

LEED STORIES FROM PRACTICE

CASE STUDY

BIODESIGN INSTITUTE AT ARIZONA STATE UNIVERSITY










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CASE STUDY

Biodesign Institute at Arizona State University

Prepared for the U.S. Green Building Council

Case Study Lab
Center for Housing Innovation
University of Oregon

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2		BD+C					
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	NA	.5	1	NA	.5	NA	NA

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Written permission has been obtained from all participants in this project, following an extensive edit and approval process, to include their interviews and videos in this document.

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USGBC Case Study Project

The U.S. Green Building Council, in conjunction with the University of Oregon, initiated this pilot program of five case studies to gather information on green building practices. Through a series of interviews, selected project team members from the Biodesign Institute at Arizona State University tell their stories in this case study. The interviews were recorded, transcribed, edited, and compiled to form the narratives on the following pages.

The USGBC intends to use these narratives as educational content for instructor-led workshops, podcasts, webinars, books, magazines, articles, and other research-oriented and curriculum products. The University of Oregon will use the material for educational purposes only, in classes and conferences. The five pilot case studies comprise a cross-section of certification levels, building types, and themes that occur in practice. The USGBC plans to expand its case study database with more project stories covering different themes, to enhance case-based teaching methods.

BIODESIGN INSTITUTE AT ARIZONA STATE UNIVERSITY TEMPE, ARIZONA



The Biodesign Institute provides an eastern gateway to the Arizona State University campus from the nearby light rail stop.

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PROJECT TEAM MEMBERS

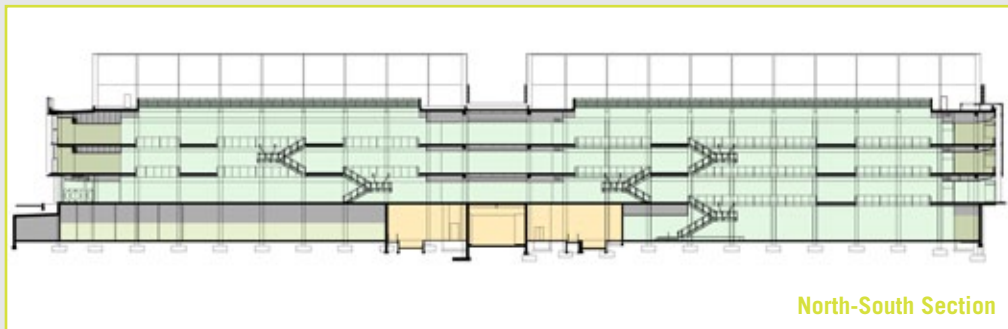
<i>Architect:</i>	Lord, Aeck & Sargent, Atlanta, GA
<i>Architect of Record:</i>	Gould Evans, Phoenix, AZ
<i>Structural Engineer:</i>	Paragon Structural Design, Inc., Phoenix, AZ
<i>Civil Engineer:</i>	Evans, Kuhn & Associates, Inc. Phoenix, AZ
<i>MEP Engineer:</i>	Newcomb & Boyd, Atlanta, GA
<i>Irrigation Engineers:</i>	Aqua Engineering, Inc., Tempe, AZ
<i>Project Contractor:</i>	DPR Construction, Inc., Phoenix, AZ
<i>Head Contractor:</i>	Sundt Construction, Tempe, AZ
<i>Landscape Architect:</i>	Ten Eyck Landscape Architects, Phoenix, AZ
<i>Interior Designer:</i>	Gould Evans, Phoenix, AZ
<i>Acoustical Consultant:</i>	Colin Gordon & Associates, Brisbane, CA
<i>Commissioning Agent:</i>	Working Buildings, Atlanta, GA

University of Oregon Professor Alison G. Kwok, Advisor Nicholas B. Rajkovich, and research assistants Rachel B. Auerbach, Kristen B. DiStefano, Britni L. Jessup, and Amanda M. Rhodes prepared this narrative. © 2009 U.S. Green Building Council and the University of Oregon. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means without the permission of the USGBC.

PROJECT DESCRIPTION

The Biodesign Institute's master plan consists of four interconnected buildings that will comprise a total of 800,000 square feet. Currently, two buildings are complete and house nearly 600 faculty, researchers, staff and students. A dwindling research agenda prompted Arizona State University (ASU) to consider creating these state-of-the-art facilities to regain stature among research universities and help revitalize related sponsorships. Knowing the impact of the school's reputation on recruitment and retention efforts, then incoming ASU president Michael Crow championed the initiative. The result is the Biodesign Institute at Arizona State University, which represents the largest single investment in research infrastructure in Arizona.

The project team completed Building A in 2005 and Building B in 2006. They did not consider LEED® certification until the construction of Building A was nearly complete. Building A achieved LEED Gold; Building B earned LEED Platinum. The fact that the buildings were able to achieve LEED certification late in the process speaks highly to the project team's collaborative process and the standard sustainability practices and measures that were project goals from the onset.



PROJECT DATA

BUILDING A:

LEED NC v.2.2 Gold,
Completion: January 2005,
Cost: \$74,000,000
Area: 177,661 sq. ft

BUILDING B:

LEED NC v.2.0/2.1 Platinum
Completion: January 2006
Cost: \$78,500,000
Area: 174,583 sq. ft

LOCATION

City: Tempe, Arizona
Latitude: 33.42 North
Longitude: 111.93 West

CLIMATE²

HDD65: 1117
CDD50: 9566
Annual Precipitation: 8.71"
Solar Radiation: 660 kBtu/sf/year

ENERGY METRICS

Measured EUI:3
Building A: 360.5 kBtu/sf/year
Building B: 551.0 kBtu/sf/year

NOTABLE GREEN FEATURES

One of the goals of this cutting-edge research facility was to create an interactive and dynamic environment that connected the occupants of the building to nature and each other. By using an atrium that ran the length of the building, the team was able to provide the occupants with a view to the outside and create a daylit spine to inspire collaboration among the researchers. Even in the middle of the large building, daylight penetrates to the lower floors from the spectrally selective skylights. These skylights are able to keep out the majority of the heat from the sunlight, which helps to minimize the cooling load for the building. This is an important factor considering the buildings' location in Tempe, where heat gain is an issue.



Skylights in the Atrium

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During the design phase, the City of Tempe began planning a new light rail system. The project team wanted the institute to have access to the system because several other research institutions are located in downtown Tempe and Phoenix, so easy access was

important in order to promote collaborative and interdisciplinary research projects. The team, however, needed to work with the city to relocate the line to avoid electromagnetic interference and vibrations from the rail, which could have interrupted research.

To avoid the interference and eliminate the vibrations, the building had to be oriented to the east and west faces. On the west face, brick cladding and small punched windows match the existing campus buildings and deflect the harsh afternoon sun. On the east face, however, the building's concept of a high-profile gateway to the campus dictated a more open, glass façade. Anticipated maintenance problems with operable exterior louvers prevented the team from shading the glass externally. Using computational fluid dynamics modeling, the team designed operable louvers inside of the glass to mitigate the potential heat gain problem. Mechanical and electrical systems helped to address the energy penalty of the east façade, while still providing excellent lab space conditions. The operable louvers on the east façade are user controlled in the offices and sun-angle dependant in the public spaces. A variable air volume HVAC system fine tunes the ventilation to each space, and high MERV filters ensure high-quality indoor air.

The heat gain through the envelope, combined with the heat from the energy use in the labs and the hot climate, requires the HVAC system to cool the interior spaces. The team knew cooling would be the biggest challenge and saw the collection of the water condensing from the air conditioning equipment as a non-conventional source of recuperating some of the spent resources. This made especially good sense in the summer time, when the plants need more water and the mechanical units are running 24 hours a day. By gathering the condensate from the top-floor chillers and collecting it in an underground tank, they were able to use the water to irrigate the native plants during the summer months when irrigation is needed the most.



Native plants around the Amphitheater

© Josh Partee 2009

The new goal of achieving LEED certification did not change the construction schedule and added little to the project's overall costs. Mike McLeod, the director of facilities management, explained that with good design and commissioning, achieving LEED certification was not difficult. The team was diligent in seeking the needed credits and, for little cost, made a few changes and added additional monitoring to achieve LEED Gold certification for Building A. Building B achieved LEED Platinum certification through additional measures, such as including condensate collection on the

chillers and focusing on improving construction waste management efforts. For both buildings, commissioning and monitoring played a large role in being able to achieve LEED certification.



Computer Monitor

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Commissioning started early in the project development phase and the process went smoothly, even though a strong push was needed at the end. According to McLeod, commissioning never stops and monitoring and managing a building's performance is critical to a green building's success. His commitment to this belief is illustrated by his Three-M Strategy—a strategy that includes metering, monitoring, and managing. The strategy requires the facilities department to continually fine-tune the build-

ing. With occupants changing and unforeseen issues arising, the department must constantly make adjustments. The need to tweak building systems to address actual usage was addressed in the facilities department training, so staff is prepared. For example, the HVAC system has a tremendous amount of information, including what is happening in particular rooms, even within specific labs. Therefore, if a room is using an exceptionally high volume of air, McLeod knows it. The variable air system has been critical in identifying where the greatest opportunities for energy savings are located. As a result of the Three-M Strategy, the facilities management team at the Biodesign Institute has reduced the buildings' energy consumption every month.

A clear understanding of the important role building performance plays in creating a green building was a key component of the Biodesign Institute's success. A green facility does not simply check all the required boxes on the LEED checklist; it must be a building that performs as it was intended. Therefore, project teams need to think about commissioning, monitoring, and operations and maintenance practices early in the design process.

The checklist is an excellent starting point, but in order to ensure a project meets its energy-efficiency goals, the expertise of the engineering and facilities management staffs needs to be tapped and their commitment secured. Their experience should inform the project's design to not only ensure the building performs as intended, but to lay the foundation for seeking ways to continually improve the building's energy efficiency performance and other sustainability initiatives over time. The Biodesign Institute showcases the success of such a process.

The Biodesign Institute at Arizona State University is often referred to the building that keeps on giving. Through ongoing efforts to meter and monitor the buildings' performance and the continued success in seeking ways to decrease energy usage, the lessons learned are being applied campus wide and shared with other universities and research institutes throughout the U.S.

BEST PRACTICES AND LESSONS LEARNED

- The owner's support for building green is critical. ASU's focus on sustainability and its commitment to create a cutting-edge research facility made the project possible.
- Assemble a project team that is committed to working together. The Biodesign Institute was successful because—from the onset—it was a collaborative effort. Key stakeholders, including the administration, architects, engineers, facilities management, construction and occupants, need to be at the table.
- Collaboration does not stop after the design phase is complete; it should be the mantra throughout the construction phase and for the facilities management staff as well. Any process or protocol to solve problems should include bringing key players together to discuss and determine solutions.
- Achieving LEED certification is just the beginning; a successful green building must perform as intended. Tracking the building's performance to ensure it is meeting the energy-efficiency predictions and other sustainability goals is an important aspect of a green building. It should be noted that a well-designed building has the flexibility to adapt; it has systems that can be recalibrate to address actual usage and performance.
- Commissioning, testing and quality assurance programs are imperative and must be seen as ongoing efforts. The Biodesign Institute continues to fine tune the building through its Three-M Strategy, which focuses on metering, monitoring, and managing. As a result, the institute has decreased its energy usage every month.



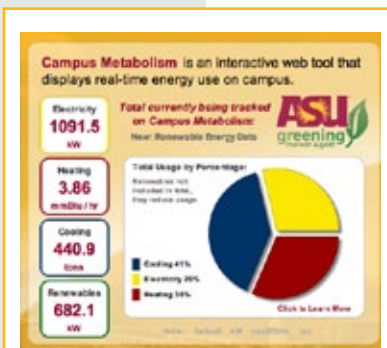
Student in lab

© Josh Partee 2009

- Make sure the people who are going to operate the building, understand it. Early in the design and development process include the engineering and facilities management staff to solicit ideas and opinions and secure their support of the project.
- Expect to spend time looking at how occupants' use what was installed in the building in order to continue to reduce the consumption of resources within the buildings. At ASU, it helps that students, faculty and researchers strongly support the university's campus-wide sustainability efforts.
- The depth of expertise at both the architecture and construction firms allowed for the needed continuity when key members of the team left the project. The institute has also benefitted from a relatively permanent facilities management staff, which has created the consistency needed to manage a complex research facility.
- Develop a plan to train subcontractors. LEED used to cause a lot of anxiety, especially for subcontractors, who perceived green building as added work or too complicated, so. Provide clear instructions and be prepared to walk them through the process, especially if it is the subcontractor's first LEED project. Make it simple.

Prepare a list of the products and services required.

- Create a process or protocols to address concerns quickly. Problems arise on every building project, especially issues related to the building's green features and LEED credits. Keep in mind that one simple change can affect several, seemingly unrelated building systems and/or processes.
- Many universities and colleges have long-established design and construction standards, so it can be difficult to get staff to move beyond the old and embrace the new. Schools should consider developing new green design and construction guidelines that guarantee a certain level of energy-efficiency performance and integrate other sustainability goals. LEED can provide the framework for establishing such standards.
- Communications is critical to the success of any green building project. Consider investing in tools to help facilitate discussion and encourage interaction among project team members. In the case of the Biodesign Institute, the investment in video conferencing equipment proved invaluable, since several key members lived in different states.
- Occupants play a critical role in green building performance and return on investments. Creating an educational program that includes training, manuals and demonstrations on how to use the building, its sustainable features and detail the occupants' role in making sure these features reach their maximum performance level. Be patient: it takes time for occupants to learn how to use the building.
- Capture and use performance data like energy savings or the amount of recycled materials, to demonstrate the success of individual efforts. The perception may be that turning off one light or one computer does not make that much of a difference, but campus-wide, it can be significant.
- Make the case for building green. Finance and accounting departments are often more willing to agree to build green if quantifiable data on building performance (reducing energy and water usage) demonstrates cost savings. There are other key benefits—improved health, increased productivity and sick days saved—that are also important, but are difficult to quantify. Developing a way to calculate and capture both types of cost savings is important to show true cost benefit.
- Design a process to capture lessons learned from the project. Documenting what worked and, especially, what did not helps inform future projects and may save time, money and heartache.
- The LEED Accredited Professional (LEED AP) credential is important. Several members of the Biodesign team, including key construction staff, pursued it. The credential proved invaluable since it provided team members with critical knowledge and the confidence needed to make decisions. When it was decided late in the process to pursue LEED certification, the team was ready.



Campus Metabolism ASU has developed Campus Metabolism, an energy dashboard system that can be accessed from the internet and allows students and building occupants to evaluate their energy usage. Currently, there are 13 buildings being monitored, but the goal is to include all 52 campus facilities. ASU is seeking funding to build a framework to allow the system to be deployed to others colleges and universities.

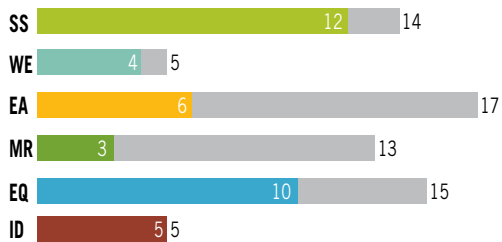
PROJECT AWARDS

- 2009 Recipient: ASLA Award; American Society of Landscape Architects
- 2007 LEED-NC v.2.0/2.1 Platinum; U.S. Green Building Council
- 2007 LEED-NC v.2.2 Gold; U.S. Green Building Council
- 2007 Environmental Excellence Awards: President's Award; Valley Forward
- 2007 Environmental Excellence Awards: Crescordia Award; Valley Forward
- 2007 Aon Build America Award, Building - New Construction; Associated General Contractors of America
- 2006 Merit Award; AIA Arizona
- 2005 Citation; Arizona Masonry Guild
- 2005 Citation; AIA Western Mountain Region
- 2005 Environmental Excellence Awards: Crescordia Award; Valley Forward

LEED CREDIT DISTRIBUTION

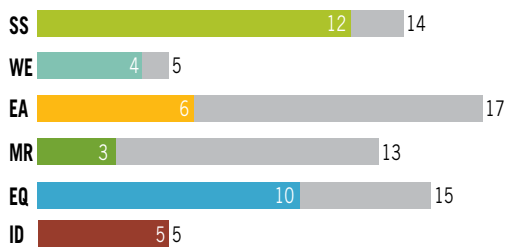
BUILDING A

LEED-NC v.2.2 Gold



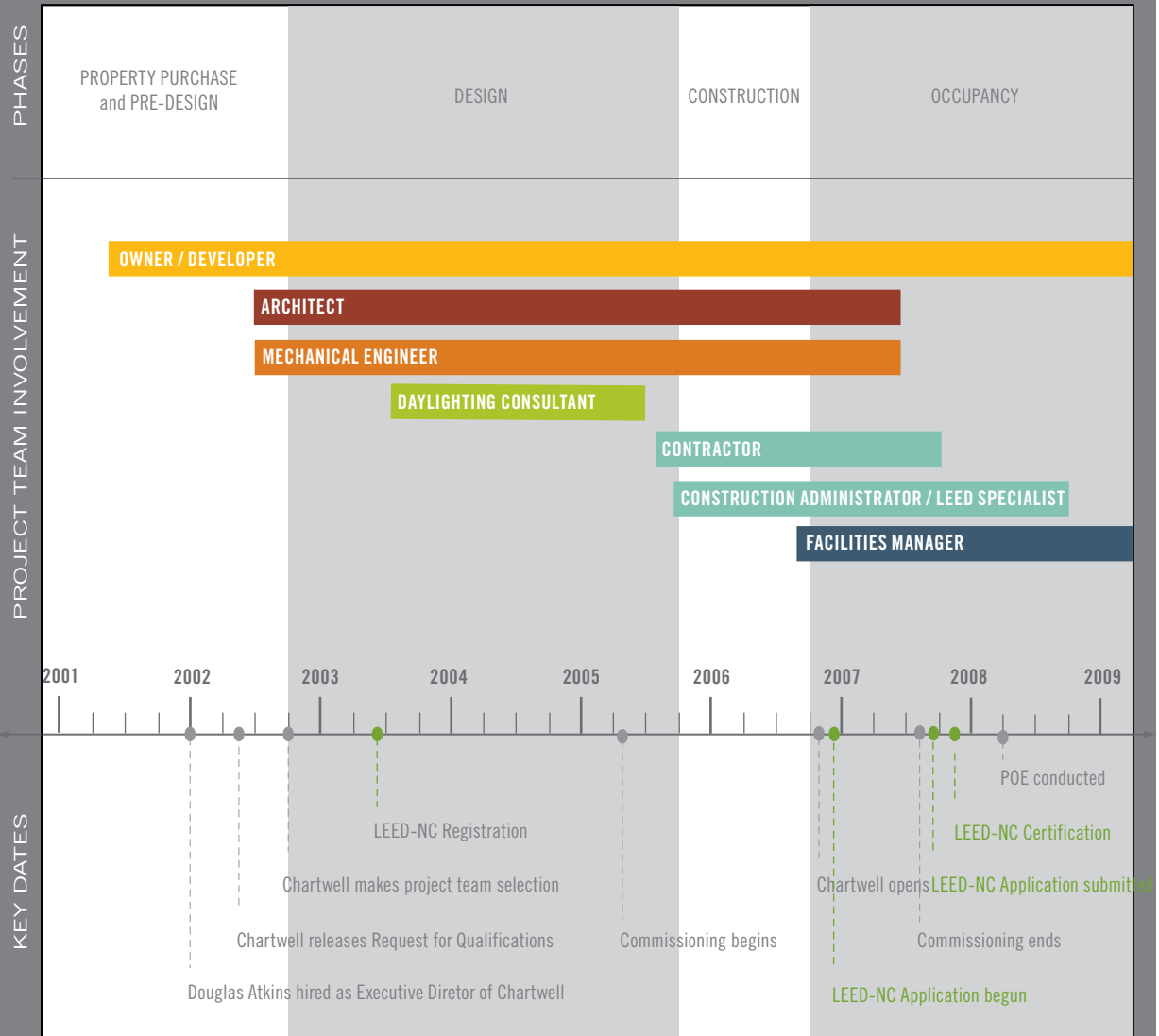
BUILDING A

LEED-NC v.2.2 Gold



TIMELINE

CHARTWELL SCHOOL PROJECT TIMELINE LEED-NC v.2/v.2.1 Platinum



* This timeline contains an approximation of key dates, project phases, and project team member involvement.

SCORE CARD: ASU BIODESIGN INSTITUTE, BUILDING A



Gold 40 of 69 possible points

RATING SYSTEMS: LEED-NC v2.2



SUSTAINABLE SITES

12 of 14 possible points

x	x	Prereq 1	Construction Activity Pollution Prevention
1	1	Credit 1	Site Selection
1	1	Credit 2	Urban Redevelopment
	1	Credit 3	Brownfield Redevelopment
	1	Credit 4.1	Alternative Transportation, Public Transportation Access
1	1	Credit 4.2	Alternative Transportation, Bicycle Storage & Changing Rooms
	1	Credit 4.3	Alternative Transportation, Low-Emitting & Fuel Efficient Vehicles
1	1	Credit 4.4	Alternative Transportation, Parking Capacity
1	1	Credit 5.1	Reduced Site Disturbance, Protect or Restore Habitat
1	1	Credit 5.2	Reduced Site Disturbance, Maximize Open Space
1	1	Credit 6.1	Stormwater Management, Quantity Control
1	1	Credit 6.2	Stormwater Management, Quality Control
1	1	Credit 7.1	Heat Island Effect, Non-Roof
1	1	Credit 7.2	Heat Island Effect, Roof
1	1	Credit 8	Light Pollution Reduction



WATER EFFICIENCY

4 of 5 possible points

1	1	Credit 1.1	Water Efficient Landscaping, Reduce by 50%
1	1	Credit 1.2	Water Efficient Landscaping, No Potable Use or No Irrigation
	1	Credit 2	Innovative Wastewater Technologies
1	1	Credit 3.1	Water Use Reduction, 20% Reduction
1	1	Credit 3.2	Water Use Reduction, 30% Reduction



ENERGY AND ATMOSPHERE

6 of 17 possible points

x	x	Prereq 1	Fundamental Building Systems Commissioning
x	x	Prereq 2	Minimum Energy Performance
x	x	Prereq 3	Fundamental Refrigerant Management
1	1	Credit 1.1	Optimize Energy Performance, 10.5% New / 3.5% Existing
1	1	Credit 1.2	Optimize Energy Performance, 14% New / 7% Existing
1	1	Credit 1.3	Optimize Energy Performance, 17.5% New / 10.5% Existing
1	1	Credit 1.4	Optimize Energy Performance, 21% New / 14% Existing
	1	Credit 1.5	Optimize Energy Performance, 24.5% New / 17.5% Existing
	1	Credit 1.6	Optimize Energy Performance, 28% New / 21% Existing
	1	Credit 1.7	Optimize Energy Performance, 31.5% New / 24.5% Existing
	1	Credit 1.8	Optimize Energy Performance, 35% New / 28% Existing
	1	Credit 1.9	Optimize Energy Performance, 38.5% New / 31.5% Existing
	1	Credit 1.10	Optimize Energy Performance, 42% New / 35% Existing
	1	Credit 2.1	Renewable Energy, 2.5%
	1	Credit 2.2	Renewable Energy, 7.5%
	1	Credit 2.3	Renewable Energy, 12.5%
	1	Credit 3	Enhanced Commissioning
1	1	Credit 4	Enhanced Refrigerant Management
	1	Credit 5	Measurement & Verification
1	1	Credit 6	Green Power



MATERIALS AND RESOURCES

3 of 13 possible points

x	x	Prereq 1	Storage & Collection of Recyclables
1		Credit 1.1	Building Reuse, Maintain 75% of Existing Walls, Floors, & Roof
1		Credit 1.2	Building Reuse, Maintain 100% of Existing Walls, Floors, & Roof
1		Credit 1.3	Building Reuse, Maintain 50% of Interior Non-Structural Elements
1		Credit 2.1	Construction Waste Management, Divert 50% from Disposal
1		Credit 2.2	Construction Waste Management, Divert 75% from Disposal
1		Credit 3.1	Resource Reuse, 5%
1		Credit 3.2	Resource Reuse, 10%
1	1	Credit 4.1	Recycled Content, 10%
1		Credit 4.2	Recycled Content, 20%
1	1	Credit 5.1	Local/Regional Materials, 10%
1	1	Credit 5.2	Local/Regional Materials, 20%
1	1	Credit 6	Rapidly Renewable Materials
1		Credit 7	Certified Wood



INDOOR ENVIRONMENTAL AIR QUALITY

10 of 15 possible points

x	x	Prereq 1	Minimum IAQ Performance
x	x	Prereq 2	Environmental Tobacco Smoke (ETS) Control
1	1	Credit 1	Outdoor Air Delivery Monitoring
1	1	Credit 2	Increase Ventilation
1	1	Credit 3.1	Construction IAQ Management Plan, During Construction
1		Credit 3.2	Construction IAQ Management Plan, Before Occupancy
1	1	Credit 4.1	Low-Emitting Materials, Adhesives & Sealants
1		Credit 4.2	Low-Emitting Materials, Paints & Coatings
1	1	Credit 4.3	Low-Emitting Materials, Carpet Systems
1		Credit 4.4	Low-Emitting Materials, Composite Wood & Agrifiber Products
1	1	Credit 5	Indoor Chemical & Pollutant Source Control
1	1	Credit 6.1	Controllability of Systems, Lighting
1		Credit 6.2	Controllability of Systems, Thermal Comfort
1	1	Credit 7.1	Thermal Comfort, Design
1	1	Credit 7.2	Thermal Comfort, Verification
1		Credit 8.1	Daylight & Views, Daylight 75% of Spaces
1	1	Credit 8.2	Daylight & Views, Views for 90% of Spaces



INNOVATION AND DESIGN PROCESS

5 of 5 possible points

1	1	Credit 1.1	Innovation in Design: Green Building Education
1	1	Credit 1.2	Innovation in Design: Green Housekeeping
1	1	Credit 1.3	Innovation in Design: Exemplary Performance, SS5.1
1	1	Credit 1.4	Innovation in Design: Exemplary Performance, SS5.2
1	1	Credit 2	LEED® Accredited Professional

SCORE CARD: ASU BIODESIGN INSTITUTE, BUILDING B



Rating System: LEED-NC v.2.0/2.1

Platinum 52 of 69 possible points



SUSTAINABLE SITES

12 of 14 possible points

x	x	Prereq 1	Erosion & Sedimentation Control
1	1	Credit 1	Site Selection
1	1	Credit 2	Development Density
	1	Credit 3	Brownfield Redevelopment
1	1	Credit 4.1	Alternative Transportation, Public Transportation Access
1	1	Credit 4.2	Alternative Transportation, Bicycle Storage & Changing Rooms
	1	Credit 4.3	Alternative Transportation, Alternative Fuel Vehicles
1	1	Credit 4.4	Alternative Transportation, Parking Capacity & Carpooling
1	1	Credit 5.1	Reduced Site Disturbance, Protect or Restore Open Space
1	1	Credit 5.2	Reduced Site Disturbance, Development Footprint
1	1	Credit 6.1	Stormwater Management, Rate and Quantity
1	1	Credit 6.2	Stormwater Management, Treatment
1	1	Credit 7.1	Landscape & Exterior Design to Reduce Heat Islands, Non-Roof
1	1	Credit 7.2	Landscape & Exterior Design to Reduce Heat Islands, Roof
1	1	Credit 8	Light Pollution Reduction



WATER EFFICIENCY

4 of 5 possible points

1	1	Credit 1.1	Water Efficient Landscaping, Reduce by 50%
	1	Credit 1.2	Water Efficient Landscaping, No Potable Use or No Irrigation
1	1	Credit 2	Innovative Wastewater Technologies
1	1	Credit 3.1	Water Use Reduction, 20% Reduction
1	1	Credit 3.2	Water Use Reduction, 30% Reduction



ENERGY AND ATMOSPHERE

15 of 17 possible points

x	x	Prereq 1	Fundamental Building Systems Commissioning
x	x	Prereq 2	Minimum Energy Performance
x	x	Prereq 3	CFC Reduction in HVAC&R Equipment
1	1	Credit 1.1	Optimize Energy Performance, 15% New / 5% Existing
1	1	Credit 1.2	Optimize Energy Performance, 20% New / 10% Existing
1	1	Credit 1.3	Optimize Energy Performance, 25% New / 15% Existing
1	1	Credit 1.4	Optimize Energy Performance, 30% New / 20% Existing
1	1	Credit 1.5	Optimize Energy Performance, 35% New / 25% Existing
1	1	Credit 1.6	Optimize Energy Performance, 40% New / 30% Existing
1	1	Credit 1.7	Optimize Energy Performance, 45% New / 35% Existing
1	1	Credit 1.8	Optimize Energy Performance, 50% New / 40% Existing
1	1	Credit 1.9	Optimize Energy Performance, 55% New / 45% Existing
1	1	Credit 1.10	Optimize Energy Performance, 60% New / 50% Existing
1	1	Credit 2.1	Renewable Energy, 5%
1	1	Credit 2.2	Renewable Energy, 10%
	1	Credit 2.3	Renewable Energy, 15%
1	1	Credit 3	Additional Commissioning
1	1	Credit 4	Ozone Depletion
1	1	Credit 5	Measurement & Verification
1	1	Credit 6	Green Power



MATERIALS AND RESOURCES

5 of 13 possible points

x	x	Prereq 1	Storage & Collection of Recyclables
1		Credit 1.1	Building Reuse, Maintain 75% of Existing Shell
1		Credit 1.2	Building Reuse, Maintain 100% of Existing Shell
1		Credit 1.3	Building Reuse, Maintain 100% Shell & 50% Non-Shell
1	1	Credit 2.1	Construction Waste Management, Divert 50%
1		Credit 2.2	Construction Waste Management, Divert 75%
1		Credit 3.1	Resource Reuse, Specify 5%
1		Credit 3.2	Resource Reuse, Specify 10%
1	1	Credit 4.1	Recycled Content, Specify 5%
1	1	Credit 4.2	Recycled Content, Specify 10%
1	1	Credit 5.1	Local/Regional Materials, 20% Manufactured Locally
1	1	Credit 5.2	Local/Regional Materials, of 20% Above, 50% Harvested Locally
1		Credit 6	Rapidly Renewable Materials
1		Credit 7	Certified Wood



INDOOR ENVIRONMENTAL AIR QUALITY

11 of 15 possible points

x	x	Prereq 1	Minimum IAQ Performance
x	x	Prereq 2	Environmental Tobacco Smoke (ETS) Control
1	1	Credit 1	Carbon Dioxide Monitoring
1	1	Credit 2	Ventilation Effectiveness
1	1	Credit 3.1	Construction IAQ Management Plan, During Construction
1	1	Credit 3.2	Construction IAQ Management Plan, Before Occupancy
1	1	Credit 4.1	Low-Emitting Materials, Adhesives & Sealants
1		Credit 4.2	Low-Emitting Materials, Paints
1	1	Credit 4.3	Low-Emitting Materials, Carpet
1		Credit 4.4	Low-Emitting Materials, Composite Wood & Agrifiber Products
1	1	Credit 5	Indoor Chemical & Pollutant Source Control
1	1	Credit 6.1	Controllability of Systems, Perimeter
1		Credit 6.2	Controllability of Systems, Non-Perimeter
1	1	Credit 7.1	Thermal Comfort, Comply with ASHRAE 55-1992
1	1	Credit 7.2	Thermal Comfort, Permanent Monitoring System
1		Credit 8.1	Daylight & Views, Daylight 75% of Spaces
1	1	Credit 8.2	Daylight & Views, Views for 90% of Spaces



INNOVATION AND DESIGN PROCESS

5 of 5 possible points

1	1	Credit 1.1	Innovation in Design: Green Housekeeping
1	1	Credit 1.2	Innovation in Design: Green Building Education
1	1	Credit 1.3	Innovation in Design: Exemplary Performance, SSc5.1
1	1	Credit 1.4	Innovation in Design: Exemplary Performance, WEc3
1	1	Credit 2	LEED® Accredited Professional

BONNY BENTZIN

DIRECTOR OF UNIVERSITY SUSTAINABILITY
PRACTICES, ARIZONA STATE UNIVERSITY

I. PROCESS

PROJECT GENESIS

When President Crow¹ arrived at the University, he had a vision for a New American University,² but he also had a vision for a sustainable university. He wanted to move ASU into a new tier of research. The vision was not about building a green building, per se; it was about building a green research facility and that was just the beginning of the story.

