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INTEGRATION AT ITS FINEST:

Success in High-Performance Building Design and Project Delivery in the Federal Sector

Research Report
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Renée Cheng, AIA, Professor, School of Architecture, University of Minnesota
Sponsored by Office of Federal High-Performance Green Buildings, U.S. General Services Administration

Executive Summary (1 of 3)

The documentation of case studies contributes to initiatives by the Office of Federal High-Performance Green Buildings of the General Services Administration (GSA) to highlight project-delivery best practices that can be used to advance the industry's development of high-performing buildings. Selected by the GSA as exemplary project teams with outstanding building outcomes, these three cases (Wayne N. Aspinall Federal Building and U.S. Courthouse, Edith Green- Wendell Wyatt Federal Building, and Federal Center South Building 1202) together offer insights on a range of collaborative strategies, processes, and tools that were used by the teams to achieve aspirational high-building-performance goals. The range of selected projects allowed our team to explore the factors of collaboration in a variety of contexts: a new construction project on a brownfield, the renovation and expansion of an urban high-rise, and historic preservation with net-zero energy goals. It is important to understand that while all project teams in this report prioritized collaboration and implemented several strategies and tools used in Integrated Project Delivery (IPD), none of these projects used a formal tri-party IPD contract. The more informally used terms of IPD-ish, IPD-like, IPD-light, integrated teams, collaborative practices, or integrated design are appropriate to describe cases in this report.

When documenting collaborative processes, we have found that a comparative case-study strategy is effective, allowing readers to understand both isolated variables of team performance as well as the holistic interrelationship between those variables. An interactive matrix format allows users to navigate information in different ways. In this report, the first category, titled Overview, provides project narratives and descriptions. Then, the High Performance category presents the high-performance outcomes these teams were able to achieve. Next, team-performance information is organized within three broad categories: commercial strategies, leadership strategies, and logistical and process tools. Readers can focus on a specific strategy, such as team selection, easily flipping between projects to compare similarities and differences. Alternatively, readers can review a single project within all of the categories to learn how a specific team addressed each of the topics. The last category, titled Building Innovation, provides another way to understand how teams leveraged an array of strategies, people, processes, and tools to achieve success through a specific example.

Following are highlights from the report and recommendations:

Overall

- *Recommendation: GSA should continue collaborative project delivery to lead industry.*

  Collaborative project delivery is cultural. Alignment around the desired building outcome extended beyond the core group to include suppliers, regulators, subcontractors, consultants, and tenants—a notably large stakeholder group. This widespread alignment led to behavioral changes not commonly seen in the industry, leading us to understand collaborative project delivery as a cultural phenomenon.

- *Recommendation: Examine GSA processes and conventions that may be inhibiting collaborative project delivery.*

  Not every stakeholder can or should be integrated into the team; consequently, strategies for working with those entities need to be developed. The teams presented in this report developed strategies that worked effectively within their core group, yet those strategies relied on core values that others (regulators, Quality Assurance Quality Control- QAQC, GSA national, subcontractors, consultants, tenants) may not share and therefore could create tension between the team's collaborative aspirations and agency (or industry) norms. These stakeholders can create inertia, drawing the teams back to industry status-quo working methods. For example, construction-documentation conventions worked against the desire to streamline the process of documentation, often forcing the teams to retrace and document steps they did not feel were necessary in their new integrated work processes.

- *Recommendation: Be generous in budgeting time and energy to achieve high-performance-building outcomes.*

  While some aspects of these projects were fast paced, each took time in important ways to plan, engage, and investigate collaborative team culture and high-performance solutions. Aspirational goals were only possible to achieve with the input from a broad constituency, from suppliers to users. Resolving diverse and sometimes competing agendas required extraordinary coordination and communication. In these projects, it was essential to have more than standard project-planning time to integrate, test, and revise the sophisticated technological and personnel operations of the building systems.

- *Recommendation: Develop a way to assess the level of project risk, assign resources and prepare differently based on high, medium or low risk.*

  High-risk projects need complex solutions that include collaborative team performance, cultural attitudes, managerial strategies, logistics and tools, and commercial strategies working in concert to make a difference in building outcomes. In our case study research experience, lower risk projects can be successful with fewer and simpler strategies and tactics. It is important to understand the proportional relationship between risk and investment of time and energy.

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Executive Summary (2 of 3)

Commercial Strategies

- *Recommendation: The use of performance based goals in project delivery should be further explored.*

  Binding the team to performance-based goals was a powerful unifying and uplifting force. While only one of the cases used contract language to establish these goals, all of the teams used some type of formal agreement. Contracts or agreements alone were not enough to ensure success: they worked in conjunction with leadership strategies, tools, and processes.

- *Recommendation: Fully engage teams during the RFP process.*

  At Aspinall and Federal Center South, the interactive RFP process started with an open-ended scope. Through the proposal process, the teams expanded performance goals and showed options for how those goals could be achieved.

- *Recommendation: Develop and include a verification process for projects with high performance building goals.*

  Uniformly, teams believe that the inclusion of a verification process should be recommended as a best practice. Lessons can be learned in the cases of Aspinall and EGWW which did not plan or budget for a verification period. EGWW was able to use funds captured from unspent contingency for several core team members to continue work; Aspinall funded a consultant to make an in-depth study of energy loads.

- *Recommendation: Continue to use and support GSA's current best value selection processes.*

  Under American Recovery and Reinvestment Act (ARRA), contracting officers were assigned to projects for the full duration of the project. Assigning a consistent contracting officer was effective in maximizing the benefits of the best-value procurement process. In Federal Center South, the contracting officer fully understood the benefits of the best-value procurement to the project. As a result, their additional time required set up the best value procurement was perceived as a contribution to the team, not an overload.

- *Recommendation: Use transparent contingencies with shared management for integrated teams.*

  In teams where trust has been established, transparent contingencies can increase trust. In these cases, there are many examples where the process of reaching collective agreement on the use of contingency funds increased alignment and reinforced shared goals.

Leadership Strategies

- *Recommendation: Post-ARRA, GSA should continue its willingness to work differently.*

  The urgency of ARRA created openness to new ways of working for the GSA, some of which should be adopted as standards. While the exact conditions of the ARRA are unlikely to reoccur, the collaborative spirit it inspired should be maintained by adopting some new processes as standards. For example, procurement and team selection documented in these cases show how those processes can set the stage for engagement and inclusion. Also, integrated or collaborative project-delivery methods that were effective here can be effective industry-wide. The GSA can be a leader by shifting its processes to support collaboration and integration as the norm rather than the exception.

- *Recommendation: Invest in building relationships proportional to project complexity.*

  Critical to project success was the intentional establishment of relationships, trust, respect, and effective communication. They were established in a variety of ways (preplanning or continual improvement). The amount of time invested and timing of investment can vary. Return on the investment in collaboration was high, but not all projects may need the full-scale investment used in these cases. Complexity of context, aspirational goals, and personnel limits are factors in the decision to invest in collaborative practices or to follow conventional methods.

- *Recommendation: Whenever possible, create time for early planning.*

  Both EGWW and Federal Center South benefited from situations that created the time to deliberately pace the early planning phase. This allowed the teams to develop a strong set of core values and identify problems to anticipate complexities in the project. While not always possible in every project, if time can be budgeted early on and used to build the team, the payoff provides a high return on investment.

- *Recommendation: Develop a set of questions that could be used to assess the fit of each team participant in the organizational culture.*

  In addition to helping identify team members that would fit well into a collaborative environment, the tool could also help identify areas in the organizational culture where additional support is required for collaboration to be fully adopted by the entire team.

- *Recommendation: A designated team liaison should actively engage tenants throughout the project delivery.*

  In GSA projects, managing tenant expectations is always important. For buildings with high-performing goals, tenant needs and behavior is critical. Federal Center South noted that even with a single tenant with clear decision-making, communication with individual departments and users would have been improved if the team had a single point of contact. Aspinall used partnering sessions and mock ups to align tenant and project team goals. EGWW created a "condo" model to since several tenants were not confirmed until late in the process.

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Executive Summary (3 of 3)

Logistical & Process Tactics

- *Recommendation: Invest in developing process tools proportional to project complexity.*

  An intentional development of process tools was critical for teams to manage information and complexity and at the same time support collaboration. Teams effectively paired tools with needs and explained the connection. Master schedules created buy-in and shared understanding. Building information and energy modeling were extensively used. Teams acknowledged the need for expertise beyond their core groups; GSA peer reviewers were leveraged resources, as well as other stakeholders and supply-chain entities.

- *Recommendation: For design-build delivery, time the first peer review early.*

  The early timing of the first GSA peer review is critical in design-build delivery. By the time the contract is awarded, the team has invested in design development. Review should occur shortly after the team is selected, before too many decisions have been finalized. The first review for Federal Center South resulted in changes to the locations of mechanical systems, if the team had invested in design work before that point, it would have been wasted effort.

- *Recommendation: Create prioritized "buy-back" or "betterments" lists during the value engineering process and commit to finding ways to add items back to project scope.*

  Tracking value creation by tying value engineering (VE) decisions to the financial outcomes is a powerful incentive but is time consuming to maintain. EGWW creating a prioritized "buy-back" list motivated the team during VE. Even before the Federal Center South team was awarded the project, they created a wish list of "betterments", many of these items were successfully incorporated.

Conclusions

We have created sidebars highlighting "takeaway messages" in each of the Commercial, Leadership, Logistical topics sections of the report. These are drawn from best practices, lessons learned and quotations that succinctly capture the essential messages we believe should be understood.

These projects were exceptionally good exemplars of collaboration and positive building outcomes. Yet they are not so unique that their success cannot be repeated. The GSA should consider that while some aspects of these teams are impossible to replicate for others (either due to the ARRA, a particularly successful individual team leader, or an unexpectedly positive team chemistry), others can be easily repeated for all future projects (investment in relationships, team development of their work processes, mechanisms for alignment, intentional engineering of team chemistry), and some can be strategically repeated where ROI may be lower (heavy investment in custom communication plans and custom implementation or schedule). We hope that these case studies provide the impetus and support for important discussions that will elevate all GSA projects and project teams in the future.

Wayne N. Aspinall Federal Building

Edith Green- Wendell Wyatt Federal Building

Federal Center South Building 1202

COMPARATIVE ANALYSIS

Comparisons & Best Practices

WAYNE N. ASPINALL FEDERAL BUILDING & U.S. COURTHOUSE

Historic Renovation
project type

Design-Build
project delivery

Integrated Firms
team culture

EDITH GREEN - WENDELL WYATT FEDERAL BUILDING

Renovation
project type

Custom CMC+6
project delivery

Up-Front Team Building
team culture

FEDERAL CENTER SOUTH BUILDING 1202

New Construction
project type

Design Build
project delivery

Leverage Project Interactions
team culture

Research Methodology (1 of 5)

Research Goal for This Report

The importance of an integrated design process and the use of integrated teams have long been recognized as a core concept in creating high-performance green buildings. *Employ Integrated Design Principles* is the first of the Guiding Principles for High Performance and Sustainable Buildings, which federal agencies are directed to apply to building projects. Methodologies for implementing integrated processes have been developed (e.g., *Integrated Project Delivery: A Guide*, AIA; *The Integrative Design Guide to Green Building: Redefining the Practice of Sustainability*, 7group/ Reed), but there is a lack of research on the effects of using such a process, particularly for federal government projects. This study examines the collaboration processes of three recently completed GSA projects to link high-performance outcomes with integrated decisions made during the design and construction processes. The study focused on economic impacts and risk assessment, and includes an assessment of related performance-based contracting provisions.

The findings of this study support the use of collaboration processes on future projects. We seek to influence improvements to government procurement processes and offer lessons learned for project teams seeking to implement integrated processes and performance contracting.

Development of Case Study Categories

The research team has experience with several studies on integrated project delivery (IPD), high-performing buildings, and collaborative practices. For the analysis of the cases in this report, we adapted Case Study Categories from prior studies: context, key ingredients, team outcomes, and building outcomes. This framework functioned as a guide for data collection and was refined throughout our research.

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Development of Case Study Categories

Case Study Categories

The Case Study Categories describe the broad framework common to all projects: 1) Project Context, 2) Key Ingredients, 3) Team Outcomes, and 4) Building Outcomes.

Project Context

Project Context variables describe the complexity and risks surrounding each case, looking at the levels of budget, cost, schedule, and technical complexities and risks faced by each project team. In other words, context variables are those given factors that influence the project environment but that are not a direct result of decisions made by the project participants

Key Ingredients

Key Ingredients include commercial, leadership, and logistical/process strategies. Commercial strategies include variables in the General Services Administration (GSA) funding process and decisions, such as the project-delivery type and contract type. The leadership strategies are demonstrated in how teams are built – collaboration facilitated through alignment and accountability. By studying logistical and process tactics, we capture tools used for information management and processes such as colocation and the type and quantity of team meetings.

Team Outcomes

Team Outcomes can be measured by looking at how well the teams collaborate, using markers such as mutual trust and respect. Team performance outcomes rely on effective communication, risk management, and the quality and efficiency of decisions.

Building Outcomes

Building Outcomes are based on a variety of building-performance measures, including meeting project scope and sustainability goals, overcoming budget complexity, producing a high-quality building and demonstrated innovation.

Research Methodology - Report Navigation, Definition of Categories and Glossary of Terms (2 of 5)

The presentation of this report follows the framework established by the Case Study Categories. Categories identified by the research team as key ingredients are organized as horizontal bars along the top of each panel. Tabs for specific topics are grouped beneath those bars. Tabs running on the vertical axis help the viewer navigate the three cases as well as compare the cases. Team Outcomes are integrated into the text under a variety of topics. Building Outcomes are addressed in the High Performance category, and the Building Innovation category provides specific examples from each project.

Category Tabs

The *Overview* section describes the factual information about each project as well as the contextual factors contributing to the development of the program, site, budget, and schedule, including the constraints and goals of the American Recovery and Reinvestment Act (ARRA). This section includes team organization and a timeline of each project's milestone events alongside ARRA milestones.

The *High Performance* section describes how building outcomes for each project compare with industry conventions, such as those of LEED. Tabs under each project describe the specific technologies used to achieve the outcomes.

Commercial Strategies includes a range of issues related to procurement: how the GSA developed the request for proposals (RFP), the process of team selection, relevant contract terms, and creation of a verification phase post occupancy.

Leadership Strategies includes how the collaborative culture was created through intentional team building; how leaders defined goals, communicated them, and achieved alignment with them; how roles were defined; and how leaders established accountability within the teams.

Logistical and Process Tactics describes how decisions were made, communicated, and tracked. We included Building Information Modeling (BIM) and design documentation strategies and the ways that meetings were scheduled and tracked as well as the physical environment of the formal and informal interactions between team members and stakeholders. The GSA peer review process is a separate category used to describe the timing, effectiveness, and ways the process was leveraged.

Building Innovations is used to describe one particular innovation that illustrates the holistic interaction of the Case Study Categories.

Vertical Axis

Along the vertical axis, each project is referenced by type as a renovation of a historical building, a high-rise renovation, or a new-construction project. Project-delivery methods are listed in the heading. Also listed is the strategy used for building the team and establishing the culture of integration.

The definition of terms used to describe the teams' culture are:

- Integrated Firms – a partnership between two firms, each of which have integrated expertise within their enterprise (e.g., architectural designers as well as construction and engineers).
- Up-front Team Building – a strategy where significant investment is made in early planning and team building before the project begins.
- Leveraged Project Interactions – a process by which investment in team building is made throughout the project using specific project events to develop the team's integration.

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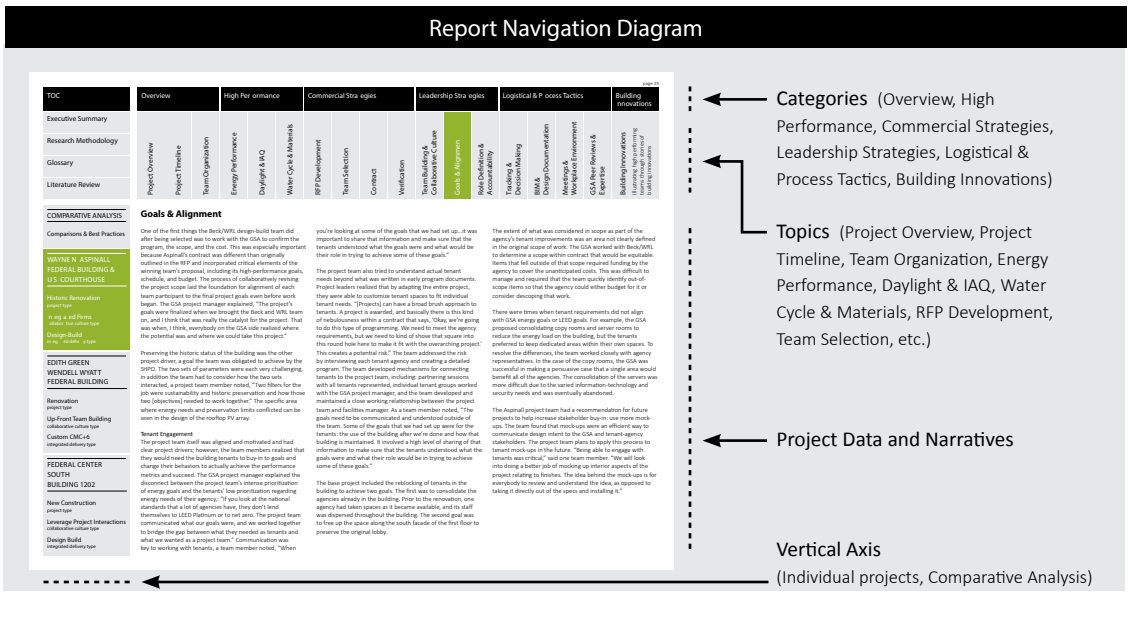
Report Navigation Diagram



Research Methodology - Data Collection and Analysis (3 of 5)

Data Collection

Framework for Study

Based on our experiences and previous research on IPD, we set up a framework (see Development of Case Study Categories) that identified variables to be studied and evaluated. These variables shaped interview and survey questions and were refined during the research process.

Interviews

The research team visited three project sites and conducted two-hour interviews with each core team, primarily with representatives from the owner (the GSA) as well as with the contractor, architect, and engineer. Several follow-up interviews were also conducted with each team.

Documents

Documents, such as GSA peer review reports, were collected from each team in the study as a source of data verification and supplemental information.

Qualitative Comparative Analysis Survey

We developed a qualitative comparative analysis (QCA) questionnaire to assess context variables, to determine the presence of key ingredients, and to measure team and building outcomes. The questionnaire was distributed to the project manager of all three projects. We used interview and document data to internally validate these findings and also compared the three cases in this study to baseline information gathered from past research.

Analysis

Interviews and Document Data

Interviews were transcribed, and the text was sorted into four broad categories (context, key ingredients, team outcomes, and building outcomes). These categories were based on the research team's expertise and customized for drivers apparent in these three particular projects. Survey results and further sorting of text created the detailed list of strategies, tactics, and team-collaboration and performance outcomes that structure the research narrative (Overview, High Performance, Commercial Strategies, Leadership Strategies, Logistical & Process Tactics, Building Innovations).

Qualitative Comparative Analysis as a Method

We developed descriptive statistics for the three case studies based on a prior QCA study of eleven GSA ARRA cases. QCA methods emerged from political science (Ragin 1987; 2000) and are useful techniques for studying complex and unique cases where the variables of the study are interrelated. QCA is used when there is simply not enough real-life data to statistically analyze but when the richness of the information about each case allows powerful and compelling stories about the likely causes for desired outcomes to be told. In situations where the number of cases studied is small, traditional statistical methods that rely on probability cannot be used, as these statistical studies require a large number of cases (usually more than two hundred) to prove significance and to ensure the validity of the results.

When employing the QCA method, researchers define a case with a set of variables (in this study, a case is one of the GSA projects). This allows researchers to study the variables in the context in which they occurred as well as across the projects where they were observed.

QCA Variables

We conducted a survey of the GSA project managers to assess each project. We also validated the QCA survey results with the joint core-team interviews. For the analysis, we reported on the relationship between the data from these projects with the QCA data from the previously studied projects to compare how these projects performed relative to their GSA-ARRA counterparts. The previous results are not included in this report, but they helped us to define the influential factors of the projects and to contextualize the project outcomes. This process was guided by the research team's deep experience in studying collaboration, technology, and building projects of this type.

Just as in the interview analysis, context variables measured the complexity and risks surrounding each case. The survey measured the levels of budget, cost, schedule, and technical complexities and risks of each project. In other words, context variables were those elements that influenced the project environment but were not necessarily the results of decisions that project participants made. These variables include the experience level of the team, the impact of scope changes and refinements, and the level of complexity and risk of the project.

Survey questions related to causal variables captured responses about the presence and quality of various management, commercial, and logistical-and-tools strategies. The management strategies category included the impact of the ARRA goals, involvement of stakeholders, quality of team relationships, and jointly accomplished team operations. The commercial strategies variables captured the GSA funding process and decisions, such as the presence of performance-based incentives in the contract. The logistics-and-tools category captured the use and level of project technologies, such BIM, and processes like co-location and the type and quality of team meetings.

Survey questions related to the outcome variables included participants' perceptions about team culture, and team performance, as well as building performance. First, the cultural atmosphere category included the assessment of mutual trust and respect between team members and firms, of goal alignment, as well as of the impact of GSA leadership in achieving project goals. Then, the team performance variable covered effective communication, the impact of BIM, the quality of decisions, levels of collaboration, as well as the team's capability for collaboration. Finally, the building performance outcome variable incorporated an assessment of a variety of building-performance measures, such as producing a high-quality building and being innovative. Success was measured against original objectives, such as early risk identification and acceptance (e.g., financial), meeting goals (e.g., sustainability), addressing complexity, producing a high-quality product, being innovative, and predicting the schedule.

COMPARATIVE ANALYSIS

Comparisons & Best Practices

WAYNE N. ASPINALL FEDERAL BUILDING & U.S. COURTHOUSE

Historic Renovation
project type

Design-Build
project delivery

Integrated Firms
team culture

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FEDERAL CENTER SOUTH BUILDING 1202

New Construction
project type

Design Build
project delivery

Leverage Project Interactions
team culture

Research Methodology - Qualitative Comparative Analysis Results (4 of 5)

A comparative analysis table shown in the comparative analysis/project overview section of this report summarizes each of the cases across the case study categories. This table is intended for viewers to see a high level of information for all three projects and all the category topics at once *(click here to go to the qualitative table).* While there were only three cases in this report, using baseline data gathered in our previous research on other ARRA projects, we were able to draw conclusions about the performance of these projects. The QCA survey also internally validated the interview findings and highlighted the important challenges the teams encountered during project execution.

Context Variables

Compared with their ARRA peer projects, these three high-performance projects were more complex and risky. The GSA managers rated these projects as somewhat-to-significantly more complex than other projects they had worked on in the past. The timing of the ARRA funding was both an advantage and a challenge. On the one hand, these projects were in the early phases of planning and design when the ARRA monies were made available; therefore, the project design progressed with the high performance green building goals well established. On the other hand, Wayne N. Aspinall Federal Building and Courthouse and Federal Center South Building 1202 both experienced relatively high frequency of design revisions throughout the process that was a challenge for the integrated team to effectively manage.

Causal Variables

In general, all three projects met or exceeded their ARRA counterparts in the commercial, management, and logistics-and-tools categories. Within performance-based-contracting strategies, all three projects rated very high in commercial strategies. Management strategies, such as creating and communicating clear project objectives, were also extremely positive—with one exception. Several of the projects gave low ratings to the support and cooperation of the GSA regional and national leadership. This aligns with the case narratives. It stands to reason that as project managers attempt new management strategies, these tactics may be at odds with the standard procedures of large, established organizations, such as the GSA. It is the regional and national leadership's responsibility to hold their project managers accountable. This sets up a natural and expected conflict between standard processes and the local agents for change. This friction highlights one of the strong themes in all three cases: strong leadership. Strong project leadership—in the local GSA representatives, designers, and construction managers—was present in all three projects. It is worth noting that not all GSA interaction was negative. For example, the GSA peer review process proved to be very successful in leveraging national expertise. In terms of logistics and tools, all three teams are on par with their ARRA counterparts—using BIM in appropriate ways, sharing information and data when relevant, fostering team building through conducting productive meetings, and using co-location strategies.

Outcome Variables

The team-performance variables are spectacularly high on all three projects. There is no question that the team engagement and collaboration in the three projects were very high, with effective communication and high-quality joint decision making. The results for the cultural atmosphere variable are more average as compared to their ARRA peers—tensions between the team and the regional and national leadership impacted these scores. Nevertheless, the three projects have higher-than-average ratings for the development of mutual trust and respect, which align with the qualitative narratives from the projects. In terms of building outcomes, these teams achieved extremely high levels of innovation and advanced sustainable-building technologies.

Discussion

Compared with our previous research on GSA-ARRA projects, all three of these high-performance projects rate among the top in most categories. They matched or exceeded the results of the other GSA-ARRA set of projects in forty-two of the fifty-one truth-table variables.

Since all three projects were highly complex, they needed to leverage an array of strategies to be successful. This aligns with the finding from the earlier study that high-risk projects require complex solutions, which combine team performance, cultural attitudes, managerial strategies, logistics and tools, and commercial strategies, working in concert to make a difference in building outcomes.

We do want to qualify these results with a caveat regarding the data used in this analysis. The comparison between the three projects in this study and the previous GSA-ARRA QCA study does not prove the causal relationships we discuss here. This study is a first step in understanding these relationships. Our findings suggest that there is an opportunity to understand what types of risks and complexities can be successfully managed with project tools and logistics, as well as with commercial and management strategies. We recommend further study of a larger number of projects with a range of outcomes to prove causal pathways and relationships with a complete QCA analysis. However, in this project, there was strong internal and external validation. The survey results and descriptive statistics align very closely with both the interview data collected for this project as well as other studies we have conducted on collaboration, technology, and IPD. This alignment and the high levels of consistency with the GSA-ARRA projects support the validity of the findings in this analysis.

Research Methodology - Credits (5 of 5)

Research Team - University of Minnesota, School of Architecture
Renée Cheng, AIA, Principal Investigator
Katy Dale, Primary Consultant on Project Delivery and Report Structure
Chris Wingate, LEED AP, Contributing Author, Coordinator, and Graphics
Dustin Harford, Research Assistant and Graphics
Linda Lee, Editor

Survey Development and Analysis Consultants
Carrie Sturts Dossick, PhD, PE, University of Washington – Department of Construction Management
Gina Neff, PhD, University of Washington – Department of Communication
Laura Osburn, PhD, University of Washington – Department of Communication

Study Contracted and Managed by
Bryan Steverson, GSA, Office of Federal High-Performance Green Buildings, Green Buildings Advisor
Don Horn, GSA, Office of Federal High-Performance Green Buildings, Deputy Director

Peer Reviewers
Phillip Bernstein, Autodesk, Vice President Strategic Industry Relations
Bob Fox, COOKFOX, Architect and Partner
Ann Kosmal, GSA, Architect
Vivian Loftness, Carnegie Mellon University, Professor
David Nash, US Navy (retired), Rear Admiral
Sarah Slaughter, PhD, Built Environment Coalition, President and Executive Director

Photography and Image Credits
Kevin G. Reeves- pages 3 (top), 13 (top), 28 (top), 29, 33, 34, 35, 36, 37, 38, 41, 46
Nic Lehoux- pages 3 (middle), 13 (middle), 47, 50, 51 (bottom), 53, 54 (top right, bottom), 56, 59.
Benjamin Benschneider- pages 3 (bottom), 13 (bottom), 28 (bottom), 68 (bottom), 69, 70, 71, 72, 82
Laura Swimmer- page 73.
The Beck Group and Westlake Reed Leskosky- page 32.
SERA Architects- pages 28 (middle), 51 (top), 54 (top left), 59.
ZGF Architects LLP- page 68 (top).

Primary Participating Projects and Team Members Interviewed
GSA Office of Federal High-Performance Green Buildings
Kevin Kampschroer, GSA, Office of Federal High-Performance Green Buildings, Federal Director
Judith Heerwagen, GSA, Office of Federal High-Performance Green Buildings, Program Expert

Wayne N. Aspinall Federal Building and U.S. Courthouse
Jason Sielcken, GSA, Design and Construction Division – Region 8, Project Manager
Courtney Westlie, GSA, Design and Construction Division – Region 8, Contracting Officer
Kenya Freeman, GSA, Design and Construction Division – Region 8, Contracting Officer
Demi Chavez, GSA, Design and Construction Division – Region 8
Kim Bailey, GSA, Design and Construction Division – Region 8
Michael Murray, The Beck Group, Principal
Todd Berry, The Beck Group, Senior Project Manager
Louis Sierra, The Beck Group, Senior Project Architect
Steve Ludwig, The Beck Group, Assistant Project Manager
Paul Westlake, Westlake Reed Leskoski, Managing Principal
Rodger Chang, Westlake Reed Leskoski, Principal
Ravi Maniktala, M.E. Group
Carrie Nordby, M.E. Group

Edith Green - Wendell Wyatt Federal Building
Patrick Brunner, GSA, Design and Construction Division – Region 10, Project Executive
Paul T. Witherspoon, GSA, Design and Construction Division – Region 10, Project Manager
Donald Eggleston, SERA, President
Clark Brockman, SERA, Principal
Jim Riley, SERA, Project Architect
Mark Perepleitza, SERA, Sustainability Resources Group Manager
Matthew Braun, Howard S. Wright Constructors, Project Executive
Troy Dickson, Howard S. Wright Constructors, Project Executive
Brad Nydahl, Howard S. Wright Constructors, Project Director
Erik Teyema, McKinstry, Manager of Mechanical Construction
Bill Bieganek, Energy Misers, Principal

Federal Center South Building 1202
Dan Brown, GSA, Design and Construction Division – Region 10, Director
Duane Allen, GSA, Design and Construction Division – Region 10, Project Manager
Rick Thomas, GSA, Design and Construction Division – Region 10, Project Manager
Dawn Ashton, GSA, Design and Construction Division – Region 10, Senior Contracting Officer
Todd Stine, ZGF Architects LLP, Partner
Jack Avery, Sellen Construction, Senior Vice President
Tom Marseille, WSP Flack + Kurtz, Senior Vice President

Literature Review (1 of 4)

Review of Relevant Literature

To better understand the commercial strategies, leadership strategies, and logistical and process tactics of the three projects in this study (Aspinall, Edith Green- Wendell Wyatt, and Federal Center South), it is helpful to understand the theories developed in management and social science on partnering, swift trust, and framing. Research on these three topics addresses the development of culture and the social relationships that occur between project participants from potentially diverse backgrounds and with individual work scopes, who put aside their personal interests for the purpose of collaborating with others to achieve project goals and tasks. Published research informed our insights regarding positive collaboration through use of artifacts (e.g., contracts and other written or visual documentation) and effective communication techniques. This section describes literature on these theories, including how the theories conceptually fit together and how to apply them to the construction industry.

Partnering

The concept of partnering, which was first broadly applied in the design and construction industry in the 1980s by the Army Corps of Engineers (Manley, Shaw, and Manley 2007), focuses on building long-lasting business relationships in which risks and benefits are shared equally between two or more partners. While there are different definitions of partnering found in the literature (Bygballe, Jahre, and Swärd 2010; Manley, Shaw, and Manley 2007), the Construction Industry Institute (CII) maintains partnering as:

"A long-term commitment by two or more organizations for the purpose of achieving specific business objectives by maximizing the effectiveness of each participant's resources. This requires changing traditional relationships to a shared culture without regard to organization boundaries. The relationship is based upon trust, dedication to common goals, and an understanding of each other's individual expectations and values. Expected benefits include improved efficiency and cost-effectiveness, increased opportunity for innovation, and the continuous improvement of quality products and services" (Construction Industry Institute 1991, iv).

This definition lists the qualities and characteristics, such as a shared culture and trust, that make up positive partnering relationships. It also acknowledges the multiple benefits of partnering, including improvements in efficiency, quality of services, and opportunities for innovation.

A part of developing strong partnering relationships is the effective use of formal and informal tools (Bygballe, Jahre, and Swärd 2010). Formal tools include artifacts, which are the physical materials used to engineer social connections between different actors and to cultivate trust (Bygballe, Jahre, and Swärd 2010; Wong and Cheung 2004). Likewise, informal tools, such as the development of an agreed-upon set of cultural values and expectations and a deeper understanding of the psychology of social dynamics as well as effective communication skills, also establish positive social connections, build trust, and provide a sense of a shared culture between diverse actors (Bygballe, Jahre, and Swärd 2010).

