# ORGANIZATIONAL INNOVATION FOR ENERGY CONSERVATION



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## A Case Study of Poudre School District

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Since 2000, Poudre School District has built seven green schools and steadily improved the energy performance of all existing school buildings. The Operations Services department has received over 30 awards from local, state, and national agencies for energy conservation and sustainable design. This report provides the results of a case study that examined how Poudre School District adopted innovative practices and became a national leader in high performance buildings. We found that the adoption of sustainable design guidelines and a sustainability ethic was part of a larger organizational transformation that made sustainability the core mission of Operations Services. We describe this change process using an eight-step model that builds on previous research in organizational change; and we discuss the importance of framing the changes to generate broad-based support for sustainability. In addition, we found that Operations Services operates as a "learning organization" in a densely connected network with other public and private organizations.

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# Organizational Innovation for Energy Conservation

### A CASE STUDY OF POUDRE SCHOOL DISTRICT

## EXECUTIVE SUMMARY

This report describes the results from a multi-disciplinary, mixed-methods, case study that examined the behaviors and strategies utilized by Poudre School District to adopt energy efficiency and sustainable building design missions. Three main results were found to support the sustainability and high performance design initiatives in the district: 1) an organizational transformation for sustainability, 2) appropriate framing of the change process as "high performance buildings", and 3) extensive collaboration within the district, as well as with external partners that fostered learning, support, and leadership during the change process.

**ORGANIZATIONAL CHANGE.** We discuss how the district went through eight steps to generate organizational change that led to high performance buildings and sustainability: 1) Changing the mindset, 2) Establishing a team, 3) Creating a clear vision, 4) Communicating the vision, 5) Empowering the team, 6) Using early success to continue the process, 7) Learning from mistakes, and 8) Embedding sustainability into daily life.

**APPROPRIATE FRAMING.** This organizational change was supported by an appropriate framing of the goal of the process. By extending the name of new initiative from "green buildings" to "high performance buildings," the district generated broad-based support from a variety of individuals with different motivations, and combated resistance to the changes. Framing worked hand-in-hand with the team approach to encourage participation, promote environmental literacy, and remove the need for explicit employee incentives.

**NETWORK COLLABORATION.** Collaboration within the district and with external partners such as, Fort Collins Utilities, the Governor's Energy Office, energy consultants, architects, and ENERGY STAR® provided numerous learning and support mechanisms during the construction phase and as part of the daily operations. The Green Team Network is a densely connected, distributed network structure, indicating that individuals are highly connected with many others in the network. Densely connected, distributed networks are highly resilient and effective work networks, especially good for coordination of complex projects, like building design and construction. In addition, the Green Team Network was able to adopt innovative design features through learning from a broad and diverse peripheral resource network.

### Recommendations

Looking to the future, we make a few recommendations that were drawn from this case study.

1. Expand use of the Sustainability Management System (SMS) across the district in order to engage teachers, students and other building occupants in sustainability efforts.

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2. Engage teachers and building occupants in behavior change that supports energy savings. A process similar to that undertaken within the operations services department should be used to institutionalize the energy conservation mission with building occupants, including increasing communication and participation, adopting appropriate framing, and increasing empowerment and learning mechanisms. Specifically, we recommend:
    a. Creating a team process that includes teachers, students, and parents in energy projects.
    b. Supporting current energy champions and fostering more champions through a paid energy role, similar to coaches and extracurricular staff positions.
    c. Further utilizing expertise on behavior change, especially the energy education expertise of Fort Collins Utilities personnel.
3. Expand the outreach efforts related to sustainable design to other school districts and members of the architectural, design, and construction industries.

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# INTRODUCTION

In most public school districts, utility costs are the second largest expense following salaries (Governor's Energy Office 2009). Over the past several years, the Poudre School District (PSD) implemented a variety of programs and initiatives to increase energy conservation. Staff from PSD's Operations Services have shared data with eight other school districts across the state of Colorado, and found that among these eight school districts, PSD is the most energy efficient. On average, PSD buildings use 25% less kBtu/square foot/year and 33% less kWh/square foot/year than other districts. For example, Rocky Mountain High School (RMHS) reduced its electrical consumption (kWh/square foot) by 50%, to a level below that of the newly designed and built Fossil Ridge High School, a LEED® certified building (Schelly, Cross, Franzen, Hall and Reeve 2010). Across PSD, conservation of energy translates into 37% fewer dollars spent per square foot/year than other school districts in the state.

As state and local governments face increasing energy costs and decreasing budgets, reducing the costs of energy use is essential to protecting the educational mission of schools. The purpose of this research was to develop a model of the strategies used to design and build high performance buildings and reduce energy consumption in both new and existing buildings. This model of strategies used by PSD will help other organizations develop plans for minimizing the costs of energy use and reducing their carbon footprint.

## Research Questions

A preliminary study of energy conservation at RMHS revealed that the school was able to achieve a 50% reduction in electricity use as part of a larger organizational change that was supported at all levels of PSD, from the Board of Education to the Superintendent, and from Operations Services to the schools. Discussions with building staff and personnel from Operations Services suggested that an organizational change had taken place, and that much of this change was supported by relationships with other agencies (e.g. Fort Collins Utilities, the Governor's Energy Office, and ENERGY STAR®). This study was designed to examine the components of organizational change across the school district and the role of inter-agency relationships in supporting learning and innovation.

Specifically, this research sought to answer four primary questions:

1. How did PSD accomplish substantial improvements in energy efficiency and innovation in sustainable design?
2. What are the social structural (professional network relationships, organizational support) and behavioral (professional development, information sharing, leadership, communication) changes that occurred in the organization that can be linked to changes in energy management and use?
3. How do the changes at PSD relate to existing knowledge on incentives for energy conservation, adoption of innovation, and organizational change?
4. How can PSD's success be replicated elsewhere?

# RESEARCH METHOD

We conducted a multi-disciplinary, mixed-methods study that examined the behaviors and strategies used within PSD that lead to adoption of innovation and energy conservation. We conducted semi-

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structured interviews with 26 individuals, several informal interviews with Stu Reeve and Bill Franzen, content analysis, document analysis, and social network analysis.