My role at the University was a little different then than it is now. At that time I was working in the president's office to help design the university-wide vision for sustainability. That was what was called an initiative's office; it was a temporary office. Eventually, we finished that project. Now, we have the Global Institute of Sustainability (GIOS). My role was actually fairly minimal with the Biodesign Institute. Now, I'm much more involved with all aspects of our operations, green building efforts, and things like that.

The Global Institute of Sustainability is the hub for sustainability at the university. In it are different areas that we focus on: research, education, outreach, and engagement. Research and education are the primary missions of the university; that's why we exist. The outreach and engagement is really about how we connect with the community, the University, and K-12 schools. We have to think about how we demonstrate sustainability practices on this campus. If we're going to be a leader in research and education, we'd better know how to do that, too. I'm based in GIOS and here, we bridge out into the entire University community to connect the dots between our different opportunities and to track our goals. It's certainly a big challenge. This University is a large, complex organization with 81,000 individuals: faculty, staff, and students. There are four very different and unique campuses, as well as two research parks. They all have different values that are being exercised throughout the entire University. There is a set of challenges with how we facilitate change here at ASU. What



BONNY BENTZIN, LEED AP, joined Arizona State University in late 2003 and spent 3 years as the Assistant Director of Sustainability Initiatives in ASU's Office of the President designing the foundation of ASU's university-wide sustainability program. In her current role as the Director of University Sustainability Practices at ASU's Global Institute of Sustainability, she is leading ASU toward carbon neutrality and integrating sustainability into all of its operational practices. Bonny has a degree in Environmental Problem Solving from Mount Holyoke College in Massachusetts.

¹ Michael M. Crow became the 16th president of Arizona State University on July 1, 2002. Under his direction ASU has initiated a dramatic research infrastructure expansion to create more than one million square feet of new research space. Prior to joining ASU, he was executive vice provost of Columbia University, where he also was professor of science and technology policy in the School of International and Public Affairs. He led the creation of the Columbia Earth Institute, and helped found the Center for Science, Policy, and Outcomes in Washington, D.C., a think tank dedicated to linking science and technology to desired social, economic, and environmental outcomes.

² The New American University is a new model for how a university runs with a more collaborative and integrated approach to all disciplines. The eight principles guiding the vision of the University include: Leverage Our Place, Transform Society, Value Entrepreneurship, Conduct Use-Inspired Research, Enable Student Success, Fuse Intellectual Disciplines, Be Socially Embedded, and Engage Globally.

University of Oregon Professor Alison G. Kwok, Advisor Nicholas B. Rajkovich, and research assistants Rachel B. Auerbach, Kristen B. DiStefano, Britni L. Jessup, and Amanda M. Rhodes prepared this narrative. © 2009 U.S. Green Building Council and the University of Oregon. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means without the permission of the USGBC.



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Amphitheater "We have to balance the various values from education to research to our students' and faculty's needs... The interesting part about sustainability is that we're starting to see people recognize that this is a value that we can imbed within all those other values."

I like to think about is that when we do change and the University adopts sustainability across the board, then we'll have a huge impact on the world. That's what makes it interesting: it's challenging because of our size and complexity, but we can have a huge impact.

This is a complex university. It has a lot of different parts. We have to balance the various values from education to research to our students' and faculty's needs. We have to balance those concerns. The interesting part about sustainability is that we're starting to see people recognize that this is a value that we can imbed within all those other values. It's doesn't necessarily have to be an either/or situation. Sustainability is something we're trying to imbed into our culture. Right now, I have some student interns; sustainability is their goal in life. I'm just trying to help them learn as much as they can, so that I can get out of the way and let them take over the world.

I wasn't part of the team selection process for the Biodesign Institute since I was working on a different program that dealt with the university-wide level of the vision behind it. I will say that from what I understand about the process, one of the successes behind it was that everyone at the table agreed that they were going to try and take that project as far as they could go. That was the key.

II. DESIGN CHALLENGES

One of the challenges you have with that particular building is that, no matter how you design it, it is going to use a lot of energy. It's a biodesign research facility. It has equipment running 24/7. We're doing very valuable research and we can't afford to lose data because of environmental fluctuations. There's important work being done in that building. So, one of the challenges

is how can we build a high caliber research building, adapt it to LEED,³ and also make sure it works well for the occupants. Biodesign is certified at some of the highest levels you can achieve in LEED, but we've had to spend quite a bit of time balancing the building. We couldn't just guarantee, as if by magic, that we would have this perfectly operating building. We can't forget the human component. We can't forget that we can design a building but, even as we're designing and building it, the function of the building is changing as soon as people start moving in. What we've had to do is spend quite a bit of time going in and looking at how we use what was installed in the building to then reduce the consumption of resources within the building. What's interesting with the Biodesign Institute is that the occupants are extremely strong supporters of our sustainability efforts across campus. When we were redesigning the recycling program, for example, they were the ones who said they wanted it first. I don't know if it's because of the philosophy of the occupants of the building or because of the building, but that's something that we've seen. They've been early adopters of any challenges we've thrown out.

A modeled building is definitely different than one that's built. Reality is a little different than what is on the computer screen. It's an important message to understand. We've got to go back into these buildings and constantly evaluate the progress.

III. OPERATIONS

MONITORING BUILDING PERFORMANCE

One of the challenges we have in the state of Arizona is that we don't necessarily have the staff in place to constantly update or review the buildings. Our energy managers and facilities managers have been looking at some different team models that we can use for continuous commissioning. Continuous commissioning means trying to send a team around to comprehensively check every building at least once every three

years. Basically, they just continue to circle around the campus. Once they're done, they go back to the starting point and begin again. That's something that our facility managers are looking into.

In the U.S., we've set up some great systems. We don't have to question where our energy comes from. We don't have to question where our trash goes. We can put the refuse in a container and it magically disappears. One of the challenges with that is that people lose touch with the impact of their behaviors. In this university setting, we have, for the most part, a master utility budget for the whole Tempe campus. We're running quite a few buildings on that one budget. You don't necessarily have an understanding of what your impact is on the budget, especially given how many buildings and how many people we have here. The perception might be that one light or one computer isn't going to make a big difference. As a university, we've developed a program called Campus Metabolism.⁴ It's on the internet, and it's in 13 buildings right now. It's basically a building dashboard system, except that rather than contracting this program out, we did it in-house. It's a visualization tool that allows the average, everyday user to see what the building is using in energy. Again, it's only in 13 buildings right now. There are 52 buildings on the campus that could be on it that we currently have metered data on. Biodesign is one of those buildings. We're currently working on a plan to add those remaining buildings onto campus metabolism. If you go to Campus Metabolism, the virtual room is really the key to understanding individual contributions to the energy footprint. We're one of the first institutions to actually have that option. In the virtual room, you can click a residential hall room or an office. For example, my office has quite a few illegal appliances in it, which you can click on and off and see what the footprint is in each individual space. I've actually had two students tell me that they're going to get rid of the refrigerators in their room because they had no idea the carbon and financial costs were so high. That's the

³ The Leadership in Energy and Environmental Design (LEED) Green Building Rating System, developed by the U.S. Green Building Council (USGBC), is a suite of voluntary standards for green buildings. It awards certifications at Certified, Silver, Gold, and Platinum levels.

⁴ Campus Metabolism is an interactive web tool that displays real-time energy use data from buildings in the Arizona State University system. For more information, visit the website at cm.asu.edu.



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Electric Vehicles "How can we focus on these individual buildings and still remember that they are part of a system... we're trying to connect the dots in the system."

type of understanding we're trying to foster. I'm not going to tell you that you shouldn't have a refrigerator in your room; if it's an office, you're not allowed to anyway. The students are authorized to have a small refrigerator in their rooms. We let them make the decision based on the information that they have.

LESSONS LEARNED

People often ask me why this project is so successful: it was collaborative. If we hadn't had each of those members at the table, we wouldn't have gotten it done. We're in the process of trademarking Campus Metabolism. We're trying to figure out how to deploy it to more campuses. We have databases for industry and hospitals, but not for Higher Ed. We don't want to track just LEED checklists; we want to really know what's working and what's not working. We don't do enough of that in colleges and universities. We don't necessarily have the luxury of going back

and really evaluating what's working and what's not. That's something we really need to do. I'll give an example of this building, the GIOS. It's LEED Silver certified. It's an existing building.⁵ GIOS used to be the old nursing building. Now, it's the sustainability building. We put motion sensor light switches in almost every room in this building. A couple of the common areas, the restrooms, and the conference rooms don't have them. But otherwise, they're everywhere else. Actually, my observation is that we could have saved a lot of money by only putting them in the common areas. The reason being that you can teach an individual to take care of his or her personal space, but watch the dynamics of people coming out of a conference room or classroom or hallway. There's a hesitancy that goes on of who is supposed to take ownership of this space, of who is responsible for cleaning it up. It's better to

⁵ LEED for Existing Buildings (LEED-EB) provides a benchmark for building owners and operators to measure operations, improvements, and maintenance.

focus those sensors on the common spaces and leave the conventional light switches in the individual offices. I'll go the next step. I'll ask people if they've ever been in a building that has motion sensors and auto faucets. If it's a big group, I'll get one or two people raise their hands. I'll ask how many times they have put their hands under the faucet trying to get it to start just to find out they've gone into a building that doesn't have the sensors. They all say they've done it. Think about that. We don't have motion sensors at home. So, if I put them in my office and I train myself not to turn my lights off anymore, there's a risk that I'm going to reduce the impact of the University, but that when I go home, I'm leaving more lights on, since I'm used to the lights turning on and off automatically. That's just an example of something that I've observed in this building. That is the type of information we need to get out: what's actually working, what's not working, what we would never do again, what we wish we had done, and what we would do over and over again. We need a model that trains people to go back and evaluate.

FINANCIAL INCENTIVES

We're looking at all kinds of funding. We want to figure out if we can create in-house financing, so that if we're going to fund something later, then maybe we could fund it now. That saves us money. We try to make that happen. We try to build some funds, revolving funds, which split the cost of ownership for some of the installations that may not have a lot of direct value for the occupants, but yet have a significant value to the University. We try to balance those values. Of course, we also look into grants and third party financing. Many of the solar installations have been done through a Power Purchase Agreement,⁶ what we call a Qualified Management Agreement. They have a similar function, but are slightly different terms. Those are the types of funding sources we're looking into. In many cases, we're looking at how it's not necessarily costing more to do something; we're just trading off or capitalizing savings from a deci-

sion. As a nonprofit, we can't directly benefit from tax incentives, but under Power Purchase Agreements, or Qualified Management Agreements, we can pass those incentive savings onto our third party provider.

There are a couple of challenges with what we're doing. First of all, how can we focus on these individual buildings and still remember that they are part of a system. That's the idea behind Campus Metabolism. We want to help people understand that these buildings and this campus have a metabolism, just like any human body that has cells that come together to make organs that come together to produce resources and waste. A campus has that, too, and we're trying to connect the dots in the system.

The other challenge is acquiring good data. We've got a private grant right now that will allow us to better capture the data of all four campuses, all the different areas of the University. We're missing data on many of our goals: our zero solid goal, water waste goal, and carbon neutrality goal. We're such a large, complex organization. The other challenge is planning. I've had a few conversations about this with others in the past few weeks. In Arizona, with the desert environment, construction happens 365 days a year. Compare that to Chicago or Boston, where there's a winter season that allows for some planning before the big rush for construction. We don't have that here. There's construction happening 365 days a year. Combine that with the fact that we don't have many natural disasters, such as earthquakes, mudslides, snowstorms, hurricanes, or tornados. It makes for a culture that doesn't necessarily have the luxury of long-term planning. We do a lot of short-term crisis management. We're missing the data and the planning pieces. We have to understand that this is all part of the same system.

THE LEED CERTIFICATION PROCESS

Currently, our mandate is LEED Silver for new buildings that are owned and operated by the University. We were an early adopter of that mandate that we set in place in 2005. Since then, we've met or beaten it. We were an early adopter because it was an important program to implement

⁶ A Power Purchase Agreement is a legal contract between an electricity generator and a power purchaser. Such agreements play a key role in financing independently owned electricity generating assets, such as solar panels.

so that we could raise awareness and attention to green building and the impact that the built environment has on our resource consumption and overall world around us. It's important for ASU to be a leader. One of the things we're doing right now is developing some design guidelines for internal use at the University. Those will help us guarantee certain performance standards in all our buildings. With LEED, it's easy, especially since our mandate is for only LEED Silver, to have some tradeoffs and gain points in areas that don't necessarily guarantee a quality building or quality work environment. What we're looking for is a hybrid system where we still use LEED, because our project managers like having something they can move toward and achieve, but we also establish some pretty significant design guidelines of our own as baseline measurements that every building must meet. We're really geared toward developing a building that's more productive, uses less energy and water, and provides an overall better work environment. Identifying some of the categories that impact the environment is really what LEED does. When you set out a checklist that's very easy, sometimes the tendency is to create workarounds, regardless of the safeguards that are in place at the USGBC.⁷ We're trying to put in another set of back checks to make sure we're getting the building we need for this environment and region.

THE VALUE OF LEED CERTIFICATION

LEED has value, and it gives projects some structure. Whether we've got new project managers on the team or seasoned project managers, they have a structure and some guidelines they can follow. But we have to look at how we adapt those guidelines for this particular region. LEED also gives people assurance that ASU pays attention. It gives them some understanding of the value system that we considered when we were building this building for the occupants. Human beings like to be in natural daylighting. They like clean, healthy air. Our productivity goes up. That's a number that's tough to capture and sell to the University. That's something we don't necessarily try to do in the early planning

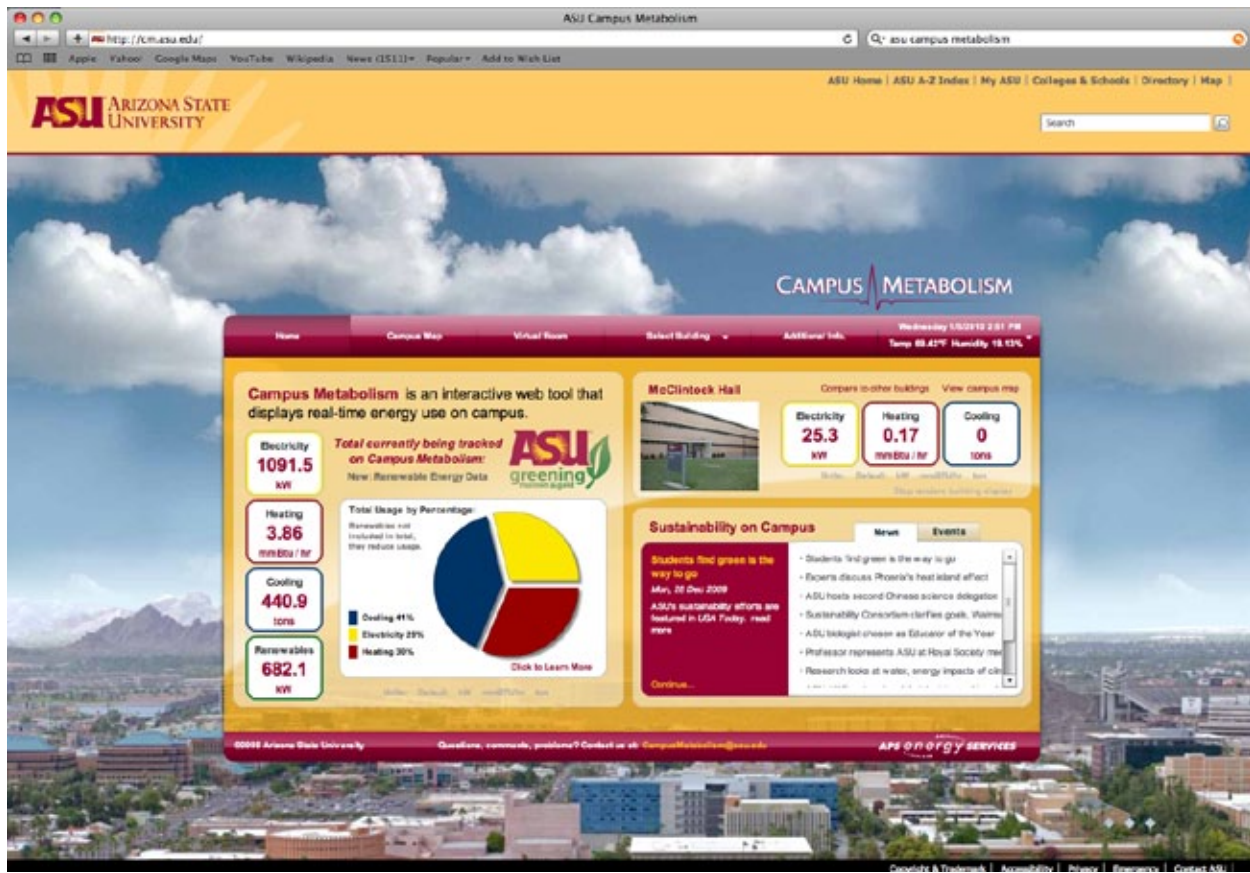
stages; we don't try to sell it on the merits of increased productivity or sick days saved. We just try to roll that value into the other choices we're making. When you talk to the bean counters who want a cut-and-dry cost benefit, it's hard to capture that. We're figuring out how we can use LEED as a communication tool and guide. We're figuring out how we can use LEED and build better buildings.

GAPS IN RESOURCES

We really need a strong data collection mechanism, not just for this building, but for all buildings. In this building alone, we've got six different departments that are, in some way, involved in managing it. Then there are the users or the building occupants. We really need to make that data available, not just to the facility managers but also to the occupants. That's one of those lessons learned. We have Campus Metabolism and GIOS, but we need to move it to include other data points to frame out the Metabolism project with solid waste and water data as well. The meters and tools are expensive so we have to balance the value of providing real-time accurate information with providing overall information for the University. With some data points, like recycling and trash, we'll probably provide monthly data points for areas of the campus, because quite frankly there's not much of a return to force the custodians to weigh the trash that's headed out of the building every day. That would burn more bridges than it would build, but we can take our weigh bills of what's going out to the landfill or the recycling sorting facility. We can provide that monthly and break the campus into areas.

All the players on the table have to be on-board. Then, they really understand the long term goals of the University. When you're dealing with a campus this size, any university this size, the players at the table also include the building occupants. Once again, they don't necessarily have a financial stake in the operations of that building. The rest of the team is made up of the project managers and architects, the construction people, the engineers, and a number of other people. If any one of those has doubt in their minds as to what they can accomplish, then

⁷ The U.S. Green Building Council (USGBC) is a non-profit organization dedicated to sustainable design and construction.



cm.asu.edu

Campus Metabolism "We really need a strong data collection mechanism, not just for this building, but for all buildings... We really need to make that data available, not just to the facility managers but also to the occupants."

that's a problem. We've got to get everyone on the same page and have people at the table who really want to do something special, people who want to push the envelope. Those people will build the best building for this University.

Each project is a new challenge, but as we continue to have successes and as we can start to document the return on those successes, we're in a better position to continue that process.

MAKING IMPROVEMENTS FOR THE FUTURE

We are currently back filling some areas that were missing in our sustainability arsenal. We have things like a tool box for greening offices. We've got a recycling manager that goes in and educates the occupants about what to recycle as well as the new program. It's a different program than we've had in the past. We've just finalized a contract with a company that's going to come

in and help us reduce our energy consumption through changes in human behavior. We think we can save about 10% of our annual energy consumption through conservation alone. All these pieces are averaging out to a program that will create greater awareness among the occupants.

We have a well-rounded vision, but we're still working on building out the approach. Every university will tell you that they are only half way with its efforts; there's always more to do. We're seeing some great successes here, and we're seeing some great successes at colleges and universities across the country. What's great about those successes is that if we continue to share those messages of success and failure then, quite frankly, we can move all the different schools across the country to greater achievement. That's what really important. Most of my colleagues in this industry tend to define success when not just our own university is doing it, but when all of our peers are doing

it too. With Higher Ed being 3% of the market share, we can actually move mountains. Also, we can turn out leaders from our universities and colleges and the research that we do. If each one of those people take one leadership role, put one bottle in the recycling bin, turn one light off, or rethink how they purchase a product, what they purchase, or how we run a building, they'll be making an impact. All those small actions add up to the big vision that ASU has and that other colleges and universities have as well.

Overall, people have been very receptive. In some cases, we've had situations where someone has misinterpreted an effort and we've had to go back and reinforce our intentions with communicating and marketing the impact. An example is the tray-less dining in our food services. Our food service partner is ARAMARK;⁸ they manage all of our food service. One of the things that has swept across the U.S. is getting rid of trays in the all-you-can-eat facilities. The reason is that trays are just one more thing that you have to wash. ARAMARK calculated the number of gallons of water and soap that we have avoided using. With trays, students tend to take more food and either consume that food, or they don't really want it and it goes to waste. They take more food than they are going to eat and they throw it away. If they have to get up and get more food on one plate, they tend to think more about their decisions. When we first did this, we had some really angry students. They just assumed it was one more layer of bureaucracy infringing on their rights. There was one student who was very vocal. Someone took him aside and explained the number of gallons of water and gallons of soap it takes to wash the trays. That just hadn't occurred to him. His impression was that we were just creating one more layer of bureaucracy, one more barrier to what he wanted to do on campus. When we took the time to explain, then he just said, "Well, why didn't you just tell us that in the first place." It just goes back to the fact that people need data. You can't just tell human beings, particularly not Americans, that you should do this or you have to do that. People need to under-

stand why. We give them the opportunity, when possible, to make the right decisions themselves. It's really about closing the loop so they can understand why they are doing it. We've got to balance the awareness of our actions with how we operate these buildings, how we engage them, and which systems we have in place for efficient operations.

This narrative is based on a video- and audiotaped interview conducted by Britni Jessup on November 10, 2009, at the Global Institute of Sustainability on the ASU campus in Tempe, AZ.

8 ARAMARK is a professional services company, providing food services, facilities management, and uniform and career apparel to health care institutions, universities and school districts, stadiums and arenas, and businesses.

LARRY LORD

PRINCIPAL,
LORD, AECK & SARGENT, ARCHITECT

I. PROCESS

GETTING INVOLVED WITH THE PROJECT

In 2000, there was a request for proposals to do a strategic planning exercise for the research facilities here at Arizona State University (ASU). We joined up with a local firm, Gould Evans,¹ and together, Lord, Aeck & Sargent² and Gould Evans decided to present all of the information that we had. I had a good bit of experience in strategic planning. We were selected and we did the strategic plan first. Out of that, the first building they wanted to do was called AZ Bio. That was renamed Biodesign at a later date. We did the master plan for the campus, then the site, and then we started the first building. It was very exciting.



LARRY LORD, FAIA, is a founding Principal of Lord, Aeck & Sargent and is an expert in strategic planning, program management and design leadership for a wide range of facilities. He is a nationally recognized lecturer on managing the complex technological and financial requirements of science facilities and research centers for colleges and universities. Larry has practiced architecture since 1965.

COLLABORATING WITH GOULD EVANS

Trudi Hummel,³ the head of the Gould Evans office here, had talked to people at ASU, and they liked a project that we had done called the Manufacturing Research Center at Georgia Tech. It had some features and some approaches that they thought were really good; so, Trudi called me and we started talking. It evolved into a working relationship that proved very successful.

ROLE ON THE PROJECT TEAM

For Biodesign, I was the project director and orchestrated a lot of the parts and pieces of the strategic plan. Part of my expertise is in budgeting and making sure that total project budgets are pulled together. In those early discussions, I got excited about energy conservation. At that time, it wasn't called green building or sustainability, but we discussed energy conservation and many of those kinds of ideas in thinking about how to make this a successful research building. I also got very excited about their push for interdisciplinary research. All of those things were pushed very hard by the small group of people with whom we worked from the outset of the project. We had a really good team of people from Gould Evans, Lord, Aeck &

¹ Gould Evans is a design firm specializing in architecture, interior architecture, graphic design, and planning/landscape architecture. The firm has offices in Kansas City, Missouri; Lawrence, Kansas; Phoenix, Arizona; San Francisco, California; and Tampa, Florida.

² Lord, Aeck & Sargent is an architectural firm with over 3,000 completed projects. With offices in Atlanta, Georgia; Ann Arbor, Michigan; and Chapel Hill, North Carolina; the firm has five studios: Architecture for Arts & Culture, Architecture for Education, Architecture for Historic Preservation, Architecture for Science, and Architecture for Housing & Mixed-Use.

³ Trudi Hummel is a Principal with Gould Evans in the Phoenix, Arizona office.

University of Oregon Professor Alison G. Kwok, Advisor Nicholas B. Rajkovich, and research assistants Rachel B. Auerbach, Kristen B. DiStefano, Britni L. Jessup, and Amanda M. Rhodes prepared this narrative. © 2009 U.S. Green Building Council and the University of Oregon. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means without the permission of the USGBC.