For researchers T. Roger Manley, Wade Shaw, and Robert Manley (2007), partnering is in and of itself a culture that is observable and subjective. This culture consists of formal materials (images and texts that represent cultural values and ideas), patterns of behavior (routine activities), norms (acceptable or unacceptable behavior), values and beliefs (concepts of truth and reality), and basic assumptions (internalized values and beliefs). Manley, Shaw, and Manley state that understanding organizational cultures can reveal why partnering works in some situations and not in others. The researchers suggest that partners must develop a "shared," or "boundary" culture, otherwise there will be heightened tension and a lack of trust between partners. The authors offer a series of steps that partners can use to collaboratively produce documents that provide a set of agreed-upon goals,

(continued on next page)

Connections to Case Studies - Partnering

All three projects provided evidence for the use of formal and informal tools. All three teams relied on formal tools, such as the betterments list, formalized meeting structure, BIM-execution plans, and a collaborative schedule system, to establish shared understandings of project priorities. These formal tools also supported key informal factors among team members, such as effective communication. Likewise, in all three projects, a peer-review process was used to influence positive social dynamics and communication, informal tools that support partnering.

Federal Center South used many formal and informal tools, sometimes in combination. Formal tools included effective use of contracts, use of a full-scale mock-up of one bay of the building as the basis for the punch list, team workshops, and a betterments list. In particular, the transparent contingency in Federal Center South's contract was an excellent example of a formal tool used to build trust. The management of the contingency led to the creation of the betterments list, another powerful formal tool for the team. The implementation of the betterments list led to yet another formal tool, the project schedule. Managing the schedule and the betterments list relied on informal tools of communication to establish and relay the importance of each item and the critical time frame for making project decisions.

Literature Review (2 of 4)

communication and behavioral norms, and plans for anticipating risk and risk management between partners. Manley, Shaw, and Manley rely on the collaborative production of formal tools to produce informal tools: an agreed-upon boundary culture that sets up behavioral expectations and norms for partnering organizations.

The CII definition also establishes the importance of trust in partnering relationship development. A lack of trust can have negative consequences. Researchers Kristian Bohnstedt, Kim Haugbølle, and Erik Bejder (2013) suggest that perceptions of low trust between partners is one of the reasons behind the construction industry's high levels of cost and low levels of productivity. In their survey of various participants in the construction industry, the researchers found that trust was developed through experiences of control mechanisms, mutual respect, repeated cooperation, shared understanding, and communication. The survey also revealed that there was, in general, a low perception of trust in the construction industry that did not always correlate with actual experience of trust. This perception of trust varied depending on the type of partner: clients were viewed as the most trustworthy and contractors the least trustworthy. The survey respondents prioritized mutual respect and effective dialogue and also viewed control mechanisms and shared understanding as some of the most important factors in facilitating trust between partners. Respondents viewed breach of contracts, economics, prejudice, lack of communication, and control mechanisms negatively, demonstrating that formal tools and informal tools can impact social relations in terms of trust.

Swift Trust

Swift trust literature provides further evidence and insight into the importance of informal tools in developing positive relationships. Swift trust theory explains how trust occurs in short-term relationships: how to rapidly develop trust among actors with highly differentiated skill sets and personal goals to achieve a single collaborative goal. Like partnering, swift trust theory places trust as a central part of a project's success. Swift trust is generally studied in the context of temporary systems (i.e., teams or groups), such as film crews, construction, and information- and communications-technology networks (Ramo 2007; Meyerson, Weick, and Kramer 1996). This area of theory focuses on the temporary teams, which feature a high level of interdependence between workers, a unique task that brings these workers together, a shared sense of the importance of the task in the success of this specific temporary team, and the use of clear goals to define the task. Each of these features provides certain social constraints and resources that in turn provide a context for trust (Meyerson, Weick, and Kramer 1996).

Whether or not swift trust develops in these teams depends upon a variety of factors (Meyerson, Weick, and Kramer 1996). First, swift trust occurs rapidly when the team draws from a small labor pool—this magnifies the expectations that team members are accountable to one another and will not engage in harmful behavior. Second, trust develops when there are distinct and clearly defined roles in the team—inconsistent role behavior, or a blurring of roles, slows the development of trust. Third, the time pressures of a temporary team emphasize the need for category-driven information processing, which relies more on the quick confirmations of information rather than absolute accuracy. Fourth, category-based information must reflect the organizational culture, standards, and positive work expectations of the team. Fifth, workers seek out the trusting behaviors of others in their team, which can lead to

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Connections to Case Studies - Swift Trust

Swift trust is critical to projects involving people with differentiated skill sets and personal goals. The high-performance goals central to all three projects created a particular type of scenario where swift trust could develop. In these cases, individuals with highly differentiated skill sets worked toward a single collaborative goal. Each of the three projects successfully formed a common set of building-performance goals within its team, established expectations for team performance, and linked incentives to achieving these goals. Incorporating goals into the contract and/or verification processes also created a shared sense of the importance of the collective efforts, allowed for trust to develop, and set the stage for successful team collaboration.

While swift trust was evident in all teams, the Edith Green - Wendell Wyatt Federal Building provided several strong examples of swift trust through their team-selection process and development of team roles. For example, the GSA project manager embodied a key variable to forming swift trust: the project champion. He also created a culture that provided a formal mechanism for removing team members who did not support the collaborative system, which ensured that workers would observe trusting behaviors of others in their group. Typically, research has found "inconsistent role behavior, or a blurring of roles, slows the development of trust" (Meyerson, Weick, and Kramer 1996); however, the Edith Green- Wendell Wyatt team managed to allow team roles to shift and blur in order to optimize team expertise and actually leverage these shifts in building trust. This project's shifts in roles were planned in the Master Schedule, which formally designated flexibility for changing roles through assignments. This allowed for each team member to expect role flexibility and view this flexibility as a defining feature of their role on the team.

Literature Review (3 of 4)

self-fulfilling prophecies: an individual witnessing other team members engaging in trusting behavior will believe trust exists and also engage in similar behavior. This can also inversely create a context with greater risks of distrust if a worker does not perceive trusting behaviors between other workers. Sixth, swift trust is more likely to occur when there is a moderate level of interdependence between members. Finally, the development of swift trust is dependent on the establishment of a lead-contractor role – a leader in the team who creates expectations of goodwill within the group and emphasizes the value of the project. These factors highlight the importance of the relationship between social structures (a working group with diverse skill sets) and social behaviors.

While swift trust has primarily been used to explain the development of trust between contractors on very short-term projects, researchers Gina Neff and Carrie Sturts Dossick have found in their work in the construction industry that the spirit of cooperation and collaboration, combined with clear decision-making authority, generated a high degree of swift trust among actors collaborating on construction projects. They also discovered in their work that role confusion and information delays in these collaborative settings deteriorated trust and led to poor communication and collaboration.

Framing Theory

While swift trust literature reviews the psychological and social role of trust in effective collaboration between members of a group with a diversified skill set, framing theory demonstrates how the effective use of cultural artifacts, narratives, and discourse are used to generate shared stories that persuade organizations and individuals from diverse backgrounds to collaborate and work toward a shared goal. Framing theory has often been applied in social-movement research, the subjects of which are organizations and individuals focused on political goals. Consequently, framing theory highlights the centrality of culture and storytelling in developing collaborative relationships between diverse actors and in motivating them to strive toward goals that may not produce benefits that can be directly experienced in day-to-day life.

Framing, as a concept, is the human practice of cultural meaning-making: how organizations, institutions, and individuals perceive and communicate reality through storytelling, dialogue, and other forms of communication. Framing occurs through specific framing tasks, which produce a specific cultural interpretation of reality. Strategic framing processes target specific individuals, groups, or organizations for collaboration and mobilization in particular types of actions (Benford and Snow 2000). One of the factors determining the success of framing tasks and strategic framing processes is whether it will resonate with the target audience. Resonance depends on two factors: the credibility of the frame (is it empirically verifiable, produced by a reliable source, and does it lack contradictions) and its salience (is it central to the beliefs of the audience members, their personal experiences, and does it align with their cultural narratives and myths) (Benford and Snow 2000). Frames that have a high degree of resonance are most likely to motivate the audience of a diverse set of actors to take action or collaborate, even when the ultimate goal of the action may not affect their own personal lives.

As framing is a process that occurs between actors, it, like swift trust, occurs in a context of social relationships (Passy 2003; Mische 2003). Social-movement scholar Anne Mische (2003) found that framing processes occur during dialogues between social-movement actors who hold divergent sets of political goals. While Mische's work relates specifically to political organizing, framing mechanisms highlight how communicating a shared culture and cultural values and downplaying individual differences may have an impact on successful partnering. By moving these framing processes and tasks out of the realm of social-movement politics, it is possible to see how the formation of shared cultural values can increase trust and partnering in the construction industry. *(continued on next page)*

Connections to Case Studies - Framing Theory

The use of framing was evident in all three projects. All teams noted the high level of interaction that the GSA invited during the RFP process where the GSA placed a high value on the consultants' and contractors' ideas. These interactions are examples of narrative framing, showing that it is possible through framing to form shared cultural values to increase trust and support successful partnering. Procurement documents used in the RFP process included language that called for collaborative teams that would achieve high-performance goals and set the model for twenty-first-century workplaces. These goals established a narrative frame based on values. Framing was especially apparent in the Aspinall project where the team's proposal to achieve net zero was incorporated into the final scope of work. In Edith Green-Wendell Wyatt, the team members' names were inscribed into a wall that is prominently placed near the building entrance. This wall was a physical representation of the collaboration narrative and aspirations outlined in the RFP and contract documents.

Building performance was also a prominent narrative frame for all three projects. Design goals were communicated in ways that resonated with project stakeholders, ranging from the GSA peer reviewers and State Historic Preservation Office regulators to building tenants. The care with which the teams crafted the message to the GSA peer reviewers was evident in the planning of presentations and site visits as well as the time allowed for discussion, which contributed to the resonance of their message. Tenant engagement was another place we observed framing. Aligning tenant goals with project-team goals was critical to achieving their building-performance goals. By making the project goals clear to the tenants, the team framed high-performance-building goals for buy-in by all stakeholders in the project.

Literature Review (4 of 4)

Conclusion

Partnering views relationship development as a process established through formal and informal tools. Formal tools use artifacts to improve relationships between different firms with disparate goals in order to achieve a single goal. Informal tools are concerned with interpersonal-relationship development and the construction of shared cultural values. Partnering also indicates that there is a need for trust in these types of relationships, which, as Manley, Shaw, and Manley (2007) suggest, can be developed through the collaborative production of formal tools that develop a shared boundary culture. Swift trust literature provides a picture of how trust can develop rapidly in scenarios that involve individuals with highly differentiated skill sets working toward a single collaborative goal. This literature also indicates that clearly defined roles for members of the group and a leader who is able to make quick workplace-issue decisions are crucial to developing trust in collaborations. Framing literature highlights the need to create a sense of shared cultural values that resonate with the target audience. When placed into the concept of the collaborative workplace or partnering environment, framing reveals how the effective use of cultural artifacts (such as texts and visual aids) or specific types of conversational mechanisms in interpersonal communication can increase a sense of personal connection and the desire to achieve a larger goal that may not have an immediate impact on an individual's own life. In this way, literature on partnering, swift trust, and framing all point to techniques that can be implemented to establish successful collaborative relationships in which individual workers feel personally and emotionally invested in achieving a common goal.

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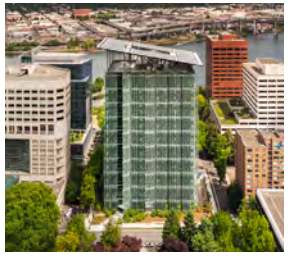
Project Overview - Projects at a Glance

		Overview	High Performance	Commercial Strategies	Leadership Strategies	Logistical & Process Tactics
All Three Projects	Wayne N. Aspinall Federal Building & U.S. Courthouse Edith Green- Wendell Wyatt Federal Building Federal Center South Building 1202	• Projects selected by GSA for this report for exemplary team and building outcomes • Highly complex projects that met or exceeded budget and schedule parameters • ARRA context demanded fixed schedule and high performance	• Far exceeded ARRA high performance goals • Achieved goal to advance building industry as exemplary projects • AIA COTE Top Ten award winners • LEED Platinum certified	• GSA ARRA contracting requirements • Documented performance based goals, post-substantial completion verification • Interactive engaged procurement process	• Aspirational building performance goals unified the team • Strong emphasis on team building with formalized team goals, stable core team with fluid roles, and transparency	• Paired tools with needs • Master schedules created buy-in and shared understanding • BIM and energy modeling • Used GSA Peer Reviewers as a resource
Wayne N. Aspinall Federal Building & U.S. Courthouse		• High performance renovation of historically designated building • Project had multiple tenant groups • Project was occupied during renovation	• First net zero historic preservation project in the United States • 84% energy reduction from national average • 40% potable water reduction from baseline	• Design-build project delivery • Both primary firms were integrated firms • Contract was firm fixed price • Project's high-performance goals incorporated into the scope during procurement	• Integrated firms with aligned cultures • High levels of team member accountablity through colocation • GSA Project Manager inspired collaboration	• Started formal weekly meetings with discussing positive achievements • Internal and informal information channels • Colocation + Webex
Edith Green- Wendell Wyatt Federal Building		• High rise retrofit • Multiple tenant groups (most unknown until late in process) • Extensive renovation of façade and building perimeter	• 29 kbtu/sf/yr net EUI • 71% energy reduction from national average • 61% potable water reduction from baseline	• CMc+6 Custom contract • Guaranteed maximum price contract • Performance goals established by teams but not in contract	• Investment in up-front team building and onboarding • GSA project leadership championed integrated project culture • Subcontractor and manufacturer involvement	• Master and mini-master schedules • Colocation with a shared information room (iRoom) • BIM snapshots aligned with design milestones • Process flowcharts
Federal Center South Building 1202		• New construction on brownfield site • Single tenant group located nearby during construction • Material reuse from original warehouse as a goal	• 26 kbtu/sf/yr net EUI • 71% energy reduction from national average • 79% potable water reduction from baseline	• Design-build project delivery • Performance-based firm fixed price contract that witheld 0.5% of contract until performance goals were met • Transparent contingency	• Used onboarding and leveraged project Interactions to facilitate team building • Team selection based on trust • Alignment throughout	• Betterments list to track potential project improvements against available funds • Design work packages matching construction stages

Project Timeline - The American Recovery and Reinvestment Act (ARRA)

All three projects included in this study were funded by the American Recovery and Reinvestment Act (ARRA) and impacted by its unique goals, requirements, and procedures.

In 2009 the American Recovery and Reinvestment Act (Public Law 111-5) was enacted in response to the severe economic downturn in the United States.

The ARRA established three national goals:

1. Create new jobs and save existing ones
2. Spur economic activity and invest in long-term growth
3. Foster unprecedented levels of accountability and transparency in government spending

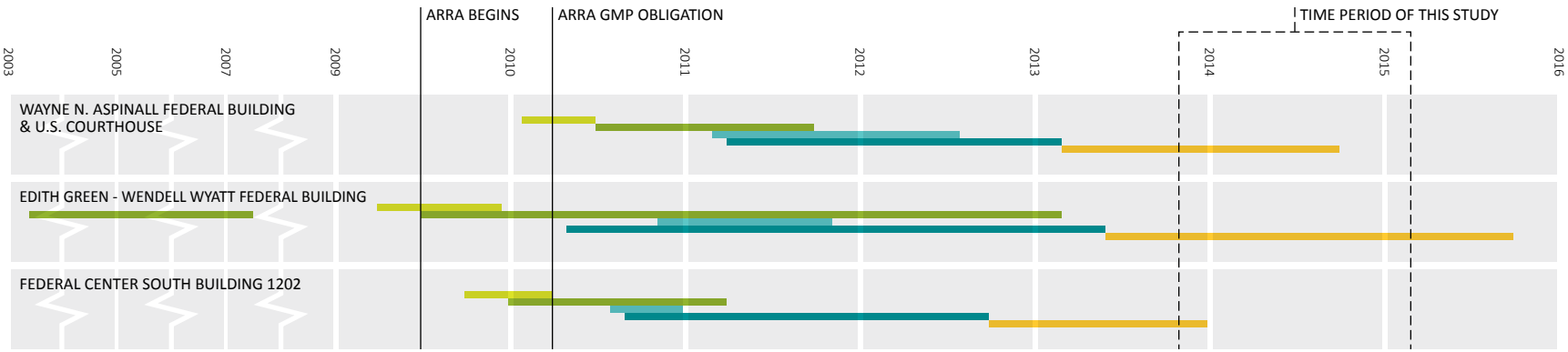
And a fourth goal specific to the GSA:

4. Raise standards of energy efficiency and promote high-performance buildings

The estimated total investment of the recovery act was $840 billion. The GSA received $5.857 billion, of which $4.5 billion was allocated to convert existing GSA buildings into high-performance green buildings, as defined in section 401 of the Energy Independence and Security Act (Public Law 110–140). This conversion would modernize the nation's infrastructure, reduce the federal government's consumption of energy and water, and increase the use of clean and renewable sources of energy.

All ARRA projects had tight schedules and had to meet unusually stringent reporting requirements—and within an agency that faced the challenge of having to greatly increase its number of active projects. To provide a sense of scale, a typical annual GSA project budget is $1 billion—the ARRA offered more than five times that amount. The unique conditions of the ARRA added complexity to all GSA projects from 2009 until about 2013. Another common contributor to complexity in these three projects was that project teams raised the already-high standards of performance on their respective projects. The resulting three projects all won AIA COTE (Committee on the Environment) Top Ten Awards for excellence in sustainable design—only five GSA buildings in total have received this honor. Reaching this high level of achievement was remarkable since the ARRA required projects to meet many criteria—some of which did not directly improve the performance of the building—and within very short time frames. Many strategies, processes, and tactics were implemented to plan and manage complexity created by the high-performance goals.

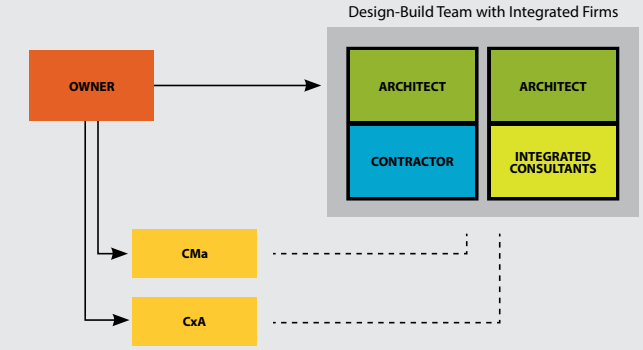
All three projects in this report met the challenging budget and schedule parameters in addition to the aspirational performance and design goals.



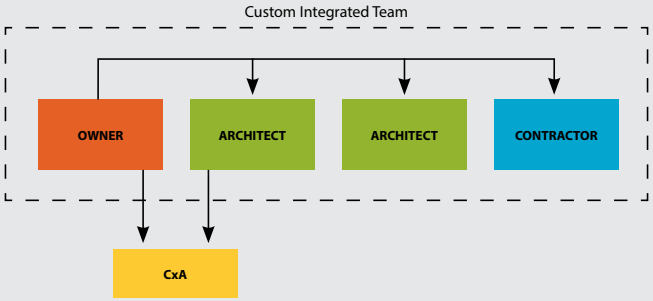
Team Organization

In these sections, the structure of the core project teams are graphically depicted, providing reference for the narrative description of the contracts, team selection, and request for proposals (RFP). In the tabs for each project, the project directory lists the primary team members and several of the subcontractors and consultants who were heavily engaged.

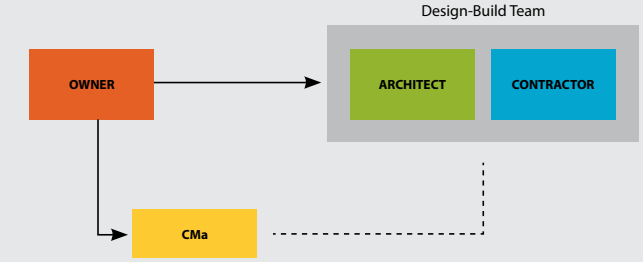
Wayne N. Aspinall Federal Building — Design-Build with Integrated Firms



Edith Green - Wendell Wyatt Federal Building — Custom Integrated Team



Federal Center South Bldg 1202 — Design-Build



Key

- Owner
- Architect
- Contractor
- CMa and/or CxA
- Consultants
- Subcontractors
- a → b Entity b is under contract to entity a
- a ◄- - -► b project interaction between entity a and b

High Performance

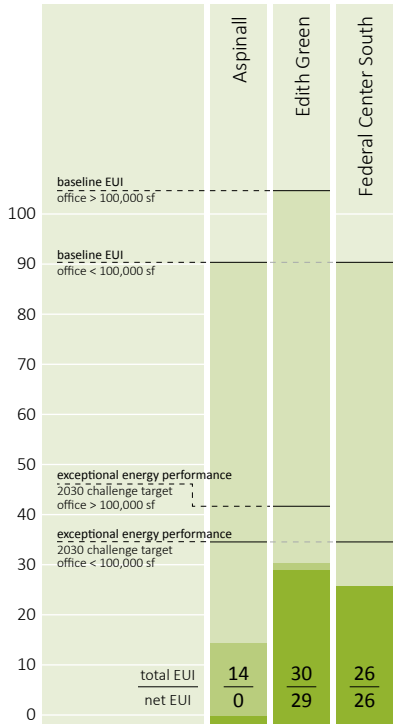
The GSA set general goals for performance, but developing the specific ways that the projects would meet or exceed those goals was the responsibility of the individual teams. Notably, entrusting the teams to set their own goals led to a higher level of specificity and expertise, revealed the potential for even more ambitious goals than originally imagined, and allowed an engagement with the project that yielded innovative ideas and cost savings. In all three projects studied, the aspirational high-performance goals provided clarity for the teams to align their work, advancing new methodologies and outside-of-the box thinking to achieve the challenging goals. Several unusual technological solutions grew out of the team's effort, such as development of radiant ceiling panels *(click for more on radiant ceiling panels)*, extensive material reclamation *(click for more on material reclamation)*, and challenge of resizing the solar array *(click for more on resizing the solar array)*. High-performance goals were incorporated into procurement and continually revisited during critical points in all three projects. The specific policies and incentives around performance became an important framework around which all three projects organized their work.

Metrics from AIA Cote Top Ten Awards 2013-2014

- **EUI before renewables (kbtu/sf/yr)** - annual operating energy on a per unit basis.
- **EUI after renewables (kbtu/sf/yr)**- annual operating energy minus annual energy produced by renewable energy sources and purchased offsets measured on a per unit basis.
- **% energy reduction (%)** - % energy reduction compared to the national average for comparable buildings.
- **Fully daylight (% sDA30fc/50%)**- % of occupied areas with daylighting levels that allow lights to be off.
- **Views to the outdoors (%)** - % of occupied spaces that have views to the outdoors.
- **Operable windows (Y/N)**- does project have operable windows?
- **Potable water reduction (%)** - % reduction of potable water.
- **Potable irrigation (Y/N)** - does project use potable water for irrigation?
- **Stormwater control (%)**- % of rainwater from two-year storm event that can be managed on-site.

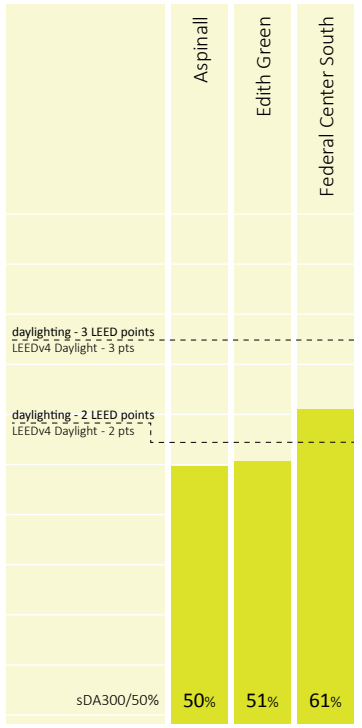
Energy

Lower numbers indicate improved building performance



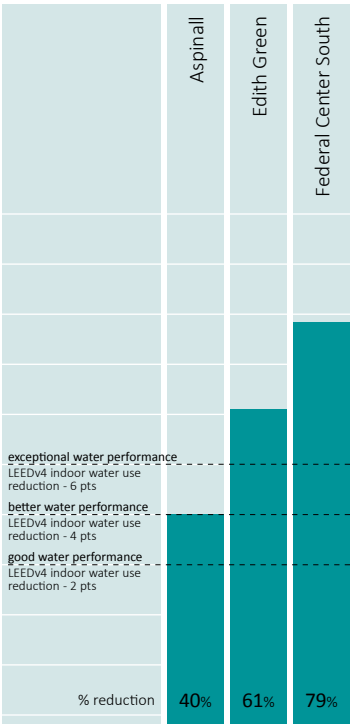
Daylight

Higher numbers indicate improved building performance



Water Cycle

Higher numbers indicate improved building performance



Energy Use Intensity

Energy Use Intensity (EUI) measures a building's annual energy use per unit area (kBtu/sf/yr). Each project's EUI is compared to a national average baseline EUI for office buildings of comparable size. A low EUI is an indicator of good energy performance as it represents an energy savings against the baseline.

EUI before renewables	14	30	26
EUI after renewables	0	29	26
% energy reduction	84%	71%	71%

Spatial Daylight Autonomy

Spatial Daylight Autonomy (sDA) describes how much of a space receives sufficient daylight. The metric describes the percentage of the floor area that recieves a minimum illumination level, 300 lux, for at least 50% of occupied hours (sDA300/50%). Higher percentages indicate good daylighting performance.

Fully daylit	50%	51%	61%
Views to the outdoors	92%	96%	90%
Operable windows	N	N	N

Reduction of Potable Water

Water use reduction is simulated by comparing the amount of water used by a project's interior fixtures to a baseline (percent reduction). The baseline fixtures are determined by the Energy Policy Act of 1992 fixture requirements. Higher percentages indicate good water performance.

Potable water reduction	40%	61%	79%
Potable irrigation	N	Y	Y
Stormwater Control	NA	90%	100%

COMPARATIVE ANALYSIS

Comparisons & Best Practices

WAYNE N. ASPINALL FEDERAL BUILDING & U.S. COURTHOUSE

Historic Renovation
project type

Design-Build
project delivery

Integrated Firms
team culture

EDITH GREEN - WENDELL WYATT FEDERAL BUILDING

Renovation
project type

Custom CMC+6
project delivery

Up-Front Team Building
team culture

FEDERAL CENTER SOUTH BUILDING 1202

New Construction
project type

Design Build
project delivery

Leverage Project Interactions
team culture

RFP Development

The GSA prepared the RFP based on internal discussions about the project-delivery type appropriate for each project. Prior to the ARRA, the GSA had very limited experience with design-build project delivery, but several GSA regions had been studying the potential use of alternative delivery types that were more integrated than the conventional design-bid-build. The context of the ARRA with its short time frames and aspirational goals for economic stimulus and high-performance buildings provided ideal conditions for modeling the use of more collaborative delivery types, such as design-build or integrated project delivery (IPD). The GSA as an institution was unfamiliar with design-build so their process and policies were not well aligned for this type of project delivery. These difficulties were relatively easy to overcome due to the extensive experience with design-build held by some GSA team members, partner architects, and contractors. IPD was a newer delivery type; fewer people had experience with it. The Edith Green- Wendell Wyatt Federal Building (EGWW) team's pursuit of this delivery type ultimately resulted in the development of a customized delivery method that bridged GSA delivery with IPD. For all three projects, the adaptation of standard GSA practices to these delivery types required additional time investment and support.

"During procurement, we were defining what a high-performance building is. We were creating policies. We also looked to the design teams and asked, 'Are there things we can do to improve the project and make it higher performing? Come to us with your ideas. We want you guys to be creative. We want you to come back with a list of options to better the building.' We didn't want them going out…thinking that the information we provided them is the only way to design a building." – Federal Center South team member

Takeaways

- Best practices found in both Aspinall and Federal Center South is an interactive RFP process that began with a flexible approach to the scope of work. The open-ended scope encouraged proposals that expanded ideas on building performance and a variety of approaches for how those goals could be achieved.
- In Federal Center South, the team provided a list of options during the RFP process that eventually became a highly effective tool referenced as the betterments list.
- Several teams noted that the GSA should consider compensating short-listed teams to develop comprehensive proposals.

Project Services Procurement at a glance (development and award of RFP, team selection processes)

Wayne N. Aspinall Federal Building and U.S. Courthouse
- Early decision to use design-build project-delivery and best-value selection process
- CMa hired to advise on procurement, integrating high-performance goals
- Two-step process of RFQ then RFP
- Two rounds of interviews were done with short-listed teams
- Minimal need for consultants since awarded team was composed of integrated companies

Edith Green - Wendell Wyatt Federal Building
- Initial project approved as design-bid-build delivery, architects hired for design services but project was not funded
- During the ARRA, project approved to proceed but revised to meet high-performance goals
- Market research and decision to pursue CMc delivery
- SERA retained as architect, selection process for contractor included early exchange workshops
- Commissioning agent selected to manage risk of technical issues of innovative high-performance systems
- Top tier subcontractors named in contractor-selection process, finalized contracts after input from architect and the GSA

Federal Center South Building 1202
- Early decision to use design-build project-delivery and best-value selection process
- Site feasibility concerns prioritized awarding of geotechnical team before primary team
- CMa hired to advise on procurement, integrating high-performance goals
- Two-step process, RFP then short-listed firms invited to submit comprehensive design proposals
- Top tier subcontractors named in selection process, finalized contracts done collaboratively with emphasis on added value

Team Selections

The procurement process was intentionally created to elicit interactive approaches from the teams that would help shape the goals and the specifics of the project delivery. The teams were asked if the high-performance goals were appropriate or if they could be raised, as well as how they would work with the GSA to achieve the goals. For the two design-build projects (Federal Center South and Aspinall), the teams' responses to the original RFPs introduced new or more-lofty goals, which were eventually incorporated into the final building scope. For the EGWW, the RFP process was extended due to the revision of the project scope.

All three teams had some degree of integration. At Aspinall, the Beck Group, an established design-build company, joined Westlake Reed Leskosky (WRL), an architectural and specialist-engineering firm. The Federal Center South team had relatively few instances of key-personnel turnover and relied on a consistent, integrated core team, which included many individuals who had previously worked with each other. The EGWW team used a contractor-selection process that tapped established industry expertise. Subcontractor selection was more collaborative than in conventional delivery types, with a great deal of input offered by all members of the primary team.

In addition to the increased team involvement, there were several factors of note that affected the selection process: the high-performance goals generated specialized technical needs; economic-stimulus goals led to careful tracking of involvement by minority-owned businesses and other equity concerns; and the economic climate and the RFP process created an entrepreneurial culture in which subcontractors actively engaged in offering alternatives that would either save money or create new opportunity to achieve the building-performance goals.

Takeaways

- Best practice found in EGWW and Federal Center South placed emphasis on identifying team members who would share core values and commit to the high-performance goals. Interviews of consultants by core team members was one method for identification; EGWW held a workshop before selecting the contractor.
- At EGWW, all contractors intending to submit proposals were required to attend a multiple-day workshop that was structured to create interaction and develop shared values.
- The "Best Value" process uses a combination of factors to select team members, including past performance, technical capacity, and key personnel, and seemed to work well for these teams. Federal Center South team had the same contracting officer throughout the project. Witnessing the full duration of the project, she understood her time to implement best value procurement was an important contribution to successful project outcome.