## Interviews

A purposeful sampling strategy was used, where subjects were identified based on a defined characteristic that suits the study objectives (Patton 1990). The selection criteria were people who participated in the change and/or who were seen as important contributors to the process of designing, building, and operating green buildings in the school district. We began with two individuals noted as key participants in the changes within the operations services department. We then used a snowball sampling technique to develop a list of individuals who met the selection criteria (Patton 1990). The complete list of key participants included 44 people, of which 26 were available and agreed to be interviewed. Those who were not interviewed included retirees and others who are no longer associated with the district and not available to participate, those who refused saying they saw their role as insignificant, and others, like school board members, who saw their role as supportive rather than substantive.

The interviewed participants included 16 men and 10 women, whose ages ranged from 33 to 62. Ten participants were from outside the district, and 16 were district employees, either current or previous. Most district employees worked for the school district for a decade or two; the average length of full-time employment among interviewed district employees was 20 years, with a range of 1 to 35 years. School district participants included directors, department heads, and staff in Operations Services, as well as teachers and administrators.

The interviews were analyzed separately by the three researchers and a graduate assistant. Interview data were analyzed using the grounded theory approach—data is coded and recoded in stages, first searching for categories or themes in the data, then examining relationships between the general categories and themes, and finally identifying a core concept or process, and recoding the data in relation to this idea (Charmaz 2001; Strauss and Corbin 1990).

## Network Analysis

Each of the participants interviewed also completed six network rating sheets. The original list of 44 key participants was given to each interviewee. Each person was asked to identify the names of individuals whom they (1) knew personally; (2) viewed as leaders regarding sustainable design and energy management; (3) gave and (4) received support from; (5) learned from (6) and who learned from them. These rating sheets were then formatted into network matrices, and analyzed using social network software (Borgotti, Everett, and Shirey 1992).

## Document Analysis

The interviews were supplemented with observations and analyses of documents. The three researchers observed a PowerPoint presentation given by the former Executive Director of Operations, who described the processes and outcomes related to high performance buildings. Numerous documents related to sustainability plans and awards received by the district were referenced by the participants during the interviews. These and other documents were reviewed by the researchers, and are available on the school district website (Poudre School District 2010), as well as other websites (e.g. ENERGY STAR®, news outlets). Other documents analyzed include the ENERGY

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STAR® database of labeled schools (Energy Star 2010), documents about the building process, Green Team communication, district energy reports, and news articles about the LEED® certified buildings.

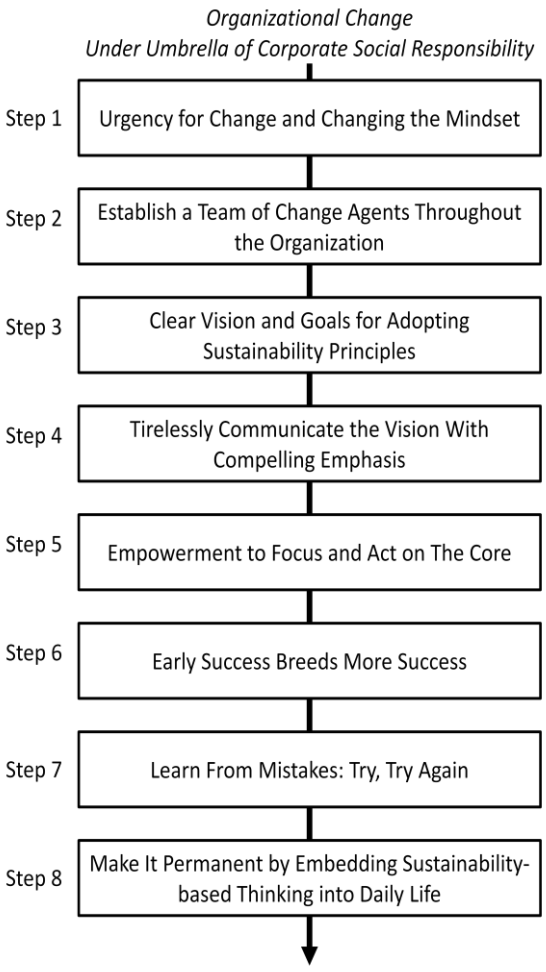
## RESULTS

This report outlines three primary findings from the study. First, the interviews revealed that Operations Services triggered an organizational change, by first changing their mission and their regular practices, and later negotiating change within the entire district. Second, the interviews revealed that they created broad ranging support for green buildings, by overcoming organizational obstacles through a negotiated process. In the end, the label "high performance buildings" became a successful frame for describing the organizational goals and commitments related to green buildings and sustainable building operations. This frame supported and fostered the organizational transformation. Third, we found that the social network structure of internal and external relations allowed the district to be on the leading edge of green school design and operations.

### Describing Organizational Transformation

PSD went through organizational transformation to become the sustainability leader they are today. To describe this change process, we developed an organizational change model for sustainability by integrating two models from the academic literature: Doppelt's (2003a) seven blunders/solutions for sustainability and Kotter's (1995) eight steps of organizational transformation. Figure 1 displays the steps in our organizational change model, and we detail each of these steps below.

**Figure 1. Organizational Change in PSD**




#### Step 1: Urgency for Change and Changing the Mindset

We integrated Doppelt's (2003a) first blunder/solution and Kotter's (1995) first step into Step 1. Doppelt's first blunder is engaging in patriarchal governance that leads to compliance with regulations. This blunder can be handled by changing people's mindset about sustainability. Doppelt suggests that most organizations need a crisis to trigger the adoption of a new mental model. Kotter's first step to effective organizational transformation—to establish a sense of urgency—provides the solution to Doppelt's first blunder. For PSD, this crisis occurred in the late 1990s, when the district was running out of classroom space for their K-12 community. The urgency for building growth in 1998-1999 forced the district to plan for the next bond (totaling $175 million).

Kotter explains that new leadership is often necessary to kick an organization into

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changing; the new leader brings a fresh perspective that may release the current management from being locked into in their current state. PSD did experience new leadership in key positions (e.g. director of operations and director of construction).

The initial seeds of change at PSD actually began a few years prior in Operations Services. Frustrations with the previous bond-funded building phase were high; buildings previously constructed hard to maintain because they were designed and constructed under the direction of the assistant superintendent, which is typical in school districts. Specifically, those who know best how to build and maintain buildings (facilities, HVAC, maintenance, etc.) were not involved in the design and construction of the buildings. Changes in leadership, a statewide energy management mandate, and the awareness that another bond year was on the horizon, together generated ideal conditions for organizational transformation. Communications between administrators and facilities were more free flowing, and groups traditionally not involved were pulled into discussions for how to approach projects differently. Hence, the bond issue of 2000 was not *the* trigger for organizational transformation, but the accelerator—the urgency behind an overall organizational change. The bond itself, therefore, did not drive the change, but enabled the change that was brewing to occur at an organizational level.