Sargent, and Newcomb & Boyd⁴ that comprised the design team, and then we had the people from the Biodesign Institute and the facilities people there. We had an incredible confluence of energies around a project that aligned very closely with my goals of doing large-scale research projects, and doing them within a budget, so that we could get a great design that met both aesthetic and functional requirements.

THE UNIVERSITY'S GOALS

ASU's impetus for these projects was in part that they wanted a return to being a Research 1⁵ institution. Their sponsored research had dwindled to something like \$27 million a year; that's a fairly low level, and they wanted to increase it. I think last year they went over \$300 million. The emphasis for the project was on how we could get them back from being just an education-based institution to being an institution with an emphasis on both students and research. Their goal was very clear; that's what they wanted to achieve and they knew that this would be an opportunity to achieve it. When they decided on this location for the building, it became the gateway from the east. ASU didn't have any buildings beyond the site, and it became an important entry to the campus from the east.

When we were getting started, we had an opportunity to talk about the light rail. We were able to be part of the group that got to work on it. Initially, they were going to route it to a different location. It was going to come down the street just to the west of the site, instead of crossing Rural Road north of the facility. Well, we did these electromagnetic interference studies (EMI), because EMI is a really big problem for a research building. Vibration is another problem. We were able to come up with an analysis to show that if they routed it west of the site, we would have to

find another site. We were able to work with the City and the University to get the light rail relocated to better accommodate the building.

The other important factor was the light rail station. Once we got it relocated, you could get off right there on the corner, and walk right past Biodesign, down the engineering mall, and toward all the rest of the research buildings.

Interdisciplinary work is often thought of as being done in one room or one building that's shared. At the time, there were a number of research institutions that were being planned or built downtown. The fact that you can walk across the street, get on the light rail, and be at TGen⁶ or one of the other research facilities in a jiffy, makes abundant sense. You don't have to have all the research buildings or people in one place; they can be in different places if they're still readily accessible.

ASSEMBLING THE PROJECT TEAM

Assembling the team was really important in securing the job. We recommended to Gould Evans that we bring in Newcomb & Boyd. Newcomb & Boyd is based in Atlanta; we had worked with them a lot, and we wanted to make sure that we had that close coordination for the engineered systems. We always bring the mechanical engineer to the first meeting. It is critical to have them there on a research building that is going to have a lot of huge ducts; so, we bring them to the table early. We really had a great team. Soon after we got going, we selected the construction team, of DPR⁷ and Sundt.⁸ All the subs came on later. In an institution like this, working within facilities is also critical; assembling that part of the team is not really our responsibility, but we had to make sure that it happened. Later Mike McLeod,⁹ was the person

4 Newcomb & Boyd is a multidisciplinary consulting and engineering firm which provides innovative solutions for facility design, construction and maintenance. The firm is made up of the Consulting Engineering Group, the Commissioning Group, the Special Technologies Group, and the Lighting Design Group.

5 Though the term is still used, it is no longer valid. Research 1 was previously used by the Carnegie Classification of Institutions of Higher Education and indicated universities that offered a full range of baccalaureate programs, were committed to graduate and doctorate education, gave a priority to research, awarded 50 or more doctoral degrees per year, and received annually more than \$40 million or more in Federal support.

6 The Translational Genomics Research Institute (TGen) is a non-profit 501(c)(3) organization focused on developing earlier diagnostics and smarter treatments.

7 DPR Construction, Inc. is a builder with technical/laboratory expertise located throughout the United States.

8 Sundt Construction is a contractor based in the southwestern United States offering Construction Management At-Risk, Design Build, and Build to Suit Contracting services.

9 Mike McLeod is the Director of Facilities Management at the Biodesign Institute and was the Project Manager for ASU in the construction of both Building A and Building B.



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Light Rail "Interdisciplinary work is often thought of as being done in one room or one building that's shared... You don't have to have all the research buildings or people in one place; they can be in different places if they're still readily accessible."

with whom we worked. Everybody was focused on the goals.

Our firm had done work all over the country, so we took charge of the strategic plan, and then the master plan. We also worked on the first designs of how the building might come together. Then, we worked corroboratively with Gould Evans; John¹⁰ and others at Gould Evans, took over the design of the exterior of the building and we continued to work on the design of the interior of the building. It's hard to define exactly where we stopped and they started.

PROJECT COMMUNICATION

The first thing we did, which was a sustainable idea, was to talk them into buying the videoconferencing equipment. It's really an important thing. We do everything by videoconference. It's not as good as two people sitting in the same

room together, but it does work very well. We're able to look at people and we can show the Schematics¹¹ and Design Development¹² by camera. I came to Phoenix almost every week. We had two or three people who would come out and work to get the project to a certain level for a week and then we'd send somebody else. Then, I would come a little less frequently, and we continued to work that way. It was a matter of divvying up the work so that it made sense that they would do this part and we would do that part. The videoconferencing worked well because once you'd been out here a few times, we kind of knew where all the parts of the room were and who was there.

¹¹ The Schematic Design phase is part of the design and delivery process, which consists of the following phases, listed in their order of sequence: Schematic Design, Design Development, Construction Documentation, and Construction Administration.

¹² Design Development (DD) is the second part of the design and delivery process, which consists of the following phases, listed in their order of sequence: Schematic Design, Design Development, Construction Documentation, and Construction Administration.

¹⁰ John Dimmel is an architect with Gould Evans in Phoenix, Arizona.



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Laboratories "I remind everybody that we're working on a research building, not just an edifice that's trying to make the cover of a magazine."

II. DESIGN

DECIDING TO PURSUE LEED CERTIFICATION

Going back to 1976 or 1978, when we had the first energy crisis, I got involved in building the most energy conservative high-rise office building in the world, at that time. It was the Georgia Power corporate headquarters building in Atlanta; so, I learned how to reduce energy use. We came up with all kinds of solid ideas that are still valid today.

For me that's still the underlying characteristic of sustainability: how can I use the fewest resources and still design a building to perform at its highest level? I thought about that a lot. I kept working on that idea through the years and by the time we got to Biodesign, it was in our genes; that's what we knew how to do. By that time, we had started incorporating certain sustainable ideas into our specifications design processes. In the early 2000s, the sustainability movement was just really gaining momentum. We came to the table with a lot of ideas and experience, and then we began to learn what other people were doing to work toward sustainability. It was not until later that we actually did the LEED¹³ checklist. It was late in the construction of Building A when we really got on-board with the idea of LEED. As we were starting Building B, we wondered if we shouldn't certify both buildings. We went back and reviewed what was in Building A; we had to reconstruct that documentation, but it passed the test.

Interestingly, I'm a numbers and benchmark guy, so I'm always thinking of things in terms of metrics. I'm always trying to think of how I'm going to test an idea later on. You can think something is really lovely, but "lovely" is not much of a metric. "Lovely" is your own personal viewpoint and opinion, but if you only use so many BTUs¹⁴ per year, then you've got something. I work on metrics and on the cost. That's an important loop; it's a lot easier to push back on some wild design idea that might look like it's expensive. You have to evaluate if it's really going to benefit the end product or if you should push back a little bit. I can do that with either energy or with dollars, and it's amazing how that can work. I usually approach things that way. I try to leave the aesthetics to those who get up every morning trying to make a better building. We combine pretty well as a team.

¹³ The Leadership in Energy and Environmental Design (LEED) Green Building Rating System, developed by the U.S. Green Building Council (USGBC), is a suite of voluntary standards for green buildings. It awards certifications at Certified, Silver, Gold, and Platinum levels.

¹⁴ The British thermal unit (BTU) is a traditional unit of energy equal to about 1.06 kilojoules. It is approximately the amount of energy needed to heat one pound of water one degree Fahrenheit.

LEED CREDIT CHALLENGES

There were many challenges, but there's one story that comes to mind. In the context of the master plan with two buildings north-south and two buildings east-west, we decided that the north-south building farthest south was the best place to put the first building, in terms of the lower EMI and vibrations. It was the farthest away from the light rail, roads, and high power lines, so we started with that. Of course, that was antithetical to some people's view of how you should orient a building. We had to work hard to convince ourselves that it would work, since that gave us big east and west façades to deal with. The campus is primarily brick, so masonry was fine for the west façade that was facing the campus, but to the east we wanted to open it up to welcome people to the research community and the campus. That became the new campus entry from the east. We were ready to use some shading devices to deal with the east exposure, and we thought we'd be good to go, but the campus rejected the shading devices because of the birds. They insisted that the birds would defecate on the shading devices. We fought them for quite a while, because we wanted to keep the heat outside of the building, but eventually, we were told that we couldn't do it.

We decided that we would work on the inside. There were elaborate studies and computational fluid dynamic models of the whole interior. We tried to figure out how to make it work, and we developed the automated louvers on the inside. We had a challenge, but we overcame it. Some people might say it's not the ideal solution, but if you know the context, it does make good sense.

CHALLENGES OF THE PROJECT

We had challenges that were similar to those of any design process. Across the country, one of the biggest challenges is campus standards. If campus standards have been developed over the last 20 years, people are used to knowing certain building products and how to maintain them. They wonder why they would ever agree to change to something else. One of the biggest challenges we face is the desire to stick with the status quo. In terms of

campus standards, people are not willing to move beyond the products and systems they know. At ASU, though, we had a good bit of cooperation around that issue. We had some interesting meetings with the shop people to try to make sure that they were going to be willing to maintain these unique systems.

FUNDING AND INCENTIVES

It was very clear that being a Research 1 university and increasing the amount of sponsored research had a direct relationship to ASU's recruitment abilities. They couldn't just stick with the researchers who were here already; yes, they wanted to use them, but they had to compliment them with high-profile researchers from around the country. So, we knew that both recruitment and retention were very important to the success of the project. There was a guy who was working with us from Procter and Gamble, and he had a feel for corporate research. He loved the open plan of the large, flexible labs, because he knew you didn't need a little cubicle to do your research. He thought that if people could be open to sharing, then that would be the best way to do it. It was not until the building was finished and people walked into it that they understood what we meant by the energy and the excitement in the building. We really worked to get that important point across. We had to create an environment that would bring in great people. Now, the Institute has a Nobel laureate, and four people with the Academy of Sciences. Some great people have come to work here, and I couldn't be prouder of that.

DESIGNING THE LABS

In the late 90's, we were doing all kinds of labs. A lot of those same tenets are part of most researchers' desires. We were doing a public health laboratory in Atlanta for the state of Georgia, and we proposed that instead of having all of the little rooms they had in the old building, that they have one big laboratory. That would give them the flexibility to move around as different research came and went. They could have that flexibility over a long period of time. It was the first major project in the U.S. where we had the open and flexible lab. It won R & D Magazine Lab

of the Year, and was very well received. So, we had already become very familiar with the open lab, but we have always had to sell it to the next institution that we went to. There are so many good things about the open lab, and most people have adopted it today.

There are other facilities that are part of the Biodesign project that I think are equally challenging and important to the research environment. Roy Curtiss directs one facility. He's a Ph.D, and he's a real character. He's got this long white beard; it's just amazing, and he works with infectious diseases. There are several other people at Biodesign who work with diseases, and we had expertise in Biosafety Level 3¹⁵ laboratories. We knew how to work with that kind of space, and we had to do several of those suites within the Biodesign Institute for infectious disease work. There's also an area with lasers, and all of that has to be very stable. That's why our EMI and vibration studies were so important. The lower level of Building A is the best that you can have; it's basically benign and doesn't influence the tools at all. The third specialty area is the animal facilities. There's a whole floor of animal facilities on the lower level of the building; we have experts in our firm who design animal facilities. That's one of the pieces that ASU doesn't talk about a lot. So, there were a number of special areas, and when you add all of that together, you have an environment that attracts people with a comprehensive approach.

In the open labs, one of the things we were concerned about was that people would cover up the glass to the hallway with papers and posters. The first director of the lab put out an edict that no one could have any paper or posters on the windows. Then, he bought flat screen panels. He hung those up and the researchers could show off their stuff. In fact, they show a lot of things that a regular poster couldn't. It was very exciting to have people who were backing up the design and what it was trying to achieve. They understood the visibility goals, and every-

¹⁵ A biosafety level is the level of the precautions required to isolate dangerous biological agents in an enclosed facility. The levels of containment range from the lowest biosafety level 1 to the highest level 4. Level 3 is applicable to clinical, diagnostic, teaching, research, or production facilities in which work is done with indigenous or exotic agents that may cause serious or potentially lethal disease after inhalation.

body in the place, from the director down, respected that.

When we first got to ASU, one president was finishing up his term, and then the new president, Michael Crow,¹⁶ came in. He was aggressive and very ready to get this research agenda going. He was excited about this particular building, and he was very supportive of the new ideas our team was proposing to enhance the research environment to the highest level. We had to carefully dissect the total budget and put it into the right buckets so that we could spend it judiciously in support of that goal. When I'm working with a team, I remind everybody that we're working on a research building, not just an edifice that's trying to make the cover of a magazine. If that happens, that's fine, but the first thing we want to focus our expenditures on is creating the best research environment that we can offer.

III. CONSTRUCTION INVOLVEMENT DURING THE CONSTRUCTION PHASE

During construction I was initially involved in making sure that we had a set of drawings and were working within the construction budget. Then, I was in Phoenix every two or three weeks at the owner/architect/contractor meetings. I worked with the whole team to make sure that the project was continuing to function effectively. I have a good rapport with most of the construction people, and I worked with them to make sure that problems got solved before they became big issues.

THE COST OF LEED

Early on, LEED definitely added to our costs. It's hard to pinpoint. People say it might be about 3-5% extra. The progression has been that as

¹⁶ Michael M. Crow became the 16th president of Arizona State University on July 1, 2002. Under his direction, ASU has initiated a dramatic research infrastructure expansion to create more than one million square feet of new research space. Prior to joining ASU, he was executive vice provost of Columbia University, where he also was professor of science and technology policy in the School of International and Public Affairs. He led the creation of the Columbia Earth Institute, and helped found the Center for Science, Policy, and Outcomes in Washington, D.C., a think tank dedicated to linking science and technology to desired social, economic, and environmental outcomes.



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South Elevation “The east facing glass, which is the more transparent volume, faces the community beyond, to the east. It became the window into the research that was happening in the building.”

more products become available and more issues are understood up front, then the mechanical engineers can actually do the calculations very early. It’s become a lot easier to do LEED buildings. The part that has been constant is the contractors’ and architects’ administration of it. We talk about commissioning,¹⁷ for example, and that is an added cost, but, I don’t believe it’s added, because I’ve been putting commissioning in my budgets for a long time. It is a necessity whether you’re doing a LEED building or not. So, the way I look at it is that most of the things, except for the administration, up through the Gold level are just good design. To try to get to Platinum, you’ve got to get some other things, like photovoltaics. If you can get some of those kinds of components as part of your project’s initial budgeting, then they will frequently pay back the project, or you can arrange public-private partnerships, where somebody else owns them and you benefit from the savings that occur.

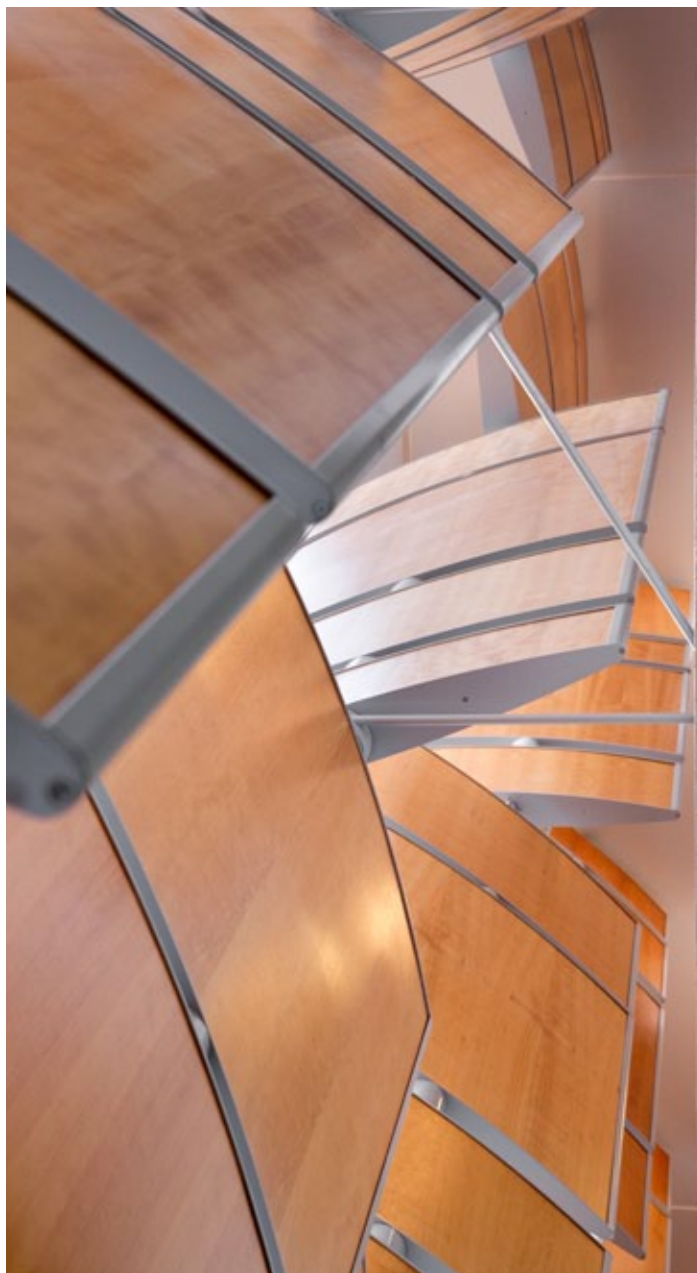
¹⁷ Commissioning is the process of ensuring that a building is performing and operating according to the design and construction intentions.

IV. OPERATIONS

OCCUPANT TRAINING

I’ve always been a big believer in understanding the operations. It goes along with my interest in budgeting. I think it’s important to understand what the operations are going to be like and then set up the owner’s expectations for the operational intent of a building. I’ve been doing that for quite a number of years. For many years, we’ve had room data sheets very early in the process to pin down the operational characteristics that we expect to have. As we get into a building, commissioning sets that up as a requirement.

We want to train people and know how all the parts and pieces are working. Someone needs to know how to fix them when they break. What we learned is that it’s important but it’s for the maintenance guy to take care of. We need to understand the metabolism of the building and get it where it works. There are very few people who can set up the computer, know the HVAC sys-



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Louvers "Thinking about operations needs to start very early in the process, because we've only succeeded when the building performs right, not when it meets the LEED checklist. Yes, that's a means to get you going in the right direction, but the LEED checklist is just a starting point. The real test is when you can say that the building is operating extraordinarily well."

tems, and then balance it together to reflect the metabolism of a particular building.

All buildings are different. You start out looking at some broad parameters, and then you work to narrow it down and get it better, to lower the energy and make it more efficient as you go along.

One of the things that I still do is go to Phoenix once a year and do the recommissioning of the infectious disease labs. I know how they should work, and I work with Mike McLeod and Tom Mason¹⁸ to make sure that we work together to make sure that everybody is operating those facilities in the right way so the researchers putting their lives at stake within the facilities are as safe as possible. Now, obviously, we don't get down into the details of certain products. We look at the broader overview, but we know that the commissioners went through a training exercise, too. We make sure that happens.

I love to get online and find out how the buildings are working. I do it from all over the place. I'm a strange bird. I'm a member of ASHRAE¹⁹ too! I used to go to all of the courses on control systems. It is so hard to find someone who really knows the whole system, and I do like to understand the control systems. As an architect, I'm responsible for reviewing the drawings and supervising the production, but the part that I look at the most is the sequence of operations. I envision how the machine is going to purr.

CHANGES TO LEED

I think about how we can improve LEED, which has caught on, and which so many people have adopted as their standard or requirement for their campus or city. We need to figure out how we take that and move it from a checklist to an inspiration. We have to look at the performance end. An ASHRAE 90.1²⁰ test is only relative to itself. It is not going to predict how much energy that building is going to use. We've got so many smart people who can run these simulations, and DOE-2²¹ has been around and improved a lot, but it's been around a long time, and there must be something better.

¹⁸ Tom Mason is the ASU Biodesign Institute's facilities project coordinator.

¹⁹ ASHRAE stands for The American Society of Heating, Refrigerating and Air-Conditioning Engineers.

²⁰ ASHRAE Standard 90.1, developed and maintained by the American Society of Heating, Refrigerating and Air-Conditioning Engineers, is an energy code standard which addresses commercial buildings in the United States.

²¹ DOE-2 is a freeware building energy analysis program that can predict the energy use and cost for all types of buildings. DOE-2 uses a description of the building layout, constructions, operating schedules, conditioning systems and utility rates provided by the user, along with weather data, to perform an hourly simulation of the building to estimate utility bills.

As we continue to build buildings that use resources during construction and operation, technology has to infuse the decision making process. What can we do to change the whole paradigm and move from a checklist or a simple computer analysis that's out of date, to something that is pushing the direction of where the analytical process needs to be? It goes back to the question of how involved we are in the operations. Thinking about operations needs to start very early in the process, because we've only succeeded when the building performs right, not when it meets the LEED checklist. Yes, that's a means to get you going in the right direction, but the LEED checklist is just a starting point. The real test is when you can say that the building is operating extraordinarily well.

We are really having trouble comparing the actual performance to the predicted performance. As Mike McLeod will point out, he's got two buildings that are very, very similar. One is only 500 feet north of the other one, but they still operate differently in terms of performance and energy use. It could be the components of the building or the impressions of a bird's wing. I don't know what makes the difference, but I do know that the Building B uses more energy because of the animal facilities. They don't like to use that term or reveal that research because there are people who don't approve of using animals for research.

SHIFTING SKILLS

The role of the architect has become a lot broader. Perhaps, it's more like it was two hundred years ago. It's come to the point where the architect has to pay attention to all the parts and pieces and the way they interrelate. My knowledge of mechanical systems is very helpful in that way. Not everybody needs to be an ASHRAE member or know that part of the building, but you have to have somebody sitting at the table who really understands it. There are very few people who can put their minds around the numerous systems, mechanisms, controls, and products. Somebody has to lead it, but there is no one person who can do everything. It takes a group of people with lots of expertise. Then, the role of the architect begins to be greatly influenced by that kind of notion. Fees start playing a role, and, for example, there is the Global

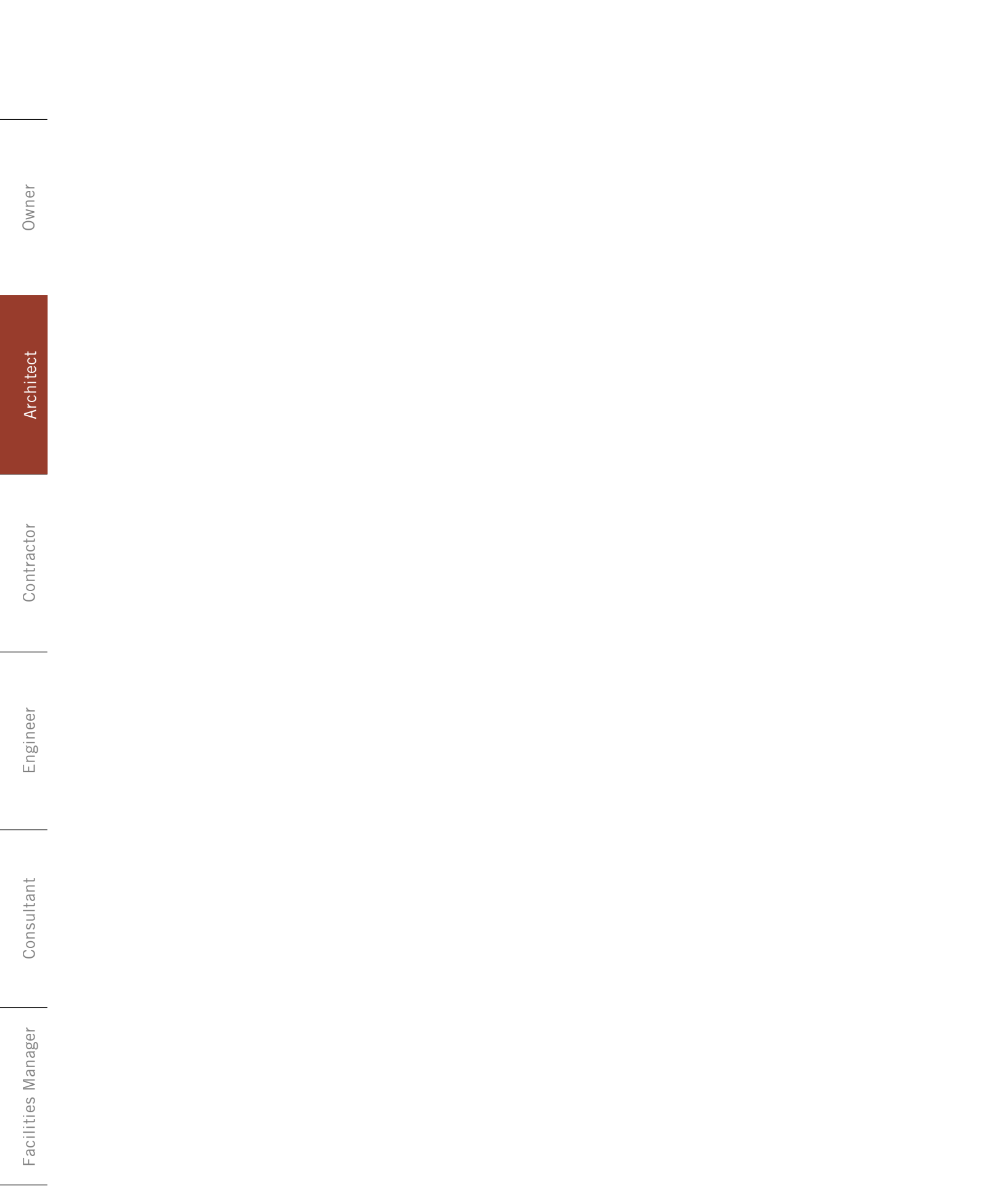
Institute of Sustainability (GIOS) project at ASU. It's a small project, but they can't use the same team setup that we had for Biodesign because they don't have the fee to support that many various experts. With the pressures of the down economy, the changes in the costs of construction and wages will influence fees since they're on a percentage basis. We're in for some very interesting times, and with this economy, people are asking for more cost-effective design teams. I'm a lot more valuable right now because people are really looking at the cost. Nobody can predict the marketplace right now, but I think the role of the architect has got to be a lot more comprehensive. We need to be able to answer the question of how we can change from a big team on a big project to a small team on a small project.

Normally, on a project like Biodesign, you bring the whole team together, and they have a great time. Then, all of the young people want to come in and do everything, and you have to tell them that they still have to draw the toilets, but then you'll bring them in on big-picture things. That's another thing that is important for us as professionals. We created Lord, Aeck, Sargent University (LASU). There's something going on at lunchtime three or four days a week to teach our employees. The other day, I taught finances at LASU. I entitled it "No Mon, No Fun: Show me the Money!" You have to teach people not only about buildings, but also about the successful management of the firm, and how to make a profit.

ADVICE FOR FUTURE PROJECT TEAMS

One of the things that I always tell our people is that you have to understand the scope of the project. You really have to understand the goals and objectives, and the way you do that is by building relationships. You have to know all the people and you've got to figure out who might influence the project in a good way and who might influence the project in a bad way. Meeting the people, getting to know the project, and developing the operational intent is important for any project, whether it's Biodesign or any other good project that you're going to work on.

This narrative is based on a video- and audiotaped interview conducted by Britni Jessup on November 11, 2009, at the Phoenix Convention Center in Phoenix, AZ.



Owner

Architect

Contractor

Engineer

Consultant

Facilities Manager

JOHN DIMMEL

VICE PRESIDENT AND PROJECT ARCHITECT,
GOULD EVANS

I. PROCESS

GETTING INVOLVED WITH THE PROJECT

The design phase started in 2002, but there might have been some programming that occurred before that. We were gathering a lot of site information and because the first building had a laboratory component that included nano-scale research, we couldn't have any electromagnetic interference or vibrations. We looked at the larger site, specifically lot 44, which was a big asphalt parking lot at the time. We needed to know where exactly we could place the first building so that it wouldn't have any of those issues associated with it. I worked on the project beginning with pre-design and worked through schematic design, all the way through the construction of Building A. Once the construction of Building A was under way, we got the go-ahead to work on Building B. I wasn't as involved in the construction aspect of Building A. I was involved in some shop drawing reviews and things like that, but we basically went right into designing Building B at that time. It was a fast track project. It was actually faster than a fast track project. Some people call it a "blast track" project. There was a lot of design still happening while the foundations were being poured. We were trying to figure out the roof slopes as they were preparing the formwork for pouring the roof. It was an intense effort all the way through. In Building B, I was involved a lot more with the Construction Administration.¹ Another person in the office and I were out there two or three times a week, just to oversee what was going on, answer questions, and work through RFIs² and shop drawings.