"All of the general contractors who were going to compete for the job were invited to participate. The first day they pretty much sat in the back of the room, but by the second day we'd gotten them all to the table. It really shows that we had a [construction] community that could meet any challenge if they were given the opportunity. There wasn't one person at that workshop that didn't want to produce a different type of building."
– EGWW team member

"One of the real values of integrated delivery is the ability to get each team member oriented and saturated before we start building. The more we can front load the schedule and the more we can allow team members to influence the project when still on paper, the greater impact we get as owners in terms of change control—cost, budget, etc."
– EGWW team member

"The goals and objectives were expressed early on in the solicitation documents, including having a collaborative team, achieving high-performing green building initiatives, and creating a twenty-first-century workplace. All of these were expressed in the statement of work and in the solicitation and were used to guide the acquisition-and-selection process."
– Federal Center South team member

Contract

Incorporating performance-based goals into the contract or other agreements represents a cultural shift in an industry traditionally made up of a contained team of owner, architect, and contractor that has set goals and controlled the schedule and costs. To achieve very high-performing buildings, teams must broaden their definitions of project stakeholders to include subcontractors, manufacturers, facilities managers, and tenants. By increasing the number of points of engagement, more aspects of building production and building use can be leveraged to influence the overall performance. To this end, building-product innovation, installation, facilities maintenance, and building-user behavior can all be harnessed to develop and implement shared performance goals.

For the two design-build contracts (Aspinall and Federal Center South) a firm fixed price was established; the EGWW project used guaranteed maximum price (GMP). The contract for the EGWW was the most unusual of the three projects, and the team invested a significant amount of time adapting standard GSA contracts to a form that closely resembled an IPD agreement. The design-build contracts followed a more conventional design-build format.

While the GSA considers all three to have some form of performance-based contracting, Federal Center South has the only formal performance clause in the base contract. Other projects used additional contracts to cover the period of time after substantial completion to more closely study performance.

Takeaways

- Best practices of how to formally document performance goals varied: incorporation into the contract language tied to fee (Federal Center South), use of specific goals in the description of the scope of work (Aspinall), and numerous instances of quantitative goals in energy models and building information modeling (BIM) (all three projects).
- Aspinall team members spent time tracking information fragmented across several documents and drawings. It was noted that a comprehensive document defining scope would have benefited the team. Such a document would have been time consuming to create, but in hindsight, that investment would have been worthwhile.

"This contract was a statement of work, and it was also based on the proposal the design team gave back to us. Achieving high-performance goals and sustainable design was an incredible driver on this project." – Aspinall team member

"Transparency is one of the precepts in an IPD. I have to hand it to the GSA project managers—the first day on the job, we learned that we had a transparent contingency. It made us want to be a team and want to spend the money in the best way we could." – Federal Center South team member

Verification

Common to all team processes was the inclusion of a time period after the typical substantial-completion milestone during which the energy model could be verified, often through testing and revising assumptions made earlier, during the programming phase. This important phase of the process is not an industry norm, but it is likely to become standard practice for higher-performing buildings, in which a sophisticated integration of factors contributes to meeting performance targets. Additionally, performance-based contracting makes metric verification as the basis for the contract a necessity.

The EGWW and Federal Center South projects used incentive pools linked to the meeting or exceeding of building-performance goals. Aspinall built the performance goals into the base contract, with a supplemental agreement for the design/engineering firm specifically focused on performance measures.

The Aspinall, EGWW, and Federal Center South teams used the terms *verification phase*, *aftercare*, and *tuning*, respectively.

Takeaways

- Teams uniformly believe that the inclusion of a verification process should be a best practice.
- Lessons can be learned from Aspinall and EGWW, which did not plan or budget for a verification period. EGWW was able to use funds captured from unspent contingency for several core team members to continue work; Aspinall funded WRL to make an in-depth study of energy loads.

"We are still navigating through how to do a net-zero building. How do we use monitoring, measurement, verification, and team collaboration to get the building to perform the way we want to? I don't think any of us anticipated early on—or even after substantial completion—the level of commitment that was going to be required of the team. Other projects looking to achieve the same goals or the same high level of performing outcomes, in terms of sustainability, should be aware of this." – Aspinall project manager

"It's inconceivable to me that somebody could get to substantial completion and expect the building to work the way it's supposed to work—or, more importantly, perform at its optimum." – EGWW team member

"I think [a verification phase] is really critical and something we would absolutely recommend for all future projects. The ability to react and understand how all the different components fit together and work together just can't be underestimated." – Federal Center South team member

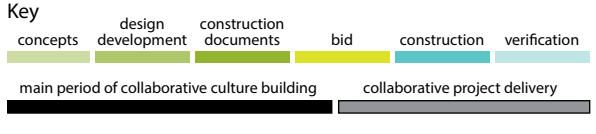
Team Building & Collaborative Culture

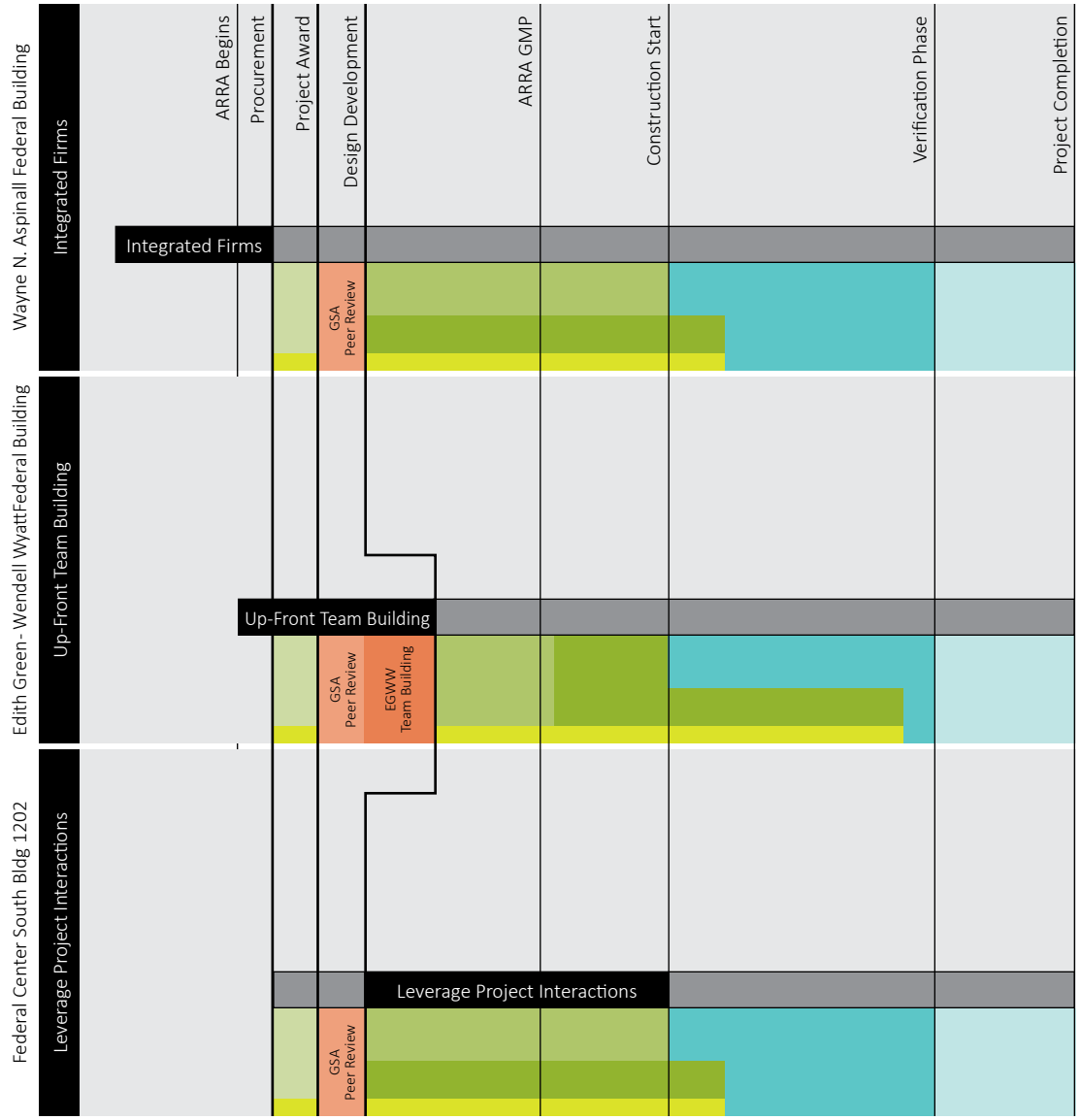
Each of the three projects developed a strong collaborative culture. However, those cultures were established and developed in ways that were notably distinct. Using a series of diagrams, this study describes the timing of the development process for each project.

All three teams invested time and energy into establishing their team cultures and their internal working relationships. The selected team members were incorporated into the team culture through various means, both formal and informal. Additions and changes to the team were handled with a similar level of care, with opportunities for team feedback on the state of the team culture. Formal mechanisms for removing team members who did not support the culture supported this system. At the EGWW a large investment in the team was made before the start of the project, and periodic team-building work followed throughout the project. The Federal Center South project had a strong core team, the members of which were comfortable shifting roles while maintaining clarity around responsibilities and deliverables; Aspinall greatly strengthened its team culture through co-location at a remote site. Though the process and sequence of time investment varied between the teams, the payoff of this intensive team building was evident in very high levels of alignment, mutual trust, and respect in all three teams.

Takeaways

The EGWW team recommended developing a tool that could be used to assess the fit of each team participant in the organizational culture as a way to improve future integrated teams. In addition to helping identify team members that would fit well in a collaborative environment, the tool could also help identify areas in the organizational culture where additional support is required for collaboration to be fully adopted by the entire team.





Goals & Alignment

The challenging building-performance goals and aspirational national goals embedded in the ARRA combined to inspire and unify these teams around clear global objectives. These particular teams were able to handle the GSA's tight time frames and complex decision-making structures, which became atypically dynamic because performance standards and economic metrics evolved during the course of the project. The teams met these challenges with relative ease, which allowed them to focus on their demanding and self-imposed energy and team-performance goals.

Building-performance goals are quantifiable: even if the means to achieve them are highly sophisticated, exceptionally technical, and involve multiple factors, they can be measured. Metrics evaluating team outcomes are far less straightforward. All three projects managed to set clear objectives on how to define their team culture and found ways to develop working processes that consistently supported those goals. The EGWW team used formal and informal means for team members to provide feedback regarding their perception about their roles in the team and if these roles were clear. Aspinall and Federal Center South implemented regular meetings to create consistency and maintain clarity around goals.

Tenant Engagement

The three projects in this study had distinctly different tenant situations. Federal Center South had the most straightforward tenant relationship: it was a new construction project near the existing facility, which meant that the tenants did not have to move far and could be easily consulted. There was a single tenant, and though there were multiple subgroups, the chain of command and decision-making processes were centralized and easy to understand. Aspinall had a more complicated but more common tenant situation: there were multiple agencies with different needs, and the building needed to be fully occupied and functional during construction. While phased construction created many logistical challenges, the close coordination with the tenants provided positive buy-in of the new design. The EGWW was also a renovation, but work was too extensive to allow tenants to remain during construction and not all the new tenants were identified until late in the construction process.

Takeaways

- A best practice seen in Aspinall was the investment of time with each tenant group and in partnering sessions to align their policies and to create detailed programs that met the high-performance goals of the overall project: "When you're looking at some of the goals that we had set up for the project, for the tenants, and for how the building is to be maintained, it was important to share that information and make sure that the tenants understood what the goals were and what their role in trying to achieve some of these goals would be."
- Both EGWW and Federal Center South benefited from situations that created the time for a deliberate pace in the early planning phase. This allowed the teams to develop a strong set of core values and identify problems to anticipate complexities in the project. While not always possible in every project, if time can be budgeted early on and used to build the team, the payoff provides a high return on investment.
- Federal Center South's performance clause had a positive effect: "There's a lot of buzz in the industry about proving that buildings perform as per the design model," said the project architect for ZGF Architects. "From that vantage point, I think [the GSA's approach] is a step in the right direction for the industry, and I think it will become more commonplace."
- Aspinall recommends increased use of mock-ups. "Being able to engage with tenants was critical," said one team member. "We will look into doing a better job of mocking up interior aspects of the project relating to finishes. The idea behind the mock-ups is for everybody to review and understand the idea, as opposed to taking it directly out of the specs and installing it."
- A lesson learned at Federal Center South was that the lack of a designated person from the team to interface with the tenant's departments created unnecessarily complicated situations, such as schedule challenges created by late identification of specialized needs.

"I've never been on a job that was this driven by the project goals. From the first day, the question was, how do we meet these goals?" – Aspinall team member

"We started to instill the goals into the team and instill the idea that this project is going to demonstrate to the entire marketplace how we can build buildings differently." – EGWW team member

COMPARATIVE ANALYSIS

Comparisons & Best Practices

WAYNE N. ASPINALL FEDERAL BUILDING & U.S. COURTHOUSE

Historic Renovation
project type

Design-Build
project delivery

Integrated Firms
team culture

EDITH GREEN - WENDELL WYATT FEDERAL BUILDING

Renovation
project type

Custom CMC+6
project delivery

Up-Front Team Building
team culture

FEDERAL CENTER SOUTH BUILDING 1202

New Construction
project type

Design Build
project delivery

Leverage Project Interactions
team culture

Role Definition & Accountability

Notable in all three projects was the balance achieved between the fluidity of roles and the maintenance of clear responsibilities. All teams shared the philosophy that decisions should be made based on the input of the subject-matter expert, regardless of the person's title or role in the formal team hierarchy. The teams used various means to achieve this balance; variation in the means can be studied to illustrate the contrasting cultures *(click to see diagram showing contrasting cultures)*.

The teams attributed the success of the fluid roles to the time and energy invested in creating a strong team culture, built with the means discussed in the culture section. The teams were also able to maintain a consistent core team, which preserved continuity throughout the project. The stability of the team created a tolerance for shifting roles that allowed optimization of expertise. For example, several teams used a non-linear approach to packaging their deliverables. It required the teams to go through repeated cycles of collaboration in various ways since roles shifted depending on the specific expertise needed to lead the development of each package. The fragmented nature of this strategy was surprisingly advantageous: through repetition the team refined their process and became more confident in their work as a group. Fluid roles require clear communication, mutual trust and respect, accountability, and other positive team behaviors and allow for the following potential values: streamlining, elimination of layers of approval, and decision making informed by expertise.

The high level of technical challenge in all three projects required specialized expertise to be identified and engaged at particular times. Subject-matter experts were sometimes identified outside of the core team; other times, a member of the core team would take responsibility for a particular subject. Assignment of responsibilities was important and needed to be tracked.

Takeaways

- A best practice used by the Aspinall team at the beginning of their work was the creation of a matrix of project responsibilities that would traditionally be assigned to the design architect and architect of record. The team altered the default matrix to assign each responsibility to the firm best equipped to meet it. These kinds of "cross-walk" documents were also used effectively at EGWW to show how tasks or milestones compared between conventional organizations and integrated teams.
- Specific tracking tools supported accountability and help create continuity.
- Federal Center South learned that not all team members understand the value of flexible roles; individuals who fall back into rigidly defined roles can disrupt a team that prioritizes accountable actions over roles.

"We didn't really get hung up on [job] titles. We got hung up on who could do the work the best, and we moved responsibilities around accordingly. The roles changed a lot." – EGWW team member

"At the end of the day, you need the right people at the table to interpret what the tools and processes are giving back to you. That is true about BIM, about betterments, and about bringing optimized value. You have to have the right people to understand how to evaluate it, how to implement it, and how to achieve it." – Federal Center South team member

"In my mind, yes, we need roles; but on the other hand, we also need people to wear multiple hats. You need to be able to participate and talk about other people's scopes of work because that's the only way to get a totally integrated solution." – Federal Center South team member

"I think everybody knew what they needed to do. I don't think there was a whole lot of need to hold people accountable. I think most people took on the responsibility of their role immediately." – Aspinall team member

Managing Schedule & Budget

Managing project schedules is always challenging, but the task was particularly complex for these teams due to the compressed time frame and the technical requirements of the high-performance goals. As with many of the factors studied, these teams used the challenge to strengthen team culture and to create collaborative consensus around shared goals. At Federal Center South, the contractor led the scheduling and was particularly effective in tying decision deadlines to the collaboratively developed priorities for the project using a mechanism they called betterments lists *(click for more on the betterments list)*. At Aspinall the schedule was managed at formal weekly meetings, which were supplemented by informal interactions facilitated by co-location. The EGWW team had the most formalized and developed scheduling system, which became a very powerful collaboration tool. The Master Schedule and mini–Master Schedules they created were extremely effective for this team *(click for more on the Master Schedule and Mini-Master Schedule)*.

All teams met demanding budget goals and also used their budget management processes to motivate and build team alignment, trust and respect. At EGWW and Federal Center South, value engineering (VE) exercises were tied to the creation of a prioritized wish-lists which served to motivate the teams to use project contingency funds effectively. Team members mentioned these mechanisms served to make what could otherwise be a negative process of budget reduction into a positive experience. For example, team members were more willing to disinvest in an item if it could be moved to the wish list instead of simply removed. The team continued to work to find ways to accomplish those wish list items in the project scope.

Takeaways

- Early in the Aspinall project, the project team used BIM to help plan phasing. Later they attached the 3-D phasing model to the schedule, scope of work, and tenant-move plan. The resulting model illustrated each phase's schedule, scope of work, tenant-move plans, and construction documentation.
- Also at Aspinall, the team worked directly with the State Historic Preservation Office to collaboratively develop a phased review process and schedule.
- EGWW developed an effective scheduling tool that drove accountability and generated a structure for other tools to develop.
- During VE, EGWW used a "buy back" process that created a prioritized list of items to add back into the scope, as budget and schedule allowed. This was similar to the Federal Center South betterments list.
- EGWW learned that tracking value creation by tying value engineering (VE) decisions to the financial outcomes is a powerful incentive but is time consuming to maintain.
- EGWW learned shared decision-making to manage project contingency would be easier if a team-wide standard process for cost projection and tracking was negotiated early in the process.
- Federal Center South found that while the betterments list was very effective in some ways, it also had a negative impact. "We were trying to take care of the betterments, we maybe didn't watch after our base job, design efforts, and progress [as much as we could have]. It really put a stress on the team to try to implement [betterments]. We were very motivated by them, but they took our attention away from getting drawings done and out the door."

"One of the best practices on the schedule was Sellen Construction saying, 'If we're going to incorporate this change, we need a decision by this date because it's going to impact our schedule.' They were really good about giving us a deadline, and we would do what we could to meet it." – Federal Center South architect

"We only had eight months to get started with construction [after being awarded the project]. We knew that design was going to continue much longer than that for a building like this. It put a lot of stress on the team, knowing that we would still be designing the project for another year after driving the piles." – Federal Center South contractor

COMPARATIVE ANALYSIS

Comparisons & Best Practices

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project type

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team culture

BIM & Design Documentation

The teams used various logistical tactics to manage BIM and design documentation. The Aspinall team leveraged the strong internal communication of the integrated design-build entity to take some of the pressure off of the documents. The Federal Center South team focused work on deliverable packages that matched construction stages rather than the traditional phased-based-documentation milestones. The EGWW team used highly tuned information-management protocols to ensure the use of BIM and that all project team members communicated consistently. Unfortunately, the teams discovered that reorganizing documentation to optimally support the teams was often incompatible with established milestone-review processes or quality-control conventions.

While the actual software used varied, all three teams employed some type of BIM and energy modeling to coordinate between a wide range of trades and expertise areas—sometimes also across geographic barriers. Interestingly, the BIM models were often limited by incomplete information from manufacturers, since the predicted energy metrics for the use of products in very low demand situations was often unknown. In other cases, the manufacturer did not fully model very detailed subcomponents of performance since most high-performing buildings do not attempt to leverage components at the granular level of specificity required in these three projects.

Takeaways

- The EGWW team estimated a $940,000 savings in project costs because of the reduction in the hours spent on design documentation made possible by integration—from a typical schedule of 53,000 hours over twenty-four months to 44,000 hours over fifteen months.
- All teams noted that their goals of streamlined and integrated documentation were compromised by the need for conventional milestones by GSA, QAQC protocols or regulatory review. Discomfort with non-traditional documentation strategies on the part of the CMas and some subcontractors created resistance to innovation.
- The Aspinall project team identified an area of BIM management that needs further study: attaining accurate data from product manufacturers. Predicted efficiency does not always match real-world performance.
- The EGWW team recommends further refinement of the BIM Snapshots document-delivery structure by requiring a formalized time-out review after a BIM Snapshot is taken. This would require teams to freeze the BIM model after taking a BIM Snapshot for a formal review period.

"One thing that is working against us as an industry is that there still are gaps in the different types of software that are talking to each other. The best tools for a particular trade aren't necessarily the best tools in terms of integrating with the other trades."
– Federal Center South architect

Meetings & Workplace Environment

The teams recognized that time invested in face-to-face meetings could minimize the need for extensive electronic communication. All teams found ways to manage their information to minimize wasted time or poor decisions. Common to all projects was the general appreciation of the effectiveness of meetings in time management, getting the right people to the table, achieving accountability, and producing high-quality decisions. Whether from strength of culture or leadership, the teams uniformly achieved excellent information management. Most teams used industry-standard tools but clearly and productively paired tools with needs.

Some aspects of the culture were based on simple human interactions. At Aspinall, for example, the weekly project meetings always began with a brief recounting of a project win, or positive outcome *(click for more on this meeting strategy)*.

Co-location at Aspinall facilitated formal and informal team interaction. The EGWW created a shared information room dubbed the iRoom, where the core team members who were co-located on site shared BIM information via a shared BIM server *(click for more on the iRoom).* The Federal Center South team was not co-located, but all core team members were in close proximity to the site and issues were frequently coordinated in the field.

Takeaways

- Aspinall used a powerful best practice: the project leaders started every meeting with positive news. The GSA project manager noted, “You always want to identify success and thank people for their work. I tried to do that as much as possible.”
- EGWW established an iRoom for centralized BIM server and co-location. The team estimates an $82,000 savings in travel costs as a result of the co-location of consultants.
- Federal Center South team member noted that with an integrated team “there’s even more of an incentive to [have regular meetings]—it is an even more important best-practice approach to resolving issues quickly.”
- EGWW learned that hand-off points between engineers and contractors needs to be well planned and managed. In this project, the mechanical and plumbing designers needed to be more fully engaged with the contracting design teams well into the detailing process to allow greater understanding between engineering and the routing of the systems.

“[Co-location] fostered the opportunity to communicate a lot more than you would if you were trying to coordinate and schedule calls. I think it drove accountability: you couldn’t dodge each other. You would go knock on somebody’s door—in most cases we just kept our doors open—and you kind of floated among the offices if you needed to talk to somebody. It broke down formal barriers and made it easy to communicate, collaborate, and work through project issues. Stuff comes up every single day on a fully occupied building renovation.”
– Aspinall team member

GSA Peer Reviews & Expertise

Peer Reviews
Several teams noted the value of early GSA peer reviews, because the process collected at a critical moment all the necessary information to make decisions that would govern the rest of the project. At Aspinall, the peer reviews focused on the tension between the historic-preservation needs and the required size of a solar array that would achieve a specific energy output *(click for more on resizing the solar array)*. The expert peer reviewers offered an unexpected resource for the project teams that extended beyond the scope of formal peer reviews themselves. At Federal Center South, the early peer review identified places where clarification of responsibilities was needed—this was especially important for this team since roles were more fluid than in traditional teams. Additionally, the streamlining of the peer reviews was an effective tactic for all the teams.

Expertise
All of the teams saw the benefit of conceiving of the project team as extending beyond the conventional core of owner, architect, and contractor. Notable in the stories included in this study is that all three projects benefited from a high degree of engagement from manufacturers, suppliers, facilities managers, tenants, subcontractors, and installers. At Aspinall, for example, the lack of buy-in from the variable-refrigerant-flow manufacturer was a critical obstacle that had to be overcome to achieving net-energy goals. In contrast, the EGWW and Federal Center South fully engaged several of the manufacturers to the great benefit of the project.

Generally, the teams placed a great deal of emphasis on getting the right people and the right expertise involved at the appropriate time. The complement to this approach is the inclusion of a mechanism that identifies and withdraws the personnel or firms that do not match the needs of the project.

Takeaways

- Aspinall and Federal Center South noted the timing of the first peer review as critical in the design-build delivery. By the time the contract is awarded, the team has already invested more in design development than in a traditional design-bid-build project. The shift in time investment means the first GSA peer review is ideally held shortly after the team is selected, before too many decisions have been finalized. A Federal Center South team member noted, "We held back a lot of our team until we could get passage of the design review. It's good that we did, because the decision was made to move the mechanical penthouse up onto the roof and the stair towers inward. If we had set the design team off fully, we would have had to peel back and recycle and redo things."
- The Aspinall team structured the sequence and timing of presentation, walk through, meetings, reflection, and response time in the peer-review process. Careful choreography was critical to using the review productively.
- The Aspinall project team continued to engage peer reviewers outside of the required process: "The GSA [as a client] has an army of expertise from roofing and water proofing to elevators and fire and life safety and on down the line, and that's pretty rare."
- The EGWW consultants were engaged with the planning of the co-location space and the development of the schedule; in many cases changes were made to accommodate their part-time involvement with the project to ensure they were present for key decisions in a rapidly paced construction process.
- Early in the design process for Federal Center South, team leaders set up a series of meetings that allowed the GSA's technical reviewers and the design team to convene over several days: "Rather than sending the documents to the technical reviewers, we just brought everybody together."

"The GSA peer reviewers were looked at as resources and extended parts of the team rather than somebody just checking up on what the team is doing. That opened up a level of collaboration and understanding that I found to be different than in other GSA jobs that I've worked on." – Aspinall team member

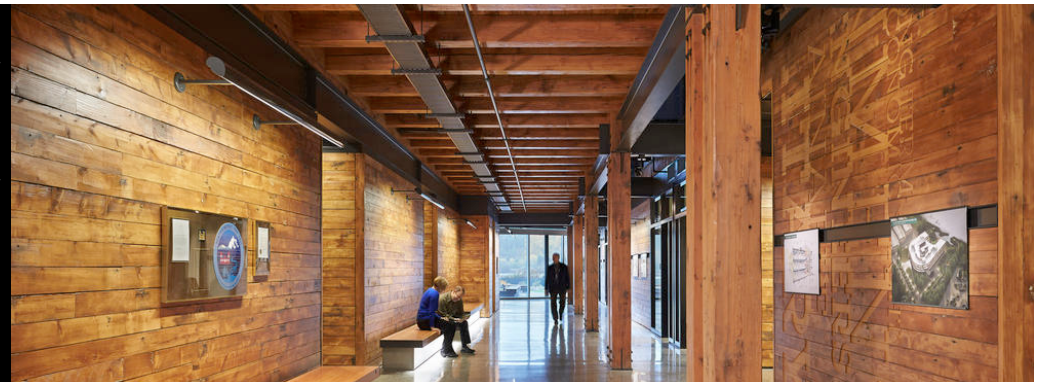
Building Innovations

For each of the three case studies, we focused on one story that illustrates a range of successful leadership strategies, logistical tactics, and process tools. The strength of the teams is evident in how they handled the situations described in their stories, which are full of evidence revealing their alignment around clear goals, effective use of the right expertise, mutual trust, and respect.

Wayne N. Aspinall Federal Building
Resizing the Solar Array

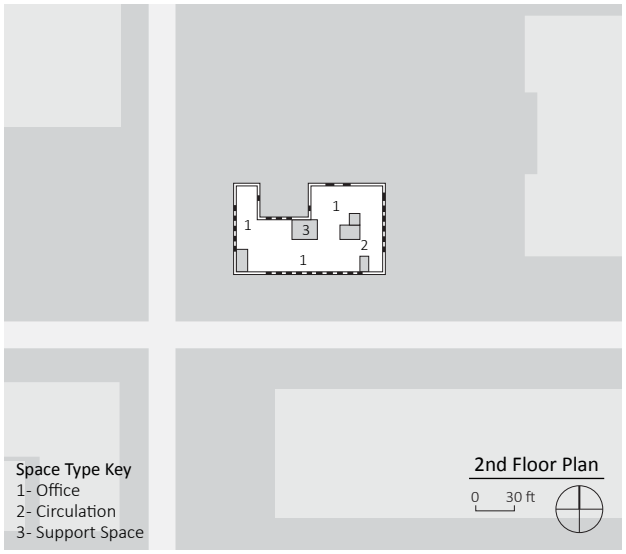
Edith Green- Wendell Wyatt Federal Building
Radiant Ceiling Panels

Federal Center South Bldg 1202
Reclaimed Wood Composite Floor System



Project Overview

Project	Wayne N. Aspinall Federal Building and U.S. Courthouse
Location	Grand Junction, Colorado
Project Type	Historic Renovation
Contract	Design-Build
Owner	U.S. General Services Administration – Rocky Mountain Region, Region 8
Design Architect	Westlake Reed Leskosky
Arch. of Record	The Beck Group
Contractor	The Beck Group
Project Start	June 2010
Project Completion	February 2013 (met schedule)
Project Size	41,562 GSF
Project Height	3 Stories
Project Budget	$15 M (met budget)

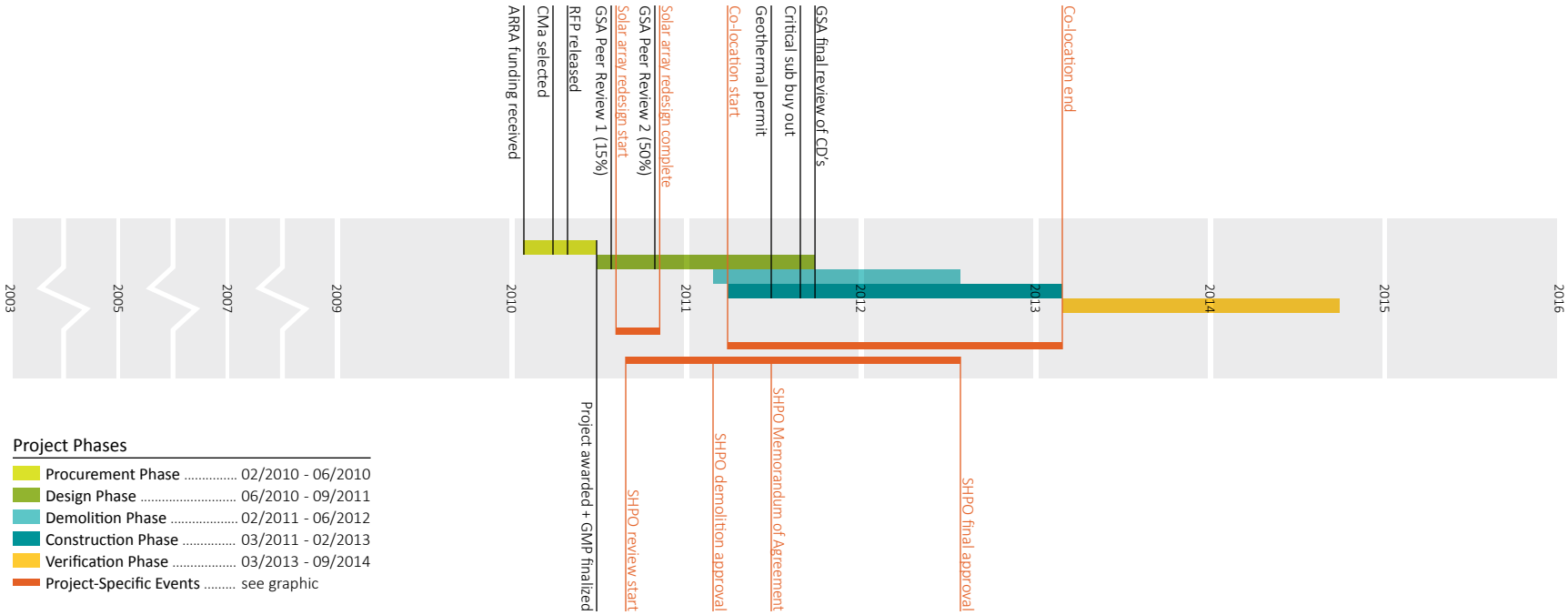


Project Timeline

The modernization of the Wayne N. Aspinall Federal Building and U.S. Courthouse is a response to the federal government's goal of achieving carbon-neutral buildings by 2030, creating a "green proving ground" that demonstrates how to make an existing historic building perform at net-zero energy—fifteen years ahead of schedule. The project involves the transformation of the original 1918 structure into an innovative, sustainable model and is the GSA's first net-zero-energy building listed on the National Register of Historic Places. The building achieved LEED Platinum, the highest level of certification from the U.S. Green Building Council. Project-specific drivers of complexity included historic preservation entities that had regulatory power over the design. Tenant logistics for the occupied building also complicated the project with phasing and swing-space planning. The project started in June 2010; construction began in March 2011 and ended in February 2013, completing on time and on schedule. The project-schedule complexity was dictated by two factors: the building remained occupied during construction, and the design required a large number of reviews because of the building's listing on the National Register of Historic Places.