**Step 2: Establish a Team of Change Agents throughout the Organization**

Kotter's second step involves forming a powerful guiding group that is large enough in the beginning to have enough power to promote change. The second blunder in Doppelt's model is when organizations adopt a "silo" approach, whereby sustainability is treated as a special program, and not an organization-wide initiative. This mistake can be handled by involving employees from every function, department, and level of the organization in the planning and implementation of sustainability principles. Kotter's second step provides a good solution to this blunder.



The school district implemented "the Green Team" comprising mostly PSD employees, who worked with the integrated design team in making sure all school designs met the Sustainability Guidelines (Poudre School District 2005). The Green Team included representatives from all areas of building development (contractors, architects, sustainability engineering), school operations, maintenance and facilities (including an energy manager, manager of food services, and security), representatives from the city utility company, member of the Board of Education, a school principal and a few teachers, the Director of Planning, Design, and Construction, and the district superintendent.

The guiding coalition, therefore, was the Green Team. They were the champions of change. The group had no single leader—instead, they formed a cohesive team and together, they led the change effort. PSD created a powerful and influential group of champions by including people from all

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departments within the district who then worked with people outside of the district (e.g., architects, utility company) in a fully integrated design-build process (Reed 2009; Yudelson 2008). Additionally, the Green Team treated sustainability as an organization-wide effort, avoiding the mistake of making sustainability its own special program.

> *"We want a building that is light on the environment, using recycled materials, doesn't smell like a new car when you walk in, is non-toxic to people, has delightful interiors, is day-lit, is energy-efficient, is acoustically well-designed, is a place where people want to be, uses less water – all this great stuff… Actually, saving money is a consequence, is an outcome of designing this high performance building. And isn't that wonderful?"*

### Step 3: Clear Vision and Goals for Adopting Sustainability Principles

Doppelt's third blunder, a lack of clear vision for sustainability, is resolved by clarifying the vision – by embracing sustainability. This solution maps onto Kotter's third step, which is to create a clear vision of the organizational change goal. One leader in the district put forth his vision, ***"The change that I was involved in fostering was not really energy-efficiency; it was high performance buildings."*** Involving the Green Team, to help develop the vision further, reduced resistance to the change. There were a few pockets of resistance to the change effort; however, appropriate framing of the sustainability changes (see next section) and getting participation helped to overcome resistance to the change (see Fernandez and Rainey 2006).

The vision was communicated through the Sustainable Design Guidelines and enforced by a letter from the district superintendent (see forward in, Poudre School District 2005). By formally declaring their vision, the Team generated accountability for themselves and the district to focus on their sustainability goals, empower staff (Step 5 below), and engender a risk free environment for innovation (Step 7 below).

### Step 4: Tirelessly Communicate the Vision with Compelling Emphasis

Kotter's fourth step towards successful organizational transformation is to communicate the vision. Under-communicating the vision results in failed transformations. Kotter's step integrates well with avoiding Doppelt's fifth blunder: failing to share enough information so that everyone understands the negative consequences of not buying-into sustainability. The Green Team held regular meetings, shared sustainability information, and worked diligently to inform all district staff about energy conservation and efficiency projects. The adoption in 2006 of a Sustainability Management System created a yearly venue for communicating, goals, progress, and expectations within each department (Poudre School District 2006). The Green Team still works to continue communication efforts.

### Step 5: Empowerment to Focus and Act on the Core

Empowering others to act on the vision is Kotter's fifth step. Everyone in facilities and operations was empowered to learn about new sustainability and energy conservation technology, and to act on the vision, as were other members of the Green Team. In the older schools within the district, schools not built for sustainability, individuals also felt empowered to act on the energy conservation vision. The superintendent commented about the students in one of the older, less energy efficient buildings: **"These students, they were hammering at teachers, *'Turn off the lights when you're not in the room.'*"** An operations staff member discussed one teacher in particular, ***"one science teacher really stepped up and put together a group of students who then went out and really were energy managers, went out and talked to teachers about turning off monitors, turning out lights, putting signs up."*** Kotter's fifth step integrated with Doppelt's fourth blunder, which is confusion over where to focus one's efforts. Namely,

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focusing one's efforts on the *symptoms* of the lack of sustainability (e.g., mitigating emissions or toxic waste) as opposed to focusing on the *cause* of the symptoms (e.g., building with non-toxic materials). The solution is to change how work is accomplished by establishing new operations and measures for success.

By empowering Operations Services, as well as others, to find better ways of building sustainable, energy-conserving buildings, PSD focused on the cause of the lack of sustainability. Making "building high performance schools" their vision, PSD embraced Doppelt's solution to his fifth blunder. They focused on the need for sustainability at the start—the construction stage of schools. Once a school is built, trying to retrofit sustainability to the school is focusing on the symptoms rather than the cause.



### Step 6: Early Success Breeds More Success

Planning for and creating short-term wins makes up Kotter's sixth step to a successful organizational transformation. None of Doppelt's blunders/solutions integrated with this step. Successful transformation takes time; immediate wins reinforce progress in adopting the new vision. A number of PSD's early successes bolstered their progress towards embracing the transformation. The successes showed people that the new way can work. Many of the short-term wins for the district were not planned, such as the awards, but the wins reinforced the vision and the transformation, thus propelling it forward. The planned immediate wins included the energy savings tracked and managed by the energy manager. **"He [the energy manager] identified for us a plan that was put in place early on, to reinforce energy conservation."** Another planned success included a strategy to:

> *Identify a percentage of the utility budget, 1%, and let's put it into a fund that we can use to do energy efficiency upgrades and projects. That became a great incentive for folks out in the maintenance department, because typically if we're doing an energy efficiency project, we're gonna get the return on investment from the project, and we're also gonna reduce the maintenance load. So this was a win-win with us.*

Interviewees referred to this plan, where reductions in energy use created savings that were returned back to the departments. Departments then used these returned funds for improvements.