ASSEMBLING THE TEAM

The idea for collaboration with Lord, Aeck & Sargent³ came as we were looking at the project, before we even interviewed. We knew that this project was coming up. At the time, it wasn't for Bidesign, it was for another type of research facility. We had to do some homework, beca-



JOHN DIMMEL, RA, LEED AP, has provided more than 10 years of public sector design experience while at Gould Evans. He has worked on over a dozen award-winning projects with the firm. John brings a strong aesthetic sensitivity to architectural projects at both the macro and micro levels. Additionally, he serves as a resource and guide for how the entire office approaches design and sustainability.

¹ Construction Administration (CA) is the fourth part of the design and delivery process, which consists of the following phases, listed in their order of sequence: Schematic Design, Design Development, Construction Documentation, and Construction Administration.

² RFI stands for Request for Information, which is the standard protocol for receiving clarification from any party of the design team.

³ Lord, Aeck & Sargent is an architectural firm with over 3,000 completed projects. With offices in Atlanta, Georgia; Ann Arbor, Michigan; and Chapel Hill, North Carolina; the firm has five studios: Architecture for Arts & Culture, Architecture for Education, Architecture for Historic Preservation, Architecture for Science, and Architecture for Housing & Mixed-Use.

University of Oregon Professor Alison G. Kwok, Advisor Nicholas B. Rajkovich, and research assistants Rachel B. Auerbach, Kristen B. DiStefano, Britni L. Jessup, and Amanda M. Rhodes prepared this narrative. © 2009 U.S. Green Building Council and the University of Oregon. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means without the permission of the USGBC.



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Atrium "The initial idea for the atrium space... began with Michael Crow's vision of bringing people into the building and what he wanted people to see and experience."

Gould Evans⁴ is not a laboratory planning firm. We do more higher education buildings, but not intense research space. We do a lot of work with the universities in the area, with ASU, the University of Arizona, and community colleges, but we didn't have the expertise that Lord, Aeck & Sargent brought to the project. We started conversations with them before the project and before we had the interview. We knew that they had a lot of good work; they have a very good design sense. We had multiple conversations with them to make sure that we could bring the best team to this project for the university. It wasn't only Lord, Aeck & Sargent. It was Newcomb & Boyd,⁵ the MEP⁶ engineers out of Atlanta. We worked with them, as well, as they have worked with Lord, Aeck & Sargent and had a lot of experience with different types of laboratory buildings. Internally, at Gould Evans, we have a lot of people who work on all different types of projects. One of the things that we looked for was a project manager who has sustainability in mind. Barbara Hendricks⁷ was that person, and she had a lot of input in the initial design and also pushed for the sustainability of the building. There were a number of people in our office who had experience working with ASU or just had great design ideas. There was collaboration between the people in our office and also the design people at Lord, Aeck & Sargent, in terms of how we started the design process.

That process of setting up the team before we interview is typical of a lot of our projects. We'll try to create the team of individuals we're looking to have work on and be involved in the project. If we're going to team with another architecture firm or if it's just a specialty consultant that we need to engage in order to create the best building, we do that so we can give the client the best

⁴ Gould Evans is a design firm specializing in architecture, interior architecture, graphic design, and planning/landscape architecture. The firm has offices in Kansas City, Missouri; Lawrence, Kansas; Phoenix, Arizona; San Francisco, California; and Tampa, Florida.

⁵ Newcomb & Boyd is a multidisciplinary consulting and engineering firm which provides innovative solutions for facility design, construction and maintenance. The firm is made up of the Consulting Engineering Group, the Commissioning Group, the Special Technologies Group, and the Lighting Design Group.

⁶ MEP stands for Mechanical, Electrical, and Plumbing. MEP engineers oversee the heating, ventilation, and air-conditioning (HVAC) in addition to the plumbing systems.

⁷ Barbara Hendricks is a project manager with Gould Evans, an architecture firm in Phoenix, Arizona.

possible team for their project. There are also times when we engage consultants throughout the design process that we may not have thought of initially.

With Biodesign, we had those types of individuals as well. Since we were working with the University, we tried to pull them into the process for Building A and Building B. We reached out to Marlin Addison,⁸ who was with ASU, to help with some of the DOE-2⁹ modeling and to help us understand the energy usage within the building. Harvey Bryan¹⁰ helped with daylighting the atrium space, which was part of the larger concept of the building. We had to figure out how to make the atrium work without having too much light at the top level where research is going on, yet bring that light down into the space, to the lowest level, and still be able to have a connection to the outdoors. Harvey helped us determine a lot of the daylighting aspects of the atrium space. We pull in consultants as we need them, as we need their expertise.

ASU is a great university; they have a great architecture program. They understand building science. This is an amazing project. It's a once-in-a-lifetime project. We had to make sure that we did everything right, that we got the right people involved at the right times.

WORKING WITH THE PROJECT TEAM

In general, we have design charrettes, depending on what we need people involved in. Early on, we had a lot of design charrettes with Lord, Aeck & Sargent. Sometimes we went to Atlanta and sometimes they came out to Phoenix. We also used video conferencing where we could exchange ideas live whenever we needed to discuss specific ideas. We could just start drawing something and ask what they thought about it. We did that at least once a week, if not more.

⁸ Marlin Addison is a Clinical Assistant Professor in the Architecture and Landscape Departments at Arizona State University.

⁹ DOE-2 is a freeware building energy analysis program that can predict the energy use and cost for all types of buildings. DOE-2 uses a description of the building layout, constructions, operating schedules, conditioning systems and utility rates provided by the user, along with weather data, to perform an hourly simulation of the building to estimate utility bills.

¹⁰ Harvey Bryan is a professor in the School of Architecture and Landscape Architecture at Arizona State University. He is also an affiliated faculty member with the School of Sustainability.

Initially, Building A was not going to be a LEED certified building. Once we started construction, we were given the go-ahead to create, or to pursue LEED Silver for buildings A and B. At that time, we started having weekly LEED meetings with all the consultants: landscape, structural, etc. Lord, Aeck & Sargent was also involved, as well as the civil engineer, ASU, and the contractors. Every week we got together and gave assignments of what we needed to accomplish in order to achieve this. We also brought in Green Ideas¹¹ to help with how we could go back to Building A, which had already been designed, constructed, and documented. That shows our commitment to sustainability. We went back and got LEED Gold on a building on which we initially didn't even pursue LEED. That speaks very highly of the collaboration between the University and all the consultants in achieving that.

There were a few project managers from the University who were initially involved with Building A. Mike McLeod¹² eventually came on-board and oversaw everything through to completion and beyond. We had many conversations with him. Michael Crow¹³ started working at the University in 2002, and he was the person who had the largest vision for this project. He wanted to bring people into the building and have them look up and say "wow." He wanted them to be able to see all the research that's going on — have it be very open — and see the collaborative nature of the people working in the labs. We ran with that idea and wanted to create a building that had a lot of areas for collaboration. That's kind of how the initial idea for the atrium space, what we called the collaborative or "colab" space started. It began with Michael Crow's vision of bringing people

¹¹ Green Ideas, located in Phoenix, Arizona, provides consulting and educational services in the field of green building. Its clients are building and business owners, architects, engineers, contractors, utility companies, green product manufacturers and other companies interested in creating business advantages through sustainability.

¹² Mike McLeod is the Director of Facilities Management at the Biodesign Institute and was the Project Manager for ASU in the construction of both Building A and Building B.

¹³ Michael M. Crow became the 16th president of Arizona State University on July 1, 2002. Under his direction, ASU has initiated a dramatic research infrastructure expansion to create more than one million square feet of new research space. Prior to joining ASU, he was executive vice provost of Columbia University, where he also was professor of science and technology policy in the School of International and Public Affairs. He led the creation of the Columbia Earth Institute, and helped found the Center for Science, Policy, and Outcomes in Washington, D.C., a think tank dedicated to linking science and technology to desired social, economic, and environmental outcomes.

into the building and what he wanted people to see and experience.

ROLE IN THE PROJECT TEAM

At the time, the Biodesign Institute was probably the largest project our office had seen. We had done a few other projects with Arizona State University. I was involved with some of them, so I was familiar with the University and how it works. I was on the team and spent 100% of my time coordinating the design effort.

II. DESIGN

ESTABLISHING PROJECT GOALS

One of the bigger goals that we brought to the project was one of connection. The building is basically set up with two masses. One is an opaque volume and one is more of a transparent volume. It's important to have a connection to the context. The masonry volume connects to the existing vocabulary of the campus, to the masonry that's used in a lot of the other campus buildings. The east facing glass, which is the more transparent volume, faces the community beyond to the east. It became the window into the research that was happening in the building.

A connection to nature was also one of the other ideas of connection. When you're in the building, you can see the great garden space that's out in the front, the bioswale, from anywhere in the building. The lab spaces have basically open glazing through the atrium space, through the office space. 95% of the people in the building have that connection to nature or to daylight through the atrium space and the skylights above. Everybody has access to daylight through the atrium.

During the master planning phase, we looked at how we might connect four different buildings together. Since Building A was constructed first, we had to figure out how we would eventually connect to Building D, which will be at the corner of Rural Road. We had to create that connection. Using a larger floor plate creates more of a collaborative nature between people. Having the floors open and connected from the lowest level all the way to the upper level really changes

how people use the building. It becomes a three-dimensional, collaborative space. Michael Crow had mentioned that he wanted the facility to be more than multi-disciplinary; he wanted it to be trans-disciplinary. There are people who are involved in science and people who are involved in technology. Bringing all those groups together to collaborate, spur new ideas and create more of an intellectual fusion within the building was key. Those ideas of connection really rang true for us in the design process.

THE LEED CERTIFICATION PROCESS

I don't think LEED changed our thought process too much. Because Building B is almost an exact replica of Building A, a lot of the same design ideas rang true for Building B as they did for Building A. There were a few other things that we started to look at, one of which was how we could reuse the condensate from the mechanical units. That was a big feature that didn't get implemented in Building A, but it's something that we investigated for Building B. Because it's a lab building, and it's heavy on mechanical systems, we looked into how we could reuse the condensate. This especially makes sense in the summer time, when the plants need a lot more water and the mechanical units are running 24 hours a day. One of the strategies was to create a condensate storage tank on the west side of the building, capture that condensate and use it to irrigate the landscape for both Building A and Building B. A lot of the same ideas applied to both buildings. Solar is also something that came about as we were looking into sustainable features for Building B. We wanted to know how we could integrate solar energy. We had big, large roofs, and ASU is committed to bringing solar to its campus. It was a perfect opportunity to bring some solar panels into the project as well.

Since we weren't pursuing LEED certification during the construction of Building A, we hadn't dealt with waste, as far as recycling products that were scrap during the construction process. In Building B, we were able to do a better job with some of that.



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Auditorium "A connection to nature was also one of the other ideas of connection. When you're in the building, you can see the great garden space... from anywhere in the building."

CHALLENGES OF THE PROJECT

One of the larger challenges that we had on this project, as far as building on a university campus, was that we generated the master plan where some of the buildings had to face east-west instead of north-south. Orientation is typically something that we always look at. We try to orient buildings so we get a lot of daylight on the south side and the north side while keeping the east and west as opaque as possible. The sun — and heat — comes in perpendicular to the building on the east and west faces. We had to work really hard at how we could deal with shading the east façade. We were looking into having something that was operable, but as far as maintenance, that kind of becomes a nightmare. Since we live in a desert climate, trying to maintain the motors of a shading system that is outside the building just doesn't work. We looked at options of fixed shades, but that didn't

give us visibility on the inside of the building through the office spaces to the outside of the building. That was a challenge, trying to get the shading elements to work on the east side and still allow for the visibility outside that was so important to the project.

The blinds on the east are something that ASU doesn't have on any of its other buildings. We had to figure out how those could be controlled. There are two sets of louvers. One is more office-occupant controlled, where you can open and close them as you wish inside the office, but then there's also a zone above that's more of a public zone and is basically controlled by the sun. In the mornings, the louvers are closed and in the afternoon — once the sun gets up high enough — they start to open up and allow everyone in the building to have access to the daylight. That's something that none of the other buildings on ASU's campus currently have. We had to make sure that we had trained or already had the

right people to help them understand how that system worked, as far as whether the louvers were on a timer or a sun sensor. We had to make sure that the occupants of the offices knew how to control the system. There was a lot of training related to the laboratories of the building as well. We had to make sure that the University was aware of all the features of the building, but as the architect, we weren't directly involved with that training. Nysan is a company out of Canada, and we worked with them to design the shading devices. After the building was constructed, we had Nysan come down and thoroughly train everybody so that they understood how the system should be used. They let them know that if there were any questions, they could contact the company.

COMMUNICATION AND RESOURCES

We try to understand what other firms are doing in terms of sustainability. We try to stay current with recent technologies. We did a lot of research on the internet and we also have people in our offices who teach in universities. Keeping that connection to the University and the research that they have going on is important. Another example is the Global Institute of Sustainability (GIOS) building, which is just down the mall on the ASU campus. When we worked on that, we pulled in a daylighting consultant that was with the University who had a vast knowledge of daylighting. We learn from university faculty and students, as well. We have a lot of students who intern with our office and they bring a lot of knowledge from what they've learned in the past through school.

III. CONSTRUCTION INVOLVEMENT DURING THE CONSTRUCTION PROCESS

Lord, Aeck & Sargent and our firm each had one full-time individual who would be at the site to answer questions and to make sure that everything was being built as designed. Within the office, we probably had a team of three people who were involved in the design process. We always try to keep whoever is involved in the design process involved during the construction process

as well, so that there's not a different team or a different set of people who come online during the construction process and kind of lose sight of the end goals of the project. If there are design questions or changes that need to happen, they are still in-line with the initial design ideas. For Building B, that was probably my role. There were actually two of us in the office who were doing Construction Administration for Building B. We just kept the people who were involved in the design involved in the construction.

COLLABORATION DURING CONSTRUCTION

We still continued to have our weekly meetings throughout design and construction to make sure that everything was being documented accurately. It took coordination with the specifications, as we were going through Construction Documents.¹⁴ In some cases we had to update that in the construction process. We continued the same process that we had into construction and documenting that and getting everything tied up.

MANAGING THE PROJECT

As architects, we have a big role to play in how buildings get built and what their impact is on the environment. Through the design and construction of Building A and Building B, we maintained the same process, but there was a little more documentation that had to happen from the contractor's side with Building B.

IV. OPERATIONS MONITORING BUILDING PERFORMANCE

Mike McLeod and Tom Mason,¹⁵ with The Biodesign Institute, have been tracking how the building is performing. They have been trying to make modifications to make sure that we keep the energy and water use as low as possible. We haven't been involved with that as much. As a

¹⁴ Construction Documentation (CD) is the third part of the design and delivery process, which consists of the following phases, listed in their order of sequence: Schematic Design, Design Development, Construction Documentation, and Construction Administration.

¹⁵ Tom Mason is the ASU Biodesign Institute's facilities project coordinator.

firm, we try to track the performance of all our buildings to see if they are performing as initially designed and modeled. We've tried to determine what we can do better on the next project. That's something that we try to do with every building we build, but as far as operations, Biodesign has been doing most of that. They've given presentations to the USGBC¹⁶ on how they monitor the buildings. It's good to see the owner continue to push the threshold as far as how the building performs.

LESSONS LEARNED

There have been a lot of lessons learned with this building. We learn from every project. We did a lot of research as far as wall construction and different types of glazing. We had to address the issues of what type of glass we used, what type of spacing we used, and the slope of the skylight. There were lessons learned with the east facing glass. Initially, we put the louvers within the mullion system, but there were some concerns as to how hot those were going to get. The aluminum Aerofoil louvers were within the mullions and the conditioned air is blowing over those. We had to consider whether the air was going to heat up and whether the occupants of those offices were going to get hot. So, we engaged a third party to do a computational fluid dynamics¹⁷ model so we could understand how placing the louvers between the mullions, would affect the comfort in the room. We came to the conclusion that it wasn't the right location for the louvers. We either had to change the color, change the location, or change the spacing. So, we went back through the design process to figure out where we should relocate those. There are definitely things that we learn on every project and that we bring into the next project, if applicable.

¹⁶ The U.S. Green Building Council (USGBC) is a non-profit organization dedicated to sustainable design and construction.

¹⁷ Computational fluid dynamics is a branch of fluid mechanics that uses numerical methods and algorithms to solve and analyze problems that involve fluid flows. Computers are used to perform the millions of calculations required to simulate the interaction of liquids and gases with surfaces defined by boundary conditions.



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Southwest Corner "We always try to keep whoever is involved in the design process involved during the construction process as well."

THE VALUE OF LEED CERTIFICATION

With each of our projects, whether we are pursuing LEED or not, we think about designing the building in a similar way. We're always conscious of trying to have the best performing building that we can for the owner. Having it achieve LEED certification doesn't change our thought process in that respect. We always try to push the performance as much as we can.

THE FUTURE OF LEED

LEED is evolving. Tracking the performance of the building, having to report that data and making sure that it's living up to the predictions is an important aspect of the evolution of the building. With Biodesign, ASU is continuing to track the building. That's important. We can design a building and say that it's going to perform a certain way, but to say that it's going to be held to those promises is a good adaptation of more current LEED thinking.

Just within the past few years, there's a push toward the building science aspect of buildings, the design and construction. People want to know how buildings are performing. We've had specialists come into our office and give presentations on what they know and how it can help us answer our questions on specific projects. There's a big emphasis on how buildings perform. That's continuing to evolve, and the energy usage aspect is big, especially with carbon neutral buildings.

This narrative is based on a video- and audiotaped interview conducted by Kristen DiStefano on November 9, 2009, at the Biodesign Institute on the campus of Arizona State University in Tempe, AZ.

BRETT HELM

CONSTRUCTION MANAGER,
DPR CONSTRUCTION, INC.

I. PROCESS

GETTING INVOLVED WITH THE PROJECT

DPR¹ was brought on-board in October of 2002. At that point, we were just in Schematic² drawings. Gould Evans³ and Lord, Aeck & Sargent⁴ had been on-board about a month before we became involved. At that point, we were really just trying to understand the job. A facility like this had never been built before, and the basic understanding of the programming wasn't there yet. ASU knew they wanted a facility to bring in the best researchers and the best science. Everything they were planning to do in this facility was going to be really top-notch. It took a lot of just getting together and trying to figure out the program the best we could in order to start designing. We supplied budgeting information and scheduling information. We knew the end date and that was not going to change. We all came together as a team and figured out how to make it work.

Because the project was pretty large, the joint venture with Sundt Construction⁵ was a good fit for us. We're more of a technical builder; we do a lot of life science projects, advanced technology, healthcare, and corporate office facilities. We brought the technical experience, and they brought the experiences of doing larger projects. They also had extensive experience with concrete; they set the formwork for all the concrete on the project. That was a key item for a fast-track project like this. They really helped control the schedule.



BRETT HELM has over 15 years of experience in the design and construction of challenging and unique laboratory and technical projects. His projects include facilities for IDEC Pharmaceuticals, Advanced Cardiovascular Systems/Eli Lilly, Apple Research and Development, and Rockwell. Brett has a Bachelor of Science in Construction Management from Purdue University.

¹ DPR Construction, Inc. is a builder with technical/laboratory expertise located throughout the United States.

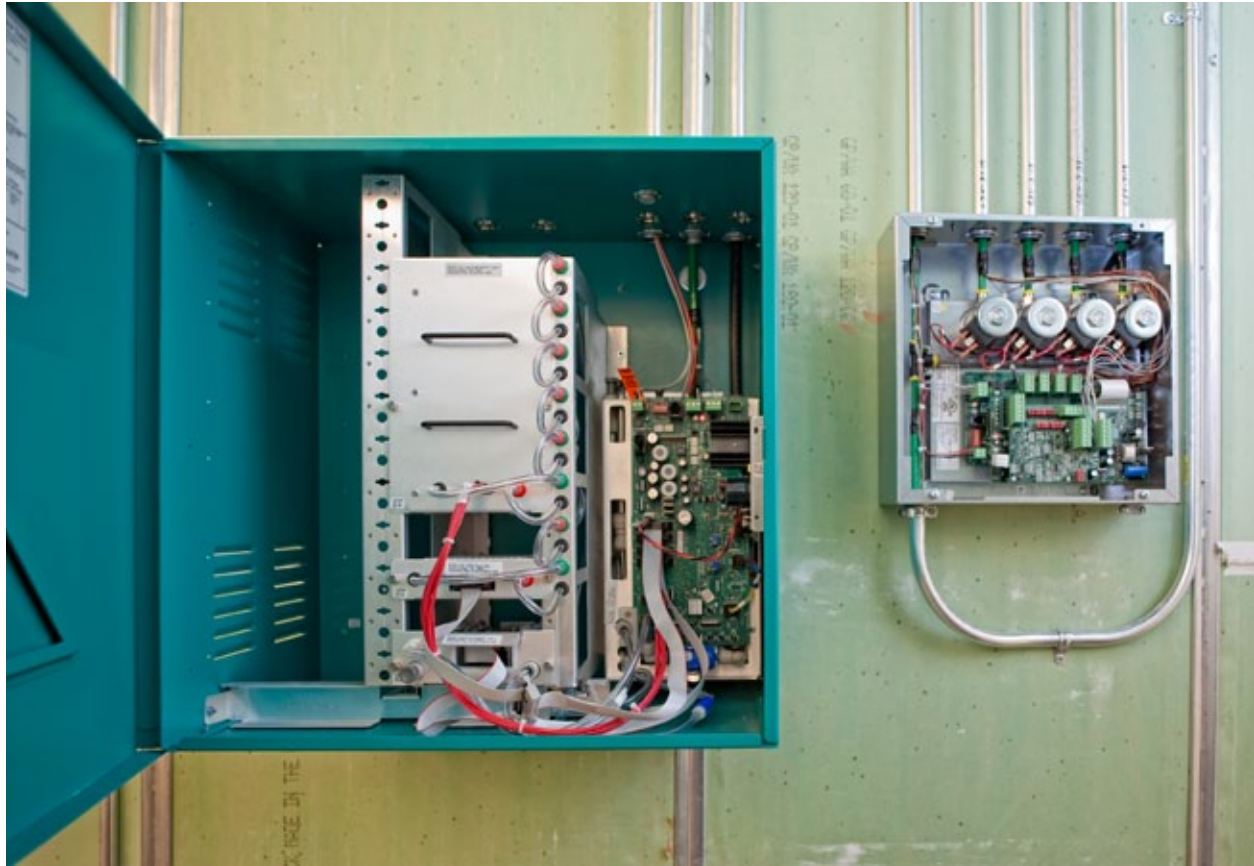
² The Schematic Design phase is part of the design and delivery process, which consists of the following phases, listed in their order of sequence: Schematic Design, Design Development, Construction Documentation, and Construction Administration.

³ Gould Evans is a design firm specializing in architecture, interior architecture, graphic design, and planning/landscape architecture. The firm has offices in Kansas City, Missouri; Lawrence, Kansas; Phoenix, Arizona; San Francisco, California; and Tampa, Florida.

⁴ Lord, Aeck & Sargent is an architectural firm with over 3,000 completed projects. With offices in Atlanta, Georgia; Ann Arbor, Michigan; and Chapel Hill, North Carolina; the firm has five studios: Architecture for Arts & Culture, Architecture for Education, Architecture for Historic Preservation, Architecture for Science, and Architecture for Housing & Mixed-Use.

⁵ Sundt Construction is a contractor based in the southwestern United States offering Construction Management At-Risk, Design Build, and Build to Suit Contracting services.

University of Oregon Professor Alison G. Kwok, Advisor Nicholas B. Rajkovich, and research assistants Rachel B. Auerbach, Kristen B. DiStefano, Britni L. Jessup, and Amanda M. Rhodes prepared this narrative. © 2009 U.S. Green Building Council and the University of Oregon. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means without the permission of the USGBC.



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Valve Controls "The mechanical, electrical, and plumbing subs make or break a project like this. Through an interview process, we brought those subcontractors on-board based on their qualifications."

ROLE ON THE PROJECT TEAM

I was brought on-board as what we call a "CR" on a project, the Construction Manager At-Risk.⁶ We were brought on-board based on our qualifications to do projects like this, and my role on the project was as site manager for both Buildings A and B. I was the overall site manager.

ESTABLISHING GOALS FOR THE PROJECT

The major goals were already set; the budget was already set for the project and we knew when the job was to be completed. At the very beginning,

we weren't even talking about LEED⁷ or being LEED certified. It wasn't until President Crow⁸ came to ASU and said that every new project on the campus had to be at least LEED Silver certified that we started looking at the rating system. That put another little wrench in the design phase of construction; it was just another hurdle we had to overcome.

⁷ The Leadership in Energy and Environmental Design (LEED) Green Building Rating System, developed by the U.S. Green Building Council (USGBC), is a suite of voluntary standards for green buildings. It awards certifications at Certified, Silver, Gold, and Platinum levels.

⁸ Michael M. Crow became the 16th president of Arizona State University on July 1, 2002. Under his direction, ASU has initiated a dramatic research infrastructure expansion to create more than one million square feet of new research space. Prior to joining ASU, he was executive vice provost of Columbia University, where he also was professor of science and technology policy in the School of International and Public Affairs. He led the creation of the Columbia Earth Institute, and helped found the Center for Science, Policy, and Outcomes in Washington, D.C., a think tank dedicated to linking science and technology to desired social, economic, and environmental outcomes.

⁶ CM At-Risk is a delivery method, which entails a commitment by the construction manager to deliver the project within a Guaranteed Maximum Price. This guarantees a set price for the owner and any surplus or additional costs are absorbed by the construction company. Typically, a CM At-Risk arrangement eliminates a "low bid" construction project.

WORKING WITH THE PROJECT TEAM

This was the first time I had worked with a lot of the people from the other firms. I knew Trudi Hummel⁹ from Gould Evans and Larry Lord,¹⁰ but only briefly. We had proposed a for a design-build¹¹ project prior to this one, but that was only a couple of months before we got involved in this project. There were a lot of new names and faces when we started.

II. DESIGN

INVOLVEMENT DURING THE DESIGN PROCESS

We were completely involved in the design of this project. We were involved in constructability issues and how the pieces and parts were going to go together. When the campus mandate came in to achieve a minimum of LEED Silver for Building A, we were involved in the charrette¹² to determine what makes sense and where we would get our best bang for the buck. While we were still in the middle of that process, we already had a few of our subcontractors on-board. Our MEP¹³ subcontractor helped us look at the laboratory facilities. The mechanical, electrical, and plumbing subs make or break a project like this. Through an interview process, we brought those subcontractors on-board based on their qualifications. We did our best to bring the right folks in so that, when it was appropriate, we could bring them in to contribute to some of the design meetings and budgeting information.

One of the interesting things that we dealt with in Building A is that we were still working on the design and, of course, we had the budget that we couldn't go over. Once we went through the rating system, did the charrettes, and knew which points we were going after, we assigned team

members to keep an eye on each of the points. If something affected the door sub,¹⁴ like if a certain wood were going to be necessary, we would give them the criteria to meet, even if it wasn't in the specifications. We'd write it out for them because we knew what the team's goals were. That was one of the things that we had to keep our eyes on, which turned out to be a lesson that we brought with us to Building B. As we were looking at budget numbers and updating estimates, we'd get back together as a team and see where we needed to value engineer. We had to constantly compare that to what was acceptable to ASU to get the project back under budget and back on schedule. We always had to look at the other parts that were affected by these decisions. We had to figure out how it was going to affect our points if we value engineered a certain item. It was kind of a new dynamic that I had never personally dealt with. It was an interesting thing to understand how everything affected everything else throughout the project.

III. CONSTRUCTION

MANAGING THE PROJECT

Typically, at the beginning of a project, we have weekly meetings with the design team. Once the design has been put in place, the LEED meetings become a monthly occurrence because, at that point, it is more about updating everyone and showing them where we're tracking on credits, such as the construction waste. We got to the point where we were so far past Silver that if we just did four or five extra items, which may cost a little more but were still within the budget, we could actually get to Gold. It made the team figure out ways we could all earn the last few points. At that point, almost everyone was on-board and pretty excited because it was going to be the first Gold building around that we were aware of. That really brought the whole team together to figure out how we could make it happen. Mike McLeod¹⁵ knew his budget and that, if he could spend a little money in the right places,

9 Trudi Hummel is a principal at Gould Evans in Phoenix, Arizona.

10 Larry Lord is a Principal at Lord, Aeck & Sargent in Atlanta, Georgia.

11 Design Build is a construction project delivery system where, in contrast to "design-bid-build", the design and construction aspects are contracted for with a single entity, usually the general contractor.