The project team encountered a major challenge early in the process. Because the project involved renovating a historic structure, the design had to be approved by the State Historic Preservation Office (SHPO) before construction could begin. The design could not be submitted to the SHPO until after the GSA selected a winning proposal and awarded the contract to the design-build team. Thus, the project began with the design, schedule, and budget contingent on the SHPO's approval.

The project site, in the relatively small community of Grand Junction, Colorado, was distant for the team members, who were also far removed from each other. Communication was sufficient, but team members noted a marked change in their ability to work effectively together when they relocated on-site. When work on the site began, team members spent many hours together in the building and in social settings. The strong site presence of most of the core team greatly facilitated communication and increased opportunities to build trust and culture. Although the design-build contract was relatively new to the GSA, team members had previous experience with this delivery type, which minimized the increased risk to the GSA for use of this delivery type.



Team Organization

Design-Build Team with Integrated Firms
Westlake Reed Leskosky (WRL) is an integrated firm of architects and engineers; the Beck Group is an integrated firm of architects and contractors. They had not previously worked together but quickly developed a strong working relationship. Most roles were handled within the primary team, with a limited number of specialized consultants.

Owner

U.S. General Services Administration -
Rocky Mountain Region, Region 8

Design-Build Team

The Beck Group
Design-Build Contractor
Architect of Record

Westlake Reed Leskosky
Lead Design Architect
Engineering
Sustainable Design
Historic Preservation
Interior Design
Information Technology

Construction Management Assist

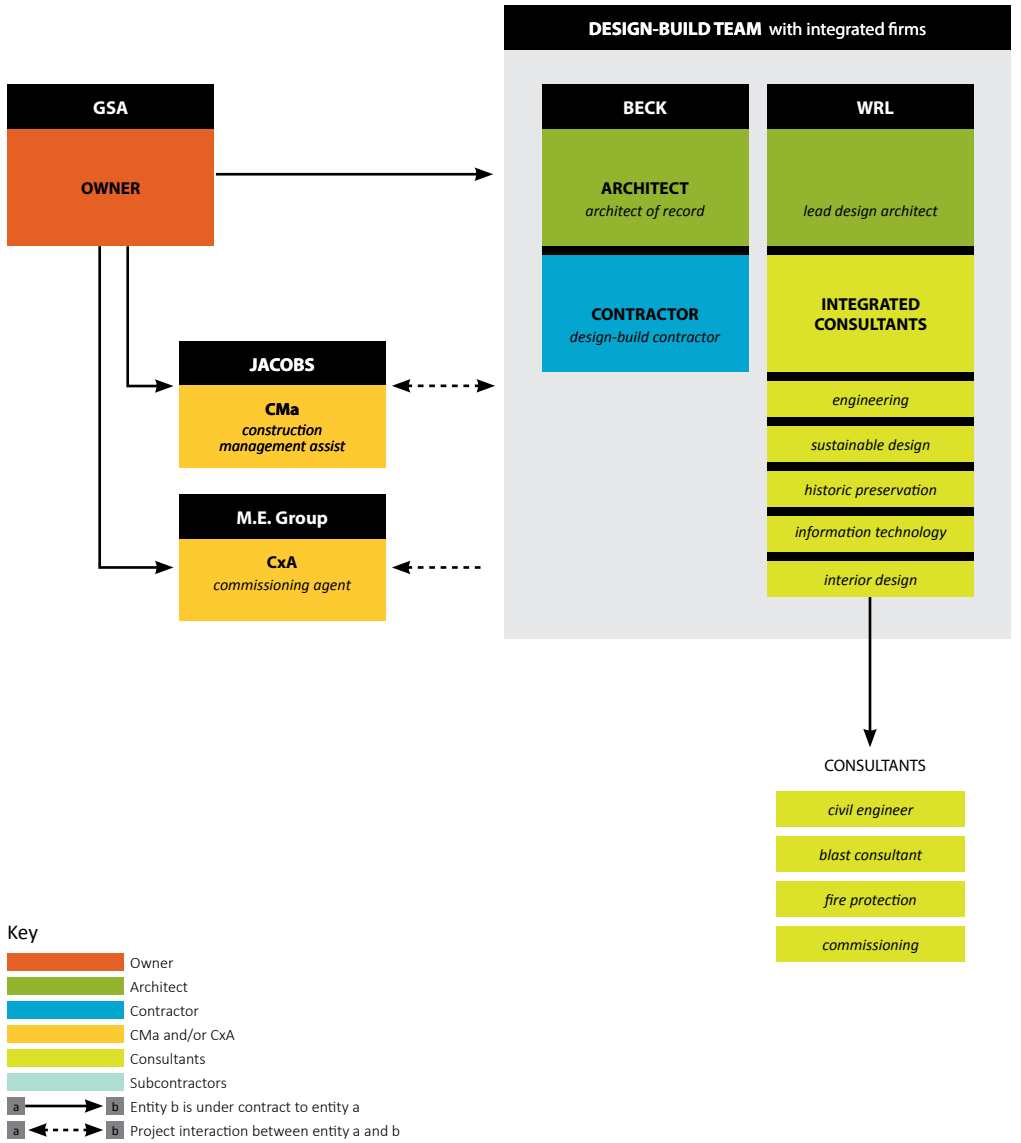
Jacobs Technology, Inc.

Commissioning Agent

M.E. Group

Consultants

Civil Engineer - Del-Mont Consultants
Blast Consultant - Weidlinger Associates
Fire Protection - Protection Engineering Group

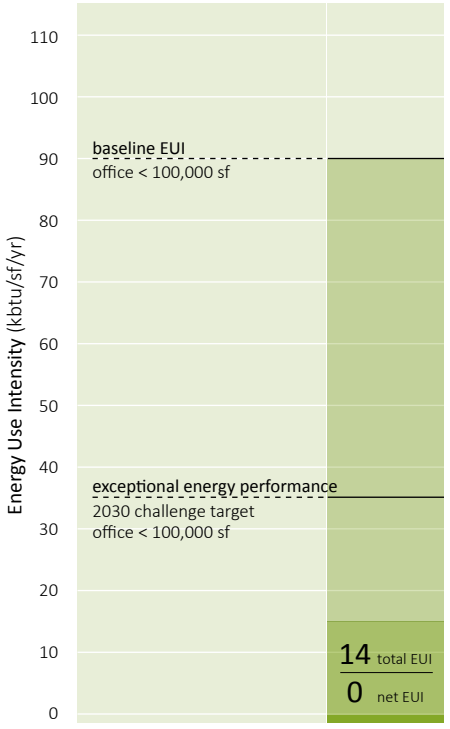


Energy Performance

Energy Performance

To meet its lofty goals, including energy independence and energy efficiency (50% more efficient than current building-code requirements), Aspinall incorporated the following: building-physics analysis; a roof-canopy-mounted 123-kW photovoltaic (PV) array (generating enough electricity on-site to power fifteen average homes); spray-foam and rigid-insulation addition to the building shell; storm windows with solar-control film to reduce demand on the HVAC system; variable-refrigerant-flow heating-and-cooling systems; thirty-two-well passive geo-exchange system for heating and cooling; dedicated-ventilation units; wireless controls and state-of-the-art fluorescent- and LED-lighting upgrades; and post-occupancy monitoring of occupant comfort.

New mechanical, electrical, and life-safety systems were sensitively integrated to avoid disturbing the historic fabric. Due to the highly restricted site and historic significance of the building's exterior, PV panels were placed atop a new, elevated canopy with a very thin profile—set back as far as possible from the principal south facade and carefully positioned relative to classical west and east facades.



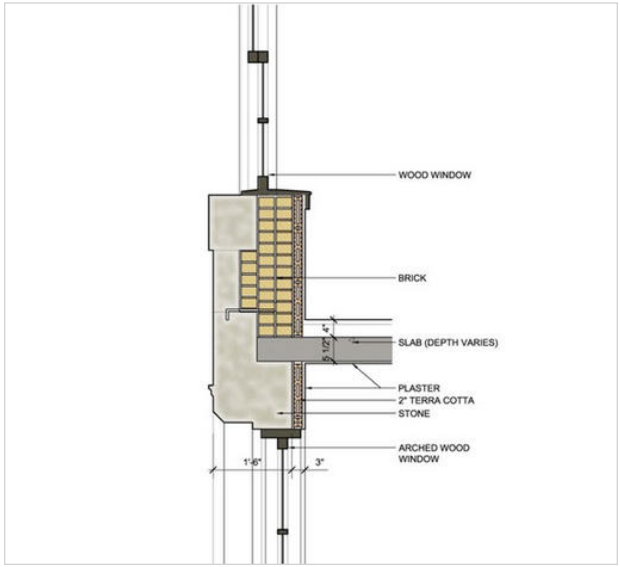
Energy Use Intensity

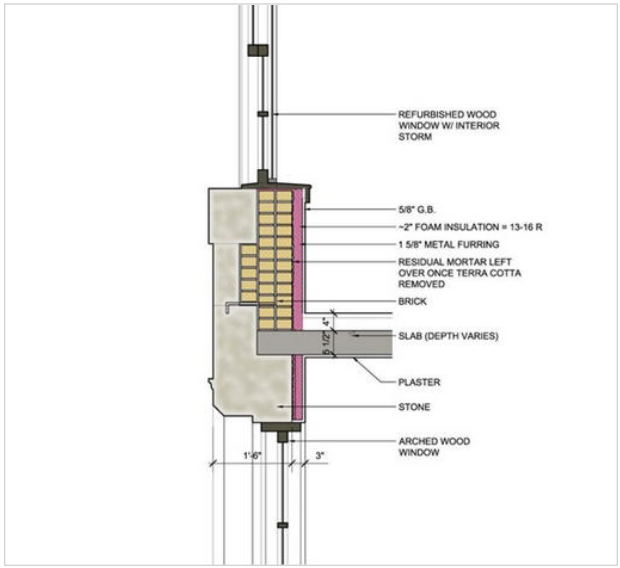
Energy Use Intensity (EUI) measures a building's annual energy use per unit area (kBtu/sf/yr). Each project's EUI is compared to a national average baseline EUI for office buildings of comparable size. A low EUI is an indicator of good energy performance as it represents an energy savings against the baseline.

EUI before renewables (kbtu/sf/yr)	14
EUI after renewables (kbtu/sf/yr)	0
% energy reduction (from average building type EUI)	84%

Key

- **Net Energy Use Intensity** after Renewables and Offsets
- **Total Energy Use Intensity** before Renewables and Offsets
- **Baseline Energy Use Intensity** for Similar Building





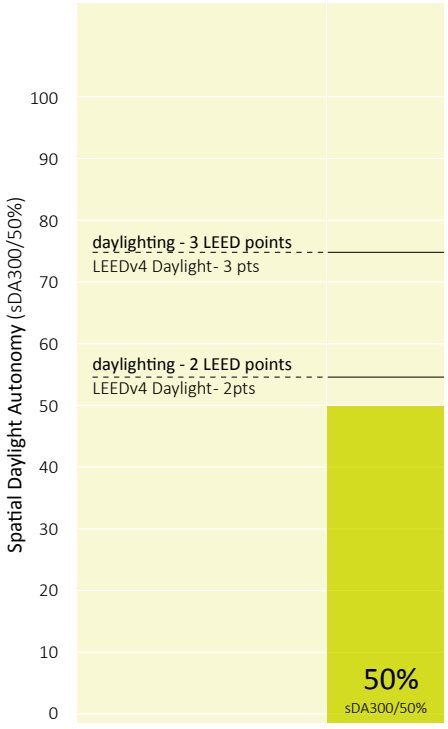
Daylight & IAQ

Daylight

Lighting was upgraded to efficient state-of-the-art fluorescent and LED technology, with wireless controls integrated with the HVAC system to achieve visually comfortable work environments. All perimeter zones include design features that allow for a balance of energy efficiency and visual comfort. Daylight sensors automatically dim ambient lighting to maintain the targeted 30 foot-candles of illumination on horizontal surfaces. Roller shades are available for occupant use to further control daylight and solar gain to match task needs. An original skylight that had been covered was reintroduced over the main Internal Revenue Service tenant space on the first floor to allow for deeper daylight penetration into the largest open-office area in the building. On the second and third floors, perimeter-ceiling zones are kept free of building services to allow maximum daylight penetration. Building services are installed in soffit zones immediately outboard of the double-loaded corridors.

Indoor Air Quality

A healthy environment is promoted through a green cleaning program. Ventilation of spaces is tracked through direct measurement at variable-air-volume (VAV) box zones, the use of the main dedicated-ventilation air unit, and by monitoring carbon-dioxide levels in occupied spaces. Natural ventilation was evaluated during concept design but was determined to be in conflict with the need for increased building security and the regulation of HVAC systems.



Spatial Daylight Autonomy

Spatial Daylight Autonomy (sDA) describes how much of a space receives sufficient daylight. The metric describes the percentage of the floor area that recieves a minimum illumination level, 300 lux, for at least 50% of occupied hours (sDA300/50%). Higher percentages indicate good daylighting performance.

Fully daylit (sDA300/50%)	50%
Views to the outdors (% of occupied spaces with view)	92%
Operable windows (does bldg have operable windows?)	N

Water Cycle & Materials

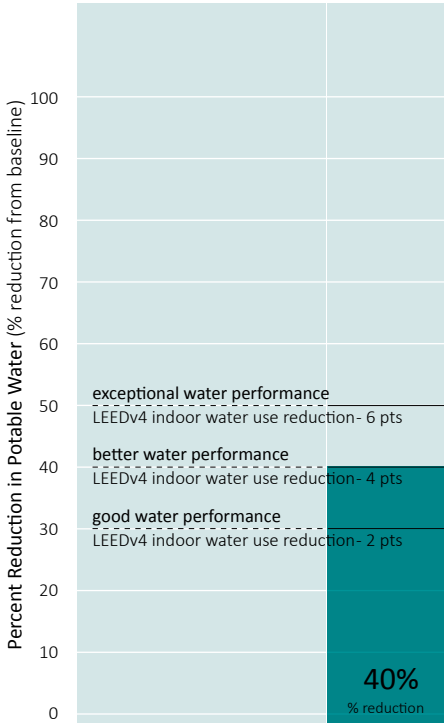
Water Cycle

Prior to the modernization, the building operated with many of its inefficient original plumbing fixtures—toilet flush rates were greater than 3.5 gallons per flush (gpf). The design team researched methods for retaining existing fixtures (with new flush valves) but determined that performance would be compromised. The final design consists of low-flow fixtures, including one-pint-flush (0.125 gpf) urinals, 1.28 gpf toilets, 0.5 gallons per minute (gpm) metered faucets, and a 1.5 gpm shower. These figures are estimated to provide a 40% reduction from the LEED 2009 for New Construction baseline. Landscape irrigation existed on-site; no additional landscape-irrigation systems were installed as part of this project.

Materials

The project reuses and restores available existing materials (historic doors, wood floors, plaster moldings, walls, ceilings). Materials and finishes contain minimal amounts of volatile organic compounds (VOC)—compounds that are easily released into the atmosphere and can be irritating or harmful to occupants and installers.. Segregated copy rooms and custodial areas, walk-off mats, and green housekeeping practices minimized exposure to chemicals and particulates.

Hygrothermal analysis helped ensure that the addition of new wall insulation would not adversely impact existing masonry. Thermographic imaging was also utilized prior to the renovation to help determine the appropriate extent of envelope renovation.



Reduction of Potable Water

Water use reduction is simulated by comparing the amount of water used by a project's interior fixtures to a baseline (percent reduction). The baseline fixtures are determined by the Energy Policy Act of 1992 fixture requirements. Higher percentages indicate good water performance.

Potable water reduction (% reduction from baseline)	40%
Potable irrigation (potable water used for irrigation?)	N
Stormwater Control (% rain managed onsite from 2 yr storm)	NA

RFP Development

The GSA's procurement team made the important decision early on to use a design-build project-delivery method to renovate the historic building and meet the American Recovery and Reinvestment Act (ARRA)–mandated high-performance goals and project schedule. The procurement schedule was very compressed. The GSA procurement team received approval of their initial scope of work in January 2010 and was given five months to develop a final scope of work, solicit the work, and award the contract. The procurement team hired Jacobs Technology as the construction manager as advisor (CMa) to meet this deadline.

The GSA crafted the procurement process to integrate the clear high-performance goals within a structure that invited open dialogue with participating firms on how to best meet goals. The GSA project manager explained, "What we found to be incredibly helpful going through the procurement process was allowing the teams that were bidding on the project to provide innovative solutions, pushing this project in terms of its sustainability goals. We asked the teams: 'You're saying it can make LEED Gold? Can you propose an option to make it LEED Platinum? What would it take to do that?'" This marks the emergence of clear goals around which the team could align. Nurturing a process for developing these goals became a positive leadership strategy throughout the project.

Since the procurement process was intentionally designed to be interactive, the GSA team left open the possibility that the request for proposal (RFP) responses might improve their understanding of project scope as it was developed post-selection. The GSA review panel's feedback to the competing teams during the procurement process was a form of peer review based on the proposal. A member of the design-build team noted, "With design-build, teams have to do a lot of work at the front end to even compete. Design-build teams that bring proposals to the GSA need to formulate a design that's progressed far enough along in terms of infrastructure, architecture, and cost. The designs should, and did, receive feedback and challenges by a really excellent GSA source-selection board during the proposal process."

Team Selection

Primary Team Selection

The GSA implemented best-value-selection processes on all ARRA projects. The Best-Value process allows the GSA to select team members based on a combination of past performance, technical capacity, and qualification of key personnel. After selecting Jacobs Technology as the CMa, the GSA began the process of choosing a design-build team. The selection procedure was a two-step open-solicitation process. Step one was a request for qualifications from teams of architects, engineers, and contractors; and step two was a RFP. Two rounds of interviews were conducted with the short-listed firms.

High-performance goals and related guidelines were set by the GSA for all projects that received ARRA funding. These goals became a primary driver during the GSA's selection process for this team. The design-build team of Beck and WRL demonstrated in their proposal how the project might exceed the mandated goals to reach net zero and LEED Platinum certification. The collaborative team's proposal stood out, and the contract was awarded to the ambitious team.

Consultant and Subcontractor Selections

Since both firms integrated within their organizations a wide range of disciplines, the depth and breadth of expertise within the Beck/WRL team precluded the need for an extensive subcontractor-selection process. A small handful of highly specialized consultants were chosen for their specific areas of expertise and previous relationships with WRL. Subcontractors for Beck were selected using conventional means, with the exception of specialized trades with expertise in particular historic preservation or restoration techniques.

Contract

The integrated team's proposal became part of the contract. They proposed the pursuit of net-zero energy and LEED Platinum as part of their "innovative options" at time of bid, along with a path to achieve this. The Beck/WRL proposal gave the GSA the confidence to raise the already-aggressive energy goals for the project. The GSA contracting officer was able to incorporate into the final contract many aspects of the Beck/WRL proposal, including their proposed schedule, budget, and high-performance goal of net zero. In fact, the PowerPoint presentation delivered by the team in their interview later became a part of the construction documentation for the project. By developing the contract in such an interactive manner, the high-performance goals became more than just a contractual obligation, they served as positive drivers of success.

Perhaps due to the unusual nature of incorporating Beck's documentation into the project scope, there were many gray areas—where responsibilities were not clear—that needed to be negotiated. Overall, the team felt that things balanced out, that some decisions created benefits or reduced risk for the owner and some for Beck. The team suggested these issues would have been mitigated if a 100% construction document could have been created as the new contract. The design-build contractor noted, "In hindsight, probably the drawings and specifications should have been the defining scope of the project at some point. I know we often had to go back to the statements of work, scopes of work, and program requirements. Parts were in the boilerplate of the contract, others in reference documents and standards. A goal could have been to create that comprehensive set of construction documents, drawings, and specifications that fully incorporated any/all of the scopes of the projects. Then, you would only have one place to go to understand the project scope."

Verification

A post-occupancy phase was not originally included in the contract, but its value is clear. The post-occupancy energy evaluation focused on all aspects of the building. As part of the contract, the GSA expected Beck/WRL to work with them after substantial completion to ensure that all of the systems installed as part of the project operated as designed and that their consumption agreed with what was modeled. As the team discovered, some systems required significant adjustments to reconcile them with their estimated energy performance. The team referred to this post-construction phase as “performance assurance.”

WRL was contracted for additional services to perform careful plug-by-plug tracking, which revealed some necessary behavioral changes in the way tenants used their space and equipment. Trending data was also helpful in verifying assumptions built into the model with patterns of behavior over time. Since Beck/WRL has no influence over the GSA’s tenant agencies in the building, work with the agencies to make behavioral changes, IT changes, and plug-load reductions has been and will continue to be a focus of the GSA and the property-management team. The GSA project manager viewed the inclusion of a period of time after substantial completion for the team to evaluate the project as a performance assurance: “We are still navigating through how to do a net-zero building. How do we use monitoring, measurement, verification, and team collaboration to get the building to perform the way we want to? I don’t think any of us anticipated early on—or even after substantial completion—the level of commitment that was going to be required of the team. Other projects looking to achieve the same goals or the same high level of performing outcomes, in terms of sustainability, should be aware of this.”

Team Building & Collaborative Culture

Collaborative Culture

This team placed emphasis on strong relationships and an open-minded approach to achieve a collaborative culture: "The tools to collaborate are personal tools. I don't know if you can really mandate or dictate collaboration through contract language. You understand the shared goals, objectives, understand where you're trying to go; and you move forward with the project as professionals." Specific leadership strategies included using meetings to consistently celebrate success so that even minor progress served to build the team and collaborative culture.

Several factors helped establish the collaborative culture found on the Aspinall team. Both Beck and WRL are interdisciplinary firms with established cultures of working collaboratively between disciplines and under unified sets of enterprise goals. Although the firms had not worked together previously, their internal organizations were compatible and needed very little alignment. The level of accountability among team members was key to developing trust: team members noted that they believed that others would perform as promised and that each team member or organization would hold themselves responsible.

Another factor that contributed to the development of strong personal relationships that helped support collaboration was the isolated project location. In the beginning, the project team was required to collaborate remotely. Later in the project, core team members were located on-site, with others traveling to the site regularly. The remote location encouraged team members to engage with each other outside the job site: for example, team members frequented a local restaurant for dinners. The team noted that the increase in direct working relationships and the ability to get to know each other on a personal basis strengthened communication, trust, and respect among the core team members.

Right People

The GSA Region 8 ARRA coordinator emphasized attitude in addition to expertise. He defined the "right people" as those who are willing to dedicate themselves to the project: "[The Aspinall project team] has been one of the most engaged teams from all perspectives, and the commitment by everyone on the team internally and externally, I think, was a huge part of the success."

Champion

The project team also identified the GSA project manager's leadership skills as an important aspect of the project's success. Specifically, the project manager spearheaded the collaboration throughout the project, supervised decision making, and almost single-handedly managed the complexities of the ARRA design guidelines, schedule, reporting procedures, and project-budget procedures so the project team could remain focused on design and construction.

Goals & Alignment

One of the first things the Beck/WRL design-build team did after being selected was to work with the GSA to confirm the program, scope, and cost. This was especially important because Aspinall's contract was different than originally outlined in the RFP and incorporated critical elements of the winning team's proposal, including its high-performance goals, schedule, and budget. The process of collaboratively revising the project scope laid the foundation for alignment of each team participant to the final project goals even before work began. The GSA project manager explained, "The project's goals were finalized when we brought the Beck and WRL team on, and I think that was really the catalyst for the project. That was when, I think, everybody on the GSA side realized where the potential was and where we could take this project."

Preserving the historic status of the building was the other project driver, a goal the team was obligated to achieve by the SHPO. The two sets of parameters were each very challenging, and the team additionally had to consider how the two sets interacted. A project team member noted, "Two filters for the job were sustainability and historic preservation and how those two [objectives] needed to work together." The specific area where energy needs and preservation limits conflicted can be seen in the design of the rooftop PV array.

Tenant Engagement

The project team itself was aligned and motivated and had clear project drivers; however, the team members realized that they would need the building tenants to buy-in to goals and change their behaviors to actually achieve the performance metrics and succeed. The GSA project manager explained the disconnect between the project team's intense prioritization of energy goals and the tenants' low prioritization of their agency's energy needs: "If you look at the national standards that a lot of agencies have, they don't lend themselves to LEED Platinum or to net zero. The project team communicated what our goals were, and we worked together to bridge the gap between what they needed as tenants and what we wanted as a project team." Communication was key to working with tenants, a team member noted. "When you're looking at some of the goals that we had set up…it was important to share that information and make sure that the tenants understood what the goals were and what would be their role in trying to achieve some of these goals."

The project team also tried to understand actual tenant needs beyond what was written in early program documents. Project leaders realized that by adapting the entire project, they were able to customize tenant spaces to fit individual tenant needs. "[Projects] can have a broad brush approach to tenants. A project is awarded, and basically there is this kind of nebulousness within a contract that says, 'Okay, we're going to do this type of programming. We need to meet the agency requirements, but we need to kind of shove that square into this round hole here to make it fit with the overarching project.' This creates a potential risk." The team addressed the risk by interviewing each tenant agency and creating a detailed program. The team developed mechanisms for connecting tenants to the project team, including partnering sessions with all tenants represented. Individual tenant groups also worked with the GSA project manager, and the project team developed and maintained a close working relationship with the facilities manager. As a team member noted, "The goals need to be communicated and understood outside of the team. Some of the goals that we had set up were for the tenants: the use of the building after we're done and how that building is maintained. It involved a high level of sharing of that information to make sure that the tenants understood what the goals were and what their role would be in trying to achieve some of these goals."

The base project included the reblocking of tenants in the building to achieve two goals. The first was to consolidate the agencies already in the building. Prior to the renovation, one agency had taken spaces as it became available, and its staff was dispersed throughout the building. The second goal was to free up the space along the south facade of the first floor to preserve the original lobby.

The extent of what was considered in scope as part of the agency's tenant improvements was an area not clearly defined in the original scope of work. The GSA worked with Beck/WRL to determine a scope within the contract that would be equitable. Items that fell outside of that scope required funding by the agency to cover the unanticipated costs. This was difficult to manage and required that the team quickly identify out-of-scope items so that the agency could either budget for it or consider descoping that work.

There were times when tenant requirements did not align with GSA energy goals or LEED goals. For example, the GSA proposed consolidating copy rooms and server rooms to reduce the energy load on the building, but the tenants preferred to keep dedicated areas within their own spaces. To resolve the differences, the team worked closely with agency representatives. In the case of the copy rooms, the GSA was successful in making a persuasive case that a single area would benefit all of the agencies. The consolidation of the servers was more difficult due to the varied information-technology and security needs and was eventually abandoned.

The Aspinall project team had a recommendation for future projects to help increase stakeholder buy-in: use more mock-ups. The team found that mock-ups were an efficient way to communicate design intent to the GSA and tenant-agency stakeholders. The project team plans to apply this process to tenant mock-ups in the future. "Being able to engage with tenants was critical," said one team member. "We will look into doing a better job of mocking up interior aspects of the project relating to finishes. The idea behind the mock-ups is for everybody to review and understand the idea, as opposed to taking it directly out of the specs and installing it."

Role Definition & Accountability

The definition of roles in the Aspinall project team was heavily influenced by the integrated structure of the two primary firms on the design-build project team, Beck and WRL. Beck is a design-and-construction firm, and WRL is a design-and-engineering and technology-design firm. Employees of these two firms filled most of the project roles, with limited outside consultants. Therefore, the internal structures of the two firms strongly guided the way roles were defined on the project team.

The majority of the project team was drawn from Beck and WRL, which had well-established methods of integration. Although WRL and Beck had not previously collaborated, the result of their union was a highly functioning project team that was self-accountable. Individual team members were already well versed in cross-disciplinary collaboration within their own firms. Project team leaders leveraged this experience to create a project team that collaborated well between firms. According to the GSA project manager: “I think everybody knew what they needed to do on this project. I don’t think there was a need for me to hold team members accountable, as I think each individual took that responsibility on themselves.”

Role definition between the two primary firms focused on defining the responsibilities of WRL as lead design architect and Beck as architect of record. At the beginning of the project, the team created a matrix of project responsibilities that would have traditionally been assigned to these two roles. The team then assigned each responsibility to the firm best equipped to meet it. The project team believed that this process helped build a collaborative attitude between WRL and Beck, as each firm came to understand and leverage the strengths of the other. WRL used their integrated team of architects, engineers, and historic preservation and sustainability consultants to play a larger role during the beginning of the project to define the design. Responsibility shifted to Beck during the second half of the project during the execution of the design. However, both firms held responsibilities and actively contributed and collaborated throughout the project.

Managing Schedule & Budget

Schedule

Managing the schedule and keeping the project on track was a challenge given the complexity added by the need to keep the building operational for the tenants and the uncertainties about the historic-review process.

To manage the building operation and the tenants during construction, the team expanded on a strategy Beck presented during the original interview. Beck had presented a digital model that demonstrated the expected phases. That model was further developed with input from the whole team. A WRL team member noted that from the beginning, Beck "realized that the approach to phasing in an occupied building was going to drive the construction-method approach and was critical to the design—so everything flowed from that." The project team used building information modeling (BIM) to help attach the 3-D phasing model to the schedule, scope of work, and tenant-move plan and then to illustrate each phase's schedule, scope of work, tenant-move plans, and construction documentation. This process supported the team and the tenants to make decisions efficiently and effectively. The Aspinall project team also constructed flex spaces to temporarily support displaced tenant agencies while their portions of the building were under construction.

The SHPO historic-review process was a risk to the design and schedule as the project team awaited approval. To help manage the risk and uncertainty of the SHPO's review process, the team reached out and developed a strategy with the SHPO to phase their review process. The project team focused on resolving their demolition plans with the SHPO first. After receiving approval the team began demolition while the rest of the project was still under review. The design team then focused their efforts on the next phase of the building and worked to incorporate feedback from the SHPO. The team was able to use this process to keep the project moving forward and manage the risks associated with the SHPO review.

Budget

The project team benefited from working within a firm fixed price budget set early in the process. Within the project team, budget decisions were considered integrally with schedule and scope. The GSA project manager noted that the fixed price was a clear motivator for the team, "we didn't ever have to ask for more money....one of my personal goals and I think one of Beck's goals was that we didn't want to go back and ask for more money. We had a team that was very good identifying what we could do to make things cost effective." Negotiation with tenants occurred in situations where responsibility for project scope was not completely clear *(click here for more information on tenant engagement)*.

Information Management

The Aspinall project team used a variety of information-management tools, including Webex. The team also considered BIM and the energy model as information-management tools, since all design decisions were made while using them and final decisions were incorporated into them.

The project team reported that, in the future, they would like to work toward an information-management best practice in which the final construction documents and specifications would come to define the project scope. On a complex project like Aspinall, different types of information are continuously shared in a range of forms. Although existing information-management tools help track, sort, and recall this information, the team saw an opportunity to increase efficiency in the process by transitioning the contractual scope of work from the initial contract, work scope, and program documents to the finalized construction documents. A team member explained, "After thorough reviews [of the design] by the CMa, the GSA, and other organizations, [the updated design documents] should have, at some point, really defined the scope of what was in and not in the project." While the management of information was effective, team members noted the project documentation required referencing several documents to obtain information, which was inefficient. Ideally, the team would have adapted the contract to include a single source of information.

BIM & Design Documentation

BIM

BIM was utilized throughout design and construction to manage project complexities, assist in design decisions related to the high-performance goals, and facilitate communication to a project site that was remote to the team members. The project team developed a BIM-execution document at the beginning of the project to help standardize how information was modeled, shared, and updated and to determine who would be responsible for each action. The team based their use of the model on best practices that Beck had developed during the last decade. Phasing and sharing of the model followed their standard practices, with the addition of extensive coordination with the many WRL energy models. The team frequently used BIM mock-ups to identify issues early on and to reduce risk. These mock-ups were also used to coordinate with the GSA and with team members and consultants who were not located nearby.

The BIM model was linked to an energy model early in the project, for which the team created a protocol. Changes to the envelope's R-value, glazing, roof construction, and other important project aspects in the BIM model would be fed into the energy model to determine the potential impact on energy use. The output would then inform design decisions.