### Step 7: Learn From Mistakes—Try, Try Again

Kotter's seventh step is to consolidate improvements and produce more change. Organizations sometimes claim victory for change a little too soon. Kotter notes that change agents can use the short-term wins to tackle the bigger problems and produce more change. Doppelt's sixth blunder is that organizations often have insufficient mechanisms for learning. To resolve this blunder, he suggests that

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organizations need to allow their employees the opportunity to learn and try out new ideas. Thus, learning from mistakes, thereby creating more change is a natural integration of both Kotter's seventh and Doppelt's sixth steps.

> *"We can brag that we can probably tell you what not to do before we can tell you what to do. Because we've made mistakes. We've learned from our mistakes. We have lots of them."*

### Step 8: Make It Permanent by Embedding Sustainability-Based Thinking into Daily Life

Kotter's last step is to institutionalize the changes that have been made during the organizational transformation. Many organizations fail when attempting an organizational transformation because they do not institutionalize their changes into the culture—the way of doing business. This step integrates directly with Doppelt's seventh blunder: the failure to institutionalize sustainability. When organizations fail to embed sustainability-based thinking into everyday decision-making, procedures, and culture, they fail to institutionalize sustainability.

We recorded comment after comment about culture change in the school district. We heard about the sustainability management system, a software program that helps employees track energy use and behavior. For example,

> ***WE HAVE ALL THESE POLICIES. WE HAVE ALL THESE PROCEDURES. WE HAVE A SUSTAINABILITY MANAGEMENT SYSTEM. WE HAVE A SUSTAINABILITY DESIGN GUIDELINE, ALL THESE DIFFERENT THINGS. SO I WOULD HAVE TO SAY THAT WE HAVE GOT A TREMENDOUS AMOUNT OF DOCUMENTATION IN OUR SCHOOL DISTRICT TO SAY WHAT WE SHOULD BE DOING AND WHY WE SHOULD BE DOING IT.***

We heard about behavior change, such as *"Someone will come in my office and go, 'We're air conditioning. Close the windows. We don't want the heat coming in,' if I don't notice it. So we're all cognizant of this."*



**THE GREEN TEAM 1999**

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## Framing the Issue to Create Buy-in

There are many reasons to support building design that is referred to as "green," "sustainable," or "high performance." Each of these names or *frames* for this type of building design identify buildings that consume fewer environmental resources, improve the comfort and health of occupants, and reduce lifetime maintenance and utility costs compared to regular construction (Johnson 2000). However, the language used—the organizational frame—affects the amount of internal support for sustainability goals and related changes in organizational processes. PSD interviewees had distinct motivations for supporting the changes in construction and maintenance including: 1) environmental, 2) financial, 3) educational, and 4) professional. Thus, we found that *framing* of the proposed changes was integral to developing support for organizational transformation, and engendering individual buy-in for the adoption of new green building practices. The frame of "high performance buildings" addressed common individual and organizational obstacles to sustainability (Hoffman and Henn 2008). A unique feature of this case study is that sustainable building practices were initiated by the building owner (PSD), rather than by the architect, design team, or construction managers. Thus, framing was critical for generating the internal support that was central to the district's success.

### Background Literature

The interviewees' discussions of, resistance to, and motivation for the sustainability changes drew our attention to the organizational literature on sustainability practices. In particular, we focused on the obstacles organizations face, as well as the benefits, in terms of cost reduction, public perception, employee morale, and health for green building (Doppelt 2003a; Hoffman and Henn 2008; Johnson 2000; U.S. Green Building Council 2010). We briefly review key points in this literature that are useful for the district.



#### Individual and Organizational Obstacles to Sustainability

Hoffman and Henn (2008) identified six individual-level obstacles to sustainable building: 1) Individuals often over-discount the future by focusing on initial rather than lifetime costs, 2) Individuals are often egocentric by overlooking aggregate consequences of their individual actions, 3) Individuals hold positive illusions about their personal environmental footprint, 4) Individuals make incorrect associations with "green," such as assuming energy-efficient buildings are uncomfortable or that green equates to radical environmentalism, 5) Individuals see a 'mythical fixed pie' in which every pro-environmental action creates a negative tradeoff elsewhere (personal comfort, choice, or cost), and 6) Individuals lack environmental literacy, as many green products and practices are new. Organizations will most likely confront these individual obstacles as they attempt to generate support for environmental behavior changes including green building practices.

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At the organizational level, internal structure, language, rewards, and inertia can stall sustainability initiatives. First, hierarchal organizational structures typically centralize decision-making and information while interrupting informational feedback loops (Cebon 1992; Doppelt 2003a; Hoffman and Henn 2008; Kulakowski 1999). Hierarchal structures also allow departments to be risk averse. For example, Kulakowski (1999) found that a university operations department believed invisibility equaled success, so avoidance of new, potentially risky technology became a strategy to prevent becoming 'visible' and thus seen as unsuccessful. Construction projects, in particular, face routine linear structures and have barriers affecting the transfer of new knowledge, assimilation of new with existing knowledge, and the application of new knowledge to real projects (Bresnen, Edelman, Newell, Scarbrough, and Swan 2003).

Second, the language used for green products or practices is often unfamiliar, thus requiring increased research and training to implement. Third, employee rewards can conflict with organizational goals, thus rewards for positive environmental behavior should be targeted at and relevant to employees. Finally, set structures, language, and rewards encourage organizational inertia or a general lack of change. Common in public bureaucracies, this inertia results from habitual routines, fear of the unknown, resource limitations, and set power structures (Doppelt 2003; Hoffman and Henn 2008: 403). Taking the individual and organizational obstacles together, Hoffman and Henn (2008: 399) argued that, "Information available to individuals regarding the viability of green building options becomes a reflection of subjective organizational goals, routines, and cultures as much as objective facts." As we show, PSD successfully changed the culture and organizational routine to overcome these obstacles and foster sustainability and green building success.

### Organizational Transformation

As discussed above, organizational transformation was important to the success of PSD. Doppelt (2003a) addressed the adoption of organizational sustainability practices as did Al-Homound (2000) in his model of *Total Productive Energy Management*. One under-researched area of organizational change is contestation affecting vision development and the negotiations processes involved. Understanding resistance and building genuine employee support for organizational change is especially crucial for sustainability initiatives, because "green" is often linked to politically-contested issues such as environmental protection and climate change (Hulme 2009). Through the interviews, we noticed that a variety of individual motivations for green building, discussed below, supported the same sustainability practices. These motivations were often contradictory, which caused some individual actions to be interpreted as resistance to the entire organizational change process. These contradictions raised the question of how the district addressed perceived resistance and generated buy-in, and led us to the academic literature on social movement framing discussed in brief below.