12 A charrette is a collaborative work session where groups or sub-groups quickly generate solutions to a design problem.

13 MEP stands for Mechanical, Electrical, and Plumbing. MEP engineers oversee the heating, ventilation, and air-conditioning (HVAC) in addition to the plumbing system.

14 Subs is an abbreviation for the word subcontractors.

15 Mike McLeod is the Director of Facilities Management at the Biodesign Institute and was the Project Manager for ASU in the construction of both Building A and Building B.



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Solar Array “We knew the points we were going to go after, what they needed us to do, and what the items were that we needed in place to get the points. From my perspective, it was pretty straightforward and bullet pointed.”

we could come up with a roadmap to get us to Gold on Building A. With Building B, we wanted to see what the next level was. We were bound and determined to at least get to Gold again, but ultimately, we wanted to see what we needed to do to get to Platinum. Then we started to look around at how many other labs out there were actually Platinum since the typical lab building requires very high energy usage because of the fume hoods and exhaust fans. We weren't sure we could get to Platinum but, with a lot of hard work and a lot of people thinking a bit outside of the box, we got there.

TRACKING LEED CREDITS

Building A was the first LEED project I was involved with. I've done a few since then. It was new at that time. That was one of the challenges of this project: it was pretty much everyone's first LEED project. I don't think there was a team member, at least on the construction side, who had been involved with a LEED project before this one. We had some LEED APs¹⁶ but no one had gone through the whole process. It was interesting because, at that time, the word “LEED” caused anxiety. Everyone thought that it was going to drive the project over budget and require a lot of additional work. Once I dove into it and I started understanding what's required of us, what we had to do, and how we were going to achieve all the points we needed, I realized that it was something we were doing anyway. When I really looked at it and, from a construction perspective, could assign each one of the requirements or points to a specific person, it was just a way of making sure that everyone was doing their job. There were certain points we were looking at, certain materials that needed to come on site. Then, we would verify that those were actually coming in. When it really comes down to it, there wasn't a whole lot of additional work. We had to get the documents together but, in reality, we do that anyway. The key was to do that as we were working on the project and not to wait until the very end. At that point, there would be a lot of paperwork and just hoping that everything was installed correctly and with the correct material. Ultimately, the anxiety level went down quickly, and we presented it to the team as something they were already doing and only needed to document a little differently.

LESSONS LEARNED

A lot of my lessons learned on Building A relate to the team, the anxiety level, and dealing with the subcontractors once they found out we were going to do LEED. They had the same anxiety we did, but we conveyed to them that, in reality, we would give them a list of the products we need-

¹⁶ A LEED Accredited Professional (LEED AP) is an individual who has passed the LEED Accredited Professional exam and is designated by the USGBC as a LEED AP. The LEED certification process requires that a LEED AP submit the required paperwork.

ed, the price we needed, and the specifications. A lot of our subcontractors were brought on-board with just the specifications, not the LEED component. So the atmosphere became a bit tense at first.

THE LEED CERTIFICATION PROCESS

Lord, Aeck & Sargent and Gould Evans helped me learn about LEED because, at that time, they knew more about it than I did. They helped take care of some of my own anxieties. They showed me the website and told me to go through it. I found that it was really easy to understand. We knew the points we were going to go after, what they needed us to do, and what the items were that we needed in place to get the points. From my perspective, it was pretty straightforward and bullet pointed. As a contractor, that's what we're looking for. We are good at answering the questions of: what do we need, when do we need it by, how much it is going to cost, and can I still meet the schedule. It came down to digging around on the website and figuring out what everything meant.

For the most part, LEED didn't affect construction. Because it was a tight site, dealing with the waste and recycling was the only issue. At that time, it was hard to get a subcontractor to split up the waste. Even if we said that boxes went to one place, concrete went in another, and steel in a third place, it still didn't always happen that way. At first we tried putting up signs, but the site was tight and everything had to be in one small area, so that didn't work very well. We ended up getting what we called a "dumpster cop" and he kept an eye on what was going in each dumpster because as soon as things were mixed together, the recycling company couldn't use them anymore; they don't re-sort anything. We nipped that in the bud quickly. Other than that, LEED didn't change our process a lot. We did what we normally do.

In Building B, Mike McLeod worked really hard to improve our energy efficiencies. He worked with the valve controller and supplier to get our efficiencies to the next level, which allowed us to earn some additional points. On both buildings, they purchased some green power. I am not sure

they needed that in A, but the budget was there so we went ahead and did it. They did the same thing with Building B, which got us a few extra points that.

THE FINANCIAL IMPLICATIONS OF LEED

LEED did have an impact on the budget, but it was pretty small. When we went to Platinum on Building B, it did affect our ultimate budget. We got the project to a certain point and then ASU spent some additional money to push it the rest of the way.

Every project is unique and organizing the project comes down to understanding what points the team is going after. Going from Building A to Building B, we all learned together. Most of the people working on the project were the same on Building A and Building B. The neat thing was that everyone had gone through the process at that point; it was already an old hat for them. Really, the first project changes your perspective. Once I got it and looked through it, I realized it wasn't so tough; it was just doing some smart things with a bit of documentation, pictures, and write-ups at the end. One of the studies we've done as a company has made us able to take a project and be able to tell the owner that, if they're Certified, this is what the building is going to cost, based on these specific numbers. Then we can evaluate the project and look at the smart points to earn. We can show them that, to get to Silver is a certain additional amount and that to get to Gold is a certain additional amount and these are the points that you need. We have developed a tool to estimate how much each certification level will probably cost the total project and what it will take to get there. We've gotten a lot more sophisticated. Once we do sit down with the owners and they're thinking about doing LEED, we actually have real data from real projects that we have done throughout the nation and can get them real-time information. That gives us owners who can make informed decisions and there's assurance that they can hit whatever criteria they are going after.



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Solar Inverters "As technology moves forward and we're building more efficient lab buildings, it's all about the mechanical equipment and making the engine work."

LEED CREDIT CHALLENGES

One challenge we had was dealing with the brick on the building and finding a local supplier. The local supplier couldn't produce it quickly enough for our schedule, but that was identified up front. We actually worked with our subcontractor and supplier to start producing the bricks ahead of when we needed them and, ultimately, when we needed the material, there was a sufficient amount to keep things going. We did other smart things that probably cost a bit. Another innovative thing we did was with the cistern. It is able to hold a lot of rainwater. In Arizona, it doesn't rain much. So, the cistern adds quite a bit of additional capacity. We also realized that the air handlers were sucking a lot of outside air and producing a lot of condensation at certain times of the year. We just piped that condensation right to the cistern. Now, there's a little additional water for the desert landscape irrigation. We have taken those ideas onto other projects in this area.

VI. OPERATIONS

THE COMMISSIONING PROCESS

We had a third party commissioning agent who was hired directly by ASU. We supported him and made sure he had all the documentation and knew, for example, which air handlers were in the building and what they were supposed to provide. He was verifying that everything was operating correctly. He would spot-check us and chase out some gremlins, which is typical of commissioning. After that was all said and done, we did two weeks of what I call the "full burn out" where we get out the new furniture smell, the new carpet smell, etc., so that when ASU occupied the building, they didn't have to worry about any of that.

We always do commissioning that is similar to the process followed at Biodesign and especially on a technical project like that. That is fairly standard. We'd always do a 48-hour test of

the mechanical systems and, ultimately, one of the processes for LEED required a similar step. We just had to get used to the new terminology, but other than that, it was pretty normal for us because of the high-tech nature of so many of our projects.

ONGOING COMMUNICATION WITH THE PROJECT TEAM

Before this project, I knew some faces, but had never worked with them as a team. It turned out great on this facility. Mike McLeod always uses the phrase that “This is the building that just keeps on giving;” the things we’ve learned from this project are really unique. We’ve worked with these people and now we realize that our company cultures are a lot alike, which is really important. No one had any other agendas on Biodesign. We just wanted to give ASU a world-class facility. If we had challenges, everyone would come together and figure out how we were going to get over the hurdle. Once we figured it out, we just made it happen.

SUCCESSSES OF THE PROJECT

The only difference between this facility and a private project is that there is a big “wow” factor. The type of researchers and people that they wanted to bring in, and have brought into this facility, are impressive. President Crow said that he wanted the “wow” factor, and I think he got it. Typically, private owners don’t quite do it that way. ASU, because it is such a pure research program, is wired differently and looks for different things.

THE FUTURE OF LEED

As technology moves forward and we’re building more efficient lab buildings, it’s all about the mechanical equipment and making the engine work. As that gets more efficient, and as water usage can be affected more, I can see LEED tightening up the ropes in that area. The construction industry is moving forward in understanding how to recycle materials and using other materials, and LEED will continue to change to reflect that. One of our big challenges when we first did these buildings was the gypsum board scrap. We put up drywall and had

a lot of cutting and, typically, a lot of waste. At that time, we couldn’t find anyone in Arizona to take it; that was a lot of material that just went back to the landfill. Since then, there are now places here in Arizona, and probably nationwide, that take gypsum board, recycle it and turn it into new board. If we could have found someone to take the gypsum board as a recycled material we could have probably hit the 75% construction waste point on both of these projects.

SHIFTING SKILLS

Contractors do need to be a little more sophisticated than a few years ago. The old construction idea was that you push and pull to get the job done and you don’t worry about anything. On this project, we had a metal building that existed onsite where Building B is that needed to be removed. Ten years ago, maybe even five years ago, that thing would not have been recycled. Now, we recycle it or reuse it. We deal with owners who want that plaque on their buildings so that they can attract tenants or end users who know they are environmentally responsible.

ASU Biodesign is a great facility, as far as the quality of research that’s happening there and, on top of that, it’s a very smart building that gives back to the community. I don’t know if I’ll ever do another project quite like this.

This narrative is based on a video- and audiotaped interview conducted by Kristen DiStefano on November 9, 2009, at the Biodesign Institute on the campus of Arizona State University in Tempe, AZ.



Owner

Architect

Contractor

Engineer

Consultant

Facilities Manager

JOEL WITT

PROJECT MANAGER,
SUNDT CONSTRUCTION

I. PROCESS

INVOLVEMENT IN THE PROJECT

Initially, Sundt Construction¹ was involved with both buildings. When I became involved in the project, I was initially sent out to see Building A after it had started. I was originally sent out as a cost and scheduling project manager for the construction team. Various transitions took place throughout the process because, when I got here, Building A was only two thirds complete and we were getting ready to start Building B. I took a bit more of a role at that point and began working with Brett Helm² from DPR³ to help get Building B kicked off. We were having pre-construction meetings on Building B at the same time that they were having construction meetings for Building A; it was a constant cycle of meetings. It was a good, fast start, and that's the way we like to start a project: by hitting the ground running.

It definitely made sense to have some DPR Construction employees as a part of the project team for Building B just because they knew so much from A. Sundt had a team, too, that had been working on the project. Naturally, we just transitioned the team from one project right into the next.

During that time, DPR and Sundt acted as one company, since it was a joint venture. We sat down with members of the team who were interconnected. The company values between Sundt and DPR are similar, so building a successful, working project for the University was a common goal for us. Failure under those circumstances was not an option. Maybe other members of the team would differ on this, but to me, there was no Sundt or DPR, and if there were players that came into the picture that felt that there were, they were taken care of. We had to ask for a change if we had that situation because it needed to be a team that essentially worked together for about three years and worked together well.

These projects weren't bid the way a traditional project is. Arizona procurement laws allow for a construction manager and the selection is through a qualification-based award process on projects like these.



JOEL WITT, LEED AP, has been in the construction industry since 1992. He joined Sundt in 2000 as a Project Manager. During his career he has served as a Project Engineer, Field Engineer, and Estimator. He has worked on major building construction projects including hospitals, community facilities, corporate office facilities, industrial, schools, and casinos ranging in value from \$1 million to over \$50 million.

¹ Sundt Construction is a contractor based in the southwestern United States offering Construction Management At-Risk, Design Build, and Build to Suit Contracting services.

² Brett Helm is a Project Executive with DPR Construction, Inc.

³ DPR Construction is a builder with technical/laboratory expertise located throughout the United States.

University of Oregon Professor Alison G. Kwok, Advisor Nicholas B. Rajkovich, and research assistants Rachel B. Auerbach, Kristen B. DiStefano, Britni L. Jessup, and Amanda M. Rhodes prepared this narrative. © 2009 U.S. Green Building Council and the University of Oregon. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means without the permission of the USGBC.

II. DESIGN

THE IMPACT OF LEED ON THE DESIGN PROCESS

The design team did a good job and looked at the LEED⁴ certification requirements early in the process. Those requirements were designed into the job. We started to realize the effects of each system on the other systems. The technical nature of the building, as far as the safety requirements and protocols in each of the different areas, are different from the basement up to the roof of the building; they all have to be considered when you are building and while you are doing functional testing. The phasing of the project definitely added a level of difficulty to the project.

The design team did a good job on this project. They were very clear, and we were able to take a set of documents and lay them out on the table and know a certain number of points would be achieved if we just followed the design. It then became an issue of diligence, from the contractor's point of view, of being disciplined and diligent about what products get brought on site and making sure that the subcontractors are doing what they say. It isn't very tough. Sundt and DPR both use high-quality subcontractors. We use quality, prequalified subcontractors. When a subcontractor tells us they are going to get their product at the Phoenix Brick Factory, we know what type of product we're getting. With LEED, it's a matter of getting the documentation so we can incorporate it into our work. We didn't have any issues that we thought might come up at the end of the job; we were able to look at our points from the beginning and count on the people that we asked for information to do what they said they were going to do. At the end of the day, when we tallied up our points, they were all still there.

⁴ The Leadership in Energy and Environmental Design (LEED) Green Building Rating System, developed by the U.S. Green Building Council (USGBC), is a suite of voluntary standards for green buildings. It awards certifications at Certified, Silver, Gold, and Platinum levels.

III. CONSTRUCTION

CHALLENGES DURING CONSTRUCTION

There was a constant churning of meetings. The mechanical systems in these two buildings are complicated. The efficiencies built into the two buildings are so incredibly complicated that the analogy—I don't know if it is the right analogy or not—is that they're almost like the human body. A poke at one end causes a reaction all the way at the other end of the building; everything affects the mechanical systems all the way down the line. We realized that when we finished up. There was a prolonged commissioning⁵ period for Building A which affected the commissioning for Building B. We realized that once we had connected the two phases, we made the complete project twice as big. All of a sudden, the project became twice as intense and intertwined. The complexities that we realized were remarkable. We recognized early on that we had to plan for when we connected B to A. It really took a huge amount of planning as we went along. We started planning for that at the beginning of construction because we wanted to make sure that it would go as smoothly as possible. The key for Building B was that we started talking about the commissioning and testing processes at the beginning of the job.

COLLABORATION DURING CONSTRUCTION

Starting off, we didn't have enough people involved. We ramped up quickly and got the right people involved, but we had already started when A wasn't quite finished; by the time we started to get through the functional testing on A, they were already applying it to Building B. All of a sudden, the number of people at the meetings was going up because we realized we needed everyone there. We started drilling down to each of the subcontractors; we had mechanical subcontractors, piping and valve subcontractors, ducting craftspeople, and the air valve people and their controls people at every meeting. We kept drilling down into the different levels of subcontractors, into the project hierarchy. Even the start-up

⁵ Commissioning is the process of ensuring that a building is performing and operating according to the design and construction intentions.

people were there at the beginning of the job, because we had to have very precise definitions of procedures for how we were going to start up.

When we started out, we were having LEED meetings about every two weeks. Obviously, as we got into the last third of the project, we were having meetings, on some level, every week. At that point, we were talking about what needed to happen next. We knew that on this building, we couldn't flip the switches and start it up; it just doesn't work that way. There's a very definite order for the way things have to be started up.

There were benefits to having both Sundt and DPR involved in the project. Going into this partnership, we were able to gain experience with high-tech laboratory projects that we didn't have going into the project. There were some resources that DPR needed to begin the project, and that we were able to provide that to them. It was a very beneficial partnership; I enjoyed working with DPR quite a bit.

MANAGING THE PROJECT

When it comes to performance, the design for Building B was pretty fixed in place; what we did in A is what we tried to do in B. There are some places where we made tweaks to improve the project. The design on Building B was more architectural, including the way the curtain wall works in the lobby entrance and some of the features on the exterior. The lab systems and the mechanical systems were generally fixed.

Both buildings have a combined atrium that needs an exhaust system to function properly. Adjustments needed to be made since Building A, when it was standing alone, had to provide enough exhaust to do its share of the work when the buildings were combined.

THE LEED CERTIFICATION PROCESS

We started talking about LEED when we started Design Development.⁶ When I walked out to the job site for the first time, I knew we were work-

⁶ Design Development (DD) is the second part of the design and delivery process, which consists of the following phases, listed in their order of sequence: Schematic Design, Design Development, Construction Documentation, and Construction Administration.



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Building B Cacti "When it comes to performance, the design for Building B was pretty fixed in place; what we did in A is what we tried to do in B... we made tweaks to improve the project. The design on Building B was more architectural, including the way the curtain wall works in the lobby entrance and some of the features on the exterior."



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Louvers "This whole project was a learning experience. We were learning all the way up and down the supply chain."

ing toward a LEED certification. I had no previous experience; this was my first job.

THE VALUE OF LEED CERTIFICATION

Everything about LEED was new; I was introduced to it all on this project. I did become Accredited⁷ during the course of the project. I became a great deal more familiar with the LEED process and what LEED means. LEED is really about doing what is right in the first place. You can take the cheapest way out and find out later that it isn't really cheap. You can start from a sound foundation in LEED and find out, at the end of the day, that it's going to provide you the best benefit in the long run for your business and from a financial point of view. The standards for each of the universities and municipalities

I work for are constantly adapting to LEED; it is becoming the standard. I feel like we're headed in the right direction and we're doing the right thing.

I recently finished a LEED project for the city of Scottsdale; it's going to be Silver certified. It seems like every project is going after some level of certification right now.

LEED CREDIT CHALLENGES

We had one episode with a door credit that almost didn't go our way. That was an alarming experience for everybody, all the way down the supply chain. With a wooden door, there are a lot of parts and pieces inside the door. One part inside the door had some added urea-formaldehyde. One of the LEED points at the time said that no added urea-formaldehyde was permissible. We found a part inside the door, a rib that had it. When they went through the testing process, they found there was no more formalde-

⁷ A LEED Accredited Professional (LEED AP) is an individual who has passed the LEED Accredited Professional exam and is designated by the USGBC as a knowledgeable professional in sustainable design and can, therefore, be called a LEED AP. The LEED certification process requires that a LEED AP be involved in a project for an additional point under the LEED-NC rating system.

hyde⁸ than occurs naturally in the atmosphere, which, of course, is the point of LEED. In the end, LEED accepted the testing documentation for the doors and that there were no more emissions from the door than occur naturally in the environment. This whole project was a learning experience. We were learning all the way up and down the supply chain. When we first started this project, the type of doors LEED required didn't exist. Now, they are the prevalent type; no doors have the urea-formaldehyde anymore. I'm not going to say that this event or this project was the catalyst for LEED to change, but I actually witnessed a change in the industry as I was working on this project. Those products and disclosures just didn't exist then, and now they do as a check box on the order form.

TRACKING LEED CREDITS

It was important to us that we didn't make a mistake that would cost us LEED credits. The process was important to us and we wanted the project to end in the spirit in which it was intended. We were watching what came on to the job site, especially during punch list time, when materials were being brought onto the job and when emergencies came up. We watched and dug product wrappers out of the trash to make sure that the building was built with the materials that met the required LEED specifications. It was important to us.

Our partners, DPR, were very valuable; they had completed a LEED certified project in California before this project. The company and the guys that were working on this project had the process under their belts. We were able to turn to DPR to get some questions answered. We were all going through the accreditation process, so sometimes we just sat down and looked at the LEED documentation. I've spent many hours with the LEED documentation trying to make sure I understood the intent. I have spent time with the credit interpretations and some other outside resources that were very helpful here in Phoenix. If I needed answers, I could find somebody who was able to point me in the right direction.

⁸ Urea-formaldehyde is a non-transparent thermosetting resin or plastic, made from urea and formaldehyde heated in the presence of a mild base such as ammonia or pyridine. These resins are used in adhesives, finishes, MDF, and molded objects.

One of the things that helped us the most, as far as methods go, is really the education of all the subcontractors. Right now, we are looking at our methodology when it comes to Design Build⁹ projects, or projects where Sundt could spearhead the LEED certification effort.

On a typical Construction Management At-Risk¹⁰ project, like the ASU Biodesign buildings, where we're not spearheading the process but we are participants, the subcontractors become a lot more motivated to help and do their part. You can rely on them as a resource, whereas, in the past, you couldn't; you really had to watch what they were bringing on-site. If there was proof of unapproved products coming in, you had to deal with that and they had to be removed. Now they've become just as interested in achieving the LEED goals. For example, when we started recycling construction waste materials on this job, we were running the spreadsheets and taking the invoices. We had an enormous pile of invoices we were logging and making sure were in the right columns. We had to be sure that the amount of recycled materials was reflected properly in the ratios. On projects now, we are seeing the subcontractors taking that over; the waste management contractors have become an information source. As they haul it off, it goes on the logs and they back it up. At any given moment, they can send you an updated, 10-line report showing where you are. The subcontractors are now learning the process and becoming involved. They have become one resource we've been able to turn to that we didn't have available to us at the beginning. It is exciting and it's growing; people are embracing LEED. In a way, it makes us more of a policeman on-site than anything else, but it helps. It really helps.

⁹ Design Build is a construction project delivery system where, in contrast to "design-bid-build", the design and construction aspects are contracted for with a single entity, usually the general contractor.

¹⁰ CM At-Risk is a delivery method, which entails a commitment by the construction manager to deliver the project within a Guaranteed Maximum Price, which guarantees a set price for the owner and any surplus or additional costs are absorbed by the construction company. Typically, a CM At-Risk arrangement eliminates a "Low Bid" construction project.

VI. OPERATIONS

MONITORING BUILDING PERFORMANCE

The commissioning started very early on this project. We recognized what we were up against. The gains in the beginning of commissioning were great; we got through 90% of it very quickly. It was pretty well planned out. The last thing we thought about were some of the smaller tweaks. It reemphasized that when you touch one thing in this building, it changes systems all the way down the line. We ran into a lot of that as we started squeezing the final numbers. We had a situation in the basement ductwork where there was a static pressure level that we had to maintain. It was too high for some reason.

At that point, we had commissioned the building from the top down and were squeezing the last little bit of information out at the end. We realized that it all came down to this problem because we had eliminated all the other options from the top of the building down. What were we going to do? Then it became a long process. It was difficult at that point; we had picked the low-hanging fruit during commissioning and had the easy stuff out of the way, but it was the last few things that took 50% of the effort. There were probably eight or nine different companies participating in the process by the time we had done the easy part and were on to the hard part. We were all focused on the same goal, which was solving these last few problems. They felt like serious problems at the time, and we were concerned about getting them resolved and making sure that the project was done correctly.

SHIFTING SKILLS

A contractor needs to think ahead a lot more than in the past. No one can do point-and-shoot general contracting anymore. A contractor needs to sit down and think about what's coming next and how every little detail is going to affect everything around it. The design, for example, is not completed in one place anymore; everybody who participates in the project completes the design. It has become a matter of how well the intent can be related to all the participants of the project and how well we can convey, for example, how everything is supposed

to work. On this project, the operable blinds on the east elevation of the building follow the sun; they're actively opening and closing during the course of the day. The system, as it was originally designed, was a stand-alone system. We had to take that system and fit it within the wall. When we did that, it didn't go so smoothly.

We've learned a lot since then; everybody has to be in the room at that interface to make sure that everybody's needs are met. The design team said what they wanted: a blind that follows the sun and is actively articulating during the day. Then, we had to figure out how to make it happen. Even the person who provided the blinds hadn't previously put all the parts together to make that happen. We learned that we had to start early and get everyone in the room to talk about what needs to happen so that everything is exactly right. We were able to do that the second time; it was a lesson we learned. It really makes a difference how far down the line you can see and how proactive you get in finding the problems and then finding the solutions. Anticipation is everything.

This narrative is based on a video- and audiotaped interview conducted by Kristen DiStefano on November 9, 2009, at the Biodesign Institute on the campus of Arizona State University in Tempe, AZ.

BILL DEAN

PARTNER,
NEWCOMB & BOYD, ENGINEER

I. PROCESS

GETTING INVOLVED IN THE PROJECT

Lord, Aeck & Sargent¹ contacted us to work on this project. We had worked with them in the past and we did a representative project, like the AZ Bio,² about ten years earlier. That project was a technical building and turned that particular campus' architectural flavor around. Knowing that we had experience with that unique building type, Lord, Aeck & Sargent asked us to be on the team pursuing the project at Arizona State University. Since we weren't from Arizona and didn't have a very long Arizona portfolio, they suggested we team with a local engineering firm. The project started out as a phase one building, and the second phase developed later. We had a \$40 million budgeted project to start with and it ended up being about a \$100 million project before we were finished. We came on-board with the team, interviewed for the process, and were successful as a team. We were the only engineers at the interview. We interviewed for it, which is not something that engineers are really good at, but that's what we did. I was fortunate enough to attend the interviews; so I was there from the beginning to the end.

ROLE IN THE PROJECT TEAM

Our firm believes in really getting buy-in to the engineering systems very early on. We came out to Arizona State University and met with all the people who maintain the buildings or would maintain our building. Sometimes there are changes in personnel, but we like to talk with the people who will be working on the project to try to get a feel for what systems they like to maintain and what systems they are used to having, and then we see where there could be challenges or some modifications for things that we are planning on doing. If we see things that can be improved, we try to encourage them in different directions. We might be able to make some improvements to their process since we work on many different campuses and can see what their peers are doing.

We don't necessarily try to make everybody the same, but we try to bring all the good practices from one campus to others. We let them know that we've had some successes and we encourage



BILL DEAN, PE, LEED AP, is a Partner and mechanical engineer with Newcomb & Boyd in Atlanta, Georgia. He has served as a member of the Georgia Board of Professional Engineers and Land Surveyors.

¹ Lord, Aeck & Sargent is an architectural firm with over 3,000 completed projects. With offices in Atlanta, Georgia; Ann Arbor, Michigan; and Chapel Hill, North Carolina; the firm has five studios: Architecture for Arts & Culture, Architecture for Education, Architecture for Historic Preservation, Architecture for Science, and Architecture for Housing & Mixed-Use.

² AZ Bio was the initial project name for the ASU Biodesign Institute.

University of Oregon Professor Alison G. Kwok, Advisor Nicholas B. Rajkovich, and research assistants Rachel B. Auerbach, Kristen B. DiStefano, Britni L. Jessup, and Amanda M. Rhodes prepared this narrative. © 2009 U.S. Green Building Council and the University of Oregon. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means without the permission of the USGBC.



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Laboratory Air Handling "If they don't have a scheme for how to color-code their pipes, we show them something that has worked on our projects on other campuses... That's how we bring the knowledge base to the next project and help each other out."

them to think about it. That's why we meet with the operations people fairly early on. We also met with some of the researchers, even though we, as engineers, were not doing the programming. As engineers, we wanted to meet with some of them to find out how they wanted to use the building. Of course, at that point it was not yet defined who would eventually occupy the facility. They were imagining who might be in this building and what type of person would be here. This was a new addition for Arizona State, even though the State of Arizona had a strong history

with the micro-processing industry, but much of this business was beginning to flee off-shore. The State was trying to backfill with some pharmaceutical and biological research; that's where AZ Bio came from. We met with some of the researchers to see how they might use the space. We met with some of the facilities people to see what their history had been. They had some very strong opinions; we like people who have strong opinions — whether good or bad — because they relieve us of having to guess what they might like. From those comments, we formed our design.

We talk to people on every project. If you try to anticipate what they might like, they undoubtedly won't like it. They have to have buy-in. That is consistent on all the campuses we've worked with, and we have over a hundred campuses in our portfolio. We try to use that knowledge base for our future projects, but Arizona State has a fairly strong way of doing things, which is good; that made the project really smooth and easy for us. We didn't have to teach them much because they knew what they were doing.

A lot of the universities we work with have certain standards. When they lack standards, we try to help incorporate other standards. For example, if they don't have a scheme for how to color-code their pipes, we show them something that has worked on our projects on other campuses. If they already have a system, then we use theirs. That's how we bring the knowledge base to the next project and help each other out.

II. DESIGN

DESIGN STRATEGIES AND TECHNOLOGIES

We started the design in about 2001, six years before they occupied the building. It took a little time to master plan, design, and start construction. It was about five years, total, from the beginning of master planning until they opened the doors and started up the building. We were there from the beginning to the end. We didn't turn the keys over, but we did turn over the thermostat code.