The Aspinall project team identified an area of BIM management that needs further study—attaining accurate data from product manufacturers. As BIM and energy modeling are increasingly used to predict the impact of design decisions, they require more detailed and accurate information about what is being modeled. The WRL engineers identified that for some building components, such as variable-refrigerant-flow systems, predicted efficiency does not exactly match real-world performance. Considerable time was spent working with manufacturers to delve into product performance to maximize the accuracy of the energy model. WRL has continued to conduct research in this area and has started a website, http:/www.recool.com, to share their findings.

Design Documentation

The project team does not believe that the design-build project-delivery method will result in the creation of less design documentation than a traditional design-bid-build delivery project. A team member noted that regardless of the delivery type, "Within the project team, we still have to communicate the information scope out to the subcontractors. That information can be related in different ways, but the content still needs to be developed to a level that somebody outside the team can understand."

The GSA project manager agreed that design-build delivery on GSA projects would not reduce the amount of design documentation created. "The GSA still requires the same number of reviews that they would require in any type of traditional design-bid-build project. The GSA employed defined milestones in each phase of the design process during which they review the project documents."

Meetings & Workplace Environment

Meetings

The Aspinall project team scheduled structured meetings at regular intervals and also encouraged informal meetings to directly address issues as they occurred. Structured meetings occurred once a week during design and twice a week during construction. Once construction started, one meeting was dedicated to resolving design issues and another to construction matters. Key team members from the GSA, Beck, WRL, and Jacobs Technology attended all structured meetings.

Over the course of the project, team leaders fell into a pattern of starting every structured meeting by discussing the complexity of the project and identifying a recent success, such as the completion of the demolition phase or an approval by the SHPO. The GSA project manager came to believe that beginning the meetings in this way helped individuals engage and created a positive atmosphere for collaboration. The meeting format was “a fantastic recommendation….You always want to identify success and thank people for their work. I tried to do that as much as possible, and I think the Beck Group did a good job of it as well.” Affirmation during meetings was a leadership strategy that served to support team building and collaborative culture.

Beck, as architect of record and the design-build contractor, held their own internal meetings after the structured construction meetings that involved the entire project team. This enabled them to distill and disseminate information from the project team out to their subcontractors in the field.

Co-location

The Aspinall project team identified co-location as an effective process tactic that supports collaboration. The project team was located in several different states during the design phase. Once construction began in March 2011, critical project team members moved to offices located in the basement of the Aspinall building. This included the GSA project manager, the GSA building manager, Beck (as design-build contractor), and Jacobs Technology (as construction-management assist). Team members from WRL did not co-locate as the majority of their work occurred during the design phase, but they still spent considerable time on-site.

The team believed that co-location helped support communication, collaboration, and efficient management of project issues.“ [Co-location] fostered the opportunity to communicate a lot more than you would if you were trying to coordinate and schedule calls. I think it drove accountability: you couldn’t dodge each other. You would go knock on somebody’s door—in most cases we just kept our doors open—and you kind of floated among the offices if you needed to talk to somebody. It broke down formal barriers and made it easy to communicate, collaborate, and work through project issues. Stuff comes up every single day on a fully occupied building renovation.” The GSA project manager concurred that frequent informal interactions were “very helpful in addressing issues early, as opposed to waiting until the next time we were able to all get together.”

GSA Peer Reviews & Expertise

GSA Peer Reviews

The GSA peer reviews are mandatory design reviews conducted periodically by GSA design and construction experts during a project's design process. In a typical design-build process, teams bidding on design-build projects have to develop robust designs—structural concepts and budgets in addition to architectural concepts—to compete for the job during the procurement phase. By the time the contract is awarded the team has already invested more in design development than a traditional design-bid-build project. The shift in time investment means that for design-build delivery, the first GSA peer review is ideally held shortly after the team is selected, before too many decisions have been finalized.

The first official GSA peer review of the Aspinall project occurred two weeks after the design-build team was awarded the contract. The project team identified this as a critical moment for the design. The GSA project manager explained, "The original design was, for lack of a better term, controversial in how we were going to approach this historic building, especially with the power-producing element, the PV canopy, which was placed above the building." It was essential for the project team to present the original design during the first GSA peer review in a way that would lead to a constructive dialogue with the reviewers. The project team developed a strategy that explained the bold design in terms of the project's sustainability and historic preservation goals: "The Beck Group and WRL did a really great job of presenting this somewhat controversial design to the peer reviewers. They explained the need [for the PV canopy] and also how it complied with the Secretary of the Interior's overall standards for preservation."

The Aspinall project team also hosted the first GSA peer review on-site. They led the peer reviewers on a full-building walk-through at the start of the session, which enabled everyone to explore the existing condition of the building and the surrounding context. This not only gave the reviewers a better understanding of the project, it also laid the groundwork for a collaborative working relationship between the two groups before the design was officially presented.

After the walk-through, Beck and WRL led the peer reviewers through the original design. They organized the daylong meeting into sessions that focused on specific building elements and allowed time for both presentations and discussions. The project team also structured interlude periods at the meeting during which they would step back and allow the GSA peer reviewers to meet, digest, and react to what they had just seen. Peer reviewers could then present their thoughts to the project team. The GSA peer reviewers conducted a more in-depth review of the design after the meeting, but because the kick-off meeting was structured to allow for real-time discussion, the design team was able to prepare in advance many of the critical items that would need to be addressed. The GSA project manager explained, "I thought there was very clear direction throughout the [initial GSA peer review] meeting. Beck and WRL were able to come up with responses to their comments quite quickly; that kept the project on track. I just think it was beautifully organized, and the timing of it was really essential to a successful process."

The Aspinall project team took a unique approach to the GSA peer reviewers by continuing to engage with them after the mandated peer reviews ended. They recognized that the GSA had a lot of in-house expertise that could be beneficial to the project. A Beck team member explained, "The GSA has an army of expertise from roofing and water proofing to elevators and fire and life safety and on down the line, and that's pretty rare for how we interact with our clients. Clients are typically a little flatter in their organization, and there is one or two people making virtually all of the decisions as they relate to the project."

The Aspinall project team actively engaged the GSA's internal experts in major project decisions. The contractor explained, "The GSA [experts] were looked at much more as resources and extended parts of the team than somebody just checking what the team is doing. That opened up a level of collaboration and understanding that I found to be different than other [GSA] jobs that I've worked on."

This team was very successful in navigating the additional reporting requirements for the ARRA. The GSA project manager used a strategy to shield the team by selecting one person per issue to be his partner in developing or tracking the specific information needed.

Expertise

The majority of the project-team roles were assumed by Beck and WRL, including those usually filled by outside consultants. WRL had in-house engineers, historic preservation consultants, and sustainability consultants on the project team, enabling a tight integration of expertise into the core team. Including key consultants in the team also increased decision-making efficiency by reducing the time and effort traditionally spent on coordinating with external consultants.

Building Innovation - Resizing the Solar Array

The example described below provides an illustration of a high-performing team that was able to work effectively together to resolve competing demands.

A WRL team leader commented, "The project demonstrated that high-performance-building design is consonant, not competitive, with historic preservation." The Aspinall project demonstrated a 'both-and' rather than an 'either-or' relationship of preservation and high-performance innovation and application. He considers Aspinall as an important model for future projects since so many buildings in older downtown areas are of similar vintage. He went on to say, "We wanted to dispel attitudes or preconceptions held by building owners and designers that historic structures preclude or limit high-performance designs and that, in fact, there are virtues of historic structures that may leverage opportunities to achieve significant energy efficiency."

Compared to a typical historic preservation project, the unique combination of Aspinall's design-build delivery method, project schedule, and procurement process increased the risk and stress of the historic-review process. The procurement phase of the design-build project incentivized prospective teams to submit well-developed designs. The winning design-build team's proposal was employed, resulting in an initial design that had already undergone considerable development. The historic-review began at the start of the project and had the potential to challenge many of the design decisions that had already been made—which could negatively affect the project schedule and even alter the approach entirely.

The most controversial design element was the project's roof-mounted PV array. The SHPO's initial review critiqued the visual presence of the array as too prominent in the view of the building's front facade, ruling that it would significantly alter the building's historic qualities. Yet the PV array in the original form was critical to meeting the net-zero-energy goals, so reducing the visual impact by making the array smaller would have a large impact on energy issues. Through a process that leverages many of the team's strengths, they eventually revised the design to create a PV-array design that met both SHPO standards and the project's energy goals.

Clear objectives helped the team successfully communicate the importance of the PV array and convey to the SHPO the project's dual goals: historic preservation and sustainability. The team's collaborative structure set the foundation for a working relationship with the SHPO that resulted in the redesigning of the PV array rather than simply removing it. BIM facilitated the discussion by making clear connections between design changes and energy-performance impact.

The project team remembered the PV-redesign process as an incredibly collaborative time: "You're quickly trying to identify and throw ideas out. 'What if we put some more insulation in the walls?' Okay, let me start working on the SHPO piece of that. 'What does that do to our energy model? How much energy does that save us?' A lot of people were throwing ideas out, and other people were picking them up and running with them." Team members described a fluid process in which ideas would be generated by any team member, regardless of expertise, and others would volunteer to study the aspect of the idea that related to their area of expertise and then bring it back to the group. To reduce the size of the PV array, the team increased the R-value of the walls and roof. Careful coordination was required to test each proposed alternative so that the wall thickness (and thereby the window-trim details) would not change the critical elements that helped define the historically preserved building. Another team member characterized the series of decisions as a "complex, interwoven matrix of opportunities to save energy and determine what we were relying on. Doing more of this or less of that: what's the value trade-off, what's the cost trade-off, what's the aesthetic trade-off?"

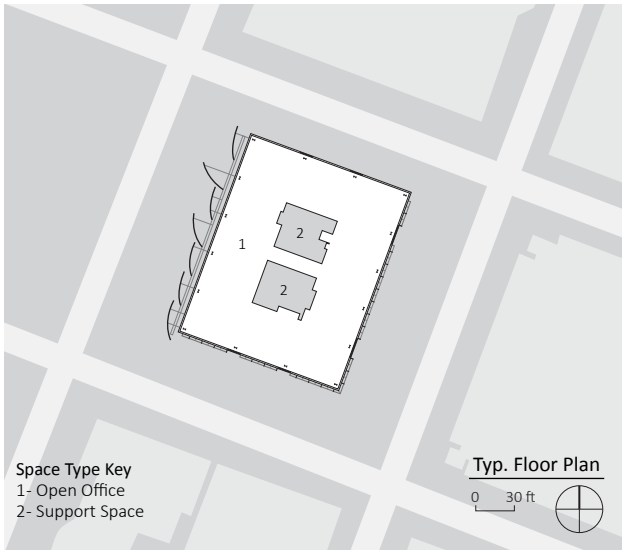
Concurrent with the study of increased efficiency in the building envelope, the team pursued increasing the energy produced by the geothermal system. The project manager recalled how his negotiation skills were called into play to support the revised energy model in which "we wanted thirty-two geothermal wells, but we didn't have enough room on the site to do that. I had to quickly run across the street to the city and start schmoozing about that request." He recalled that there was not much discussion about his role in this particular issue: "In our approach to roles and responsibilities, we never really had to sit down and say that's you or why don't you do this. There was a lot of pride on this project to pick things up and run with them."

Through this iterative process, the team was able to use multiple means to lower the energy use of the building and, working with the SHPO, finalized a smaller PV array with an acceptable visual impact. The resulting project is the first net-zero historically preserved building in the country, demonstrating that high-level energy goals and stringent preservation restrictions can be compatible.

Image: West elevation showing the solar array on the roof.

Project Overview

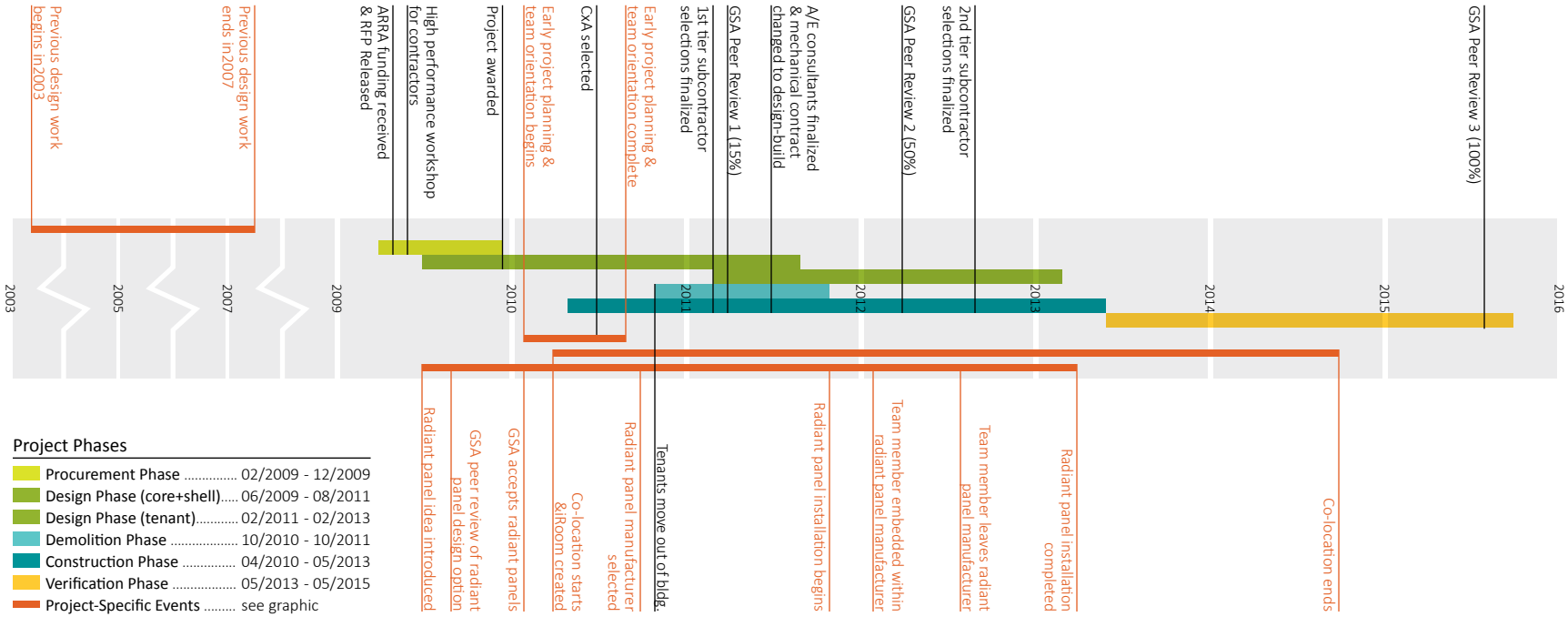
Project	Edith Green- Wendell Wyatt Federal Building
Location	Portland, Oregon
Project Type	Renovation
Contract	Multiple Independent Contracts- Custom (modified P-100)
Owner	U.S. General Services Administration – Northwest/Arctic Region, Region 10
Design Architect	SERA Architects, with Cutler Anderson Architects
Contractor	Howard S. Wright (HSW)
Project Start	December 2009
Project Completion	May 2013 (met schedule)
Project Size	512,474 GSF
Project Height	18 Stories
Project Budget	$141.5 M (met budget)



Project Timeline

The modernization of the Edith Green- Wendell Wyatt Federal Building (EGWW) transformed a relatively conventional mid-seventies building into a LEED-Platinum-certified project that is on track to become one of the highest-performance federal buildings in the GSA's portfolio. Project-specific drivers of complexity included a geometrically intricate addition of floor plates to all sides of an existing building, demanding design and performance goals, and anticipating the needs of unknown tenants. The design strategy to add floor space and wrap a sophisticated layered facade around the existing building required a high level of coordination, technical expertise, and logistic effectiveness. New systems not commonly used in the United States added to the already-challenging technical issues. Another risk factor was the late identification of some tenants, which led to the need to incorporate their goals after the overall construction schedule was established. There were uncomplicated aspects of the project. The original building did not need to meet any preservation requirements and did not need to remain operational during construction. Overall, the project was identified as high risk (but with the potential for high payoff), leading the GSA to place extraordinary emphasis on planning and preparing for complexity.

Extensive early planning was the foundation for an extremely strong team culture that influenced every aspect of the project, from leadership strategies to logistical and process tools. Achieving the project goals while meeting budget and schedule constraints was the result of many good decisions by the team. The large number of positive outcomes and process innovations were tracked by the team to better understand how this project could be a model for the GSA and to the building industry as a whole.



Team Organization

Custom Integrated Team
This team worked under a customized integrated agreement that closely mirrored commercial integrated project delivery (IPD). Several of the individuals in the primary team had prior experience working together, and significant early planning deepened these relationships.

Owner

U.S. General Services Administration –
Northwest/Arctic Region, Region 10

Custom Integrated Team

Howard S. Wright
General Contractor

SERA Architects
Executive Architect
Interior/Lighting Designer

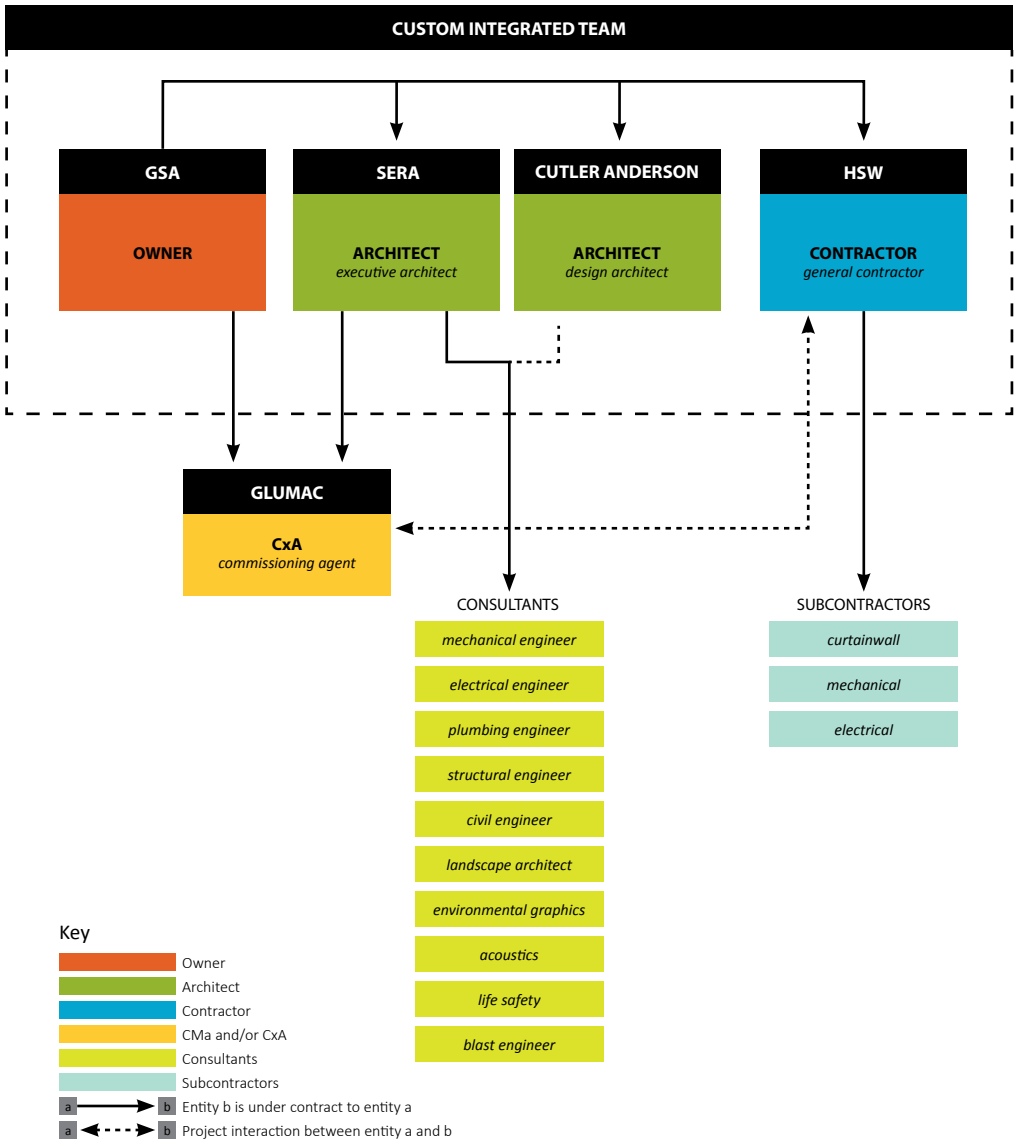
Cutler Anderson Architects
Design Excellence Architect

Commissioning Agent

Glumac

Consultants & Subcontractors

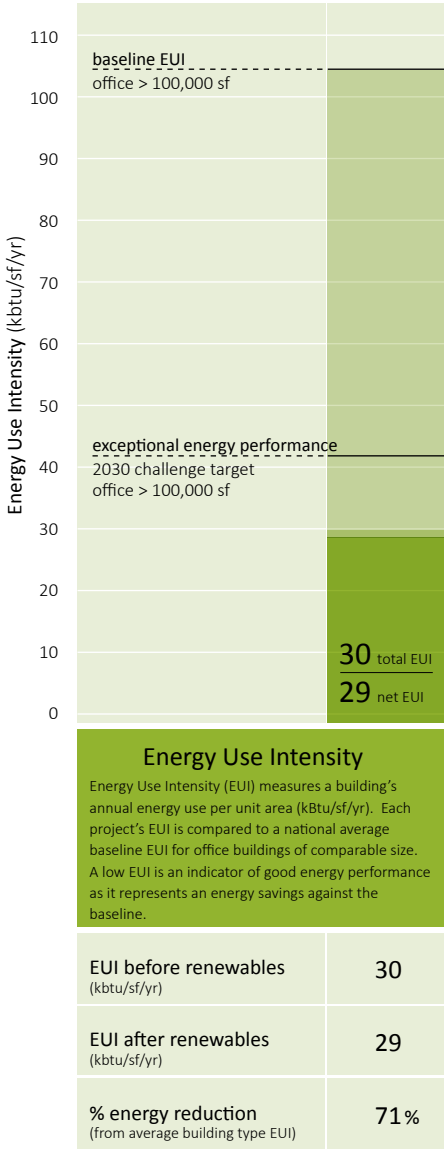
Mechanical Engineer Core and Shell - Stantec Consulting
Electrical Engineer - PAE Consulting Engineers
Plumbing Engineer - Interface Engineering
Structural & Civil Engineer - KPFF Consulting Engineers
Landscape Architect - Place Studio
Environmental Graphic Design - Mayer/Reed
Acoustics - Charles M. Salter Associates
Life Safety - Aegis Engineers
Blast Engineer - Weidlinger Associates
Curtainwall Subcontractor - Benson Industries
Mechanical Subcontractor & EOR-Tenant Buildouts - McKinstry
Electrical Subcontracotr & EOR-Tenant Buildouts - Dynalectric



Energy Performance

Energy Performance

EGWW is predicted to achieve a 55% reduction in energy use compared to a building of similar size and type, exceeding the Energy Independence and Security Act performance goals, which are in alignment with the AIA 2030 Commitment. These savings are a direct result of an integrated-design process that prioritized occupant comfort as well as energy performance. Exterior shading, tuned with facade orientation, provides solar control while also enhancing daylighting, thereby minimizing cooling load (and peak electric load) and improving thermal comfort. These integrated strategies allowed the realization of the primary energy-conservation measures, a radiant-ceiling heating-and-cooling system. The building also provides enhanced indoor air quality through use of a 100%-dedicated outdoor-air system, resulting in above-code ventilation with excellent filtration. During six months of tenant occupancy, the team incorporated a series of “aftercare” measures to monitor energy use and help building operators tune the building to achieve its goals.



Key

- **Net Energy Use Intensity** after Renewables and Offsets
- **Total Energy Use Intensity** before Renewables and Offsets
- **Baseline Energy Use Intensity** for Similar Building

Energy Use Intensity

Energy Use Intensity (EUI) measures a building’s annual energy use per unit area (kBtu/sf/yr). Each project’s EUI is compared to a national average baseline EUI for office buildings of comparable size. A low EUI is an indicator of good energy performance as it represents an energy savings against the baseline.

EUI before renewables (kbtu/sf/yr)	30
EUI after renewables (kbtu/sf/yr)	29
% energy reduction (from average building type EUI)	71%

Daylight & IAQ

Daylight

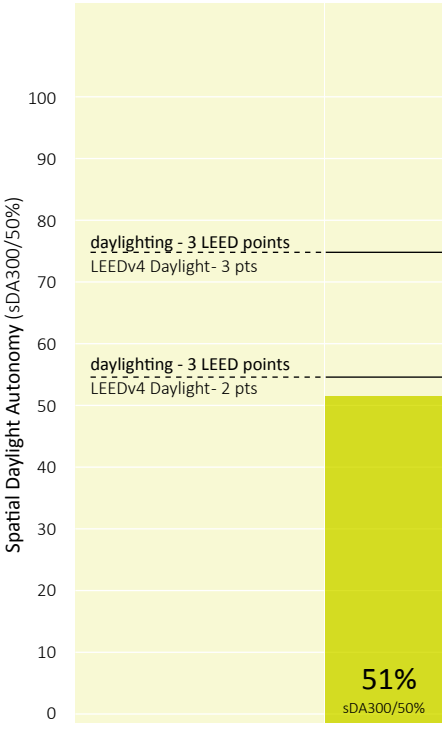
Because of the importance of daylighting to human health and comfort, the project team optimized daylighting in the perimeter zone and utilized a task/ambient approach. This alteration reduced lighting energy by 50–60% and provided occupants with valuable connections to the outdoors.

In addition to a review of the effect glazing has on required shading, a separate analysis was performed to determine the amount of daylight that could be harvested for each proposed shading system. This parametric analysis led to the following high-performance-design requirements:

- 40–42% vision glazing on the tower, maximizing glazing where shading minimizes solar gain
- Full-height shading devices on the northwest facade to address the potential for intense solar gain caused by the low-angle sun
- A combination of vertical and horizontal shading on the southeast and southwest facades—tuned specifically to address solar orientation
- Light-shelf reflectors below the window sills to maximize daylight penetration

Indoor Air Quality

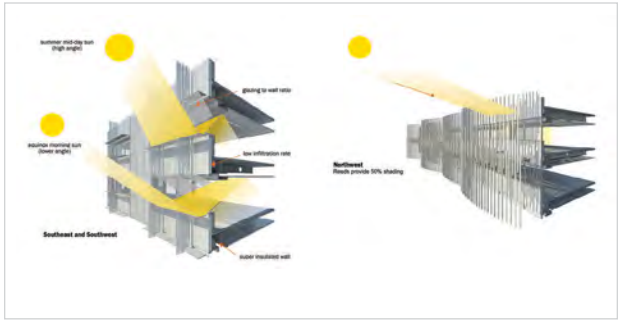
The team notes an important lesson learned regarding the relationship between air exchanges, energy performance, and indoor air quality. The HVAC-systems design minimized air exchanges to reduce energy consumption associated with conditioning exterior air. As a result of the minimized air exchanges, options were limited for resolving interior-air-quality issues such as Co2 levels, pre-cooling, and flushing the building. Flexibility to increase outside air would have provided more tools for resolving indoor air quality issues but would have been detrimental to the project's aggressive energy goals. The team was able to overcome the additional challenges of minimizing air exchanges and maintaining indoor air quality but notes the increased design work necessary to do so.



Spatial Daylight Autonomy

Spatial Daylight Autonomy (sDA) describes how much of a space receives sufficient daylight. The metric describes the percentage of the floor area that recieves a minimum illumination level, 300 lux, for at least 50% of occupied hours (sDA300/50%). Higher percentages indicate good daylighting performance.

Fully daylit (sDA300/50%)	51%
Views to the outdors (% of occupied spaces with view)	96%
Operable windows (does bldg have operable windows?)	N



Water Cycle & Materials

Water Cycle

The project's detailed water-usage modeling predicts a greater than 60% water savings through a strategy of incorporating both water-conserving plumbing fixtures and a rainwater-catchment-and-reuse system.

The EGWW water-conservation strategy started with an analysis of the original building's historical water usage. This analysis showed that 87% of the building's water usage was for interior applications and 13% for irrigation of the surrounding landscape. Because of the significant interior use, the primary strategy focused on rainwater reuse for non-potable flush fixtures. The use of drought-resistance landscaping and the incorporation of subsurface irrigation have reduced landscape-irrigation water usage by more than 50%.

A 165,000-gallon storage tank, created by repurposing an old firearm target range in the basement, allows rainwater to be stored and reused for toilet flushing, irrigation, and mechanical-cooling-tower makeup water. The tank also supports another project goal: mitigating the negative effects of urban runoff. In addition, the water-collecting "canopy" supports a 180-kW solar array that provides 4% of the building's total energy.

Materials

To minimize the landfilling of materials, the project team focused first on resource conservation and material reuse. Careful demolition eliminated more than $1 million in contingency, which was reallocated to purchase additional sustainable-design features.

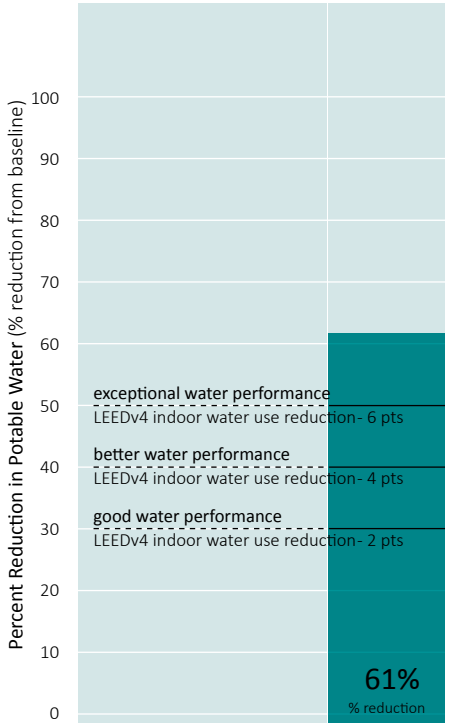
Additionally, 3,337 tons of precast concrete taken from the site was crushed and reused as road bed, and 3,500 tons of materials and products were given new lives, including:

- Two drinking fountains and five doors given to an inner-city church
- Grab bars donated to special-needs individuals
- Thirty solid-core doors sent to a village in Africa
- Mahogany strips made into bicycle fenders by a local craftsman

The project team attributes their success in reducing demolition waste to their integrated-delivery model. The demolition contractor was brought onto the team at the beginning of design. Project leadership also added additional scope to the demolition contractor, including developing demolition drawings and specs and adding a diversion/recycle/reuse deliverable. This ensured that the demolition contractor understood the project's sustainability goals and that a clear process was established to track successful achievement of the goals.

After the demolition was complete, the project team's focus shifted to the selection of new materials, using a decision matrix created by the team. In addition to Buy-American requirements and durability, the project team focused on selecting regional materials (11.9%) with high recycled content (29.8%). Indoor air quality and reduced long-term operation and maintenance costs were also considered through the selection of low-emitting adhesives, floor systems, composite wood, and agri-fiber products.

To further reduce the building's environmental impacts, the property-management team incorporated the GSA's green leasing and operations policy and created a program to educate tenants (present and future) about the building's green features and their impacts.



Reduction of Potable Water

Water use reduction is simulated by comparing the amount of water used by a project's interior fixtures to a baseline (percent reduction). The baseline fixtures are determined by the Energy Policy Act of 1992 fixture requirements. Higher percentages indicate good water performance.