> *"There were a lot of political issues… I remember we had problems with the lexicon. We said 'green buildings' and folks thought that this meant we had something to do with Greenpeace and saving whales…, back then, there were green parties and the radical elements that used the word green, and we were just talking about doing something that again was a better building…. So we had to start being careful about how we used language, and that's where terms like "high performance buildings" and 'sustainability' came in…. If we said 'green [people] thought 'you're some radical environmentalist, you're gonna burn something down.'"*

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### Social Movement Framing

To briefly review the framing literature applicable to the success of PSD's organizational change, a frame is "an interpretive scheme which renders social movement issues and goals meaningful to individuals and groups" (Cornfield and Fletcher 1998: 1306). Framing is the ongoing process of negotiation to develop this useful interpretive scheme. Framing helps with three tasks: 1) motivating supporters, 2) persuading bystanders, and 3) combating antagonists (Benford and Snow 2000: 613). To accomplish these three tasks, frames answer three basic questions about the issue and the proposed solution: 1) what is the problem and who is responsible (called diagnostic framing); 2) what are the solutions to the problem (prognostic framing); and 3) how do we encourage action (motivational framing) (Benford and Snow 2000; Cornfield and Fletcher 1998; Snow, Rochford, Worden, and Benford 1986). Each question is potentially contentious because specifying the problem will limit the potential solutions and either encourage or discourage participant action.

> *"Money gets wasted a lot of times. We see buildings that are just a waste, and it's sad, because it doesn't have to be."*

Developing a frame is an on-going process, and disagreement over a frame leads to various strategic options, in particular "frame extension," to encourage more support and combat resistance. Frame extension adapts and extends the original diagnostic or prognostic framing to encompass tangential interests or viewpoints of bystanders or resistors, thereby enlarging the support network. Frame extension is important because it realigns the frame and encourages support from those who originally disagreed with the definition of the problem or the solution. For example, a study on farm-to-school lunch programs showed how distinct diagnostic frames were complementary within one broad frame (Bagdonis, Hinrichs, and Schafft 2009). There were three distinct diagnostic frames of the problem (redressing poor food options, improving student health, and revitalizing farming communities), that all supported farm-to-school programs as the solution or prognostic frame.

Appropriate framing is particularly important for environmental issues because the link between individual environmental concern, knowledge, and behavior is weak (Diekmann and Preisendorfer 2003; Stern 2000). Also, many values besides environmentalism can support positive environmental behavior such as "frugality, luxury, waste, or the importance of spending time with family" (Stern 2000: 417). Finally, energy efficiency and energy conservation are facing challenges from citizens who view conservation as providing only eventual benefits or offering solutions that are too costly to the economy and from conservative groups who have successfully framed climate change as either not happening or not being the result of human activities (Dunlap and McCright 2008; McCright and Dunlap 2000). With these concerns in mind, the district successfully framed green building as "high performance building", which incorporated numerous individual diagnoses of the problem, combated resistance to the sustainability initiatives, and generated support for organizational change.

## Results

### Frame Extension from Green to High Performance

We begin with how the district began with a "green" frame that initially instigated resistance, and then discuss how frame extension to "high performance buildings" created an umbrella that incorporated four individual-level motivations (environmental, financial, educational, and professional) and promoted support instead of resistance. Our discussion shows how frame extension allowed

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individuals to define their own distinct problem that called for high performance buildings as the solution and motivated individuals to do "the right thing" by building "better" schools.

### Green Buildings Frame

Eleven of the 16 district interviewees mentioned the environment as a personal motivation for supporting the organizational change, and seven of the 11 indicated strong environmental motivations. These environmental motivations varied from self-described "old hippies" who evoked the 1960s environmental movement, to those who identified the problem as wasting natural resources, too much pollution and greenhouse gas emissions, or loss of clean recreation areas. Examples of this motivation are included in the box on the right.

**Environmental Motivations**

*"I don't want to have a huge footprint. I want a place for my kids and the future. So to me it makes sense that you tread lightly, that you recycle what you can, that you be as responsible as you can, reuse what you can."*

*"Probably the biggest thing is just conserve our natural resources, for me. I don't want to waste resources."*

*"We can't keep doing this; we're going to leave a legacy of problems for someone else to clean-up."*

Originally, the district used a "green" frame corresponding to these environmental motivations, but this frame was contested by other employees and outside influences. Even those who enjoyed nature were resistant to the strong green frame of the problem, as discussed in the following quote.

> ***I'm not one that buys into the whole global warming thing…. We know people can have an effect on their environment. We like clean water, clean air, good forests. We want to protect those things. [But] I think there's some things we have to be careful of.***

Operations Services leadership noticed early that an appropriate frame for green building was needed to overcome resistance and encourage participation. Noting that gasoline and electricity were affordable at the time, interviewees felt that many people over-discounted the future and assumed green building would only benefit environmental extremists. Mentioned by two interviewees, "green" in the late 1990s was, ***"almost like global warming today, a very political thing."*** To combat this resistance and encourage more support, they extended the frame to actively emphasize other benefits of sustainable buildings including financial, educational, and professional.

### High Performance Buildings Frame

By extending the original "green buildings", the new "high performance buildings" frame not only increased support for and combated resistance to green buildings, but individuals could keep their own diagnostic frame of the problem while working towards one unified prognostic frame. Figure 2 displays the four diagnostic frames that the high performance building frame encompassed and the resistance it addressed. Interestingly, this new frame was initiated before LEED® standards were fully implemented and before green schools became a movement—highlighting the innovation in this district. Below, we discuss the other three diagnostic frames identified in the interviews.

*Financial.* Budgetary constraints provided an early catalyst for changes in the district as a whole, and 14 of the 16 district staff mentioned cost savings from energy efficiency or reduced maintenance as a reason they supported the organizational changes. Five of these 14 indicated that the high cost of inefficiency was their main diagnostic frame.