We were involved in the master planning for four Biodesign buildings. It was important to be able to work on that with the team. We didn't come in after the fact; we were involved from the very beginning. Utilities were a big part of the master plan; the campus of Arizona State University has electrical power, which is distributed throughout the campus. It has emergency power, which is distributed on a campus-wide basis, from its own central emergency generators. Some of the emergency power capacity was allocated in anticipation for the construction of our building. We reviewed the campus chilled water and steam heat central systems with ASU and worked to make sure that the master plan would work for all of us. It's important for an engineer to at least, weigh in on those things to build in reliability for the future.

We were pretty excited about this project; we knew we were involved in something great. Everybody had grand expectations and sometimes it's really difficult to live up to those expectations, but we had people who were on-board with the project as we designed it. We had a professor on campus who was one of the original authors of DOE-2.³ We brought him on-board to help because he wanted to be a part of it. We also used a modeling tool, HCCL, for our building load analysis, which analyzed the building for peak cooling and heating load conditions. We built an energy model for DOE-2 and examined that in relation to our load analysis, which was comparable. We saw some differences, but we reconciled those. There was some give and take involved, so we modeled the building as often as we could. We modeled it twice in Schematics⁴ and about three times in Design Development.⁵ We also did a final model during Construction

Documents;⁶ we were constantly pushing the envelope to determine what this building needed to be and what it didn't need to be. We wanted to know how large, robust, strong, or weak to make the systems in order to make this project the most efficient possible. There's an atrium involved for which we also had to model and analyze the smoke exhaust. People really don't want to have an atrium on campus for that reason, but they recognized the other benefits. Atriums have a lot of code implications, but everybody wanted it and it is a really strong element of the design. We modeled it to be as efficient as possible and to make sure that we could meet the minimum code compliance which would clear it of smoke during an event.

ESTABLISHING PROJECT GOALS

One of the project goals was to make sure that when they moved into the building, it would be a good building for them. The overall goal was to make sure they were happy; they wanted a building they could be proud of. They knew the importance of maintaining the buildings with good systems and were proud of the fact that it really makes this a sustainable project. The indirect value is proportional to how easy the building is to maintain more than any other single component because if they maintain the filters, systems, and overall quality, then it is very good for the people. We had a clear, overlying goal to make it easy. If you look at the building, you can see how we arranged easy access to the different systems; no space is compromised trying to do maintenance.

WORKING WITH THE PROJECT TEAM

There were challenges. As an engineer, we have multiple clients. One is our architectural client; he's the one who leads the project. Then there's the user who occupies the building; he's a client. We have to make sure that the systems are functional for him. We also have the campus planning committees who protect the campus appearance and the way the campus grows, but

³ DOE-2 is a freeware building energy analysis program that can predict the energy use and cost for all types of buildings. DOE-2 uses a description of the building layout, constructions, operating schedules, conditioning systems and utility rates provided by the user, along with weather data, to perform an hourly simulation of the building to estimate utility bills.

⁴ The Schematic Design phase is part of the design and delivery process, which consists of the following phases, listed in their order of sequence: Schematic Design, Design Development, Construction Documentation, and Construction Administration.

⁵ Design Development (DD) is the second part of the design and delivery process, which consists of the following phases, listed in their order of sequence: Schematic Design, Design Development, Construction Documentation, and Construction Administration.

⁶ Construction Documents (CD) is the second part of the design and delivery process, which consists of the following phases, listed in their order of sequence: Schematic Design, Design Development, Construction Documentation, and Construction Administration.



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North Elevation "The existing light fixture for approved campus site lighting was not a downward-projecting light fixture. The challenge was to convince them that the standard fixture on the Arizona State campus would not earn us the needed credits and that we ought to do something different for our building... Now, all the lights on campus are being retrofitted to those specified in our LEED-designed building."

who don't necessarily occupy the building. In reality, we have a multi-tiered client and we have to make all of them happy. If one of them is unhappy, then no one's happy because there's a missing link in the chain. In working with people, you have to keep testing. If someone says they want to do something a certain way, you have to make sure that the two other players are still on-board. We have to make sure that we're on-board, the client's on-board, and the facilities people are on-board. Each time we make a change, everybody has to know what the change is.

It has become a magnet for the campus. A lot of people want to be in the building, which is a problem for a high-security laboratory; they have to keep people who don't belong there, out of the building. The building is so robust and it works really well with various occupant loads. If people need to work in the building because of the type

of work they are doing, ASU makes way for them and moves people out who don't necessarily need to be in the building. Though it was impossible to model the energy use of the building without knowing the exact occupant loads, we could assume who would be in there and the type of work they would be doing. The real energy model came after occupancy, when we found out which researchers were going to be there and how much energy they use. In one specific case, we had to have some capacity in the space, some localized capacity, but it turned out not to be air capacity, just cooling capacity. They needed some sensible cooling. We can't say we modeled it correctly from the get-go; it would be a misrepresentation to say we even came close. Based on our load analysis, it's a very robust project. When people first occupy the building, they don't actually ramp up to full speed in those first few months; they are really learning to use the building, which matures as it comes of age. You can easily model

it and see what's going on. Our initial models don't necessarily show how they actually operate the building. The people who operate the building are seeing how the building can change and be modified for them; that's the beauty of a good building. It has the flexibility to allow that to happen. It's probably the strongest building on the campus; you can do almost anything in the building and be successful.

Every time we presented systems, materials, or manufacturers of equipment, we bounced it off of the facilities team and asked them what they thought about this and that. They had opinions on every decision. We ended up buying a piece of equipment that they really wanted and that we thought was a good selection as well. We paid a little extra for it. The manufacturer ended up sending the system with mistakes, even though we had correct shop drawings. They ended up correcting everything very properly and promptly. It's good sometimes to choose based on quality. If they had been low-cost, they might not have been willing to make the corrections. The systems were fairly standard because we wanted easy-to-maintain systems. If we have made something very unique or something that was one-of-a-kind, it would be very difficult for someone to maintain it. It needed to be easy: easy maintenance, easy to get to it and easy to work on. We needed a robust system. We needed to provide for ease of use for the next hundred years. Unlike a commercial building that usually has a life of thirty years and then gets gutted, this is something that will be here for my great-grandchildren.

We also had to understand the bus routes around the site so that the outside air intake wasn't near where the buses park. There are two major roads that go right near AZ Bio and we wanted to make sure we knew the traffic patterns so that we could see where the carbon monoxide⁷ was being created and where the diesel fumes were being created. The multi-modal transportation, or light rail, was not there yet, but we had

to plan for it, as well. We were looking all around at what was going on. We had to be in Phoenix; it just couldn't be done remotely. We did do a lot of emailing; my email box was overflowing from this project. That's the way you do project: everyone keeps in touch. It can't be done in a vacuum.

MANAGING THE PROJECT

Going into this, we were fairly well-staffed and well-manned, not only as far as the people within the firms, but also the employees of Arizona State and their resources, as well as the manufacturers. Everyone wanted to be a part of this project, so the manufacturers bugged us quite a bit. Arizona State was good about making sure that we had everything we needed to be able to do the project. They didn't hold anything back and there wasn't anybody with a hidden agenda; everything was all out in the open. We all knew what the goals were. The end client is the key, and he's multi-faceted. He includes the people handling the facilities, the operations, and the administration. They all seemed to be very positive and the project managers are very strong advocates at Arizona State; they were the key to getting everybody to buy in.

Though we live in Atlanta, we went to Phoenix quite often to meet with the project team. We can get an early morning flight and be there early in the morning because of the time difference. We cover the United States fairly well from Atlanta and we do work on the California coast and in New York. The fact that we live near a very large airport allows us to get places fairly rapidly and easily. It's not a high cost to the project, as long as you can plan ahead and get your flights at a reasonable rate. We met once every two or three weeks to bounce what we just learned off everyone.

We weren't actively looking at metrics or benchmarks; we were working with the facilities people to make sure that we had the types of systems that they could modify in the future. We made some compromises and some changes right before they occupied it because of budget reasons. We made a couple of decisions that, in hindsight, probably weren't good decisions. They are good decisions now; we were able

⁷ Carbon monoxide is a colorless, odorless and tasteless gas, yet very toxic to humans and animals. Carbon monoxide is produced from the partial oxidation of carbon-containing compounds; it forms when there is not enough oxygen to produce carbon dioxide (CO₂), such as when operating a stove or an internal combustion engine in an enclosed space.

to make it a little more flexible, even as the building was occupied. We changed some boxes to allow for flexibility and mechanical changes on the fly. We modified a manual adjustment set-up to an automated system, so someone can make changes from a computer, which worked a little better.

DECIDING TO PURSUE LEED CERTIFICATION

We had done a number of LEED⁸ buildings before, so this was not the first time. We knew the matrix and what was required for a LEED building. We also knew the campus had some interest in LEED. The USGBC⁹ had been around for a little while, and there was an initiative coming from ASU with a desire to do something good. So, we were aware of LEED as a potential goal early on. As designers, we knew we needed commissioning and Arizona State is devoted to commissioning. They hired a very good commissioning agent who reviewed our plans early on. With those requirements, we earned the prerequisite and then the enhanced commissioning credit fell right into place because they were already doing it. It really wasn't a surprise; it was more of a surprise that they hadn't pursued certification in the first place. We had it in the back of our minds and then we found out they weren't going to pursue it. Once AZ Bio B¹⁰ came online, we realized that we were getting more and more pressure from the campus to pursue the certification. At that point, AZ Bio A¹¹ fell right into place. We were tracking it all along and we knew it was a possibility, but we needed the buy-in from the owner. There is some additional funding that was needed and the project had to be registered. That's what the LEED process is about: at the end of the day, a project is built that's going to be

sustainable, not only because of the materials we choose, but also because of how it operates. That is the ultimate goal.

We had one large challenge with this project. The existing light fixture for approved campus site lighting was not a downward-projecting light fixture. The challenge was to convince them that the standard fixture on the Arizona State campus would not earn us the needed credits and that we ought to do something different for our building. ASU did end up changing their standard fixture, and by doing that, they changed the rest of the campus in the process. Now, all the lights on campus are being retrofitted to those specified in our LEED-designed building. The rest of the things we did for the building were what we would do for a normal, well-designed building. The LEED process was used as a guide, but it didn't drive our decisions. Arizona State is a forward-thinking campus, and they already think along the lines of LEED. The way Arizona State University builds and does projects on campus really covers all the bases: if LEED doesn't relate, then Arizona State covers it. They're in great condition and deserve the recognition.

We all have to keep current and continue looking for the ways that others have helped the process. I hope that I add a little more to the profession. Since we go to different campuses, we learn from everybody on every level. Even the pipe fitter can help us out because, if you think you know more than the pipe fitter, you really can't learn much. Everybody has his or her bit to give. Hopefully, we are always combining the new with what we've learned before to benefit whoever we're working for at the time. Some people try to make proprietary things, but we try to generate ideas that are fairly generic so that everyone can benefit from them.

We have to stick with something that they buy in to.

8 The Leadership in Energy and Environmental Design (LEED) Green Building Rating System, developed by the U.S. Green Building Council (USGBC), is a suite of voluntary standards for green buildings. It awards certifications at Certified, Silver, Gold, and Platinum levels.

9 The U.S. Green Building Council (USGBC) is a non-profit organization dedicated to sustainable design and construction.

10 AZ Bio B refers to Building B, the second of four phases designed for the Biodesign Institute at Arizona State University, which was the initial project name for the ASU Biodesign Institute.

11 AZ Bio A refers to Building A, the first of four phases designed for the Biodesign Institute at Arizona State University, which was the initial project name for the ASU Biodesign Institute.

III. CONSTRUCTION

INVOLVEMENT DURING THE CONSTRUCTION PROCESS

Construction in the desert is unique because the summer work schedule is from night to morning. They come to work at dusk and they go home at dawn. They are nighttime workers in the summer because it is so hot. In the winter, normal construction schedules resume. We did the mechanical, electrical, plumbing, fire protection, communications, audiovisual and the special lighting on the building. We met with the various subcontractors at different times during the process so we could see the work and make comments on it. We were there regularly. We believe in being able to do that, too. We believe that it's to the benefit of the project for us to catch things as early as possible so they can be modified and corrected. The plans should be current; we don't try to enforce plans that haven't been drawn, but if they have been drawn, we try to make sure they follow them. We also make sure they know why something has been done. Sometimes a contractor might not see the reason behind some of the things we do, so we try to educate them during the construction.

CHALLENGES DURING CONSTRUCTION

We did find a problem during construction where the thermostats were located on the wall, with a hole in the wall behind the thermostat for the control wiring. Due to the fact that the laboratories were under a negative pressure to the spaces outside the laboratories, the thermostats were actually sensing the cavity temperature instead of the space temperature. We found this problem during construction and had to correct it by sealing the hole behind the thermostat so that it was actually sensing the space temperature and not the wall temperature. Without being onsite, you really don't find those things. Why was this box still heating when it needed to cool the spaces? Without making the commitment to be onsite, we might never know the answer to that question.



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Ramp "We learn from everybody on every level... we try to generate ideas that are fairly generic so that everyone can benefit from them."

COLLABORATION DURING CONSTRUCTION

We were at every meeting, at least by telephone. When we were not there in person, our project manager would call in during a construction meeting and he would be on speakerphone so that if there were questions during the process, he could be involved. We usually came to the site about every three weeks, but we were involved in every construction meeting that went on from the beginning to the end, either in person or by phone.

Owner

Architect

Contractor

Engineer

Consultant

Facilities Manager



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Northwest Corner "As design-engineers we like to make sure that the people who operate it really understand it... They get a knowledge base with the building and then we follow up on that... we went over the building and showed them some of the things that they have since realized in savings."

VI. OPERATIONS

THE COMMISSIONING PROCESS

The atrium is open to both buildings and so there is a smoke exhaust system for atrium A and a smoke exhaust system for atrium B. We had to combine those two because they had to be able to work together when the buildings were combined, which made the commissioning very important. We had to be sure that it would operate smoothly and be able to meet the code. Commissioning was incredibly important; we couldn't have done it without commissioning. When the occupants are moving in, they can say whether they are hot or cold, and since the system has already been checked out, they should be able to adjust it to what they want. Our goal is to make sure they do not misunderstand what the building is actually doing. We saw a couple of things in our construction site visits, and sometimes the commissioning agents would see something,

too. Having both of us there helped the project go smoothly. The contractor was on-board with commissioning because he's then able to leave the job faster. If his work has been checked and everything is fine, the contractors are able to go on to the next project without worrying about coming back for checks and rechecks. He actually was a really positive influence and had another person assigned to the commissioning process from their staff, which contributed to making the building work. It is a big building and needed that kind of attention.

We had some systems that weren't quite right and we missed that in commissioning. They thought it was a design error, so we came out to correct a few things because some of the controls weren't set up right. There was some overshooting in the hot water systems and some dumping of hot water because the domestic hot water system was over heating. It would relieve a pressure relief valve and that hot water

would go down the drain. The commissioning people couldn't understand what was going on. We, on the design side, came out and realized how the controls were operating and that they needed to be adjusted. We adjusted those things in the field.

SHARING INFORMATION AND RESOURCES

Tom Mason¹² is actually the person who tracks the performance of the building. He's the person who is actually operating the building and he calls us every once in awhile. As a matter of fact, I talked with him just yesterday. He asked me a few questions. He has been so intimately involved with the building and is there all the time. Mike McLeod¹³ is there all the time, too, and they are watching the building and how it is operating. We're not actively monitoring the building, but we are responsive to their questions and sometimes we end up participating in that way.

We sat down with Tom for a couple of days, went over the systems, and discussed with him how the systems should work. He got his hands and feet wet by getting in there and doing some of the things before we sat down with him. He knew the building and had a number of questions, but as design-engineers we like to make sure that the people who operate it really understand it. If you start to train them too early, people can get transferred to other buildings or move on. We want to do it when they first occupy it or right after. They get a knowledge base with the building and then we follow up on that. We did that with the people at AZ Bio; we went over the building and showed them some of the things that they have since realized in savings. We were able to show them how certain things can be done to create more savings based on who's occupying the building. We designed it to make sure that it worked robustly and now they've tuned it down to what it needs to do, based on what they're using it for. A lot of those things came out of our suggestions, which they are looking at one at a time. That has been a very positive outcome

from this process. They haven't done all of the things we've mentioned, nor are they only doing the things we mentioned, but they are finding efficiencies and making the most out of them.

We like to say we're stealth engineers; if we are under the radar screen, then we probably did a good job. In this case, they have some real proactive operators who know who we are. Communication with them helps us get some feedback on how the building is doing, which helps us in the future. We can take the lessons we've learned about how it's working and apply them to future projects; everybody benefits, not just Arizona State, but all the projects we are working on get some benefit out of this.

THE VALUE OF LEED CERTIFICATION

This project didn't really need LEED, because it had people who were forward thinking. It's the buildings that are designed to do the minimum; those are the buildings that need the LEED process to help realize what they can do. The people with AZ Bio were not just doing the minimum; we were actually trying to do something really positive. This building probably helped LEED more than LEED helped it. LEED certification needed to be put on the building because it is a standard that other buildings should want to follow. There are still building types, owners, and developers that need the LEED process to become better stewards of our environment. That's where the LEED process helps out. Someone has to get their attention and that's hard because they're always talking about minimizing capital costs and maximizing their return. They are always looking at the money and the bottom line as opposed to realizing they have something significant that could be a very strong marketing tool. AZ Bio ended up being a marketing tool for Arizona State because people want to be in this building; they have a hard time keeping them out. If you have that kind of a building, why wouldn't you want more buildings like that?

There are people who are forward-thinking. Some clients spend more money to be able to make an impact on their energy use. We just got finished putting in a 600-ton geothermal system and it cost about 30% more than a conventional

¹² Tom Mason is the ASU Biodesign Institute's facilities project coordinator.

¹³ Mike McLeod is the Director of Facilities Management at the Biodesign Institute and was the Project Manager for ASU in the construction of both Building A and Building B.

system would normally cost, but their return on investment is about 3-5 years. They see that as a return and something good. The buy-in has to be there. Owner buy-in is essential on all these systems. Design doesn't happen in a vacuum.

This narrative is based on a video- and audiotaped interview conducted by Kristen DiStefano on November 12, 2009, at Phoenix Convention Center in Phoenix, AZ.

HARVEY BRYAN

PROFESSOR,
ARIZONA STATE UNIVERSITY

I. PROCESS

GETTING INVOLVED WITH THE PROJECT

I was a part of the University committee involved in dealing with campus sustainability. As a part of that committee, I advocated that we establish a sustainability target for all new buildings and try to get the administration to accept it. We did, and it was accepted. Biodesign was the first new project in the pipeline; Building A was under construction, but B was in the early design stage. We decided to focus on Building B for the first LEED¹ project on campus. I was the only LEED AP² on campus at the time, and I was asked to nurse the project along. I was teaching a LEED course at my college and wanted to use this as a learning experience. I tried to get some students involved with the analysis that paralleled the design process.

ROLE ON THE PROJECT TEAM

When Building A was being designed, I worked on the daylighting of the atrium with the architecture team. It was a separate project, before we had the go-ahead to pursue LEED on Building B, which was fairly successful. I reviewed some of the design for A and was very concerned and critical of the unshaded, east-facing glass. The idea of a “shadowbox,” which is a basically a glass spandrel panel that accumulates tremendous heat gain behind the glass is a nutty detail, and I told the team that, but I could not get it changed. We considered shading along the lines of what’s on the south side for the east side, but that was value-engineered out of the project. Unfortunately, that discussion ended fairly early, without examining the tradeoffs in the energy analysis to see whether exterior shading was appropriate.

I tried to bring it back onto the agenda on several occasions, certainly when I was involved with Biodesign B, but it never happened and I think the building suffers from that today.



HARVEY BRYAN, FAIA, LEED AP, is a specialist in building technology who focuses on the interface between technology and the design of ecologically responsible environments. He is the recipient of three Progressive Architecture Awards, and has served on the ASHRAE committee responsible for developing the 90.1-1989 National Energy Standard. He is also a member of the Task Group concerned with Buildings Impact on the Environment.

1 The Leadership in Energy and Environmental Design (LEED) Green Building Rating System, developed by the U.S. Green Building Council (USGBC), is a suite of voluntary standards for green buildings. It awards certifications at Certified, Silver, Gold, and Platinum levels.

2 A LEED Accredited Professional (LEED AP) is an individual who has passed the LEED Accredited Professional exam and is designated by the USGBC as a knowledgeable professional in sustainable design and can, therefore, be called a LEED AP. The LEED certification process requires that a LEED AP be involved in a project for an additional point under the LEED-NC rating system.

University of Oregon Professor Alison G. Kwok, Advisor Nicholas B. Rajkovich, and research assistants Rachel B. Auerbach, Kristen B. DiStefano, Britni L. Jessup, and Amanda M. Rhodes prepared this narrative. © 2009 U.S. Green Building Council and the University of Oregon. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means without the permission of the USGBC.



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Open Laboratories "Lab buildings have the toughest energy problems... We slipped on that and we lost a lot of the edge that we could have had on this building. However, we do have great facilities people on-board who look at the plaque on the door as just the beginning of the process."

ESTABLISHING PROJECT GOALS

The campus set a target for LEED Silver for all new buildings. We thought we could do better than that with Biodesign because it had high visibility. It was one of the first new buildings under President Crow's³ administration; we wanted to set a high standard. There's no question that goal could result in a high quality building, but we felt we could do better than that. I don't think we set Platinum as a requirement; I don't like to set targets like that. I try to do the best I can without chasing targets. Later in the process, we focused more on the LEED goal. As

we came very close — we were high Gold on B — we decided to squeeze some more output from the photovoltaics and buy green power to reach Platinum. I don't like to make decisions based on that approach, but I understand that's the reality, especially late in the design process when the finish line is close and the target needs to be a little higher.

Energy performance was a very high priority for me because that's my field. Lab buildings have the toughest energy problems; I continually tried to drive that issue home. We slipped on that and we lost a lot of the edge that we could have had on this building. However, we do have great facilities people on-board who look at the plaque on the door as just the beginning of the process. Mike McLeod⁴ and his staff give me encouragement.

³ Michael M. Crow became the 16th president of Arizona State University on July 1, 2002. Under his direction, ASU has initiated a dramatic research infrastructure expansion to create more than one million square feet of new research space. Prior to joining ASU, he was executive vice provost of Columbia University, where he also was professor of science and technology policy in the School of International and Public Affairs. He led the creation of the Columbia Earth Institute, and helped found the Center for Science, Policy, and Outcomes in Washington, D.C., a think tank dedicated to linking science and technology to desired social, economic, and environmental outcomes.

⁴ Mike McLeod is the Director of Facilities Management at the Biodesign Institute and was the Project Manager for ASU in the construction of both Building A and Building B.

They are doing some heroic things and overcoming problems like the east glazing, which they have to deal with every morning!

They do a lot of due diligence work: they disaggregate meter data to find out exactly what's happening in the labs, and they look at the apparatuses that consume a lot of energy, like fume hoods, and try to come up with ingenious ways to manage their operation. They know the areas that they need to go after. I think they see this as a continued operational issue. Whether we go with LEED-EB⁵ or not is secondary; the facilities management staff will do a good job. This building is not like a lot of buildings these days where we're outsourcing services and we lose our connection with the building because every week there's another building manager running the building. Having a permanent person on-board who has the dashboard in front of them every morning and knows exactly what's going on is really encouraging.

ESTABLISHING CAMPUS GOALS

We pushed the dashboard and the whole Campus Metabolism⁶ project with the utility providers that manage the energy performance on campus, to get that disaggregate data. This building is new so we could get that data from the start. Some of our old buildings are not metered and we have problems breaking the data down, but this building has a lot of disaggregated data because we can extract that from the energy management system.

We're concerned that a lot of our buildings are not meeting the original performance targets, especially the energy targets, and this building is one of several we're concerned about. False positives are the worst thing that can happen, and this building is a false positive. We have the Campus Metabolism system and some other diagnostic systems in place, so we know this is a false positive, and we're not hiding it. I try to discuss it openly because I think it's an opportunity to make some changes.

⁵ LEED for Existing Buildings (LEED-EB) provides a benchmark for building owners and operators to measure operations, improvements, and maintenance.

⁶ Campus Metabolism is an interactive web tool that displays real-time energy use data from buildings in the Arizona State University system. For more information, visit the website at cm.asu.edu.

Most of those changes are going to be made on the operations side. Everybody is hampered when buildings don't go as planned. There's always going to be an east glazing-type problem. It may not be east glass in each case, but a building will usually have some problem that it inherits from the design team. Buildings are very complex undertakings; no team is going to get all the systems right. We could have started with a better platform, but we have to work with those challenges.

The USGBC⁷ has had several reports that say similar things: a lot of the performance targets are not being met. I think that's a challenge for the USGBC, and I think they're aware of that. What do we do now? Our approach on campus was to develop a real-time dashboard, find out what's going on in the buildings, engage the occupants, and engage the dorm residents — a number of our projects are dorm projects — and try to get them to understand how their lifestyle or how they're using the building can impact operations.

II. DESIGN

COMMUNICATING WITH THE DESIGN TEAM

I reviewed the design for Building A, which came first, and I was involved with the skylight and glazing selection. Some of the issues we looked at with the skylights were resolved fairly successfully. I got to know the design team fairly well during that time while pushing the sustainability issue on campus. The group then came together as the initial design team for Biodesign B. I worked closely with several people, including a couple of our former graduates to try to deal with the east glazing and shadowbox. Since they already had a fairly large façade on A, they didn't want to change the design for Building B. That happens: they inherited a bad design feature and, if they changed the curtain wall on B, it would look a little different than A. Then there would be a disjointed view on that elevation. I understand the issues, but the original mistakes were made and we tried to recover from them. We did a better job on the interior shades and louvers but, in this

⁷ The U.S. Green Building Council (USGBC) is a non-profit organization dedicated to sustainable design and construction.

climate, when the sun is coming in through the window, there's no recovery. In terms of building loads, the building starts off behind-the-ball early in the morning and never recovers.

Every two weeks we had reviews. Sometimes we reviewed very specific items and didn't look at the whole picture; that was one of the limitations. We'd bring people in for need-to-know meetings, but I would have liked to see more of a holistic review, even though it's expensive to run those types of meetings and get everybody to talk about the big issues. For this project, a lot of those issues were already decided because of Building A being so far along.

I would have liked more communication during the process; I think we could have addressed some of the more global issues, which we didn't get a chance to deal with in that way.

USING PREDICTIVE TOOLS

I tried to make sure that we had a good team assembled, particularly a good team of energy simulators. We hired a reputable simulator, but they were hampered by the rule sets in ASHRAE Standard 90.1⁸ Appendix G. In order to do that simulation, it is necessary to create an artificial reference benchmark, which was inappropriate. That's one of the reasons why the numbers are so different between our reference benchmark and the building as it was designed. The labs are very specialized, but I think we could have come up with a better benchmarking tool. We know ENERGY STAR⁹ works very nicely for the commercial buildings. We could have used Labs21¹⁰ or done more research to come up with a better benchmarking tool so that we wouldn't be so far off on the energy number we have right now. I think that's the legacy of 90.1 Appendix G being used for a building that is so driven by

internal loads.

The ASHRAE 90.1 Appendix G standard is what drives the LEED credits. A project team might dumb down the building using the benchmark in order to get the most points. Everybody does it, and this building was not an exception: we got the maximum points for Building B. We got ten points, which equals a 60% energy reduction from the benchmark. On A, which came along later and used LEED version 2.2, we only got a 21% energy reduction, but it's an identical building. That says something is wrong with this exercise!

I don't see LEED getting better on this issue; I see it getting worse. Now it is institutionalized and the Energy and Atmosphere Technical Advisory Groups (TAGs)¹¹ are composed of energy consultants who don't want to change it because it creates extra work for them.

There are easier ways to do the calculation; the New Buildings Institute¹² has come up with a comparison showing that Target Finder¹³ was a better technique than using 90.1 Appendix G, and I think there's a lot of evidence for that. This building is somewhat of an outlier because of its nature, but I think we could have gone through a better benchmarking exercise that would not have created some of the discrepancies between the LEED energy performance scoring and the actual building. It gives a false positive to think that the building performs better than it actually does. We have sophisticated facilities people here who can point that out to an administrator who doesn't understand but, in the private sector, those people don't exist and people will start to think that they have a high performance building when, in fact, they don't. That's like having cancer and not knowing it; a false positive diag-

8 ASHRAE Standard 90.1, developed and maintained by the American Society of Heating, Refrigerating and Air-Conditioning Engineers, is an energy code standard, which addresses commercial buildings in the United States.