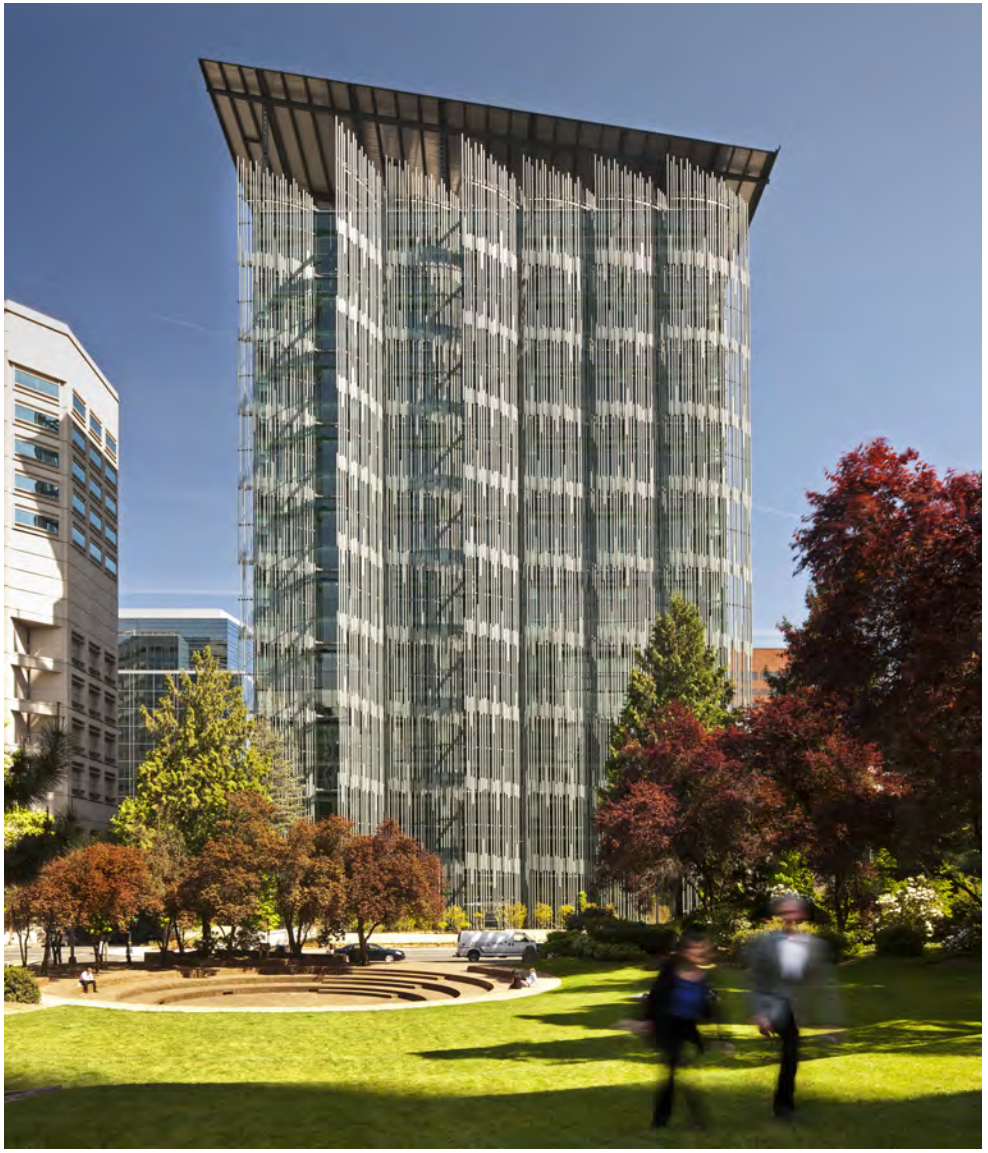
Potable water reduction (% reduction from baseline)	61%
Potable irrigation (potable water used for irrigation?)	Y
Stormwater Control (% rain managed onsite from 2 yr storm)	90%

RFP Development

Work on the EGWW began in 2003, prior to the American Recovery and Reinvestment Act (ARRA). The GSA's Northwest/ Arctic Region, Region 10, hired SERA Architects, with Cutler Anderson Architects, for design services on an extensive modernization of the existing eighteen-level government building, which housed sixteen different federal-tenant groups. The original contract followed a traditional design-bid-build delivery model, but the project was not approved for funding and put on hold in 2007.

In April 2009 the project was funded under the ARRA, which reinstated the project as active but required it to be re-scoped to align with the high-performance green building goals, adding new technical specifications. The ARRA required funding to be committed, or "obligated," no later than September 2010 and spent before September 2015. This funding goal became a driving factor in determining the collaborative project-delivery type. Market research demonstrated that a general contractor/ construction manager delivery method, which the GSA refers to as the construction manager as constructor (CMc), along with a guaranteed maximum price (GMP) contract type were most appropriate for the project scope and constraints—specifically, the securing of project funding by September 2010.

The approved acquisition plan showed the GMP as being established in July/August of 2010. Due to a variety of factors, the GSA changed the obligation-target date for all projects to March 2010, and the acceleration was very disruptive to this project team. Given the schedule and funding constraints, numerous factors led to a decision by the GSA to retain SERA as the architect for this project. SERA was able to engage in the request for proposal (RFP) process. Consideration was given to the following: SERA's original contract was not closed; SERA demonstrated past positive performance; and SERA had the support of the CMc and expertise in high-performance green buildings. To manage relationship risk for their early commitment to SERA, the GSA also included an option to convert the contract to design-build, although this was never exercised.



Team Selection

Primary Team Selection

A RFP soliciting contractors for the project was issued in late April 2009. Due to SERA's early involvement, they were involved with the selection of the contactor. The RFP indicated that the project contract would include a nine-month design phase with bilateral option for a construction-phase contract. It also invited contractors to attend a high-performance green building re-scoping workshop in May 2009. The GSA Project Executive remembered the event as a success: "All of the general contractors who were going to compete for the job were invited to participate. The first day they pretty much sat in the back of the room, but by the second day we'd gotten them all to the table. It really shows that we had a [construction] community that could meet any challenge if they were given the opportunity. There wasn't one person in that workshop that didn't want to produce a different type of building."

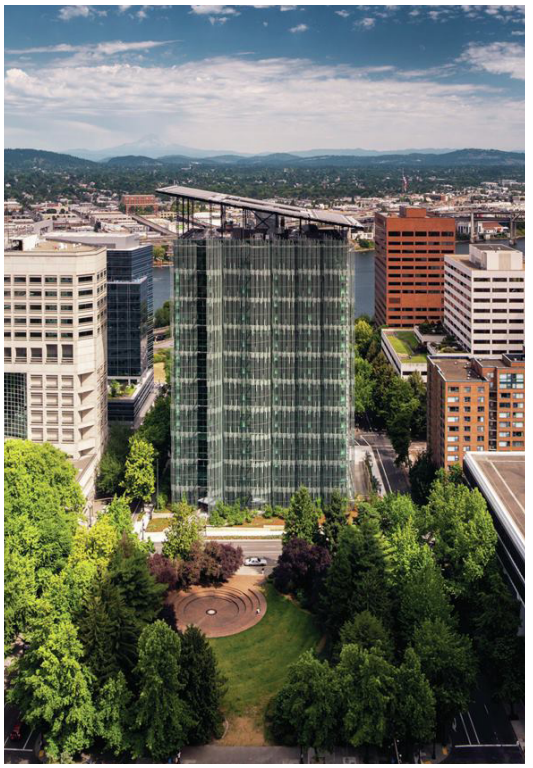
Unique to this RFP was that contractors were required to submit recommendations for their five first-tier subcontractors. Thirteen construction firms participated in early exchange meetings with the GSA's Region 10 during which they discussed the project history, design goals, and various site, budget, and schedule constraints. The integrated-delivery process was a key topic in the early exchange meetings, and it was emphasized that all applicants had to strongly support a collaborative approach. The final selection of Howard S. Wright (HSW) was based on its high scores in technical factors, including qualifications, past performance, and key personnel. The GSA also considered HSW's cost estimate and pricing for the design-phase services.

Consultant and Subcontractor Selections

Although HSW selected the five first-tier subcontracts, the GSA had active input in finalizing the selection. After evaluating HSW's recommendations, the GSA consented to HSW awarding contracts, conditional on re-evaluation during the design phase. Design-phase evaluation assured the GSA that the subcontractors selected offered the best value and had the technical capacities to put the documents together.

The entire project team was involved in the selection of remaining first-tier and second-tier subcontractors and in developing a selection process that maximized the engagement of each potential team member. The team developed a questionnaire to facilitate the process, asking subcontractors to describe their strengths, previous experiences, outcomes, and ideas for the project: "We tried to actually make [the subcontractors] co-owners of the project. We asked them for ideas. Most of them included a value engineering (VE) [cost saving] recommendation."

The selection of the commissioning agent (Cx) was unusual. Because of the GSA Central Office's concerns with radiant systems, the office tasked the project team with significant engineering analysis to validate radiant as the correct choice. The project team decided to involve peer reviews to evaluate the appropriateness of the radiant selection. The responses to the initial peer-review solicitation were limited. To increase market interest, the team solicited additional peer reviewers. Glumac was included in this round based on the recommendation of the GSA. Although the GSA's past experience with Glumac, specifically the Eugene, OR Federal Courthouse project, was positive, there were unresolved performance concerns from past project experiences between SERA and Glumac. A series of coordination sessions and team-building meetings helped resolve these issues and fully define scope, roles, and responsibilities for this project. Glumac was ultimately awarded the Cx contract and became a trusted member of the team; they contributed to improving the building while respecting the budget.



Contract

The EGWW delivery method was structured as a CMc using GMP, similar to the commercial delivery method referred to as General Contractor/Construction Manager. GMP contracts are not currently addressed in federal rules, so the type was authorized for use on EGWW as an exception. GMP contract types include a construction-contingency allowance, and in this case the contingency was not incentivized. However, an incentive fee was created separate from the contingency. In addition to rules governing contracts, there are GSA design criteria (P100, Facilities Standards for the Public Building Service) that had to be adapted for use in this project.

There is no standardized CMc delivery method, and the significant variations can be attributed to such factors as the owner/issuer, project constraints, geography, and experience of project team members. One commonality is the formation of the team (architect, engineer, and builder) very early in the project; another is that the parties will work collaboratively. One of the first collaborative efforts of the team was to convert the P100 into a set of criteria that would work for them. They created a crosswalk/checklist to identify inconsistencies between existing standards and the new high-performance standards associated with ARRA. This process led to improved quality control/quality assurance for design deliverables, identified requirements the team could not meet (and requested waivers for), and educated team members about GSA design standards quickly.

CMc+6

The GSA's Region 10 has been developing its CMc protocol since 2002, altering it after application on several projects and using a number-identification system to identify the different versions. Each instance of a major improvement to the protocol was identified with a number: the CMc+6 designation describes a protocol with six major deviations from the base CMc project. The CMc+6 method continued to be improved and revised during the project lifecycle and resulted in a delivery method that more closely resembles IPD.

There were several important collaborative strategies included in Region 10's CMc+6:

1. The GSA providing GSA on-site management/decision makers
2. Limiting third-party management contracts/contractors (owner agents)
3. Optimizing BIM
4. Selection of first-tier subcontractors before contract documents are developed
5. Shared co-location facilities
6. Scope by guiding principles and objectives to the greatest extent practicable

Improvements that were fine tuned or added at EGWW included:

- Allowing the prime to propose up to five critical first tiers as part of original CMc selection
- Emphasis on craft
- Integrated-document development
- Community outreach
- Project-labor agreements, Department of Labor–GSA Mega Project Protocols
- Aftercare phase
- Being a learning team

The GSA Project Executive (who was also the senior contracting officer) believes Region 10's CMc+ approach offers a viable alternative for integrated delivery in public projects until tripartite contract forms are authorized by statue or legislation.

Since SERA was continuing on from an earlier phase of the project, the GSA did not invest time to renegotiate the contract with SERA to include any of the collaborative commercial terms common to IPD projects. The GSA Project Executive believed that contractually separating the architect and contractor was a reasonable compromise for satisfying the GSA's contracting rules but made every effort to manage the project as much like an IPD project as possible. The structure of the team allowed for a healthy tension to be a constant in the project: each team was able to advocate for what was important to its discipline in the execution of the building but was exposed to all of the other competing priorities. This tension allowed for informed decisions to be made by the entire project team. It also offered the owner team the luxury of hearing all of the available options, allowing them to make well-informed decisions. In spite of the considerable investment devoted to developing a unique contractual language, once the contract was in place, it was not frequently referenced. The GSA Project Executive said, "Having on-site personnel, co-located with the team, has had a significant impact. This attribute may have had a greater impact than the contract form or type."

One of the challenges to integrated delivery is the budgeting of additional involvement and effort during pre-project planning. In this project, prices were based on metrics, such as level of effort or estimates of time and materials (T&M), which were later revised when program objectives and requirements were adequately defined to accurately determine T&M. Using T&M as the basis for price increased the cost risk to the owner, but since the technical requirements of the program were not fully defined at the onset, it was the more equitable way to budget.

The GSA also increased meeting frequency to mitigate the team's performance risk. The T&M approach reduced the team-member risk, as all their time was compensated. Time invested and the detailed Master-Scheduling process allowed the team to develop very accurate proposals for the fixed-price agreements in the design-development and implementation phases, which ultimately reduced the project cost for the owner. The team concluded that increased team building, up-front planning, and integrated-delivery practices reduced change orders. This team estimates its change-order rate as less than 3%, which is well below industry averages.

Verification

A verification phase was not originally planned for this project. Late in the construction phase, when approximately 90% of the costs were known, it was clear that contingency funds and savings in several areas would provide the funds to extend the original goals and improve the project. There was consensus within the project team that it was important to ensure a smooth transfer of building operations from the project team to the facilities managers. The GSA Project Executive worked with the contractor to outline the value of a verification phase and its associated costs. After looking at known post-completion problem areas, such as elevators and landscape maintenance and limits to construction warranties, the team understood that some new services might be needed. Beyond known post-occupancy challenges, the team explored the following: "We started looking at who we wanted on the site. Who had been making major contributions? Who was making value-added decisions? And what would it take to actually have them extend another year? We were trying to make sure that the tenants would be absolutely delighted by the building that we were providing them."

Costs were established and project contingency was accessed to fund services in this newly created phase, based on the belief that the investment would have a large payoff in terms of tenant satisfaction, improving the performance of the building and revealing how to do things even better in the future. The team called the verification phase aftercare. Noted in the 50% Peer Review is support for the value of the verification phase. A team member notes, that given the complex nature of high-performing buildings "it's inconceivable to me that somebody could get to substantial completion and expect the building to work the way it's supposed to work—or, more importantly, perform at its optimum."

The team expected issues when the tenants moved in and, as anticipated, received complaints about the temperature and stuffiness. The radiant heating and cooling was silent, and some users were accustomed to more noise and air movement associated with conventional forced-air systems. The electrical consumption was higher than predicted in the model, but the team was able to track down the source of the overuse. Close to one hundred changes (including new hot-water heaters and vents) to the building's automated systems were made in response to tenant feedback and to optimize energy use. Overall, the team estimates a 3–4% gain in performance efficiency attributable to these revisions.

Team Building & Collaborative Culture

Collaborative Culture

The EGWW project team instituted a number of unique processes to maximize team readiness before beginning construction. One of the most unique aspects of this project was the intensity of the planning of the work and of team orientation. A four-month process of contractor selection included early exchange meetings and market research, which led to the selection of HSW. Several more months were spent on negotiating the agreement, orienting first-tier subcontractors, converting from CMc to integrated delivery, planning building information modeling (BIM), and negotiating co-location specifics. This extensive early planning supported team building, creating a collaborative culture as well as providing a basis for alignment around goals, strong relationships leading to trust and respect among team members.

Central to the early planning effort was the Master Schedule (MS), which required input from all team members. According to the GSA Project Executive: "One of the real values of integrated delivery is the ability to get each team member oriented and integrated before we start to build. The more we can front load the schedule and the more we can allow team members to influence the project when we are still on paper, the greater impact we control as owners in terms of change control—cost, budget, etc." A payoff of the time invested in team education and relationship building became evident when the entire executive team became champions of the integration and inspired others to advocate for integrated and flexible teams.

Right People

Once the project began, the entire project team was invited to participate in open discussions about team-member fit. These discussions were open to everyone. Anyone could identify potential issues, and then the team would work to address them. This level of transparency was refreshing to team members: "This process basically gave us an understanding that if someone wasn't working out and their personal traits just weren't meshing with the team, it was time to raise your hand and say something. It's not because they were incompetent or bad people or couldn't do the work. They just weren't the right fit for the project needs."

The team observed that a collaborative environment is not for everyone. For the architects, the chosen team members met two important criteria beyond the designated skill set: an ability to take input from multiple sources and an open mind. Two additional requirements were identified by the GSA for successful team participants on an integrated project: first, a familiarity with each other and a positive dynamic, and second, a passion, desire, and commitment to work together, learn together, and innovate for the good of the project. The team recommended developing a tool that could be used to assess the fit of each team participant in the organizational culture as a way to improve future integrated teams. In addition to helping identify team members that would fit well into a collaborative environment, the tool could also help identify areas in the organizational culture where additional support is required for collaboration to be fully adopted by the entire team.

When a team member did not fit with the collaborative culture, the project leaders were expected to replace them. "When issues arise, the problem may be with scope of the project or could lie within the team composition itself." Team leaders were very deliberate in their assessment of team members—during the project they replaced an electrical-engineering firm, a mechanical designer, and a landscape-design firm.

In the case of a poor fit with a primary design consultant, team leaders faced a choice of continuing to invest in a weak link or to let the company go. This team decided to retain the consultant for the core-and-shell phase but shifted the tenant-build-out phase to the contractor, using a design-build contract. Because of the nature of an integrated team, the relationships and technical support were in place to make this major change without delaying or otherwise negatively impacting the project. Those challenges would have been devastating on a project with a traditional delivery method, potentially leaving the owner exposed to dispute.

Champion

GSA Region 10 is driven by the philosophy that the owner needs to set the value proposition. In other words: "This is my project, my money, my problems and this is what I expect of you." The owner is ultimately responsible and therefore can't sit back in a typical role but needs to take an active role driving the process and managing risk.

To be an active manager of the process, the GSA believes that the owner needs to be on-site, engaged in the integrative process and forming relationships, rather than hiring agents to be the owner's representatives. Often active participation is a challenge, especially on the institution side in which owners represent large bureaucracies that are often, by nature, risk adverse. Although the GSA's Project Executive/ senior contracting officer was officially dividing his time equally between this project and another, he spent closer to 75% of his time on-site for this project. He believes integrated projects should require the owner to be on-site full time, due to their resource-intensive nature. Investing in integrated-delivery methods is a strategic decision, and the owner needs to be prepared to provide the necessary resources.

Goals & Alignment

The EGWW team interpreted the ARRA's high-performance goals as an opportunity to "demonstrate to the entire market place how we can build buildings differently." The project team was highly motivated by the lofty ARRA mission and expanded on the building-performance goals to introduce sustainability in as many aspects of the process as possible. They asked, "'How are we sustainable in our procurement?' 'How are we sustainable in our communities?' 'How are we sustainable in how we hire the work and declare workforces?'"

The GSA project management team used a very deliberate planning phase to slow down and ensure that all team members bought-in to the project goals and developed a sense of ownership. Initially, project leaders found it challenging to slow down the team (contractor, architect, and consultants) and commit them to team building before beginning the work. Some members of the team, who wanted to begin designing sooner, recall that at the time, the six months of planning, identifying problems, analyzing issues, and clarifying the goals was "excruciating." However, most came to believe during the course of construction that the longer process maximized the effectiveness of the appropriate person at the right time, reducing wasted effort. The GSA Project Executive distinguished between the base level of service any team will provide and that of the high-performing team who define the problems, find alternative solutions, and affirm the owner's requirements, commenting that in this project, "I'm buying that high-performing team."

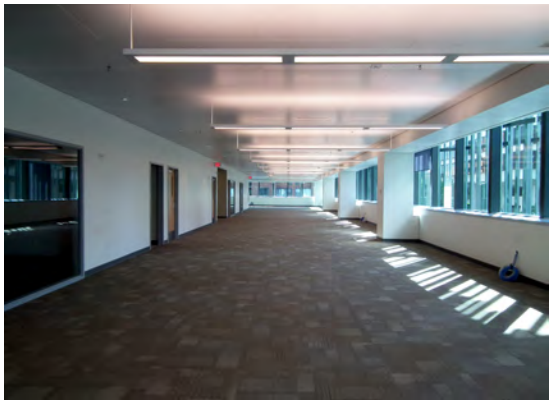
Subcontractor and Manufacturer Alignment
Alignment among the primary team members was extended to include the much larger group of subcontractors and manufacturers. The team's careful explanation of the overall energy goals to everyone involved with the project resulted in unanticipated benefits. For example, several of the manufacturers voluntarily altered their packaging and packing material, simplifying their assemblies to ship in more consolidated packages to reduce waste. A more extensive example of engagement by a range of participants is demonstrated in the selection process for the artificial lighting. The process incorporated not only the energy goals but also the operations and maintenance of the fixtures. The team asked installers and facilities managers for feedback during the light-fixture-selection process. When this feedback was shared with the manufacturers, some elected to drop out of contention and others opted to make changes to their products based on the feedback. The products evaluated during the final round of the selection process had been revised to improve the usability of the products.

Prominently displayed on a lobby wall of the EGWW is a list of names of those who worked on the building. Resembling a donor wall of a museum, this list honoring each contributing individual is a clear demonstration of the collective goals of the entire project team. A series of discussions were held at social events that also served as mandatory safety meetings. The resulting criteria determined who would be listed (minimum number of hours and days), how they would be listed (by trade or by subcontractor), and a recognition of those serving above and beyond expectations (identified through a nomination-and-selection process developed by the group and designated with bold typeface on the wall). The wall provides a source of pride for the entire team, evidenced by the many people who visit solely to see their names and point them out to coworkers and their families. The project leaders believe that there is a connection between this satisfaction and the higher-than-industry metrics for level of finish quality as well as the lower-than-industry for trade damage.

Tenant Engagement
In the first iteration of this project in 2005, the GSA had planned to keep the building operational during the course of construction. This limited the extent of the work, but there were few alternatives because of the very low vacancy rate in Portland at the time. Fortuitously, the economic downturn resulted in a nearby LEED-certified building to be left vacant. Using the building as office space for the EGWW agencies simplified the construction logistics and allowed a more ambitious program. Additionally, it freed the team from the constraints of particular tenant programs since agencies would have the option of staying in the new space or moving back to the renovated building. The team saw this as an opportunity to create a workplace that would attract agencies with values and practices that matched that of a high-performance project. Some agencies were able to work with the lack of partition walls (since the radiant-cooled ceilings were designed for specific requirements), a larger range of acceptable temperature variation, a centralized server room, and other deviances from a standard GSA building. The ideal layout clustered enclosed offices toward the core of the building, leaving open offices near the windows, ensuring access to daylight and good air flow for the radiant heating-and-cooling systems.

The team developed a strategy for conceiving the spaces in a manner similar to a condominium: the tenants could adapt the spaces as long as they respected the basic rules of how the systems operated and the office layout that supported them. The team collaboratively arrived at a strategy of a base model unit, the "condo model," which was adopted by the tenants.

Image: Radiant ceiling panels



Role Definition & Accountability

Roles

The EGWW team heavily invested in team building and leveraged planning processes and tools, such as the Master Schedule *(click for more on the Master Schedule)*, to develop trust and create a collaborative environment, reinforcing its belief that the best value of integrated-delivery practices occurs when team members free themselves from traditional roles and responsibilities. As a result, project roles were not specifically defined. Instead, the entire team was viewed as a collection of individuals who could work together to meet the project's goals: "We didn't really get hung up on [job] titles. We got hung up on who could do the work the best, and we moved responsibilities around accordingly. The roles changed a lot."

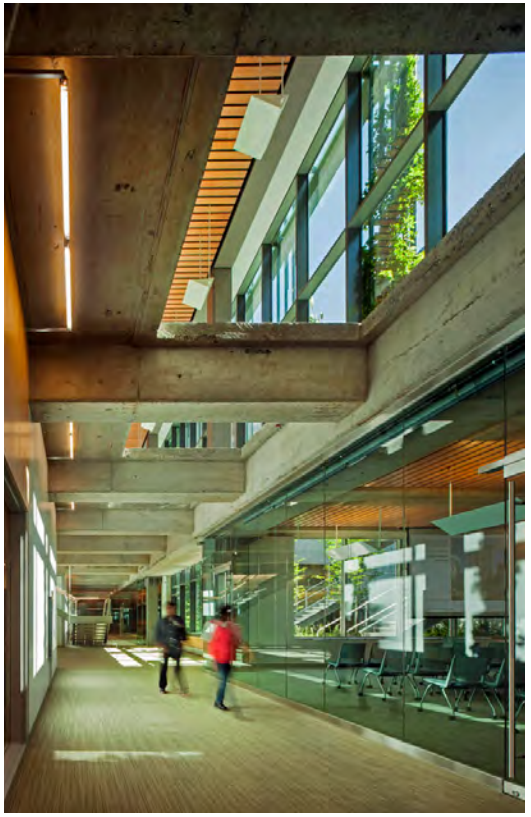
Successfully maintaining flexibility requires energy and passion as well as the ability to break others out of old routines and prevent them from slipping back into conventional roles. In this project the GSA Project Executive initially filled that role, acting as a champion for the integrated process and flexible roles. As the project and relationships progressed, the entire core team embraced flexibility and collaboration. Specific process tactics, such as the mini-Master Schedule *(click for more on the mini-Master Schedule)*, supported accountability since responsibility for tasks was tracked and individuals were held accountable for accomplishing assigned tasks.

The GSA Project Executive believes that investing in the development of collaborative teams with blended skill sets is a policy that should be more widely adopted by the GSA. He believes traditional role definitions create silos of responsibility that rely on separation and oversight, which are expensive and inefficient:. "The classic bureaucratic government response, 'We're just going to add one more layer of bureaucracy,' is fine as long as you can afford it. My argument is that you're not going to be able to build high-performance buildings this way. We will have to have blended skill sets."

Accountability

There were several logistical and process tactics that tracked assigned tasks; consistent implementation of tactics such as Master Schedule or BIM Snapshots *(click for more on BIM Snapshots)* facilitated accountability. In particular, working through schedule items allowed the team members to learn to cooperate with each other and gain a clear understanding of the team dynamic the owner required. This additional planning period provided the team members with the opportunity to work closely with the owner and each other and to develop enough confidence and trust to speak candidly with each other about what was really important to the project.

The trust and respect built by the team through their early investment in planning was maintained through team continuity. The CMc noted that one of the keys to making integrated delivery work is trust and continuity, particularly on the ownership side. In this case, the GSA committed to keeping a team in place for the duration of the project. On the majority of the CMc's other work, the architect and consultants disappeared from the project during the construction phase, spending only part time responding to field issues. This structure causes major latency risk for the contractor. Because of the commitment by the owner to support the project through its duration, the CMc was more willing to partner with the architect and engineers to both prioritize work and to let some of the work shift to later in the process because he was confident the integrated team would be there "together, feeling the day-to-day pains and rewards" for the duration of the project.



Managing Schedule & Budget

Schedule (Master Schedule and Mini-Master Schedule)
Central to process management on this project was the creation of a Master Schedule (MS). The development of the MS started as an index of potential contract activities and tasks, which then grew to become the primary statement of work and specification. The MS was created through a structured decision-making process that documented, sequenced, and prioritized all the work and team protocols required to execute the project.

Initially, the core team developed the MS. It continued to evolve and expanded to include a larger group during each design phase as the team further identified and delineated major areas of work. The GSA recognized that identifying non-priority items was as equally critical to the team's success as identifying priority items, because no project has the resources to do everything. At executive-level biweekly reviews, this tool helped the owner identify items that could be disinvested.

A series of mini–Master Schedules (mMS) detailed out how each task would be accomplished. After each MS meeting, the team reviewed the mMS to identify any missing items and to prioritize work. Developing the mMS created agendas for breakout meetings and helped identify items that required additional meetings for resolution. The MS and mMS were so effective in recording tasks and responsibilities that traditional meeting minutes were not needed.

A part of the mMS process that helped foster a sense of ownership across the entire project team was the assignment of individual team members to specific task items. These individuals were identified as subject-matter experts and became responsible for resolving their items through whatever means necessary. This created a decision-making system that led to distributed leadership. Creating multiple scales of project ownership ensured that healthy debate could lead to decisions made in the best interest of the overall project.

Budget
The EGWW team managed their budget in a highly collaborative manner. While the GSA owner was the final decision-maker, the contingency was treated as a pool of money to be used to benefit the project and decisions for its use was shared. Particular savings were attributed to the way value engineering of the GMP budget was inclusive of both prime and selected first-tier subcontractors. Collaborative decision-making was used for reducing project budget as well as prioritizing additions or restoration of budget. At the same time items were eliminated to meet the GMP, the team created a prioritized list of items to be restored, dependent on funds and schedule. Through this "buy-back", the team believed decisions and reallocation of contingency were more expeditious and less difficult than typical VE process. Like most renovations, unforeseen conditions had to be managed. EGWW took a team approach to decide how contingency would be used to address those issues. Overall, shared contingency management proved to be extremely effective for this team in two ways: sufficient funds remained to invest in a verification phase not originally in the budget and the process of managing the funds strengthened trust and alignment within the team *(click for more on the verification phase)*. The team noted a potential improvement in the future to make a more clear distinction between change orders and buy-back options. They also noted a potential for improvement by negotiating a consistent team-wide process for formulating projections and estimates of costs.

Information Management
The GSA working processes and project requirements, from contractual obligations to transparency and reporting procedures, can be difficult to understand. The team developed graphic flowcharts to present these processes visually. These flowcharts facilitated an understanding of overall processes and the requirements (and their associated tasks and deadlines) the GSA placed on the team. They also enabled the team to present the complete process when delegating individual tasks.

The team implemented a project diary into which members recorded and communicated project information. The diary was distributed weekly to the entire team, including all contract parties and at all job levels, and highlighted major decisions and progress. The architect managed the diary, but the CMc and owner also contributed content each week.

The team created a list to track value creation per subcontractor by logging VE decisions and linking them to financial savings. The list incentivized subcontractors. Unfortunately, the list proved difficult to maintain for the full duration of the project to link savings with financial incentives. For future projects the team recommends improving the strategy, as it is a way to clearly illustrate the value of integrated-delivery processes by connecting VE decisions—facilitated by early integration—and collaboration to financial outcomes.

BIM & Design Documentation

BIM

The project team was innovative in its use of BIM by developing an information room (which they dubbed the iRoom), a combination of centrally managed BIM in a co-located office. Throughout the design process, team members had access to each discipline's designs via co-located BIM models on a shared server in the iRoom. Engineering consultants were required to work in Revit and be co-located with the GSA, design, and construction teams. All BIM models were available at any time to the project team, allowing for on-the-fly coordination between disciplines. First-tier subcontractors were also co-located, allowing them to provide constructability reviews in real time using virtual models during design and construction.

BIM Snapshots

The project team also developed a unique BIM process they called "BIM Snapshots." Instead of structuring the delivery of drawing packages following typical phases (50% SD, 100% SD, 50% DD, etc.), BIM Snapshots created drawing packages by capturing images at specific moments during design, after which the team literally printed drawing sets from the BIM model.

The project team recommends further refinement of the BIM Snapshots document-delivery structure by requiring a formalized time-out review after a BIM Snapshot is taken. This would require teams to freeze the BIM model after taking a BIM Snapshot for a formal review period. The review would focus on understanding the documents that have been produced, determining if varying levels of completeness between disciplines will result in coordination issues, reviewing any outstanding engineering required for custom elements, and taking time to redefine deliverables for any subsequent BIM Snapshots.

Design Documentation

One of the most unique aspects of this project was the alignment of BIM Snapshots with the CMc's buy-out strategy, made possible by the back-and-forth coordination between the CMc and the architect. According to the owner, it was important for the entire team to acknowledge that the purpose of the technical documents was to validate owner intent and to provide the information necessary for the CMc to solicit subcontracts—the documents did not need to be complete. This approach allowed prioritization within the design process, deferring non-critical portions of design to later phases. This helped maintain the aggressive schedule. The team estimates a $940,000 savings in project costs because of the reduction in the hours spent on design documentation—from a typical schedule of 53,000 hours over twenty-four months to 44,000 hours over fifteen months.

Subcontractors embracing this process issued design-build contracts so that the tradesmen who built work would also be responsible for the design. Essentially, this allowed the architects to complete the design through an "active listening process," engaged with the trades. This was more efficient than the traditional delivery method in which architects would design independently at first and then later rework the design with input from the trades. The team estimates that the applied process reduced the change orders to less than 3%.

Meetings & Workplace Environment

Meetings

Project direction was quite fluid, and interaction occurred at many levels within a structure that centered around an executive team, which included very involved, high-level representatives, such as the project managers, owner, architect, and contractor. The executive team had lengthy weekly meetings. Project managers broke out from those sessions to work with the integrated team members. The MS and mMS were used to identify and communicate the priority tasks *(click for more on the MS and mMS)*.