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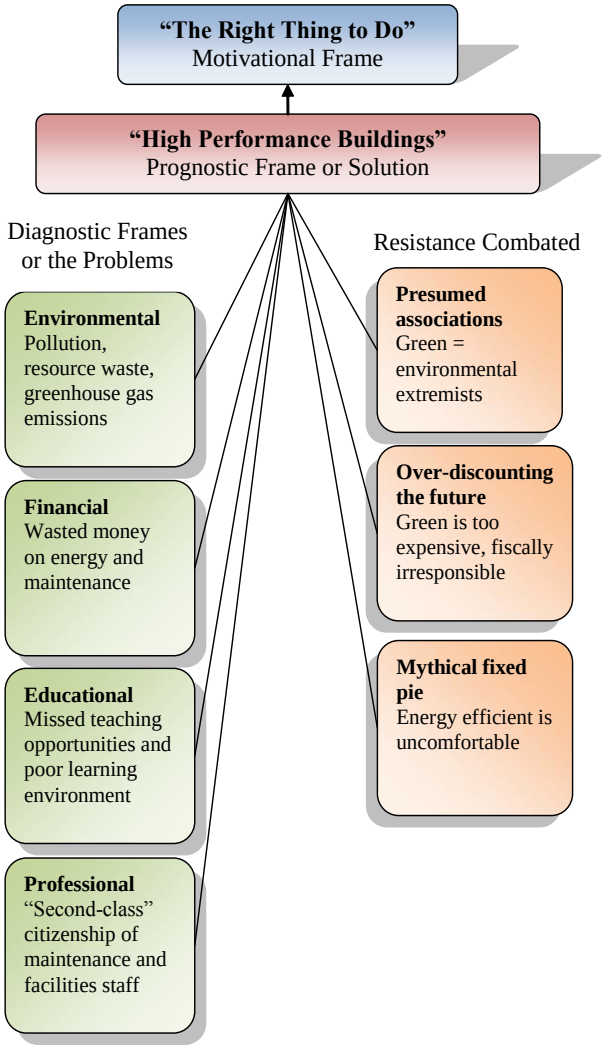
**Figure 2. Framing the Issue**




Some examples of financial concerns include:

> *This energy conservation piece was a budgetary issue.*
>
> *The more we tame energy costs, the more we have to go into classrooms.*
>
> *At the end of the day, there is a financial savings for being more efficient. And like we said, there might be some initial costs, but you do the planning, calculate through those numbers and in five years, if you're ahead, that's a no-brainer when you buy that equipment.*
>
> *The basic bottom line is cost. But there are costs people don't see when they think about energy conservation. The day-to-day operating cost is of course bottom line to our budget.*

Saving money and justifying the costs of green building was also important because beliefs about the costs of green building were an obstacle to the change process. Resistance, touted as fiscal responsibility to the taxpayer, depicted green building as a "fad" or a waste of money. A few interviewees said that the biggest criticism from inside and outside the district was the assumed expense of green design. Operations Services employees were, over the long run, forced to maintain inefficient buildings and equipment, thus they experienced first-hand the lifecycle costs of poor, initial investments in equipment and design. Acknowledging this financial resistance, the district successfully used the high performance building frame to highlight long-term cost savings of the buildings *while* insisting they stay on budget during construction. The extension of the district's frame from green to high performance made the changes appear more congruent with these financial motivations *while also* deterring resistance and overcoming assumptions that green design is more expensive (Hoffman and Henn 2008).

*Educational.* Providing the most conducive space for learning, educating kids about science and technology with the buildings, and inspiring children about the possibility for innovation and change motivated many individuals to support the organizational changes. Fourteen of the 16 district employees mentioned the benefits of green design for students and building occupants, with eight of the 14 clearly identifying occupant comfort or missed educational opportunities as the main problem high performance buildings would address. Creating the "best environments" which put "people first"in terms of comfort while supporting the educational mission was central to many employees as noted in the following quotes:

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*My philosophy was there isn't a dime that comes into this district that is not put there to help kids. Period.*

*If something is using energy efficiently and done right, people are more comfortable. That's the big thing.*

*All of the sudden you started looking at your kids and all those things that happen in your life, and you start going, "Wow, it would be kind of cool to leave that legacy of not only this belief, but how you can make a change."*

Other educational motivations included actual teaching opportunities, such as see-through walls and worm composters, allowing students to conduct LEED® building tours, and curriculum changes to incorporate building and energy information. Through diagnostic framing of the problem as missed educational opportunities and occupant comfort, the individuals with educational motivations were encouraged to support the organizational changes.

*"Now, a student and teacher in a high performance building really doesn't say every day, 'Oh we're saving energy, we're saving dollars.' What students and people suddenly understand is that, 'I like being here. I'll stay longer. This is a good place to be. I'm not getting as sick as much as I used to. I don't have as much stress as I used to have.'"*

*Professional.* This final category of motivations differs from the environmental, financial, and educational motivations as it was not highlighted through institutional channels as a reason for high performance buildings. Yet, eight of the 16 employees discussed the professional status of maintenance and operations staff, and three of those saw encouraging professional development as the issue that high performance design could address. Before the 2000 bond and the accompanying organizational changes, operations and maintenance staff were seen as "second-class citizens" and only called when something went wrong. There was a desire to empower maintenance staff and thus, build better buildings by using their expertise. The Green Team and the integrated design-build process required operations and maintenance staff to do their best work, and the high performance frame provided the justification for increasing participation and professionalism of these individuals. The following quote illustrates this professional framing of the problem.

THE OPPORTUNITY TO INVOLVE ALL THESE STAFF MEMBERS AND RECOGNIZE THEM FOR THE QUALITIES THAT THEY BRING, THE SKILL, THE PROFESSIONAL LEVEL THAT THEY BRING, THE EXPERIENCE, TO THE TABLE WHEN YOU DESIGN A SCHOOL. SO NOW WE HAD THIS OPPORTUNITY TO REALLY CROSS-CONNECT WITH THE PROFESSIONALS, THE ENGINEERS, AND THE ARCHITECTS.

From our interviews with PSD staff and external partners, we noted that many described a unified goal or vision for the district's changes. We argue that the framing practices led to this unified vision. Even though individuals diagnosed the problem differently (environmental, financial, educational, professional), they all supported the high performance solution and thus, were motivated to build better buildings or do "the right thing," as many interviewees described it. Having a unified goal was crucial to success: "Being able to bring everybody along and have a unified goal so you don't have somebody out there in left field trying to sabotage what you're doing." But, framing alone could not generate the district's sustainability success. The framing processes worked symbiotically with broader

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organizational transformation to maintain support and further dissuade contestation of the high performance frame.