9 ENERGY STAR is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy helping Americans save money and protect the environment through energy efficient products and practices.

10 Laboratories for the 21st Century (Labs21) is a voluntary partnership program dedicated to improving the environmental performance of U.S. laboratories. Co-sponsored by the U.S. Environmental Protection Agency and U.S. Department of Energy, Labs21 offers professionals worldwide an opportunity for information exchange and education.

11 LEED Technical Advisory Groups (TAGs) provide a consistent source of sound technical advice with respect to LEED. The TAGs are committees of the LEED Steering Committee (LSC) charged with assessing and recommending technical solutions for review and approval. The TAGs ensure that the integrity of LEED is grounded on technical and scientific considerations of the highest quality.

12 Since December 1997, New Buildings Institute has worked with national, regional, state and utility groups to improve energy efficiency in commercial new construction.

13 Target Finder enables architects and building owners to set energy and carbon reduction targets and receive an EPA rating for projects during the design process.

nosis is the worst thing in medical diagnostics. When a test results in a false positive, no therapy is provided to the client; they just go home and come back next year. That's what can happen with these buildings unless the mechanisms are in place to actually do the reality checks. We're doing that here, but it's a unique situation; that's not happening in a lot of places.

LEED CREDIT CHALLENGES

We could have done a better job with the daylighting, lighting controls, and ventilation. This is a tough building as far as ventilation is concerned, but more separation between the office and the labs might have allowed us to do something better for the ventilation. This was a fast-tracked building and we needed to get it up and running fairly quickly.

Part of the inherent difficulty is the coordination in having a large team, but we didn't have the lab experience in Phoenix to pull off a building like this; we had to bring in a design firm that had a lot of credentials in the lab area. Therefore, we were dealing with someone who's from a hot, humid climate; they're not going to understand a hot, dry climate. It took a while to really understand the subtleties, which can't be done by just looking at TMY¹⁴ tape. The TMY is a 40-year average; a lot of granularity is lost just looking at that. Only when the boots are on the ground can someone really understand that some weather and climate events need to be paid attention to.

TRACKING THE PROJECT GOALS

We didn't use any specific methods to track our progress, but I wish we had. I would have liked to see the simulation earlier and to have looked at some alternate options, but we had the site and we had the given orientation; we just didn't have the opportunity to do all the things that we teach in school about changing the orientation of the buildings because of the site. The site's long axis goes north-south, which is not a great orienta-

¹⁴ A typical meteorological year (TMY) is a collation of selected weather data for a specific location, generated from a data bank longer than a year in duration. TMY data is frequently used in building simulation, in order to assess the expected heating and cooling costs for the design of the building. It is also used by designers of solar energy systems including solar domestic hot water systems and large scale solar thermal power plants.



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West Windows "There will always be a problem on either the east or the west side. They dealt with the west very nicely... and it is the toughest orientation. The east façade could have learned from the west.

tion. There will always be a problem on either the east or the west side. They dealt with the west very nicely, but that's the lab side, which didn't need windows, and it is the toughest orientation. The east façade could have learned from the west or the south, which was nicely done; there are some windows that are well-covered.

GAPS IN RESOURCES

We need to rapidly move away from point-based metrics and move towards performance-based



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Air Handlers and Controls “We need to rapidly move away from point-based metrics and move towards performance-based metrics. The 30% increase in ventilation is meaningless in a building like this and it is an incredible energy burden in this climate.”

metrics. We have that in Energy and Atmosphere, although we’re using a questionable benchmark. Generally, the approach is valid. We’re not moving fast enough on materials; there are life-cycle models and programs out there. This building could be put into a cost-estimating model and we could get the impacts of the materials out of that. There’s a program in Canada that’s being used quite extensively for public buildings.

We need to get a handle on ventilation. The 30% increase in ventilation is meaningless in a building like this and it is an incredible energy burden in this climate. There’s no scientific basis for it that I can see. That point is a real question and needs to be revisited. Going after that point penalizes the energy performance of a lot of buildings.

These are things that are not unknown to the USGBC and I’ve heard from a lot of people that they’re addressing these issues. I would like

to see the topic addressed at Greenbuild,¹⁵ but most of the sessions tend to be self-congratulatory. We should be looking at which benchmark is best and bring in the critics to hash it out. The people who are going to Greenbuild are pretty sophisticated, have gone through LEED, and understand it; they’re not just coming in off the street and learning the system. We’re still in the mock-up phase and we should be well beyond that phase.

III. CONSTRUCTION

INVOLVEMENT DURING THE CONSTRUCTION PHASE

I wasn’t involved in the construction phase, but I was updated on where my recommendations

¹⁵ The annual Greenbuild International Conference and Expo was launched in 2002 by the U.S. Green Building Council and is the world’s largest conference and expo dedicated to green building.

stood. We had periodic updates on the LEED score, especially the points that were in question. The project manager sent an update to me every month or so.

I was asked to put together a couple of the innovation points for the campus as a whole. They were a campus-wide education innovation point, a campus-wide transportation innovation point, and a couple of other points. This building uses one or two of those innovation credits. They also had some credits that went beyond the requirements, which they carried over into the innovation credits.

As a consultant, I'd rather look at utility bills than waste tipping receipts. That's not something I want to spend my time doing. That's why they hired Green Ideas¹⁶ to do the LEED documentation for both buildings.

VI. OPERATIONS

CHALLENGES OF THE PROJECT

There's always going to be a disassociation between the way a building is designed and the way it is operated; there's no way to ever figure that out. At Biodesign, there are scientists trying to cure cancer; I give the lab people here a lot more space than I would an office worker or a professor in a classroom. I'm sure they're using equipment that we didn't plan on having in the facility. They could do an ENERGY STAR vetting of some of the equipment that they're buying. A lot of the equipment here is not ENERGY STAR-certified anyway, but they might be able to vet some of the manufacturers as far as the energy performance is concerned. That comes with time and, hopefully, through the outreach that Mike is doing within the building, the lab workers will understand that. Then, when they specify a piece of equipment, they will actually look at the spec¹⁷ sheet, see the energy usage, and understand that if one option has a two to one difference, it's not

¹⁶ Green Ideas, located in Phoenix, Arizona, provides consulting and educational services in the field of green building. Its clients are building and business owners, architects, engineers, contractors, utility companies, green product manufacturers and other companies interested in creating business advantages through sustainability.

¹⁷ Spec is an abbreviation for specification, which are a set of requirements for materials, products, or services that must be satisfied as part of the contracts for building construction projects.

just an initial cost issue: it's an operating cost issue. I think that will come. This building is used in a very specialized way and we have to do a lot of education for the occupants.

MONITORING BUILDING PERFORMANCE

I'm really quite excited about the facilities team here. For every project, we have to overcome some of the legacies that come from the design. We're not always going to "dot all the i's." The facilities team here is really good; they're doing a great job with a very complex, hard-to-manage building. Hospitals and laboratories are the most difficult buildings to do.

We're slowing down our construction at ASU. I think we've peaked and we're not going to see too many new buildings on this campus for quite a while. Budget concerns and other concerns have stopped most construction here and nationwide, which is good, because we should have a moratorium on new buildings that are part of the problem and work on getting our existing building stock to work effectively.

BUILDING PERFORMANCE REVIEW

I have talked to Mike McLeod and he has presented some of the building performance data to me. I have access to the campus energy management system, which has a lot more buildings on it than the Campus Metabolism public dashboard. We're hoping to get all our buildings up on the public dashboard soon, but it's taking a lot longer than we expected.

Mike might do some calibrated simulations using this building, because we have the model. In the model, the internal loads are all wrong, the operating schedule has changed because the nature of the building has changed, and different labs have come in that were not planned for. We could do a calibrated model of this building and then use real weather information. I've had some success at matching the operating energy to a calibrated model and, within a few percentage points, finding a tight fit that tracks the building really well. That might be a great diagnostic tool that Mike and his staff could use. They could do some "what if" scenarios, or look at operational changes to see the magnitude of the savings. A



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Offices "If we can show that a calibrated model is a useful operational diagnostic tool, I think it can open doors for other existing buildings."

calibrated model is a good tool, so I'm encouraged that he was willing to consider it; not a lot of people would do that. A lot of people want to bury their mistakes as quickly as possible or hide the data. Or they'd release the data in raw form so that someone else has to figure out how to disaggregate it, compare it to another building, and normalize for weather and operations. I'm excited that we're prepared to share our data and I have a couple of students who are interested in doing the calibrated model of this building as a tracking exercise. The complexity of this build-

ing is a beast to deal with. If we can show that a calibrated model is a useful operational diagnostic tool, I think it can open doors for other existing buildings.

THE FUTURE OF LEED CERTIFICATION

The folk singer Bob Dylan sang "And the first one now, will later be last"¹⁸ and that's exactly what's happening. We're seeing people in the Cascadia¹⁹ area — with the Deep Green conference²⁰ — using LEED as a platform and going way beyond that. We're seeing code bodies develop their own standards; there's ASHRAE 189,²¹ and the International Code Council (ICC)²² is finishing up a residential standard and starting a commercial standard. That's what we need. One of my biggest criticisms is that there are now a little over 3,000 certified buildings. LEED will have been around for 10 years in April and, in that time, we built a half-million non-residential buildings; we need to get to 30,000–40,000 buildings a year receiving certification and being green, not 300–400 buildings. We need to engage the building inspection community in the process. There are well over 100,000 people who work for cities who could be certifying green buildings. That's why we need to go through the International Code Council and other bodies.

We have to be consensus-based so that we don't favor certain materials over other materials. Certain materials are favored, but that's not the

¹⁸ Bob Dylan wrote and recorded "The Times They are A-Changin'" in 1964 with Columbia Records.

¹⁹ The Cascadia Region Green Building Council is one of three original chapters of the U.S. Green Building Council and, as a chapter of the Canada Green Building Council as well, is the only international chapter in North America. Incorporated in Oregon in December 1999, the chapter covers Oregon, Washington, British Columbia and Alaska, but also includes members from as far away as Idaho and Montana. The chapter is named for the Cascadia bioregion, which covers land that drains to the Pacific Ocean through the largest temperate rain forests on the planet.

²⁰ Living Future: The Unconference for Deep Green Professionals is an annual meeting of design professionals. Sessions are designed to be interactive and experiential, fostering lively discussions and collaborative solutions to creating truly sustainable communities.

²¹ ASHRAE Standard 189, developed and maintained by the American Society of Heating, Refrigerating and Air-Conditioning Engineers, is an energy code standard, which provides minimum requirements for the site approach, design, construction, and plan for operation of high performance, green buildings, excluding low-rise residential projects.

²² The International Code Council (ICC) is a membership association dedicated to building safety and fire prevention. ICC develops the codes and standards used to construct residential and commercial buildings, including homes and schools.

case if it's a consensus-based or performance-based standard because those standards have at least three competing products showing how it can meet requirements.

The scale of our efforts has to be increased by at least tenfold. I think the industry is prepared for it. The one very positive thing about the USGBC is that they have created a market and they've done a very good job. Greenbuild is a product of that and is a great event in that regard. It showed the industry that there's a market for green material. Design and engineering firms learned that they could stand up because there's a market for their services, and they've geared up for that. They've hired my students, who are always in demand it seems, even during a recession!

There is a high price point to enter the LEED system. A lot of the cost is in the documentation, which doesn't have to be so expensive. We don't have to be cops and maybe, if we engaged the local building inspection services, we'd eliminate some of the documentation. They're on the ground and they could see things being introduced into the building as the building is being constructed so that the paperwork and documentation to prove it could be decreased. Some of that might actually streamline the process, reduce the cost, and encourage participation in the certification process.

LEED for Homes²³ has inspections at several points during the process and that would be a good mechanism to use for New Construction, but it has to be introduced into the building inspection community first. We could train and certify building inspectors, just like the electrical inspectors or the framing inspectors who have a certification that is different from the general inspectors; there could be something similar for the green inspector. The Scottsdale Green Building Program²⁴ has been fairly successful and I'd like to see something like that on a larger scale, because we have to ramp up signif-

icantly. LEED is certainly a very good start, but it needs to let a thousand flowers bloom.

SHIFTS IN THE INDUSTRY

Many of my former students are working for some of the signature firms in the country and the world; they're a great group of students who are providing a lot of leadership.

Right now, we have research projects being released through the U.S. Department of Energy and the National Science Foundation that have green components. We're looking at green buildings and green futures; there's going to be a lot of exciting research coming out on the subject in the next few years. That's going to be very good for the industry, but it's also important for us to work politically. What Ed Mazria²⁵ did with Architecture 2030²⁶ was great. It's so elegant in its simplicity: it sets a target and ramps up over the next twenty years. I think it is achievable; a number of organizations have accepted a 2030-like model and that's what we want to see. We should have benchmarks along that model to see how well we are achieving that goal with any of the rating systems: LEED, Green Globes,²⁷ ASHRAE 189, or ICC. How well are we achieving those benchmarks? Energy and carbon are the big items and they can be measured. Indoor air quality is a little harder to get a handle on but, at least for the short term, energy is going to be the main issue because of global warming. We can measure and define performance around those targets, as Ed outlined. For green buildings, we're already behind. We should be at 50%

²³ LEED for Homes is a rating system that promotes the design and construction of high-performance green homes. Green homes use less energy, water and natural resources, create less waste, and are more durable and comfortable for occupants.

²⁴ The Scottsdale Green Building Program is a local program that encourages a whole-systems approach through design and building techniques to minimize environmental impact and reduce the energy consumption of buildings while contributing to the health of its occupants.

²⁵ Edward Mazria is an architect, author, and educator. He is the author of numerous published works, including the 'bible' of solar design, *The Passive Solar Energy Book*. Most recently, he is the founder of Architecture 2030, an innovative and flexible research organization focused on protecting our global environment.

²⁶ Architecture 2030, a non-profit, non-partisan and independent organization, established in response to the global-warming crisis by architect Edward Mazria in 2002 works to rapidly transform the US and global Building Sector from the major contributor of greenhouse gas emissions to a central part of the solution to the crisis.

²⁷ Green Globes is a rating system which addresses both design guidelines and assessment protocol for the integration of green building principles.

of the CBECS²⁸ average by 2010 and we're not there yet. If we were, LEED 2009 would have a prerequisite of 10 or 12 points in the energy section. We're dragging along rather than leading. Architecture 2030 is an excellent criterion. I give Ed a lot of credit for coming up with it; in some ways he was responding to the complexity that some people have built into this process, when, in fact, it's not rocket science and it's not hard. Set tough targets, decide on metrics to achieve those targets, and be diligent enough with operations to document them, improve them, and be transparent. We have to be transparent; we have to be in your face with the data.

We're trying to increase our transparency with the Campus Metabolism system. That should be a prerequisite for any green building. Now they want the information sent to Washington and the USGBC. It has to be in everybody's face. Right by the door there should be a real-time meter comparing this building to everything else in the neighborhood. It's the Prius factor: people's driving habits change when they have real-time information on their dashboard and they can compete with each other to use the least amount of energy.

This narrative is based on a video- and audiotaped interview conducted by Britni Jessup on November 9, 2009, at the Biodesign Institute on the campus of Arizona State University in Tempe, AZ.

²⁸ The Commercial Buildings Energy Consumption Survey (CBECS) is a national sample survey that collects information on the stock of U.S. commercial buildings, their energy-related building characteristics, and their energy consumption and expenditures. Commercial buildings include all buildings in which at least half of the floor space is used for a purpose that is not residential, industrial, or agricultural, so they include building types that might not traditionally be considered "commercial," such as schools, correctional institutions, and buildings used for religious worship.

MIKE MCLEOD

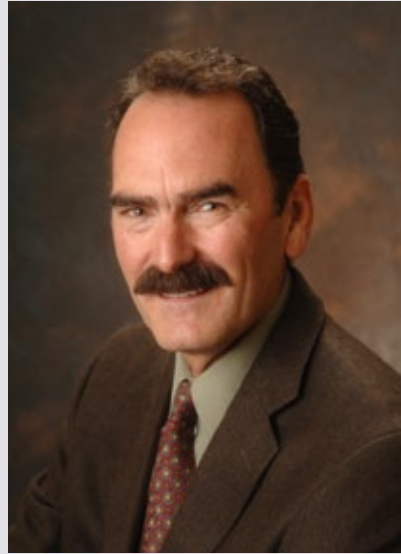
DIRECTOR OF BIODESIGN FACILITIES
MANAGEMENT, ARIZONA STATE UNIVERSITY

I. PROCESS

GETTING INVOLVED WITH THE PROJECT

I first got involved with the project in about 2003. I was the project manager for ASU who was responsible for the construction of the Biodesign Institute. As the project manager, I worked for ASU, so the budget, schedule, quality, and customer satisfaction were my responsibilities. At that time, we didn't know the Biodesign buildings were going to be LEED¹ buildings; in fact, at that time, we didn't even know who was going to work in the buildings. The director had not been selected, and we didn't know any of the researchers who were going to go in. We just started off with this big idea of a highly flexible, dynamic, high-end research institute. The premise was that we would build an outstanding building that would literally attract high-end researchers; that premise has given it an iconic look both on the interior and the exterior. If the researchers were trying to decide between Stanford University and ASU, we wanted the building to have such a "wow" factor that they would want to come here.

Usually, the other projects at ASU are much more programmed. This University doesn't build a building until it's almost full of future tenants. The next building they're building is already 120% full and its construction hasn't yet started. This was one of the first buildings — and so far has been the only building — where they just had a grand idea for what they wanted to do. It was our President, Michael Crow's,² dream to build this world-renowned institute for research. His goal was that if the President of the United States wanted some intense research done and thought of four institutes that might do that research, Biodesign would be one of them. I don't think we're there yet, but that's the direction we're headed; we will not only have the iconic building, but also be known for the research.



MIKE MCLEOD, LEED AP, brings 30 years of facilities administration experience to the post of Director of Facility Services for the Biodesign Institute at Arizona State University. He is responsible for construction, facilities, maintenance, space management, security, shipping and receiving and sustainable programs. He is a member of the Association of Higher Education Facilities Officers (APPA) and the Project Management Institute.

¹ The Leadership in Energy and Environmental Design (LEED) Green Building Rating System, developed by the U.S. Green Building Council (USGBC), is a suite of voluntary standards for green buildings. It awards certifications at Certified, Silver, Gold, and Platinum levels.

² Michael M. Crow became the 16th president of Arizona State University on July 1, 2002. Under his direction, ASU has initiated a dramatic research infrastructure expansion to create more than one million square feet of new research space. Prior to joining ASU, he was executive vice provost of Columbia University, where he also was professor of science and technology policy in the School of International and Public Affairs. He led the creation of the Columbia Earth Institute, and helped found the Center for Science, Policy, and Outcomes in Washington, D.C., a think tank dedicated to linking science and technology to desired social, economic, and environmental outcomes.

University of Oregon Professor Alison G. Kwok, Advisor Nicholas B. Rajkovich, and research assistants Rachel B. Auerbach, Kristen B. DiStefano, Britni L. Jessup, and Amanda M. Rhodes prepared this narrative. © 2009 U.S. Green Building Council and the University of Oregon. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means without the permission of the USGBC.

ROLE ON THE PROJECT TEAM

As the project manager, I'm the owner's representative. I'm responsible for selecting the designers, the architects, and the construction managers. We use a process called Construction Manager At-Risk,³ where we bring in the construction teams early on. In fact, we select the design teams, and within weeks, we start selecting the construction teams and have them involved in the process. It's like a three-legged stool. You have the design team, construction team, and project manager.

I was responsible for the project budget after it was funded. The budget for Biodesign A was about \$75 million, and Biodesign B had a budget of about \$78 million. We had all the teams get together, and we started the design process with input from a number of different groups. The University architect's office had heavy input. Eventually, we had Michael Crow's vision of what he wanted it to look like, the general parameters. Aesthetically, it had to be not only pleasing, but almost brilliant, and it had to be highly flexible. This is not an institute that you move into and stay in for the rest of your life. Your research has to meet a certain level of quality and certain criteria, a litmus test, if you will. We've been in operation about six years now, and we've turned over five or six centers, either because they decided they were going to move on, the grant funding ran out, or a number of other reasons pushed them out; it's a very dynamic environment. To deal with that, we have a highly flexible building. The lab benches are on wheels, and the furniture is modular; we can move it around quite a bit, and we do, because the building has a lot of churn.

SELECTING THE PROJECT TEAM

We had an outstanding team. We actually had two architecture and design groups and two construction groups that each joint-ventured. Gould

Evans⁴ and Lord, Aeck & Sargent⁵ were the architecture and design pair, and Sundt⁶ and DPR⁷ did the construction. There are a number of stories of how we got there, but it turned out to be an excellent situation. Where one might be a better aesthetic designer, the other was a better lab designer, and where one might be a better high-tech construction group, the other was better with concrete. It's a concrete building. So, they complimented each other really well throughout the process.

In the State of Arizona's procurement selection process, we advertise and groups submit bids. This was a big project from the start, and we must have had 22 of every discipline apply. Out of that group, we had to whittle it down to five. We did face-to-face interviews with those five, and from that we selected one and started the negotiation of their fees. The process was the same for both the architect and the contractor.

There were a number of reasons we chose two architects and two contractors. Lord, Aeck & Sargent and, I believe, Gould Evans, did a study in the late 90s that looked at Arizona State University's research and our building program. It examined how we could grow our research capabilities and the number of buildings. The interdisciplinary buildings, like Biodesign, came out of that. We've built about five interdisciplinary buildings now, plus some other buildings that focus on research, to propel us into becoming a Research 1⁸ environment. Part of the selection process is having experience with the same type

4 Gould Evans is a design firm specializing in architecture, interior architecture, graphic design, and planning/landscape architecture. The firm has offices in Kansas City, Missouri; Lawrence, Kansas; Phoenix, Arizona; San Francisco, California; and Tampa, Florida.

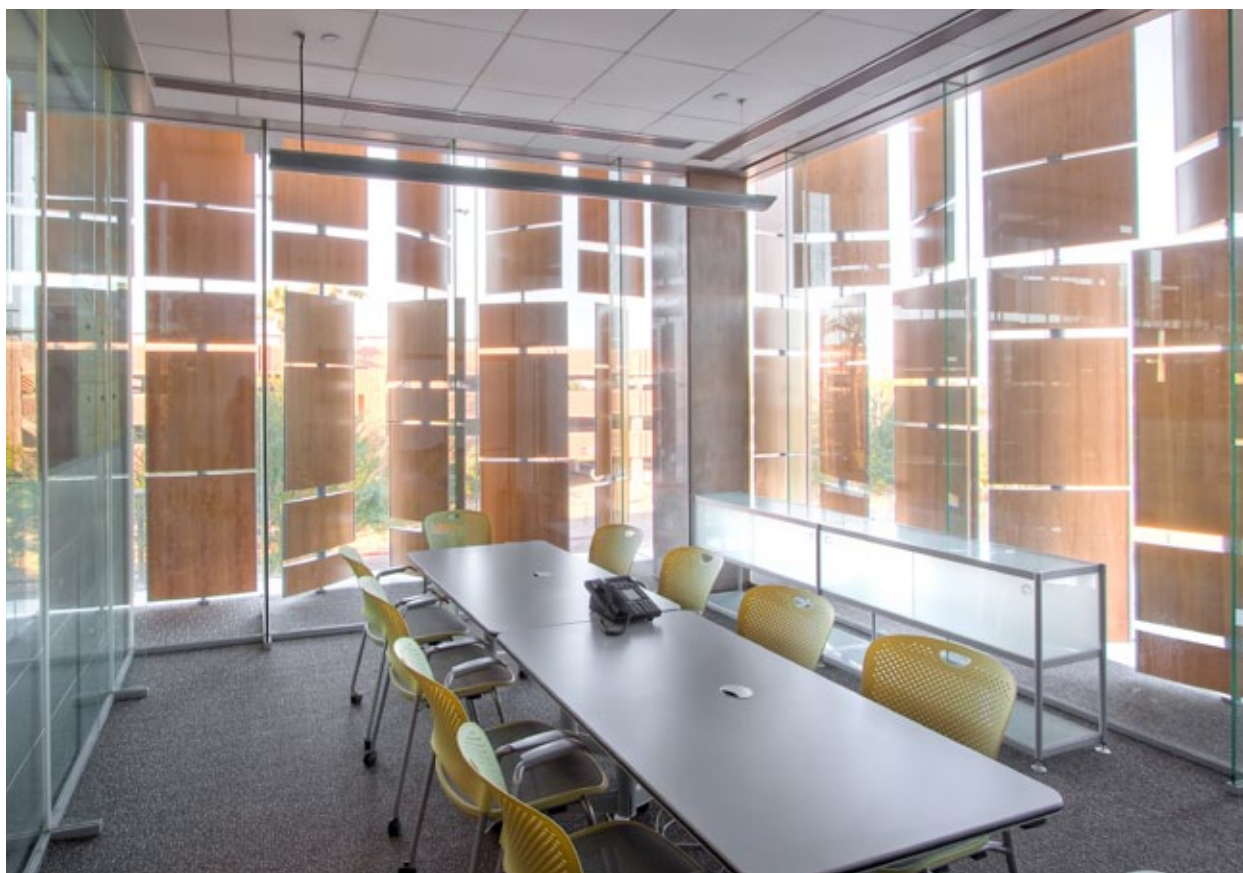
5 Lord, Aeck & Sargent is an architectural firm with over 3,000 completed projects. With offices in Atlanta, Georgia; Ann Arbor, Michigan; and Chapel Hill, North Carolina; the firm has five studios: Architecture for Arts & Culture, Architecture for Education, Architecture for Historic Preservation, Architecture for Science, and Architecture for Housing & Mixed-Use.

6 Sundt Construction is a contractor based in the southwestern United States offering Construction Management At-Risk, Design Build, and Build to Suit Contracting services.

7 DPR Construction, Inc. is a builder with technical/laboratory expertise located throughout the United States.

8 Though the term is still used, it is no longer valid. Research 1 was previously used by the Carnegie Classification of Institutions of Higher Education and indicated universities that offered a full range of baccalaureate programs, were committed to graduate and doctorate education, gave a priority to research, awarded 50 or more doctoral degrees per year, and received annually more than \$40 million or more in Federal support.

3 CM At-Risk is a delivery method, which entails a commitment by the construction manager to deliver the project within a Guaranteed Maximum Price, which guarantees a set price for the owner and any surplus or additional costs are absorbed by the construction company. Typically, a CM At-Risk arrangement eliminates a "Low Bid" construction project.



Conference Room "We select the design teams, and within weeks, we start selecting the construction teams and have them involved in the process. It's like a three-legged stool. You have the design team, construction team, and project manager."

of building in the area, and they had done that study. So, in addition to their other experience, they had experience with ASU. That probably gave them a bit of an advantage. Gould Evans was known for their aesthetics and their architecture. When we paired Lord, Aeck & Sargent's heavy-duty lab design with the aesthetics of Gould Evans, it just seemed like a perfect match. They also presented together; they teamed up on their own, and that was mostly the reason we went with that decision.

On the construction side, we went through a series of changes. DPR was selected, but the project turned out to be bigger than they could manage at that time, because they had a lot of projects going on. They opted to pick up a partner, so Sundt came on at that point, which worked out really well because during the construction process, a materials shortage problem hit. Concrete was really tough to get, but because Sundt is probably the largest concrete contractor in the

Southwest, we never had a problem. We never missed a pour because they always had enough clout to get the concrete that they needed.

We were lucky. Everybody who builds buildings knows that some buildings just work; they never stop giving, and this is one of those buildings. Some buildings flop, and you do everything you can to save them, but they just don't work as well as you hoped. This one definitely worked out well from a number of standpoints.

SKILLS ON THE PROJECT TEAM

With any project, you want personalities to align well. You don't necessarily get a lot of options to select people; sometimes you just get whoever comes in. On this project, we wanted experience. This was one of the first buildings that I had built with Gould Evans, or any of the team, except for DPR. I had built another science building at west campus with them, so I was familiar with their

work and was extremely pleased with it. Our personalities fit together, but the others had excellent reputations and good experience, and so we went with them. Being the project manager, I always felt that if somebody wasn't pulling their weight or was causing a problem, I had enough depth in all of the companies we were working with that we could change them out. Actually, we did that once or twice. People also left the team. They would go to another company, for example, and we needed the depth of the large team so that we could quickly find a replacement and bring them up to speed. We built these projects very fast, and we needed to be able to maintain that continuity. I don't know the exact numbers, but I think the construction for Building A took about 22 months; Building B was built in about 21 months. With the Construction Management At-Risk delivery system, we begin construction before the design is complete. So, we're building at the same time as we're designing.