This project had a very active meeting schedule during design that focused on specific sets of topics, such as exterior, landscape, and MEP coordination. Integrated representatives from all primary contract parties and relevant trades attended each meeting, and a point person was assigned to each topic so that the first lines of communication were clear. The clear role of the point person and the assignment of responsibility supported the overall sense of accountability shared by this team. The team recommended improving the process by dedicating an individual to be responsible for meeting scheduling, invitations, and coordination on future projects.

Co-location

As the project began to fully ramp up in January of 2010, the design team realized they needed to begin the co-location process as soon as possible to start testing the systems being purchased for the project, work flows, and personalities on the team. SERA set up a small co-location space in their office and had several members of the structural engineering and mechanical teams begin working with SERA to refine the processes the team would be using in the co-location space. The team developed the iRoom, leveraging BIM and co-location to facilitate collaboration. All consultant BIM models were hosted on a shared server in the iRoom and were available to the design team to allow for on-the-fly coordination between disciplines. The team estimates an $82,000 savings in travel costs as a result of the co-location of consultants.

When the iRoom was fitted out in March of 2010, the full design team, including the architects, structural engineers, mechanical engineers, plumbing engineers, electrical engineers, and representatives from the general, mechanical, plumbing, and electrical contractors, were present in the room. At the mid-point of design, when the engineering for the project was nearly complete, a transition from the mechanical and plumbing design teams to the mechanical and plumbing construction-detailing teams occurred. What was conceived of as a hand-off between these two entities was not fully scripted and lead to challenges in the detailing of the project. The entire project team agreed that the mechanical and plumbing designers needed to be more fully engaged with the contracting design teams well into the detailing process to allow greater understanding between engineering and the routing of the systems.

GSA Peer Reviews & Expertise

GSA Peer Reviews

Peer reviews for this project were extremely supportive of the decisions made by the teams and for the most part recommended the continuation of practices. Numerous best practices were noted, which could be shared within the GSA and industry-wide. Support for the decision to use contingency and savings for a verification phase *(click for more on the verification phase)* attest to the team's ability to demonstrate the value of aftercare and its effective use of funds, as well as the way that the team was able to use the peer-review process to test and confirm their progress.

Expertise

As part of the up-front planning process, the team reconsidered traditional staffing practices. Investment in full-time staffing for the duration of the project was identified as a key requirement to best support integrated delivery and technologies, like BIM. As the architect noted, on complex building projects as much as 50% of the architectural fee goes to pay for consulting engineers' services. The business model for most engineering firms does not support full-time staffing on one project: individuals typically work on multiple projects simultaneously and can only allocate a small percent of their attention to any one project. As a result, problems that could be resolved in a twenty-minute, three-person conversation can take days or weeks to resolve. Another compounding factor is that priorities and issues can change at a rapid pace during construction. If these shifts are not effectively communicated to part-time consultants, they may produce solutions to problems that are no longer relevant, which not only wastes time but also may require additional effort to resolve.

When the co-location space was developed, the consultants were engaged in review processes for input on layout and buy-in regarding how their staff would be utilized during the design phase. The larger project team identified when and for how long consultant staff would be needed and tailored the schedule to accommodate the consultants as they learned a new workflow. In the end, all of the design consultants had a presence in the co-location space, with the structural and mechanical teams having the largest presence and the civil and landscape teams having the least. The GSA believes that bringing on subcontractors and engaging them in the decision-making process early greatly increased their control over costs and the schedule. They estimated that 60% of their cost exposure was known before the start of construction.

Building Innovation - Radiant Ceiling Panels

The story below demonstrates how this project team was able to effectively manage risk. By working together, they developed processes to partner with a manufacturer.

The design of the interior spaces in the EGWW used several mechanisms to reach the target goal of 40% reduction in energy use. Of that reduction, 90% can be attributed to the elimination of fans found in traditional heating, ventilation, and cooling systems. Fans were unnecessary since the design called for a radiant-cooled ceiling working in conjunction with highly calibrated window shades and artificial and natural lighting.

Radiant cooling is a relatively new technology in the United States, and the team believed it could play an important role in achieving the building's energy goals, complementing the use of known technologies, such as daylight, shades, and lighting. The team's first challenge was to sort through the marketing claims from radiant manufacturers. They developed a two-stage process for procurement: first, the manufacturers estimated how many panels would be required to meet the target cooling load and the cost; second, they needed to guarantee the output and make a final bid. Information provided to meet these standards allowed the team to directly compare products.

Since radiant cooling is new to the U.S. market, it had not been incorporated into the GSA national standards, and there was resistance to using them. While identifying a manufacturer, the GSA project team successfully persuaded the GSA national leaders that radiant cooling should be used. The team shifted the focus to the overall energy goals for the building and demonstrated how new technology was essential to meeting those goals.

Using information from manufacturers, the team held "radiant summits" to work out conflicting opinions regarding the best use of the system. These were very focused, intense-yet-civil discussions that sometimes resulted in design changes: "We challenged each other around the table....The radiant panel now at the perimeter wasn't there in the original design. It got added based on input from not just McKinstry, not just Stantec, not just Glumac, not just SERA, but all of us coming together." The team used digital and physical mock-ups to test radiant-panel designs and found them very helpful. Two rounds of mock-ups were needed to finalize fit and finish. After the team reached design consensus, they focused on choosing a panel manufacturer.

The manufacturer who best met the criteria came with known risks. SERA was working with them on another project, which had serious late-delivery and low-quality issues. There were concerns about the manufacturer's capacity to handle a project the size of the EGWW while it was struggling to meet the demands of the other project. Delivery and installation deadlines are normally the sole responsibility of the subcontractor; however, the EGWW team knew that "HSW is managing the whole effort and involved in the installation. On the other project, the general contractor is just not going to touch it, saying, 'It's not my problem. Others go solve it.' But in this case, this is the whole team's problem."

The team knew they needed to manage this risk and decided to reallocate funds and designate a team member to work directly with the manufacturing facility in Ohio from the onset. A team member from SERA made many extended visits to the plant to ensure production speed and quality and also coordinated visits with the owner and contractor. Direct feedback loops occurred. For example, when paint quality was identified as an issue on the other SERA project, the team increased paint inspection. The knowledge of the risk turned into an advantage because the team could confront it directly.

Team members expressed an unusual level of mutual trust and respect, safe in their belief that others were listening to their concerns and were willing to take responsibility for the risk: "For me, it was unique to be in a position to see that my team was expressing a significant concern and having the owner in the group say, 'We understand. We think that the benefit is worth the risk.' Having that really clean and open dialogue. That's not your everyday life [in the building industry]."

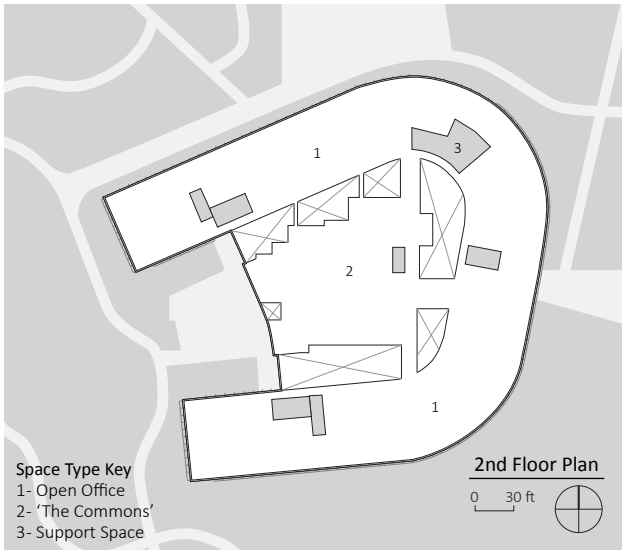
Architects do not typically work directly with manufacturers or closely with the management of deliveries. The architect had direct knowledge of manufacturer-performance issues and was willing to step outside the conventional bounds of his or her role. This willingness to fully participate in the risk reduction was largely due to trust and the collaboratively developed process: "It gave us a level of comfort to know that we're not just blowing hot air. At no point were we in a position to say, 'Had you listened to us, we wouldn't be having this problem.' We understood what the decision-making process was, and we understood how we're going to interact with the team going forward. It needed to be different in order to help HSW and McKinstry work through the management problems that we saw coming."

One of the largest concerns with radiant-cooled ceiling systems is the limitation placed on wall partitions. The manufacturer provided valuable input to minimize the negative impact, working closely with the architect, contractor, building-facilities personnel, and engineers. With the combined group expertise, the so-called dead-zones of inactive panels were developed: "These six-inch swaths provide a tremendous amount of future flexibility in case the floor needs to be remodeled, which is one of the fears with radiant." The team also worked closely with the tenants to coordinate their interiors with the radiant-panel design.

The last hurdle that the team faced with the radiant system was the system operations. Since radiant uses temperature-controlled water in a series of pipes, the operation is different than most systems, which rely on forced air and ventilation. As a team member noted, "The final piece was trying to figure out how to train the facilities managers to operate the building in a way that is consistent not with an airside building but with a waterside building. There was an extended aftercare that we implemented. You can't just turn down the air temperature. You can't just increase the amount of fresh air coming in. You actually need to look at how the building's performing on the waterside."

Project Overview

Project	Federal Center South Building 1202
Location	Seattle, Washington
Project Type	New Construction
Contract	Design-Build
Owner	U.S. General Services Administration – Northwest/Arctic Region, Region 10
Architect	ZGF Architects LLP
Contractor	Sellen Construction
Project Start	July 2010
Project Completion	September 2012 (met schedule)
Project Size	209,000 GSF
Project Height	3 Stories
Project Budget	$65 M (met budget)

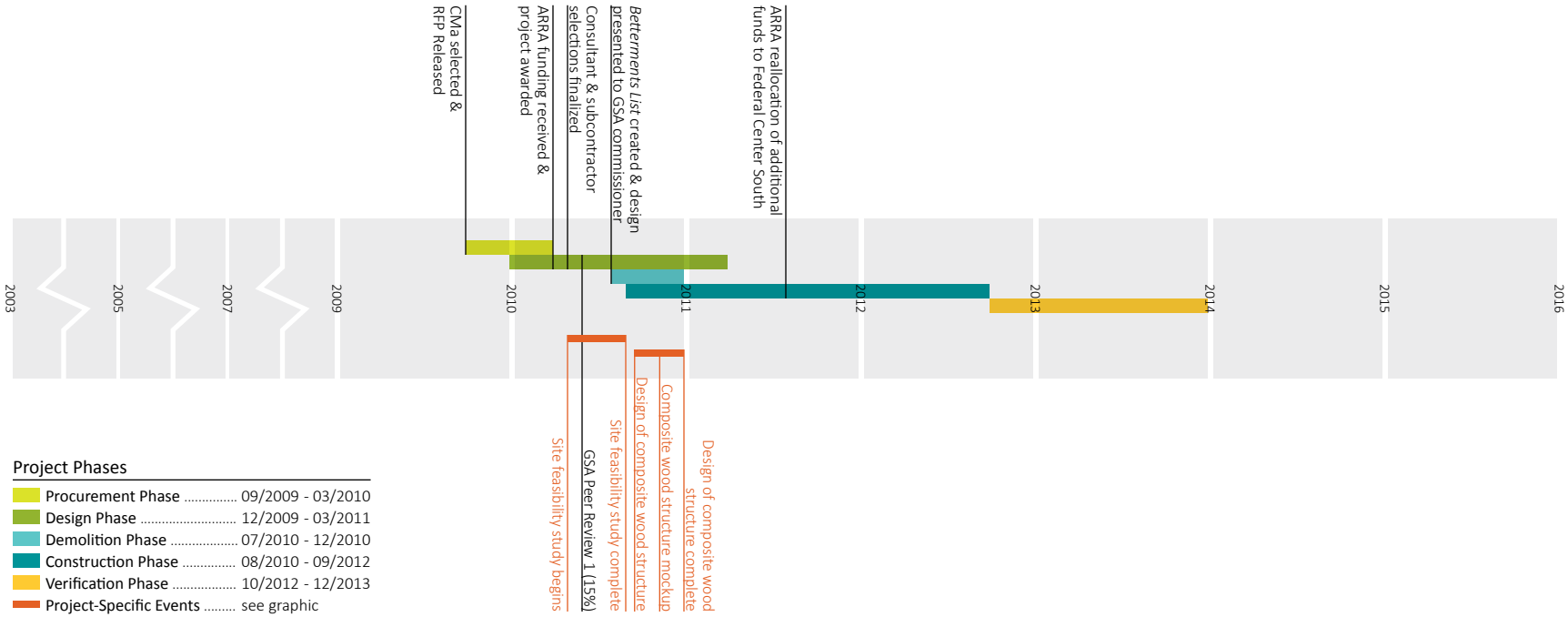


Project Timeline

The Federal Center South Building 1202 is one of the highest-performing office buildings in the United States. It transforms a 4.6-acre brownfield site into a highly flexible and sustainable 209,000-square-foot regional headquarters for the U.S. Army Corps of Engineers (USACE) Northwest District. The project team was able to achieve a beautiful designed workplace using technically complex systems within challenging budget and schedule constraints. A major source of complexity on this project was potentially contaminated soil and proximity to complex natural hydrological forces. This risk was mitigated by the GSA engaging actively as the site owner, granting early site access to the project team and obtaining information in a timely manner. Before design began, consulting experts were asked to determine the nature of specific site challenges. Team selection was done with the goal of bringing in the correct expertise for the complex site conditions. Heery International was hired as the construction manager as advisor (CMa) to complete the initial energy modeling and write a statement of work for the design-build project.

Site conditions aside, other factors contributed to the complexity of this project. A pile-supported warehouse occupied the site and had to be demolished. Timber from the warehouse was inventoried and reclaimed for use in a prominent part of the new building, which required extensive design coordination to maximize the use of the reclaimed material. The high-performance goals were achieved utilizing several innovative technologies not commonly used in the United States, which increased the need for system coordination and overall team collaboration and communication.

Decision making and tracking were key efficiencies for this team, and the team was very effective in developing stretch goals that would improve the project, creating what they called a betterments list. The list was an important decision-making mechanism, establishing aspirational goals with clear budget implications and time horizons for decisions. Although the design-build project delivery used on this project was not common for the GSA, team members' past experiences with this type of delivery meant that the novelty did not pose significant risk.



COMPARATIVE ANALYSIS
Comparisons & Best Practices

WAYNE N. ASPINALL FEDERAL BUILDING & U.S. COURTHOUSE
Historic Renovation — project type
Design-Build — project delivery
Integrated Firms — team culture

EDITH GREEN - WENDELL WYATT FEDERAL BUILDING
Renovation — project type
Custom CMC+6 — project delivery
Up-Front Team Building — team culture

FEDERAL CENTER SOUTH BUILDING 1202
New Construction — project type
Design Build — project delivery
Leverage Project Interactions — team culture

Team Organization

Design-Build Team
The architect and contractor had extensive experience working together but not in the design-build setting. The strong relationship made it relatively easy to adapt to a design-build team.

Owner

U.S. General Services Administration - Northwest/Arctic Region, Region 10

Design-Build Team

Sellen Construction
General Contractor

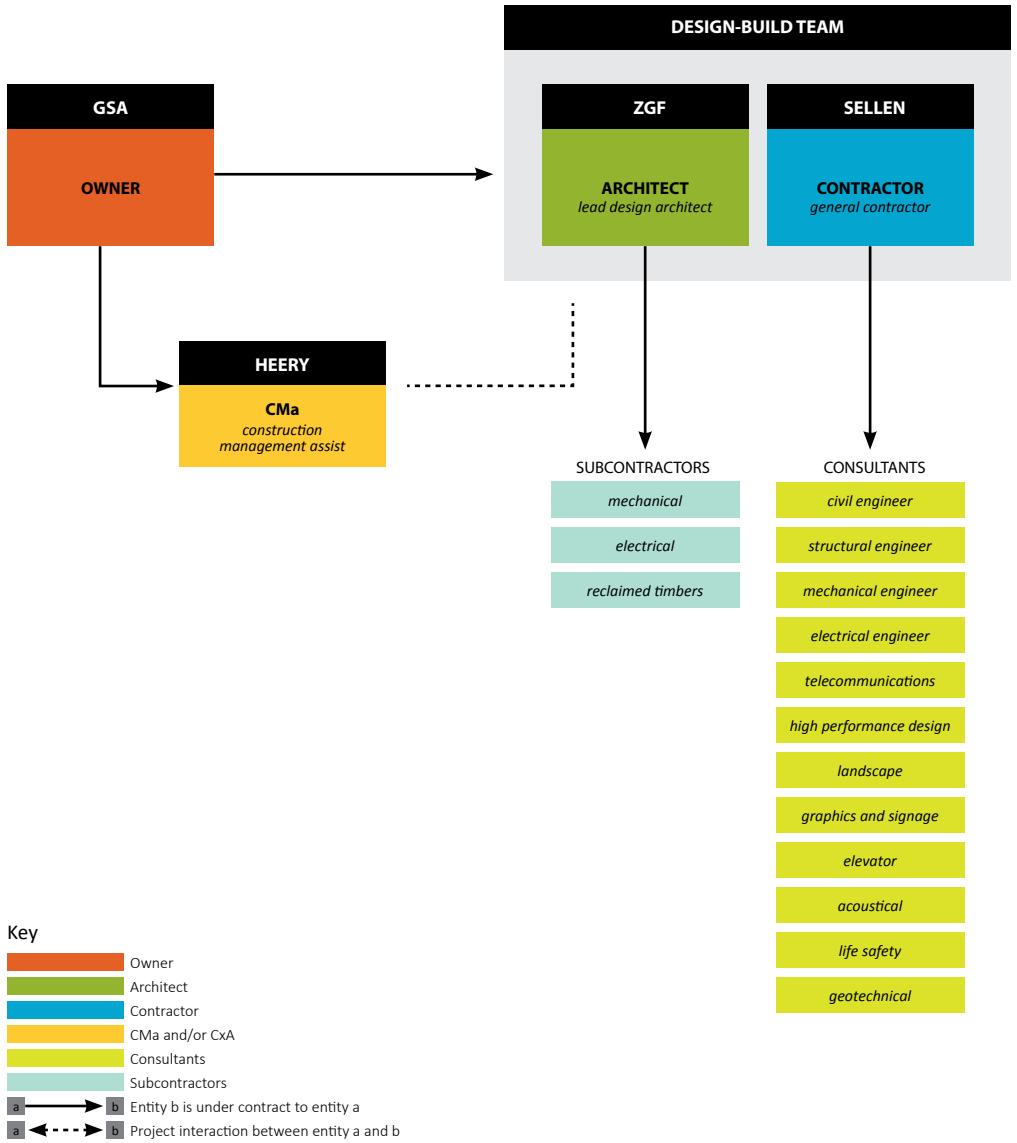
ZGF Architects LLP
Architect

Construction Management Assist

Heery International

Consultants & Subcontractors

Structural & Civil Engineer - KPFF Consulting Engineers
Mechanical & Lighting & Telecommunications - WSP Flack + Kurtz
Electrical - Lane Coburn & Associates
High Performance Design - Built Ecology
Landscape - SiteWorkshop LLC
Graphics & Signage - Studio SC
Elevator - Lerch Bates
Acoustical - The Greenbush Group
Life Safety - Tuazon Engineering
Geotechnical - Hart Crowser & Associates
Mechanical Subcontractor - University Mechanical
Electrical Subcontractor - Sequoyah Electric
Reclaimed Timbers - GR Plume Company



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Energy Performance

Energy Performance

Conventional building systems have been replaced with efficient hydronic heating and cooling. To enable these systems to perform at an optimal capacity within the project budget, an efficient building envelope—offering high-performing glass and a high level of solar control while transmitting ample daylight—that reduces the magnitude of heating and cooling demands is used.

Energy and water in this building are leveraged for highest possible use. Air conditioning is delivered to the workspace via heat-recovery air-handling units and exhausted passively through the atrium back to the air-handling unit that preheats the new outside air as it enters the building.

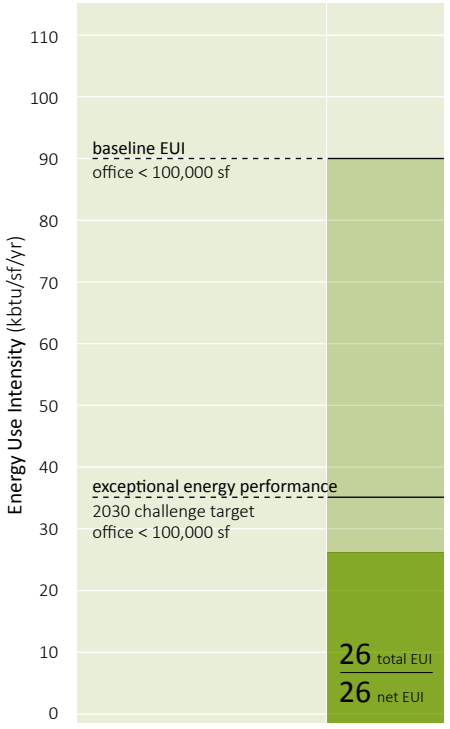
Electric-lighting design is a simple, repetitive task/ambient design that achieves a building-wide lighting-power density of approximately 0.72 W/ft2 or less.

The design capitalizes on both daily and seasonal heat-exchange patterns to collect thermal energy when available and stores it for use when needed. A thermal storage tank containing phase-change material, a solution that freezes at 55°F, is frozen during morning warm up using the free cooling generated by the heat-recovery chillers as they heat the building. The frozen thermal tank is used later to cool the building. Similarly, a ground loop acts as a heat or cooling source for efficient heat pumps when there is not enough storage in the thermal tank.

Key

Total Energy Use Intensity - Project doesn't have Renewables or Offsets

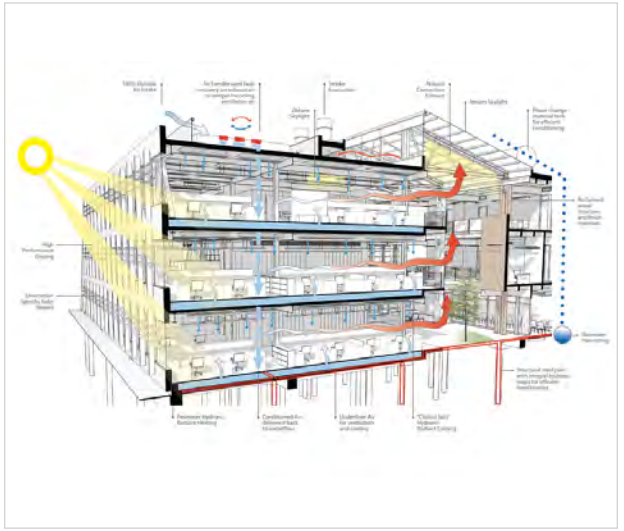
Baseline Energy Use Intensity for Similar Building



Energy Use Intensity

Energy Use Intensity (EUI) measures a building's annual energy use per unit area (kBtu/sf/yr). Each project's EUI is compared to a national average baseline EUI for office buildings of comparable size. A low EUI is an indicator of good energy performance as it represents an energy savings against the baseline.

EUI before renewables (kbtu/sf/yr)	26
EUI after renewables (kbtu/sf/yr)	26
% energy reduction (from average building type EUI)	71%



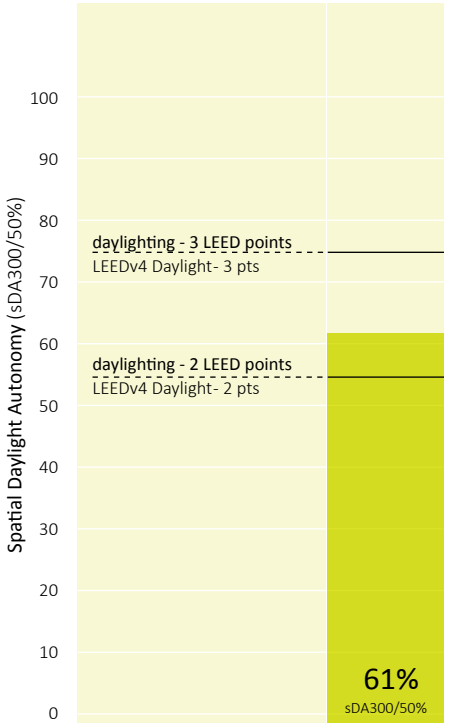
Daylight & Indoor Air Quality

Daylight

The narrow sixty-foot floor plate optimizes daylight penetration, reducing the need for artificial light and associated energy costs. Fifty-inch workstation partitions help maximize daylight effectiveness. The atrium presents a variety of changing light experiences as the sun moves across the sky. A varying percentage of frit implemented in the glass skylight responds to solar exposure, balancing light, views to the sky, and solar gain.

Indoor Air Quality

Natural ventilation was originally considered in order to save energy and promote occupant connection to the outdoors. Ultimately, this was not feasible because of federal-security requirements and poor air quality due to the proximity of a cement plant. Instead, 100% outside air (MERV-15 filtered) flows into workspaces via under-floor plenums and then exits the building through the atrium. Air handlers, with heat exchangers at the top of the roof, filter and temper incoming air from the exhaust air that rises naturally through the atrium. Air testing was performed on-site to evaluate the need for a charcoal-filtration system. Current air-quality conditions do not warrant an additional system, but space has been built to accommodate a charcoal-filtration system in the future if needed.



Spatial Daylight Autonomy

Spatial Daylight Autonomy (sDA) describes how much of a space receives sufficient daylight. The metric describes the percentage of the floor area that recieves a minimum illumination level, 300 lux, for at least 50% of occupied hours (sDA300/50%). Higher percentages indicate good daylighting performance.

Fully daylit (sDA300/50%)	61%
Views to the outdors (% of occupied spaces with view)	90%
Operable windows (does bldg have operable windows?)	N

Water Cycle & Materials

Water Cycle

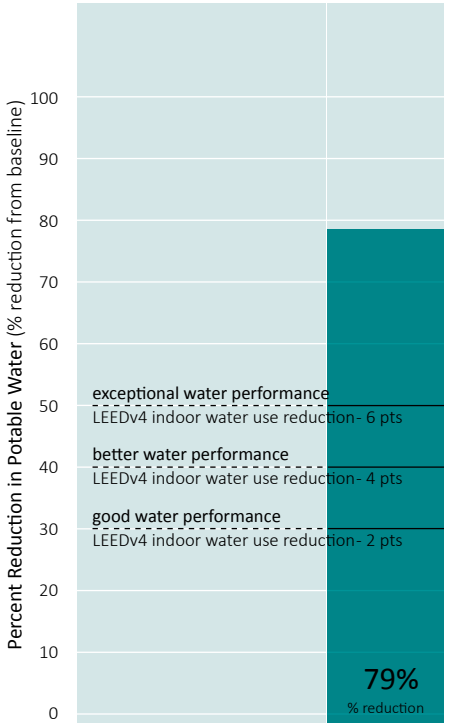
On-site drainage runoff is treated and filtered in storm-water surface ponds, rain gardens, and wet ponds. The runoff is collected around the perimeter of the site and directed to the western-most pond, mimicking natural site-drainage patterns and leveraging low-impact development techniques. The rainwater-reuse system captures water from the roof, stores it in a 25,000-gallon cistern, and treats it prior to use in toilets, for irrigation, and at a rooftop cooling tower and water features in the atrium. These systems provide the required water-quality treatment. A series of exterior rain gardens were designed to drain and treat a ninety-fifth percentile rain event, entirely on-site, eliminating the need for a connection to the city's storm-water system.

An estimated 430,000 gallons of rainwater will be harvested annually—providing a 79% reduction in potable-water use for toilet flushing and a reduction of irrigation demand by an additional 14%. Furthermore, domestic potable-water use is reduced by 58% through efficient fixtures, low-water landscape, and rainwater reuse.

Materials

As a part of the project's effort to reuse existing materials, the design-build team reclaimed significant amounts of timber from a demolished warehouse on-site. To optimize the use of the available materials, the engineer suggested the use of a composite design for the floor system. Since this was the first time this type of design was used in the United States, the team built a mock-up in the adjacent warehouse to test the structural integrity of the proposed composite timber-concrete system.

Construction waste is one of the best-known culprits contributing to the domestic solid-waste stream; building activity contributes about 40% of the total solid-waste stream. This project is not a typical example of the industry, achieving a 99% construction-waste diversion rate.



Reduction of Potable Water

Water use reduction is simulated by comparing the amount of water used by a project's interior fixtures to a baseline (percent reduction). The baseline fixtures are determined by the Energy Policy Act of 1992 fixture requirements. Higher percentages indicate good water performance.

Potable water reduction (% reduction from baseline)	79%
Potable irrigation (potable water used for irrigation?)	Y
Stormwater Control (% rain managed onsite from 2 yr storm)	100%

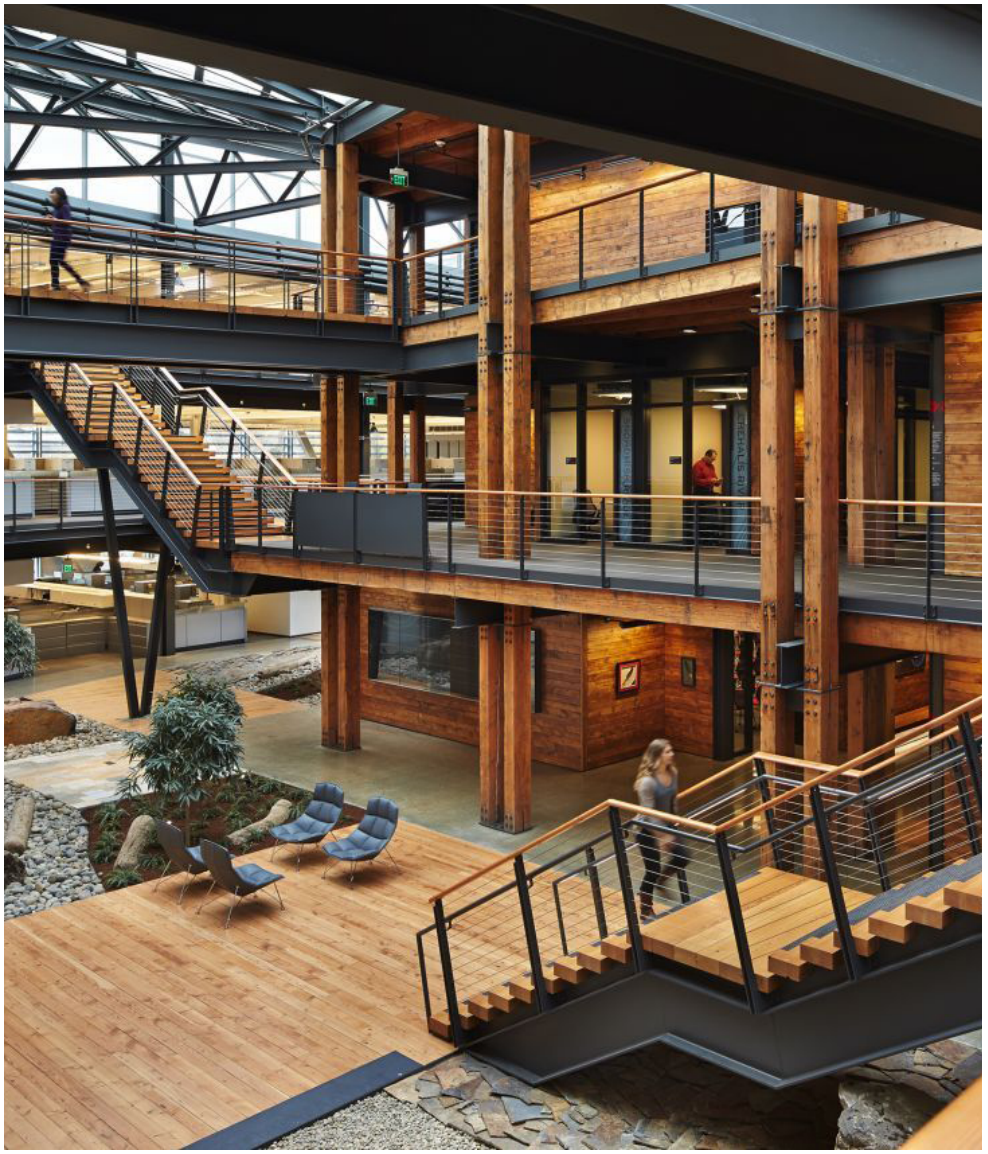
RFP Development

Federal Center South's procurement phase was heavily influenced by the compressed schedule and high-performance goals of the American Recovery and Reinvestment Act (ARRA). The ARRA funding was packaged with a congressional mandate to award the contract by the end of September 2010. The GSA had its own mandated guaranteed maximum price (GMP) date, the end of March 2010. The GSA contracting officer noted, "The goals and objectives were expressed early on in the solicitation documents, including having a collaborative team, achieving high-performing green building initiatives, and creating a twenty-first-century workplace. All of these were expressed in the statement of work and in the solicitation and were used to guide the acquisition-and-selection process."