### Framing and Internal Structure

Internal structural reorganization to the Green Team sustained the framing process in two ways: 1) it held the district accountable to the frame extension by attending to conflicting individual diagnostic frames with increased communication and enhanced environmental literacy, while also 2) generating support for the organizational changes without explicit rewards or coercion.

While noting a unified goal, the four different frames still created disagreement on particular choices in the design phase. All members were encouraged to offer their opinions, thus the team environment was where conflicts between diagnostic frames, and gut-level opinions, played out. For example, environmentally-motivated individuals introduced new, but unproven technology that had purported environmental benefits. Others were concerned about financial costs of unproven product that may require more maintenance or be defective. These financially-motivated individuals could be perceived as resistant to the change process—and some organizational transformation models would support such a conclusion or interpret this difference of opinion as an obstacle (Doppelt 2003; Hoffman and Henn 2008).

An alternate view is to see the desire for proof of product viability by those financially motivated *not* as resistance, but rather a natural part of the negotiation or discursive framing process leading to improved design and the adoption of technology. The High Performance Building frame provides language and standards that allow for all four diagnostic frames to be included in the consideration for each design decision. These discursive negotiations led to winners and losers on each technology introduced, but because the Green Team encouraged participation, employees continued supporting the prognostic High Performance Building frame. The importance of the team for addressing resistance is seen in these quotes.

> "I keep bringing it back to our team, because from our energy manager to our directors, to our department heads, we'd all get together and show and tell, if you would, where we'd sit down and talk about what they'd found out, what they'd learned, or bringing the rep back, the manufacturer's people in, where they could talk about this product and have everybody else be able to ask a few questions, not just take it at face value and then reach a consensus."

> ***It was uncomfortable to look at just the way we were changing. A lot of that is—energy saving. You had heard that the maintenance was probably not worth it, but we tried it and it's proved to be true… Energy savings probably didn't help that much, and we think, 'OK, we might have went too far ahead on that, let's back up a little bit'…. I can think of other times since I had everything on paper, they agreed with me and we didn't—we changed from what the architects, the engineer and everyone wanted, to this way, and it still has proved to be a better solution. It was a learning experience for me. If I'm gonna find something, I can't just say, 'I know.' I've got to have facts and numbers. Everybody here's smart enough, if they look at the facts and the numbers, they're gonna go the right way…. I've had to back off, too, because I see the numbers and I've had to go [with others' ideas], too. It sort of goes both ways.***

The encouragement to do internet research and travel to visit other product users also increased the environmental literacy of all team members, which is noted as key to implementing organizational sustainability. Genuine participation and communication are necessary for successful organizational change (Doppelt 2003b; Fernandez and Rainey 2006; Kotter 1995), therefore, if the team approach had been insincere or just for political purposes, members would not have maintained the internal support necessary for successful organizational change: ***"So many times you just go 'words,***

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***words, words' I'm kind of paying attention to you, but really not. I definitely feel that this group, our operations group, pays attention to people and what they say."***

Without true collaboration and communication about green building choices, the high performance frame could easily have become a facade for environmental motivations. As one interviewee noted, "We need that, somebody looking over our shoulder and going, 'Why are you doing this?' You can either answer that intelligently or take a step back and be honest and go, "Good question.'" The Team provided an avenue for proof and for complaints—a safe space to bring in work orders as evidence or to just say, "I told you so," and then they learned from those mistakes (see Step 7 above). The new framing and team atmosphere in the district generated ownership, personal responsibility, motivation, commitment, and overcame "resistance and unleash[ed] the potential of people to work toward sustainability" (Doppelt 2003: 80).

### Framing, the Team, and Rewards

Rewards are often seen as important in generating organizational change (Al-Homound 2000; Doppelt 2003b; Fernandez and Rainey 2006; Kotter 1995). Yet, our interviewees never discussed explicit rewards or disincentives, because participation in building decisions became a reward in itself to these professionals. While the workload increased, few complained:

> *It definitely did affect workload in the sense that you had to take time out of your everyday routines that had to get done, code issues, tests, procedures that you've got to continue working to go to these meetings, to do the research, to take a trip to take a look at something. But nobody complained about that, because they were involved.*

Employees even noted how lucky they were to work for an organization that supported input and professionalization, as discussed in the quote at the right.

> *"Just from talking to people I know that work in other school districts, they're surprised and jealous that we get to do what we do…, I feel fortunate. I like waving it in front of these other guys when I see them. 'Look what I do.' It's been good. Out of the 100 things that have been good, there might be one or two that weren't. There's no comparison. It's the right thing to do."*

### Discussion

Our case study shows how organizational transformation worked with the frame extension process to eliminate obstacles to organizational sustainability. The high performance frame became a solution to the four diagnoses of the problem (environmental, financial, educational, and professional) and motivated district staff to pursue "the right thing," which was "better schools." These two processes became the foundation for the district's success in integrated design-build and integration of sustainability into routine maintenance and operation.

## Social Network Structures Support Innovation

A common theme in the interviews was the collaboration between PSD and outside organizations. These collaborative relationships were described as a key component of learning, support, and encouragement for the adoption of new and innovative practices. In addition to the interviews, the study participants completed network-rating sheets that allowed us to illustrate the structure of the inter-agency relationships related to support, leadership, and learning for the construction of high performance buildings.

Social scientists use network analysis to examine how the informal relationships and connections between people or organizations influence organizational behaviors like adoption of innovation,

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change management, information sharing, and team performance. In this case study, we aimed to examine how relationships between PSD employees and representatives in outside agencies contributed to the adoption of sustainability practices in PSD. We found an unusually densely connected network comprising people within PSD (crossing over several levels of organizational hierarchy) and people from outside agencies. Before describing the traits of the high performance building network, we will first describe a few principles of social networks.