II. DESIGN ROLE IN THE DESIGN PROCESS

We did design charrettes where we met for many hours a day for three or four days in a row. We took the input of the key players who had an influence on what this building should look like. After that, we had weekly design meetings where we would go over our progress. I had to monitor the design team's progress to make sure they were on time. We had milestone dates where we had to present. The architects did most of the presentations. They had to present what the design looked like, convey the direction it was going, and get approval; that went on for a couple of months.

Biodesign B was about the 20th building I'd built in my career. I'd also run a few buildings. I had a pretty good feel for what would and wouldn't work. I did not want to stifle creativity, so I wasn't overly demanding, but there were areas that I wanted to make sure worked really well. I'm more mechanically and electrically focused than aesthetically focused, so that was where my real interests and worries were.

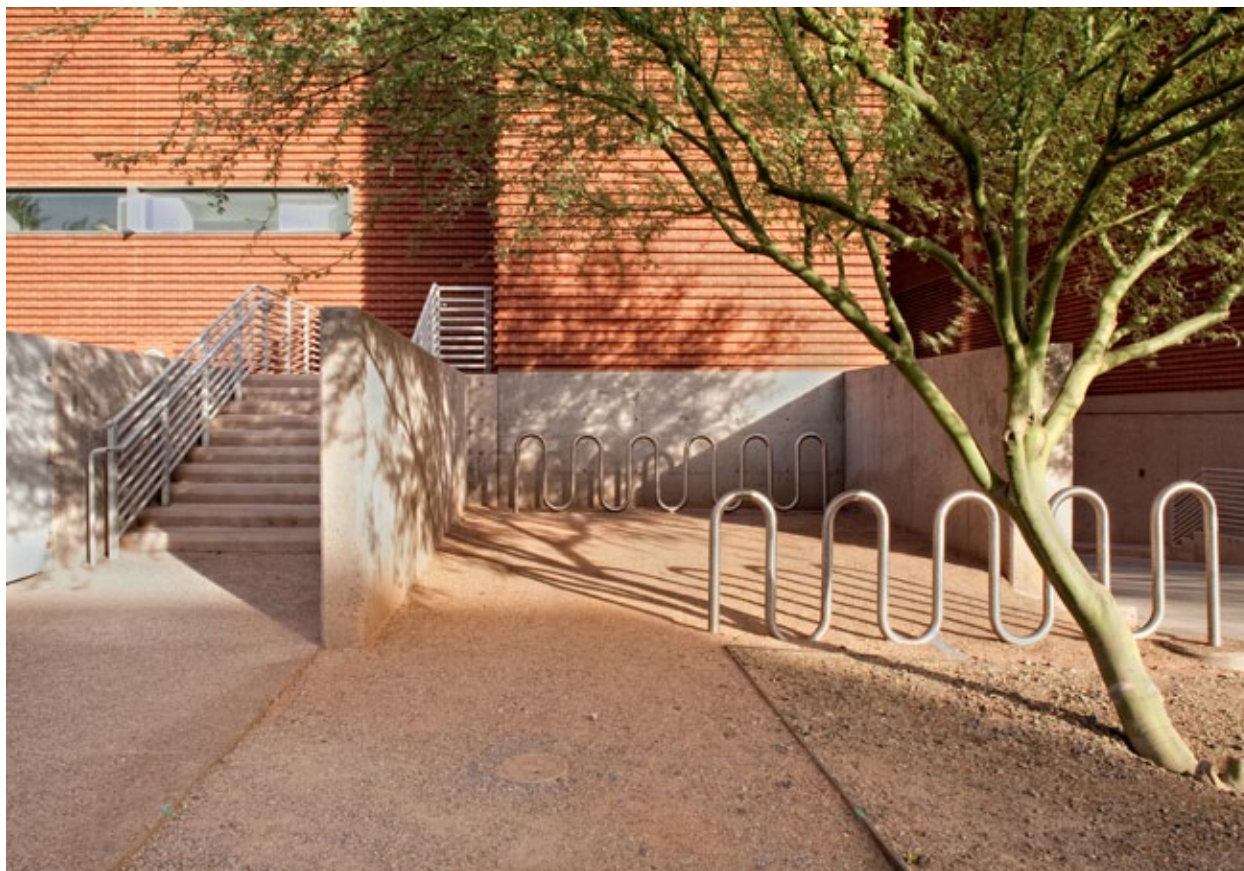
I came from the semiconductor industry, which was so cyclical in its economics that I rarely moved

into a building for any length of time when we finished it. We would finish a building, and I would only operate it while I was waiting for the next construction phase. That adjusts your thinking. When you believe you're going to leave a building you don't care about some of those details, but that two minute conversation and decision you make in a ten hour design meeting could haunt you for the rest of your career if you're the operations manager. When you're sticking around, you have a tendency to take those decisions a little more seriously and think through what they really mean.

Fundamentally, the design for the building was excellent. The electrical system uses double ended substations, which means if one broke you could tie the other one in and at least run a partial building. The main air handling system is on a manifold, so if one air handler goes down and one exhaust goes down you have others to make up for them. There are a lot of things like that; there's a lot of redundancy that an operational person is really interested in. I was looking for that redundancy to make sure that the lab never went down, that research never stopped. The team was so good that I didn't have to do too much of that kind of design. Most of my time was spent making sure they stayed on schedule and within the budget. They had enough pride and took it on themselves to make sure the design and the quality of construction was right.

III. CONSTRUCTION INVOLVEMENT IN THE CONSTRUCTION PHASE

I was here all the time and I interacted with everybody. I even liked to get down to the craftsman level to see what they were doing out there. I didn't have a lot of time to do that, because I had well over a \$100 million worth of projects going. I had to be very careful with my time. But, we had weekly, scheduled construction meetings and we had milestones that we had to report on. So, I had to stay on top of where everyone was. Design is never perfect, and construction is never perfect, so we dealt with change orders. One thing about the Construction Manager at Risk approach is that there's a lot of negotiation. When



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Bike Racks "With good, solid design and commissioning, getting LEED certification was not a problem at all; it was just a matter of doing the paperwork... Plus, all the work with public transportation and recycling on campus was starting at that time and helped us achieve more points.."

a change order came up, we had to negotiate and see what we were getting and why we missed it. A lot of that went on. Later in the project, we broke it down so that we had a finance meeting, a schedule meeting, a change order meeting, and a critical factors meeting. We needed to figure out what the critical factors were to make sure we got the project done on time and within our budget. So, we broke it down as the progression of the construction continued.

PURSuing LEED CERTIFICATION

We started to pursue LEED just after we had selected the architects and the construction manager for Building B. Building A was about 75% done, and the president put out a statement that he wanted all Arizona State University buildings to be LEED Certified. Shortly after, the governor of Arizona came out and said that all public buildings would be LEED Certified, and then President Crow upped the ante and said that

University buildings would be LEED Silver. That was the goal we were looking at. I remember having to go back and negotiate with the designers to include the LEED process in Building B. At that time, we decided not to go back in to Building A. We thought we would just go with Building B, and the whole idea was to pursue Silver certification for Building B.

Building A is an interesting study, by itself. It was totally complete and occupied, and we were just within the time frame that the U.S. Green Building Council⁹ allowed you to register a building under the title of New Construction. We commission all of our buildings; in fact, I won't build a building that I can't commission, because that's a huge part of making it run properly. What we discovered was that with good, solid design and commissioning, getting LEED cer-

⁹ The U.S. Green Building Council (USGBC) is a non-profit organization dedicated to sustainable design and construction.



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Northeast Corner "We moved very fast, because we kept the team together and because the building was so similar. They knew what they were building because they had the example right next door."

tification was not a problem at all; it was just a matter of doing the paperwork. After we got into it, we discovered that we might be able to get to LEED Silver. All the power for these two buildings comes out of the cogeneration plant, the CHP, which is a chilled hot water plant, which helped get LEED points. Plus, all the work with public transportation and recycling on campus was starting at that time and helped us achieve more points. We kept working it, kept looking for points, and for very little money we made a couple of changes and added some more monitoring to achieve LEED Gold.

LEARNING FROM BUILDING A

I didn't start with Building A; Building A actually had two other project managers. I was doing another research facility on the west campus. B started at about 50% construction on A. I was brought in to run B, and both of the project managers for A left at different points, so I took over and became the project manager for the very end of A.

The interesting thing about Building B is that it is almost a duplicate of Building A. The whole idea was that we would have two buildings that were

very similar. Now, there are some differences between the two. They have a full administration up front, and there are some other research lab differences in Building B, but fundamentally, they're identical buildings. They let us go ahead and keep the same designers for Building B, but we had to reselect contractors. The reselection wasn't because we thought they were doing anything wrong, but because we're a public entity, and part of our procurement is to be fair and give everybody an opportunity. The team that worked on Building A had the most experience and they knew how to talk to us; so, eventually they got the project. It was kind of a double-edged sword; usually this type of crew works together for one project and by the end they are ready to not see each other for a long time. In this case, I'd say 95% of the people continued on to Building B. Some interesting interactions developed between people, and I had to work on improving those; all the idiosyncrasies of how they all worked together had to change. To be honest, we were late with Building A, and we did not have a happy move in. The customers were not happy. That gave us a huge incentive to make sure that Building B was perfect, and that's what we did. We strived for that, and everybody was intent on making sure we ended on a high note. I told them that if we could do that, then everybody would forget all the earlier problems we had. There weren't horrific problems. They wouldn't have barred anyone from doing work here, but our customers weren't happy. We were within the budget, but we needed to do better. We needed to get into a world-class mode and make the building what it needed to be. We needed to move in on time, meet everybody's expectations, and just work harder at it; they did, and it was wildly successful from my standpoint.

MANAGING THE PROJECT

We moved very fast, because we kept the team together and because the building was so similar. They knew what they were building because they had the example right next door. Even though there were differences, the buildings were similar enough that we could tell people to look at what we did in Building A. It's amazing that even after you have just finished a build-

ing, you forget the details, and people have to go back in and check out what it looks like.

It was my responsibility to select the end date, and everything backs in from there. The University wanted to know how soon we could have it done. So, we all worked as a team to come up with a date, and then we challenged each other: "Can we really do it by then?" There are different stages of design: there's Schematic,¹⁰ Design Development,¹¹ Construction Documents.¹² We'd put them on this whole schedule, which was huge. It had a lot of detail in it, it was dynamic, and we were constantly changing it. The big thing that I had to commit to for the University was the end date. The date of occupancy and the date of move in were actually two different dates, because after construction ended we moved all of the furniture in and got it ready for people to occupy the building.

TOOLS AND RESOURCES

I did a lot of small calculations on Excel, but it was really about that simple. I did the scheduling based purely on experience. The architects had a lot of work going on, so they had their own schedule for the design all planned out, and the construction folks had a whole schedule all lined out. Mainly, what I did was to pull those together. I did not have specific tools. With the University and the State, it's important to follow the policies and the procedures, and it was part of my responsibility to make sure all policies and procedures were followed. Sometimes you worry that policies override product. I had to make sure that I was following all of the policies, but I also wanted to get the products that met everybody's expectations out on time. That was probably my biggest concern.

¹⁰ The Schematic Design phase is part of the design and delivery process, which consists of the following phases, listed in their order of sequence: Schematic Design, Design Development, Construction Documentation, and Construction Administration.

¹¹ Design Development (DD) is the second part of the design and delivery process, which consists of the following phases, listed in their order of sequence: Schematic Design, Design Development, Construction Documentation, and Construction Administration.

¹² Construction Documentation (CD) is the third part of the design and delivery process, which consists of the following phases, listed in their order of sequence: Schematic Design, Design Development, Construction Documentation, and Construction Administration.

SHARING INFORMATION AND RESOURCES

We didn't really need additional training for this project. When they decided to go ahead with the LEED certification, I thought it might be a trend, because throughout my career, I've been the energy manager or energy conservation engineer. I've done that for years, but I always knew that the minute fuel got cheap, energy got cheap, or business took off, they'd drop that priority and we'd go off in another direction again. I felt like this one was going to stick; catchy terms like green and sustainability sounded better than conservation, and I immediately went out and got my LEED AP.¹³ It was interesting because a lot of us got that accreditation, but didn't tell anybody that we were going to go get it. We thought it might poison the whole process because we could be written off as greenies who just wanted all these strategies because we were conservationists. I didn't want to portray that, and I didn't want to poison the project. I became an AP, and I learned a lot going through the process. I was ahead of the curve on what we would need to do to get the LEED certification. I'm sure in the long run it helped a lot. People on the team started going for it too, and I was pleased to see the design folks jump on it. Even the construction folks started going after it, which was a surprise to us. They felt it was important. It was new to everybody. We didn't know what it was, so we had to find out what it meant. We wondered if we'd have to start driving electric cars to qualify! We talked to people who had gone through the process to ask how tough the certification process was. We needed to know whether we'd have a chance to rebut if they rejected a point we turned in. So, we learned, and we went from zero to 100 miles an hour in just a couple of months.

I've always had an interest in energy conservation. I recognized a long time ago that we couldn't keep going at our current rate of energy consumption for generations and generations, because fossil fuels are only so plentiful. I always had an interest in it, but it wasn't my main business. My main

business was building buildings, running them, and making sure they were as efficient as possible. When this came about, it was a very good fit for me. I felt comfortable with it; I kind of knew what to do to make it work, and I knew that energy would be the big factor. When conserving energy, you can save the most money. Upper management will listen to you on energy saving projects. LEED is more holistic, though, and I get a little bothered by people only focusing on the energy portion of LEED, because there's so much more. There's recycling and daylighting. People who've got allergies come into this building and say their allergies clear up in here because we filter the air so well and we make sure all the air handlers and ducts are extremely clean. We watch the chemicals that come in; in our view, if you can smell it, it's probably not good. There are VOCs¹⁴ and formaldehyde, and we really keep an eye on them. Knowing that, understanding it, and training the people in the building to watch out for it is really important. People go with their habits, and they sometimes won't stop to think about whether what they're doing is right or not. We're really lucky here because there is a lot of sustainability research that goes on here.

VI. OPERATIONS

OCCUPANT TRAINING

For us, it's not so much about training as it is about awareness. There are common sense things that we want everybody to do and be aware of. We started with our service, custodial, and pest control contracts, and made sure that they're as green as they can possibly be. On the video monitors throughout the building, we can do little campaigns; we're getting ready to launch into one called "Lug a Mug," encouraging people not to use disposable cups, but instead to use a ceramic mug to use again and again. Our recycling programs have improved, and I'm proud to say that Biodesign has always been the campus star with that. We're the first to jump on a program when it comes in, and we do everything we can to fund it and make it as effective

¹³ A LEED Accredited Professional (LEED AP) is an individual that has passed the LEED Accredited Professional exam and is designated by the USGBC as a LEED AP. The LEED certification process requires that a LEED AP submit the required paperwork.

¹⁴ VOCs are volatile organic compounds comprised of organic chemical compounds that vaporize and enter the atmosphere under normal pressure. VOCs combine with nitrogen oxides in the air to form ozone. Some VOCs are neurotoxic and carcinogenic.

as possible. One of the things that really worked out is that we can now combine our recyclables. Now, we don't have to sort paper, plastic, and aluminum; we just throw them all in one blue bucket and they're divided out at the recycling center. We also installed a compactor downstairs for the recycling. It's that old marketing cliché, "You make it easy for the customer to buy." We're trying to get them to buy into recycling, so we make it as easy as we possibly can.

ONGOING COMMUNICATION WITH THE PROJECT TEAM

I try to keep in touch with the project team; we developed friendships. I've given references to many of them. Part of my goal in saying that Bidesign was such a successful project is to help pay them back, and I'm willing to do that because it was so well done.

Larry Lord,¹⁵ of Lord, Aeck & Sargent, still does work for us. In fact, we had a selection process for an architect so that we didn't have to keep going through the selection process when we needed to get projects done. We selected Lord, Aeck & Sargent. We're presenting at Greenbuild¹⁶ this week.¹⁷ I'm working with John Dimmel¹⁸ and Larry Lord on that presentation. Brett Helm¹⁹ has been a good resource on things that we've done in the past, and there are several Sundt guys I'll talk to from time to time. We pretty much stay in touch. Of course, with this being the first Platinum building in Arizona, and LEED being so incredibly popular right now, they obviously use it in their marketing as one of their big projects. Usually, it's one of the first projects to pop up on their websites, which is what we want.

¹⁵ Larry Lord is a Principal at Lord, Aeck & Sargent in Atlanta, Georgia.

¹⁶ The annual Greenbuild International Conference and Expo was launched in 2002 by the U.S. Green Building Council and is the world's largest conference and expo dedicated to green building.

¹⁷ Greenbuild 2009 was held in Phoenix, AZ from November 11-13.

¹⁸ John Dimmel is an architect with Gould Evans in Phoenix, Arizona.

¹⁹ Brett Helm is a Project Executive with DPR Construction, Inc.



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Atrium "Early on, we thought that we could do a lot more setbacks for temperature and lighting, because we hoped people would be gone by 9 o'clock at night. That has not been the case... They'll be in there all hours of the night... We've got to provide them with the environment they need to make sure the science keeps going."



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Atrium "We work really hard to keep the temperature within the ranges that the occupants are happy with. We used to be able to adjust that, but with the downturn in the economy and the drop in funding, we've had to raise the upper end of the temperature range to 80°F, and we've lowered the lower end to 65°F in the office areas."

MONITORING BUILDING PERFORMANCE

We have the Three-M theory that I developed: Meter, Monitor, and Manage. Our strategy is to

Meter, Monitor, and Manage by having all kinds of telemetry in the building. You can't have enough, and we don't; ASU has a budget every year to put a certain amount of metering in the buildings. I'm greedy and I try to pull as much of that money in as I can. So, we monitor all of the parameters of the building. We have meter-

ing, particularly with energy consumption. The HVAC is what we meter the most. We have indicators, and every month I get a series of graphs showing how much we recycle, how much waste goes out, even how much water and energy we use; there's a whole list that goes in my monthly matrix report. We watch that to see how we're trending from last month and last year, and I report that to the upper management. Within the HVAC system, we have a tremendous amount of information that comes in, including what's happening in particular rooms. We can see if a room is using an exceptionally high volume of air, because we have a variable air volume system, even within the labs, which is rare. It's almost an experiment. We can adjust the volume based on the conditions in the room. Our system is called the Aircuity²⁰ system, and it feeds into a larger system, the Metasys,²¹ which is actually monitored both here and at our central plant. The building is monitored 24 hours a day, 7 days a week, and 365 days a year. We take that information and try to fine-tune the amount of energy that we're using. I've got a series of graphs that show that, since I became the director of facilities services in November 2007, we've reduced our energy consumption every single month. I don't suspect that will go on forever, but right now I can say that for two years, it's gone down every single month.

The main lab areas are all open plan, and then we have smaller, individual instrument and procedure rooms in the back. You might walk onto a floor that's a large open lab area, and there'll be three or four different PIs²² working. We've put up little metal signs so that they can identify whose lab areas are whose. Actually, they know; it's probably more for our benefit. So, the cleanliness, the flexibility, and the capabilities are all attractive. We're probably running this building at 115% over what it was meant to do, and we're still finding ways to get more people and more research in here. We will continue to do that until we can build another

²⁰ Aircuity is a manufacturer of facility monitoring systems that cost-effectively reduce building energy and operating expenses while simultaneously improving indoor environmental quality.

²¹ Metasys is a Johnson Controls building automation and controls system.

²² PI stands for Principal Investigator.

building. We'll probably be up to 120%-125% capacity and the building will still be able to handle that and maintain the level of operational professionalism that the researchers require. We now have four Academy of Science members here and a Nobel laureate, so we've done a pretty good job of attracting the type of talent that we want. Since we didn't really have a research reputation at the time, a lot of building the talent base was done by the administration here, the facility, and probably the gorgeous winter weather in Arizona.

COMMISSIONING

I think it's imperative to have commissioning on any new building. It's a good, third-party check when you can go through and exercise everything from the electrical system to the HVAC system. The third-party commissioners did everything on this building, and it was great. We found a lot of things that didn't work; in fact, we even went through and poured water in all the drains to make sure they worked. You'd be surprised. We have about a thousand drains here, and we actually found two that weren't connected underneath; the water just went straight through to the floor below! It's nice to fix that before people move in. The commissioning, testing, and quality assurance programs are imperative. We always plan to have a lot more time to commission than we really do. I knew the commissioning agents, and a lot of time was spent with me breathing down their necks asking when they would be done, because we were running out of time. We flushed the entire building for about two weeks as part of the LEED process, which was great. The principal of our original commissioning company got hurt in a car accident, so we actually had to bring in another company. Larry Lord had a company that he brought in as a backup to help finish the process. All things considered, it went pretty smoothly. But, to me, commissioning never stops. We're still fine-tuning this building, and with researchers changing and different things happening within the building, we will be constantly fine-tuning this building and adjusting what we do.

OPERATIONAL CHALLENGES

Biodesign is a very cutting edge, dynamic research facility. There are very high-end, high-energy people here; you would be amazed at the emails I get from midnight to two o'clock in the morning from people asking questions and doing things. They're very passionate about their work. It puts a lot of pressure on me and my team to be as passionate and aggressive as they are, and to spend time to give them the research environment that they want. It's not a matter of their trying to push us to be better; it's a matter of setting the lead and us wanting to be as dynamic and as influential as they are. We have to have a team that really likes to do what we're doing. If somebody is here to be an eight to five, they're not going to be happy, and they're probably not going to survive. It's a 24/7 operation. The tenants do research. If you want to meet some of the PIs, you have to come in at 11 o'clock at night, or on the weekends, because that's when they're doing their work. Early on, we thought that we could do a lot more setbacks for temperature and lighting, because we hoped people would be gone by 9 o'clock at night. That has not been the case. We've got to be very careful. They'll be in there all hours of the night, and if they've got a deadline they'll be in there all night, and we can't inhibit that. We've got to provide them with the environment they need to make sure the science keeps going. When we have equipment or a process down, their research stops. It's like a manufacturing line with a broken belt: nothing's moving. We can't allow that to happen, so we put a lot of pressure on ourselves to make sure we meet their requirements. Also, it's such a gorgeous facility, which has won so many awards, and we do so many tours; so, we want to make it look like the day it opened. That takes a lot of attention to detail; we make sure every corner's clean, and we make sure that if something gets damaged it's repaired as soon as possible. We don't wait for three glass panels to crack before we fix them. If one's cracked, it gets replaced. We want to keep that pristine look and that adds a level of intensity. I personally enjoy that, because I think that just a standard operation in a standard building would be rather boring. So, it's a part of what we do.

Owner

Architect

Contractor

Engineer

Consultant

Facilities Manager

OCCUPANT FEEDBACK

I'd say, for the most part, that they really like it. In fact, I've gotten no real complaints on the building as a whole. I hear criticisms on certain things, things we could improve; I see things we could improve, and I would change some things if and when I build the next building. The researchers are all very positive about the building. Most of them saw the building, and it was part of their selection process to come here. There were several researchers who were already on the ASU campus, and it was very competitive to get in here. The rest of them came from other parts of the country and the world, and seeing the building was part of their selection process; so, they already had a positive approach to it.

We work really hard to keep the temperature within the ranges that the occupants are happy with. We used to be able to adjust that, but with the downturn in the economy and the drop in funding, we've had to raise the upper end of the temperature range to 80°F, and we've lowered the lower end to 65°F in the office areas. We've had to work extra hard to move enough air through the space to not make it stifling, because with a variable air volume system, if a space doesn't need cooling or heating, the air shuts down to minimum. We've had to do some dynamic work on that to make the occupants more comfortable. All in all, the systems work extremely well and I've got a really good team that makes sure that level of quality stays up. I'm real big on customer service. I believe the customer is right, and we need to do everything we possibly can, as soon as we can, to help them in their work. That positive customer service attitude has helped a lot with the occupants, and it's made them appreciate my organization and appreciate the building even more. When you see some of the 100-year-old buildings they came from, where the air conditioning hadn't been changed in at least 20 years, this looks like a really great facility.

We get new researchers in, and they're usually from a different university, so they have to get used to a whole new system. We recently got a fellow from Harvard. They run the systems totally different there. So, we have to understand how they run it, and what the fellow needs. He needs a

higher level of service in certain areas, and no service in others. That makes what I do very dynamic. I don't understand his science, per se, but I need to understand what his science needs in order to make him highly successful. As we turn people over, I'm constantly learning that.

IMPROVING BUILDING OPERATIONS

On the sustainability side, we're constantly trying to test and do research about our facilities. That makes working in this building wonderful, because everybody here heavily supports sustainability and reducing energy usage, and they are willing to fund some things in that area. I work with some of the researchers here. I have the perfect example: antibacterial soap has in it triclosan and triclocarban. One of our researchers has identified those compounds as staying in the ecosystem way too long, and they're trying to remove them. We're one of the first to take them out of all of our soaps and everything we use here. So, we discovered it; he's now taking it out to the rest of the world, but we've already implemented it here. They've just implemented it on the rest of the campus as well. There are several examples like that, and that's always exciting. In addition to that kind of research, we have things that we're experimenting with in facilities. This Aircuity system, which is a variable volume system for labs, actually measures total VOCs, CO₂, particles and contaminants, and can vary the volume of air. Every cubic foot of air that we use costs me six dollars a year. Every time I can reduce a cubic foot of air per year, I save six bucks. Well, we pump hundreds of thousands of cubic feet per minute (CFM) of air into this building, so if I can reduce that, that is my largest energy saving opportunity. We do research on that as well and we're experimenting with some of these things. We just got a new custodial group that's nationally known for their sustainability, and I hope they're going to teach me a few things about what other institutes are doing, and how they're handling their green custodial work. I love that type of learning, that dynamic research, if you will. My own little research world here is wonderful, and it really makes the job rewarding, not only for me, but for my entire staff.

I think the real ticket here is that the building is now iconic. The building has served its purpose to attract attention to the school with its LEED Platinum rating, the Building of the Year award, the Lab of the Year award, the AIA awards, and the contractor’s awards. Now, we’re creating the research environment and reputation. We’re well on the way to making that happen. It’s a two-step process, if you will.

This narrative is based on a video- and audiotaped interview conducted by Britni Jessup on November 9, 2009, at the Biodesign Institute on the campus of Arizona State University in Tempe, AZ.

Owner

Architect

Contractor

Engineer

Consultant

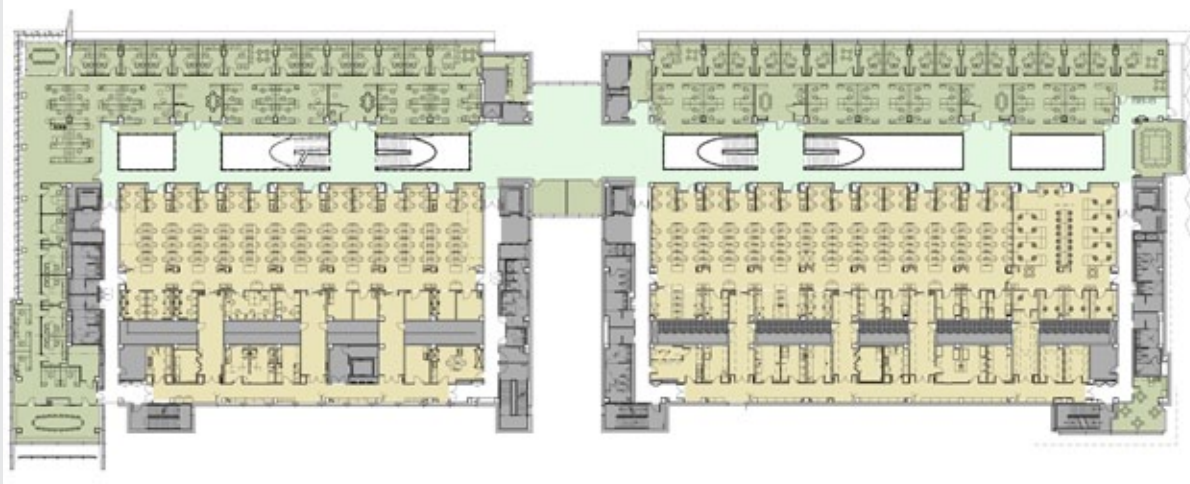
Facilities Manager

APPENDIX A: IMAGES



Images on this page courtesy of Gould Evans Associates







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“The Biodesign Institute represents the largest single investment in research infrastructure in Arizona, and has generated impressive returns for the community. It is master-planned as four interconnected buildings that will comprise 800,000 sq. ft. Currently, two buildings (350,000 sq. ft.) are complete and house nearly 600 faculty, staff and students.”
 – *The Biodesign Institute at Arizona State University Website*

Prepared for the U.S. Green Building Council by the Case Study Lab of the Center for Housing Innovation at the University of Oregon, this book documents the visioning, design, construction, and operation of the Arizona State University Biodesign Institute in Tempe, Arizona.



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