The GSA procurement team decided to use a design-build project-delivery approach because they believed the delivery type could be more streamlined than traditional design-bid-build, better equipping them to meet the demanding ARRA schedule. In addition to the ARRA, site concerns were a primary driver in the early stages of this project. The GSA contracted several reports: a poly-seismic study, an environmental assessment, a geotechnical study, and a hazmat study. These reports demonstrated that the site was feasible for construction and identified general areas of site challenges.

Heery, the CMa, was engaged early specifically to assist in writing a statement of work for the design-build request for proposal (RFP) and to develop preliminary energy modeling that set initial project-performance goals.

The GSA crafted the procurement process to combine clear goals with a structure that invited open dialogue with participating firms on how to best meet goals. The GSA's project manager explained, "During procurement, we were defining what a high-performance building is. We were creating policies. We also looked to the design teams and asked, 'Are there things we can do to improve the project and make it higher performing? We want you to come back with a list of options to better the building.' We didn't want them thinking that the information we provided them is the only way to design a building."



Team Selection

Unique to this project, site conditions were a priority and those contracts related to site work were awarded before the primary team was selected. Contracts were awarded to geotechnical consultants for a seismic study, an environmental assessment, and a hazmat study. The CMa, Heery, was also awarded early in the process before the selection of the primary team.

Primary Team Selection

The design-build team of Sellen Construction and ZGF Architects was selected through a two-part competition. Phase one was an RFP. Of the many submitted proposals, the GSA selection committee shortlisted three design-build teams and invited them to submit comprehensive design proposals for phase two. No stipend was offered to the shortlisted teams that were not awarded the project, although the GSA is considering a change to this policy in the future to compensate for time invested in developing a comprehensive proposal.

Sellen Construction and ZGF Architects had more than twenty years of experience working together in settings other than design-build and had worked on projects together in the recent past. The contracting officer described how the team was chosen based on alignment with the GSA collaborative goals set forth in the RFP: “The team that got selected was the one that responded to that solicitation and obviously understood it.”

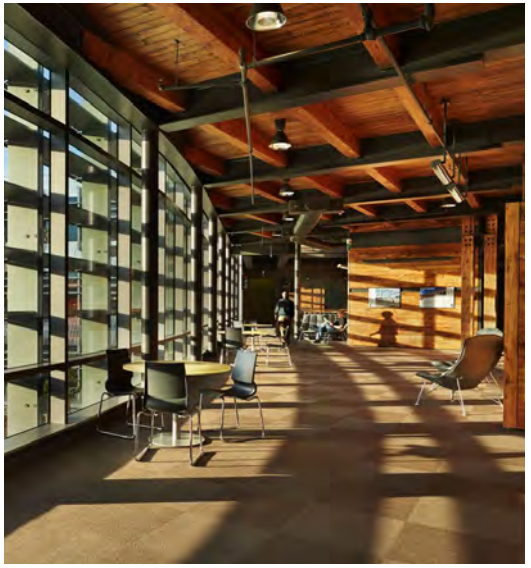
Consultant and Subcontractor Selections

The proposals from design-build teams were required to include a full list of consultants. After winning the job, Sellen Construction and ZGF Architects worked with the GSA to finalize consultant selections.

The contractor developed a small-business-subcontracting plan to meet the GSA mandates. Sellen Construction hired a sourcing consultant and held two outreach events to achieve the small-business-subcontracting goals.

Key members of the general contractor, architect, and ownership teams all participated in the final subcontractor selections. After shortlisting subcontractors based on submitted proposals, the design-build team interviewed them to determine if they could meet the design intent and add value. During this process, some subcontractors offered suggestions that resulted in cost savings. For example, one roofing subcontractor advised they could meet design intent at a lower cost by adapting the construction documentation wording, saying, “change this one word in the specification, I’ll give you back $80,000.” While they contributed ideas that led to cost savings, the potential financial incentives from the use of a firm-fixed-price contract did not extended to include subcontractors. The main incentive for the subcontractors was to obtain work during an economically depressed time in the building industry.

The high-performance objectives inspired the primary team to seek specialized expertise from their subconsultants. A team member recalled, “We wanted to win this job. We hit [the high-performance goals] hard. Those were what drove us. With our mechanical consultant, we felt we needed somebody with international bandwidth that could bring in people with global perspectives to develop a building that was unlike anything in Seattle in terms of energy performance.”



Contract

Federal Center South used a design-build project delivery with a firm-fixed-price contract. The GSA also included a performance clause in the contract and a post-occupancy-verification phase. Both policies were developed by the GSA's Northwest/Arctic Region, Region 10, and was used for the first time in this project. The design-build team responded positively to the contractual structure, with one team member saying, "The GSA has done a good job of setting up a process to transform the market. Any public- or private-sector owner looking at performance should look at this method."

The firm-fixed-price contract was chosen over a GMP contract. The vice president of Sellen Construction addressed how a firm-fixed-price contract provides more motivation compared to a GMP: "I find people that can bring value to the table. In a GMP, I have to give any value I find back to the owner in the end if the project is brought in under budget."

Transparent Contingency

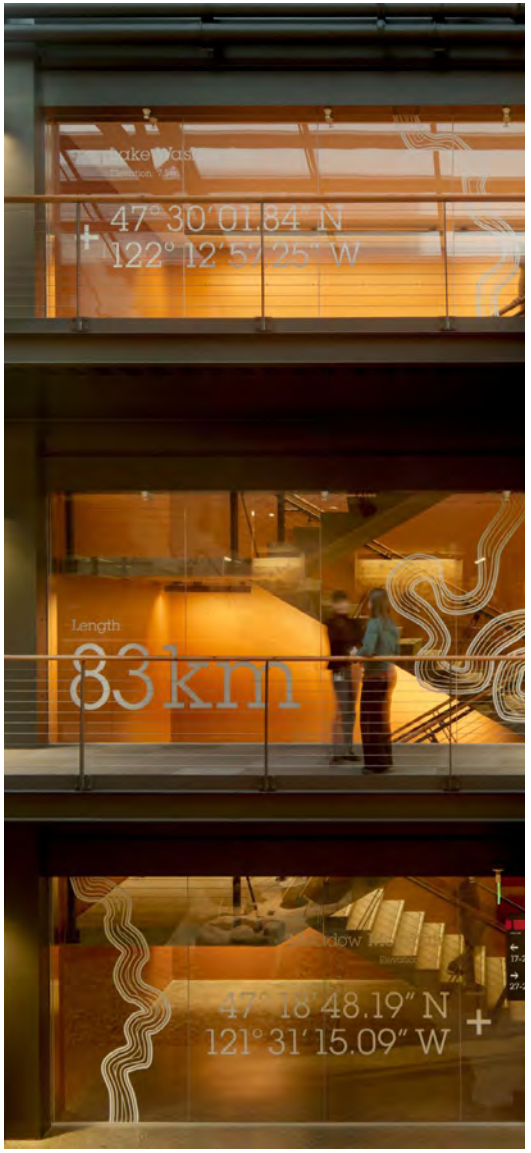
The GSA project team instituted a transparent contingency on Federal Center South due to the confluence of high-performance goals, trust between the owner and the design-build team, and challenging site issues. The GSA project manager explained how the idea for a transparent contingency emerged: "We recognized that we have a project contingency to deal with different site conditions. What happens if we don't use all of that contingency? [A transparent contingency] was a risk-based solution: as we got further into construction, we knew what our risks were and were willing to allocate some of the contingency to strategies that improved the performance of the project."

The transparent contingency deepened the initial trust within the team. "Transparency is one of the precepts in an integrated project delivery [IPD]," explained the contractor. "I have to hand it to [the GSA project managers]—the first day on the job, we learned that we had a transparent contingency. It made us want to be a team and want to spend it in the best way we can."

The transparent contingency was successful in keeping the project on budget and enabling the team to add additional performance strategies. Additionally, it contributed to the team's satisfaction with their working process and was a source of pride in the level of trust between the team and owner: "It was an honor to say, let's take the contingency and actually budget it, look at the risks across the job, and confidently spend it to add value to the job."

Contractor as Owner

The contractor controlled the project budget on Federal Center South: responsibility for managing all project funds, and the associated liability, were contractually delegated to the contractor. This was Sellen Construction's first experience with this type of contractual structure, and the senior vice president of Sellen Construction discussed the experience: "I was in charge of spending this money efficiently. As a contractor, usually, you can make recommendations and suggestions, but it's the owner who usually has final decision power. In this case, I was in the position to make those decisions. I have to say the role is harder than normal contracting. It is much more intense."



Verification

The contract coupled the performance clause with a twelve-month, post-occupancy evaluation-and-verification period, which allowed the project team to spend a year tuning the building to meet energy-performance targets. This team realized that the conventional idea of a completion date as a milestone when control over the building is passed from project team to owner and facilities manager needed to be redefined for this project: “The historic, traditional, substantial completion date doesn’t exist anymore, because we’ve got these sophisticated systems—lighting control, sound masking, furniture delivery—and they are all interdependent. We had a learning experience, all of us, and discovered that when you do a high-performance building, the traditional hand off has to be better and more organized.” The creation of a verification phase allowed for a sufficient time frame to effectively manage transition from project team to owner and facilities management. It proved to be a necessary and valuable process. The building adjustments that occurred during the verification phase ultimately enabled the building to achieve its energy targets.

The building failed to meet its energy targets during the first six months. The team responded by developing a series of diagnostic tools to identify systems that were operating differently than expected. For example, the boilers were accidentally running some nights instead of shutting off as the energy model assumed. The team uncovered issues like this and resolved them, and each fix would get the building closer to achieving its energy target. “For the last six months, we’ve been under [our energy] target,” said a member of the project team. “Once we got the [equipment] adjustments under control, we got the building wrestled to the ground. We were successful.” Additionally, the design team found that reviewing building operations revealed additional energy savings that had not been anticipated in the original design.

There has been discussion in the GSA about applying the verification phase and performance clause pioneered at Federal Center South to future projects. However, the project team cautioned that further development of the process is necessary before it can be assuredly applied to other projects. The GSA’s contracting officer explained that the performance clause and verification phase were included in the contract from the start, but the process of actually applying them was developed as the project progressed.

One of the major issues when comparing energy-modeling predictions and real-world building performance lies in the assumptions that all energy models must make about factors like weather and occupancy. When reality deviates from the suppositions, actual building performance will differ from the predictions. The team addressed the issue by updating the energy model throughout the verification phase; they continually replaced the baseline assumptions with real-world data that they collected. This increased the accuracy of the energy model and its energy-performance predictions. The energy target in the contract’s performance clause was updated in tandem with the energy model.

One team member commented that a tuning phase is logical for all high-performance buildings that have sophisticated systems that are often in unique configurations: “The designer and the contractor should be running the building for the first year to [tune] it because it’s like buying a Prius. You don’t drive your first Prius off the line and expect it to run right.” The project architect said, “I think [a verification phase] is really critical and something we would absolutely recommend for all future projects. The ability to react and understand how all the different components fit together and work together just can’t be underestimated.”

Team Building & Collaborative Culture

Collaborative Culture

Facilitated team-building strategies were not used; however, as the team worked together through the challenging goals and context of the project, a collaborative culture emerged, marked by strong alignment, mutual trust, and respect. The development of working processes, such as the betterments list *(click for more on the betterments list)* functioned as a tool that encouraged collaborative input from team members. Positive pre-existing relationships established a tenor of trust. Among the ZGF team, Sellen Construction's reputation was that they "allowed the design team [to have] a little more rope than a lot of other contractors do, allowing them to explore ideas and have enough time to let good ideas really come to the top." Additionally, many of the subcontractors had worked with Sellen Construction before and "there was a high level of trust already established....We didn't have to build trust. We were already there. We could go beyond that and just perform."

While many saw Sellen Construction as the champion for collaboration, others believed their entire leadership team filled the champion role. One of the team made the following comment about the project-leadership group: "It was that type of leadership that wasn't demanded with the stick. It was exemplified every time they did something. Made it so that the parties who needed to be accountable were accountable. The risks were always identified up front. They were distributed in the way that they should be. It felt like there didn't necessarily need to be a leader for collaboration, but there was collaboration because the leaders were making it happen."

The GSA had identified site complexity as one of the first challenges facing the team. After contracting the design-build team, the GSA gave the project team full access. Unlike non-federal projects that require permits before any site work can begin, this project offered the team members the opportunity to get a jump on the planning to deal with the complex site issues from the beginning of design: "We mobilized immediately. We were doing soil borings, thermal testing, and other [site exploration] early on. We could prepare the site while we were still doing design work. We had an eight-month window from the time we were awarded the project to the time we started driving the piles. The eight months allowed us to do discovery work on the site, relocate and repair existing utilities, install a new power service, and inventory and deconstruct the existing warehouse prior to starting the building." This early work not only helped to manage the risks of the site, it also served to build the team culture. By leveraging the team's interaction around site issues, collaborative practices developed early on set up continued success for the team.

Onboarding

The Federal Center South project team discussed the importance of onboarding consultants because of the unique nature of the project. The combination of high-performance goals, tight schedule, and design-build delivery method demanded that team members approach the project with fresh perspectives. An architect explained that minor problems arose when team members were brought on later in the project and without an onboarding procedure. Building a culture of collaboration required investment during the process of bringing new people to the team: "It became clear that we didn't do a good enough job explaining the [unique aspects of the project and our team culture] to them or factoring that in. The few team members that we had bumps with—it was because they didn't quite get to understand that."

Right People

The GSA project leadership explained that the trust required by an integrated-delivery process places additional emphasis on having the right people on the job: "The big lesson I learned from this is to bring in the right people that you can trust, because this type of delivery method, it has to be transparent. As soon as you have a player who's going to take information and have a hidden agenda—they're going to use it to disrupt the team and the process falls apart."

Because of a shift in the GSA's policies related to the ARRA, contracting officers were assigned to ARRA projects for the full duration of the project. Assigning a consistent contracting officer to a project for its duration is an effective way to maximize the benefits of the ARRA-mandated best-value procurement process. The GSA project manager explained the importance: "If the contracting officer thinks that his or her job is over when the award is granted, then the best-value procurement is perceived as additional work. If the contracting officer views themselves as a part of a project team—and the job is over when everything is done, and the building is performing, and the building manager understands how to tune the building—then you have a very different thing, because the contracting officer experiences the benefits of the best-value procurement. It's hugely important that the contracting officer has a continuous role on the team."

Comments from the team consistently emphasized the importance of having the right people engaged, particularly highlighting the more innovative and collaborative aspects of team interaction: "You need the right people at the table to interpret what the tools [and processes] are giving back to you. That is true about BIM, about betterments, and about bringing optimized value. You have to have the right people to understand how to evaluate it, how to implement it, and how to achieve it."

Goals & Alignment

The Federal Center South project team identified the project's high-performance goals as a strong motivating factor and a key element to the project's success. In response to the ARRA-mandated goals, the GSA began communicating project priorities early on, with the RFP process. Embedding the project goals in the selection process ensured that all prime contract parties would be clear about the high-performance priority and expectations. The contractor commented, "I've never been on a job that was this driven by the project goals. From the first day, the question was, how do we meet these goals?"

Throughout the delivery process, these goals continued to guide decisions. Team members understood how cost control of the overall budget had a direct impact on their ability to include high-performance technologies. For example, they noted, "When we ran into unforeseen issues, we were motivated to address them and keep costs down because we wanted to do geothermal." The team acknowledged that while there was strong agreement on the overall building goals, particularly around building performance, there were many different agendas that needed to be aligned to avoid risk: "Everybody coming into a project has their own motivation. The contractors are going to be prodding people to work. The architects want a wonderful design as well as a design that works. The owner wants to have a building that's going to operate efficiently for a number of years."

Performance Clause

The GSA used the contractual performance clause as a mechanism to clearly communicate the project goals, aligning the team to the owner's priorities. Until the building has proven that it meets the energy-performance targets, 0.5% of the original contract award is withheld from the team. There were no financial incentives for exceeding the energy-performance targets. The design-build team understood that the risk of falling short of their energy-performance targets would mean missing out on a portion of the contract. They managed this risk by dividing the potential withheld amount among the team members who had the most influence on achieving the energy-performance targets. The performance clause was an effective way to incentivize performance. "There's a lot of buzz in the industry about proving that buildings perform as per the design model," said the project architect for ZGF Architects. "From that vantage point, I think [the GSA's approach] is a step in the right direction for the industry, and I think it will become more commonplace."

Punch List

The streamlined manner with which the punch-list process was implemented is an example of benefits that occur when there is a high degree of alignment between the design-build team and the owner. On a typical project, project completion is marked by the creation and resolution of a list—commonly called a punch list—of remaining items that have not been finalized. Usually the contractor, owner, and architect generate separate lists, and then these are compared in what can sometimes be a confrontational process to determine the tasks to be completed. On this project, the owner and contractor accompanied the architect while he created a preliminary punch list for a very limited area of the building as a sample of his standards and concerns. As they described the process: "We made sure that we were in alignment regarding what we were looking at." After that point the contractor proceeded to correct and complete the work according to how he understood the standards. Only minimal checking was needed to confirm that the final items were resolved. The owner commented, "The amount of time that we put in for the final inspection was almost non-existent as compared to past projects." The punch list was a straightforward process, inspiring the architect to state, "We're on the same team. We need to make it work for all of us and find a way to do it."

Tenant Engagement

Having a single tenant, the Army Corps of Engineers, meant that the tenant-user group could be considered one entity (although with fifteen departments), with one very clear decision-making hierarchy. Decision making was clear, but because of the number of departments, communication needs were demanding. The contractor commented that a lesson learned was that the lack of a designated person from the team to interface with the departments created unnecessarily complicated situations. One such case was when requests (for example, for screens or specialized equipment) came late in the process. The team developed mechanisms, such as town hall meetings, and installed information systems in the lobby to educate users about the building systems. The team noted that the energy strategy acknowledged that some parts of the building, during certain times of the day or year, had larger ranges of comfort than would be typical in an office building. There were building users who were comfortable moving to the many alternative social or private work spaces to find the right temperature level, while others needed their fixed space to remain within their desired comfort zone.

Role Definition & Accountability

The Federal Center South project team used a two-fold approach to define roles: establish and maintain a consistent project team and allow for role flexibility in order to adjust to the integrated nature of design-build project delivery. Team consistency was established very early: "The team that worked during the solicitation process was the same team that entered the administration phase. There was little turnover, which stabilized the team and ensured consistency in process and procedures."

While there was a remarkable level of stability of team personnel, roles were dynamic. The architect discussed why roles evolved: "This was our first true design-build project with Sellen Construction, so there was some learning in terms of roles between us, them, and our consultants. This was one of the first design-build projects for the GSA, so there was also a learning curve between [the design-build team] and the GSA on how to approach it. The roles were somewhat fluid throughout because we were all learning as we went along in terms of the best way to do this design-build delivery."

Most team members came to value the effectiveness of flexible role definitions for collaboration. However, the early GSA peer review (15% peer review occurs when the project is approximately 15% complete) noted that a few consultants and subcontractors wanted additional role clarity to maximize their performance. Core team members noted that problems caused by the fluid role definitions were usually the result of individuals focusing on traditionally defined roles and not fully embracing the integrated approach. For example, one subcontractor stopped attending meetings that had agendas that did not appear to be relevant to his defined scope of work. Standard practice is for subcontractors to wait to coordinate their work until higher-level decisions are completed. In this case, his absence negatively affected his work and that of others since his expertise was not incorporated into those higher-level decisions and he did not understand the context of his work. His subcontracting group quickly fell behind schedule. After investigation, the project team found out that the subcontractor had frozen his work, because he—using a traditional approach—was waiting for the team to finalize decisions before proceeding. The lost time caused by the subcontractor was ultimately resolved but only at the expense of the loss of valuable resources to get him back on track.

The design-build team viewed the process of understanding the degree to which roles should be defined as a necessary part of transitioning to more integrated types of project delivery. An architect noted, "In my mind, yes, we need roles; but on the other hand, we also need people to wear multiple hats. You need to be able to participate and talk about other people's scopes of work because that's the only way to get a totally integrated solution."

Managing Schedule & Budget

Schedule

The complexity of Federal Center South and the tight time constraints of the ARRA stressed the importance of successfully managing project scheduling. The contractor emphasized the pressure resulting from the fast-tracked schedule: "We only had eight months to get started with construction [after being awarded the project]. We knew that design was going to continue much longer than that for a building like this. It put a lot of stress on the team, knowing that we would still be designing the project for another year after driving the first piles." The contractor, Sellen Construction, had the primary responsibility for managing the schedule. Sellen Construction kept the project team updated on project scheduling at regular intervals.

Sellen Construction was successful at identifying important upcoming issues and tying decision deadlines to each of them. A GSA team member asserted, "One of the best practices on the schedule was Sellen Construction saying, 'If we're going to incorporate this change, we need a decision by this date because it's going to impact our schedule.' They were really good about giving us a deadline, and we would do what we could to meet it."

Budget (Betterments List)

Successful management of the project budget was facilitated by two mechanisms, the transparent contingency formally put in place by the GSA *(click for more on transparent contingency)* and the other, a "betterments" list, developed by the team as they recorded budget and schedule implications of project options. The GSA project manager coined the term betterments to describe the wish list of items not included in the budget that the team believed would improve the project. The list began very early in the proposal stage when the team first began to define the scope of the work. As the architect described it: "The design-build team came up with a lot of great ideas about how to make this project really progressive in terms of energy performance and design excellence, but when we got down to two weeks before it was due, our proposal didn't fit in the budget. So we said, 'Okay, what are the great ideas that we leave out but would still like to talk about?' We made a betterments list in our proposal, which was well received and appreciated by the GSA."

The betterments list evolved to become a mechanism for collecting, evaluating, and ranking strategies to improve building performance based on full-life-cycle cost-and-payback analysis. These items were implemented if funds were made available—whether by savings, release of contingency, or additional funds. The list also tied each strategy to a decision date in the project schedule. If the strategy was not implemented by the decision date, it was removed from the list. Items that were implemented on Federal Center South include the use of fritted laminated glass in the atrium skylight to increase daylighting performance and the installation of geothermal piles, upgraded lighting controls to provide dimmable ballasts, occupancy sensors at workstation task lights, and a rainwater-harvesting system. In addition to the reallocation of budgeted funds, approximately $3 million was added to the project budget from other ARRA projects, mainly to address items from this list. Under the ARRA, funds could be shifted from one project to another if clear benefit and value were demonstrated. Using the betterments list, the GSA personnel involved with Federal Center South could clearly articulate how much each strategy would cost, the schedule implications, and the value toward advancing project and ARRA high-performance goals.

However, the contractor noted that the betterments list sometimes distracted the team. He mentioned that while "we were trying to take care of the betterments, we maybe didn't watch after our base job, design efforts, and progress [as much as we could have]. It really put a stress on the team to try to implement [betterments]. We were very motivated by them, but they took our attention away from getting drawings done and out the door."

BIM & Design Documentation

BIM

BIM (building information modeling) was used to facilitate collaboration among the entire project team, including building owners, occupants, contractors, architects, and subcontractors. In the design, systems were exposed and made part of the interior aesthetic, placing importance on full systems integration.

The design-build team originally intended to share BIM information between architect and contractor by using a single model rather than concurrent models for design and construction. However, the team had issues integrating subcontractors into a single model and had to create separate, manually integrated models. An architect explained, "One thing that is working against us as an industry is that there still are gaps in the different types of software that are talking to each other. The best tools for a particular trade aren't necessarily the best tools in terms of integrating with the other trades."

One example of the limitation of non-compatible BIM software emerged during the design of the central common area. The architect described the difficult process of resolving multiple sources of information and the importance of timing when merging models: "We had dueling models active when trying to figure out the structure and timber for the Commons. The mechanical design and the subcontractors came in—their software choice was not compatible with our models. We started the process [of integrating BIM models] probably earlier than we should have, in hindsight, so it dragged on much longer than maybe it should have." In spite of these frustrations, the team believed BIM was an effective tool.

Design Documentation

The project team viewed the design-build delivery method as an opportunity to improve the efficiency of design documentation. Sellen Construction and ZGF Architects developed strategies to match the level of design documentation created to the level needed by the design-build team.

At the beginning of the design phase, the project team created an organized schedule of design-documentation deliverables instead of the typical phase-based documentation. Based on Sellen Construction's previous experience with IPD, with its front-loaded design process, the team anticipated creating ten packages of information that would match specific stages of construction. The release of these ten packages was scheduled to deliver information as it was needed in the field. The use of a system of queries the team called design clarification/verification requests (referenced by the team as DCVR or DV), which could be reviewed and responded to weekly, reduced the amount of documentation from typical numbers. The GSA project management supported this initiative and charged the design-build team to efficiently plan, implement, and deliver the project using whatever documentation they deemed necessary. However, the quality assurance and quality control (QAQC) process managed by Heery required full verification of drawings to building, so drawings were updated to close the loop on the QAQC process. Team members noted that some subcontractors were not comfortable without typical construction documents before proceeding with their work. These pressures interrupted the planned strategy, ultimately leading to the creation of a traditional amount of design documentation.

The GSA's internal quality-control processes were factors that resisted the streamlining of design documentation. The contractor explained, "It got traditional very fast. We had Heery hired [as CMa] in the role as a quality-control person. They wanted 100% Construction Documents to inspect the job. We provided it. We ended up having to overproduce—in my mind just to satisfy them and document a building they could inspect."

The design-build team does not discount the value added by having a CMa on the project team but sees room for improved efficiency. "[The CMa] would go out and inspect something and say, 'Well, this isn't in accordance with the specification you issued or the drawings.' We would then have to get our engineer to come in and revise the specs to what was there....This made us go back and have to reissue a lot of documentation so that it was clean. It's not that the CMa didn't do their job, and they did bring issues up, but ultimately, we weren't expecting to do 100% CDs coordinated to quality control. There's a good opportunity here to ask, 'How would you do it better?'"

The GSA is in the process of discussing their own procedures regarding the use of CMas. "It's a point of discussion [for the GSA] because we staff projects provisionally with the CMa. The CMa often creates value by doing more reviews. Then there's a balance in [an integrated] delivery method that's more reliant on the contractors' quality of work."

Meetings & Workplace Environment

The Federal Center South project team structured their meeting schedule to support the project's compressed schedule and the additional collaboration needed to accommodate the design-bid delivery method. Project meetings with the entire design-build team, owners, and consultants were held weekly. The team identified the weekly meetings as beneficial for team performance and an effective way to ensure open communication lines: "We started having weekly project meetings from the very beginning. Everybody was at the table, including the designer, the contractor, the GSA, and even the building tenant. We used the meeting as a means to address issues when they came up."

The contractor described how the process worked during the initial eight-month site investigation before design: "We had active people on-site investigating and doing demolition. Site issues were brought up in weekly meetings. We then made a determination if we needed follow-up meetings. If not, we would take the information to the GSA, run that information, and come back with a recommendation of what types of solutions we needed to implement. The key to this was just having a regular structured meeting every week with everybody at the table." Field issues arise on any project, but with the integrated team, as a team member noted, "there's even more of an incentive to [have regular meetings]—it is an even more important best-practice approach to resolving issues quickly."

GSA Peer Reviews & Expertise

GSA Peer Reviews

A peer review is an opportunity for teams to benefit from targeted expertise as reviewers evaluate and identify opportunities at pre-determined points in the project. After the design-build team was awarded the project, the GSA commenced with the mandatory design review of the proposal. Traditionally, the process takes a few weeks: The GSA's technical experts review the submitted design documentation and respond with a list of suggestions. The design team is then charged with evaluating the suggestions and responding. This process continues until the design is approved. The project team made a prudent decision to delay the start of work for the entire design team until the GSA design review was complete: "We held back a lot of our team until we could get passage of the design review. It's good that we did, because the decision was made to move the mechanical penthouse up onto the roof and the stair towers inward. If we had set the design team off fully, we would have had to peel back and recycle and redo things." The 15% review included suggestions for processes improvements, such as more clear role definition for some subcontractors who were uncomfortable with the collaboration expectations.

Because of Federal Center South's tight schedule, the project team developed a process to streamline the GSA's design-review process. Early in the design process, Federal Center South team leaders set up a series of meetings that allowed the GSA's technical reviewers and the design team to convene over several days. "Rather than sending the documents to the technical reviewers, we just brought everybody together," explained the GSA's project manager. Attendees included members of the design-build team, engineering consultants, representatives from the Army Corps of Engineers (sole building tenant), GSA project owners, technical reviewers, and cost estimators. Sellen Construction and ZGF Architects worked together to develop detailed agendas for the three days of meetings, which were organized by review topics, such as structural design and mechanical design.

The GSA project manager expressed the importance of focused discussions, which occurred in meetings due to the intensive schedule and high expectations: "My recollection is they shortlisted options at the end of each meeting. The teams then worked off-line and went back to meet again. They weren't looking at twenty items. They looked at probably the three most practical ones."

Expertise

This project benefited from expertise applied at the early phases to identify and address site challenges as well as later in the project when a reclaimed-wood specialist worked closely with the team to coordinate technical installation and material issues.

Building Innovation – Reclaimed-Wood Composite Floor System

This story exemplifies the iterative collaborative processes that this team used throughout the project. This example shows the high level of coordination between technical designers, the consideration of construction parameters during the design process, and a highly engaged owner.

The Commons is the communal central space in the building. The configuration, the programmatic connection to other spaces, and the light and material quality of the Commons were the areas of focus of a great deal of the design team's energy. The architects' early conceptual designs showed extensive use of wood reclaimed from a decommissioned non-historic WWII warehouse on the site. After preliminary layouts were completed and the project was awarded to the project team, a new team member with expertise in reclaimed timber, GR Plume, joined the group. GR Plume determined that there was insufficient material to achieve the preliminary design. In response to this information, the structural engineer, KPFF, suggested a material palette of concrete and wood, working together in a composite system. Joining the wood with concrete deck created an unusual composite system not covered by existing U.S. codes, so testing was required to demonstrate structural capacity. Using national standards for wood-member spacing, the team developed and tested a design that met structural standards and that was accepted by the GSA.

A more detailed inventory by GR Plume revealed an insufficient amount of material to achieve the composite system as designed. Because there was not enough time to revise the design again, the team considered several options. Supplementing the reclaimed wood with new lumber was considered but rejected on aesthetic grounds—since the wood structure was exposed, new materials would disrupt the unified Commons space. KPFF studied alternative spacing for the wood members while working with the fabricator to determine a composite system that could be easily installed. The final assembly used a custom lag bolt and a custom drill bit that streamlined the installation. The time invested in testing and the creation of the custom hardware put stress on the schedule, but the team understood that the work was essential to the design integrity of this prominent space.

Testing of the assembly also required close collaboration between engineering, design, fabricator, and contactor. Verifying a portion of the composite system required temporary supports. Since structural-load tests cannot rely on temporary supports, measures had to be taken to ensure that the temporary structure did not alter the structural behavior of the composite system. Sellen Construction constructed the test assembly, and KPFF installed sensors to monitor the movement of elements. The mock-ups demonstrated that the system exceeded the required standards and was accepted for final construction. Later revisions were needed to adjust the placement of the conduits, which created complications in the installation of the electrical system.

The use of reclaimed wood resulted in a 99%-diversion rate of construction waste. Approximately 200,000 board-feet of structural timber and 100,000 board-feet of decking were salvaged from the warehouse. Using a phased demolition process, wood components were individually harvested from the warehouse. The team pulled nails, unfastened bolts, removed brackets and devices, trimmed out fractures, and sorted the wood before it was shipped to a local mill for structural grading and fabrication for use in the new building.

Images

Top: Deconstructing and reclaiming wood from the original warehouse. Image courtesy of Structure Magazine.

Middle: Test of beam just prior to failure. Image courtesy of Charles Lozner.

Bottom: Commons interior. Composite floor above.