de Gruyter GmbH & Co. KG.), 13(4), 563.

O'Connor, J.T., Gibson, G.E., and Migliaccio, G. C. (2004a). Essential Elements of CDA Master Contract, Report 0-4661-P2 to Texas Department of Transportation, CTR, Austin, TX, August 2004, pp.82.

O'Connor, J.T., Gibson, G.E., and Migliaccio, G. C. (2004b). CDA Procurement Process Model, Report 0-4661-P1 to Texas Department of Transportation, CTR, Austin, TX, August 2004, pp.56.

O'Connor, J.T., Gibson, G.E., Migliaccio, G.C, and Shrestha, P. P. (2006). Organizational Structures and Communications on the SH130 Project, Report 0-4661-P3 to Texas Department of Transportation, CTR, Austin, TX, March 2006, pp. 122.

Oklahoma Capitol Restoration CAP Solicitation No. 15151DB Report (2014) State of Oklahoma Office of Management and Enterprise Services Division of Capital Assets Management Construction and Properties Department CAP Solicitation No. 15151DB Oklahoma Capitol Restoration - Interior RehabilitationState Capitol Building, Oklahoma City Office of Management and Enterprise Services.

Papernik, B., and Davis, B. (2006). "Innovation in Highway Delivery: Survey of SEP-14/SEP-15 Projects." Design-Build Dateline, 13(4), 8-11.

Pietroforte, R., and Miller, J. B. (2002). "Procurement methods for US infrastructure: historical perspectives and recent trends." Building Research & Information, 30(6), 425.

Rein, C., Gold, M., and Calpin, J. (2004). "The Evolving Role of the Private Sector in the U.S. Toll Road Market." Journal of Structured & Project Finance, Euromoney Institutional Investor PLC, 27.

Sanvido, V. E., and Konchar, M. D. (1997). "Project Delivery Systems: CM at Risk, Design- Build, and Design-Bid-Build." 133-1, The Construction Industry Institute, Austin, Texas.

Walewski, J., Gibson, G. E., and Jasper, J. (2001). "Project Delivery Methods and Contracting Approaches Available for Implementation by the Texas Department of Transportation." CTR 2129-1, University of Texas at Austin, Austin, Texas, USA.

Volk, R., Stengel, J., & Schultmann, F. (2014). Building Information Modeling (BIM) for existing buildings — Literature review and future needs. Automation in Construction, 38, 109–127. doi:10.1016/j.autcon.2013.10.023.

Yi, W., & Chan, A. P. C. (2014). Critical Review of Labor Productivity Research in Construction Journals. Journal of Management in Engineering, 30(APRIL), 214–225. doi:10.1061/(ASCE)ME.1943-5479.0000194.

Yin, R. K. (1994). Case study research - Design and methods (4th ed.). SAGE Publications.