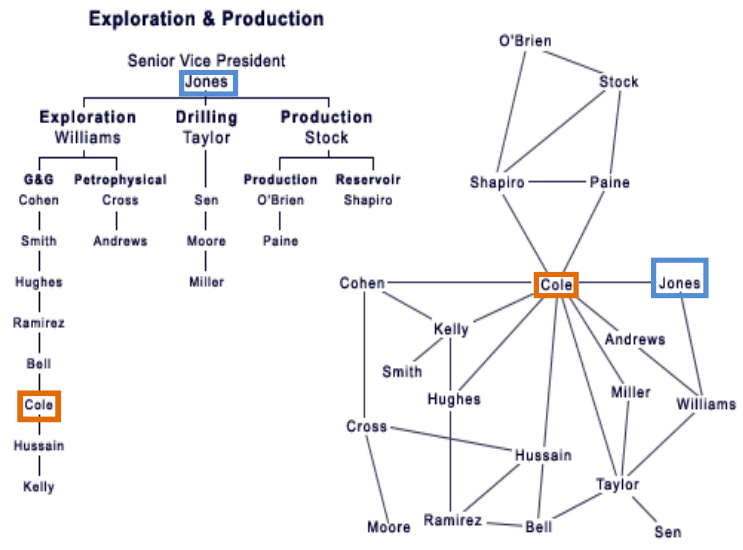
## Understanding Social Networks

### Social Network Structures

When we talk about the structure of social networks, we refer to the pattern of relationships that can be depicted graphically (see Figures 3 & 4). In organizations, the organizational hierarchy is the formal social network, but there also exist informal social networks based on relationships of trust, advice, past working relationships, or team membership (Cross and Parker 2004; Krackhardt and Hanson 1997). Figure 3 illustrates an example of a formal versus informal social network. Notice that although Jones is the Senior Vice President and has three ties in the formal network, he has only two ties in the informal network. In contrast, Cole is not in a formal position of leadership, yet in the informal network he has the most ties and is the most central person in the network. In addition, Cole connects what would otherwise be two distinct networks, with O'Brien, Stock, Paine, and Shapiro making a network separate from the rest.

It is within the informal networks that change often occurs and where innovations either find support or opposition. In this study of high performance buildings, we examined the informal networks based on learning, support, and leadership.

Figure 3. Formal versus Informal Networks




Source: Rob Cross, What is ONA? http://www.robcross.org/network_ona.htm

One of the factors associated with learning and innovation in organizations is the structure of social networks. Three basic structures of social networks—centralized, decentralized, and distributed—have very different implications for information sharing, learning, and adoption of innovation (Figure 4). In a typical hierarchical organization, the formal relationships between staff members would look something like the decentralized network. However, the informal network might have a very different structure.

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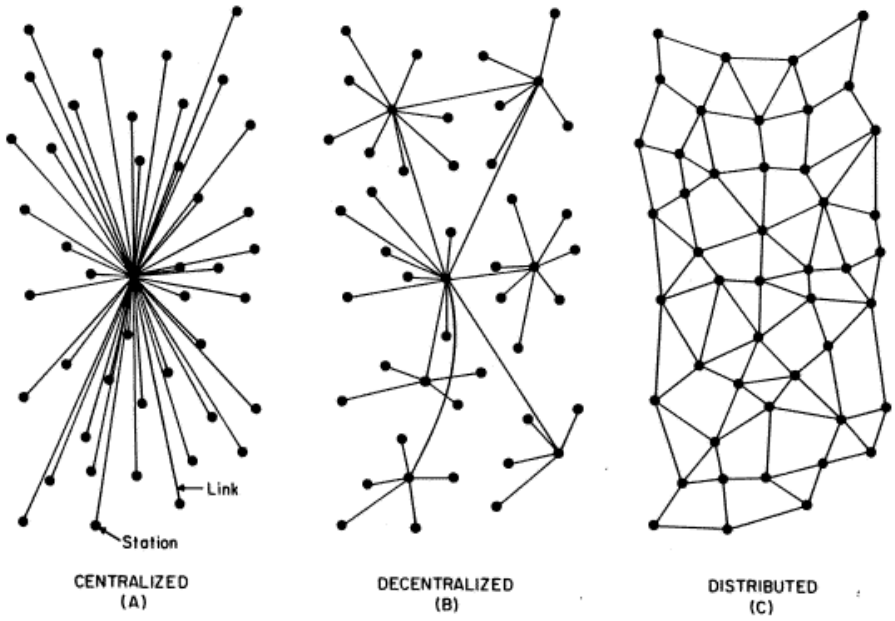
**Figure 4. Social Networks Structures—Centralized, Decentralized, and Distributed**




[Source: Paul Baran, " On Distributed Communications: MEMORANDUM: RM-3420-PR," AUGUST 1964, The Rand Corporation (available online at: http://www.rand.org/publications/RM/RM3420/.)]

Centralized networks have one person who is highly central, whereas disbuted networks have minimal centrality. Centralized networks are vulnerable to breakdown when the central member leaves the network, whereas distributed networks are highly resilient to changes in members of the network. We will examine each of these three characteristics of the high performance building network including PSD staff and external partners.

Three characteristics of distributed versus centralized or decentralized networks are relevant to this study. First, distributed networks are more efficient in spreading information across the network because of the many paths information can travel from one node (person) to any other node (Baran 1964). Second, distributed networks are more resilient than others are; if one or more nodes leave the network, the basic structure of the network is unchanged, thus making it possible to continue functioning with the same efficiency as before. Third, distributed networks are generally considered to create more effective work teams (Anklam 2007).

*"We were able to do what we did because we had all these great partners from Utilities, ENERGY STAR®, architects, consultants. Everyone helped us, we learned from them and they learned from us."*

### Social Network Characteristics

In addition to the overall structure of a social network described above, there are also a variety of statistics that describe other characteristics of the network and individual nodes within the network. In any network, the number of actual ties divided by the number of possible ties between members is refered to as *density*. Thus, in a network where every member has a relationship with every other member, the network density would be 1.0 or 100%. In general, the larger a network, the lower the

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density. More dense networks are more resilient, as well as more effective at spreading knowledge and information through the network.

### Interagency Network

We discuss two social networks: the Green Team Network and the Resource Network. The Green Team Network includes only those individuals who were interviewed for the study, both PSD employees and representatives of outside organizations. The Resource Network comprises the Green Team Network as well as all the additional individuals named by the Green Team Network as providing support, leadership, or learning related to high performance buildings. The Green Team Network includes 25 members, whereas the Resource Network includes 102 individuals.

#### Green Team Network

Research has demonstrated that project teams working on focused, detailed work are most successful when they have limited membership and are densely connected (Brown and Miller 2000; Katz and Lazer 2003). The majority (70%) of the Green Team Network is made up of PSD employees, and the remainder is comprised of representatives from several outside agencies including architects, consultants, utility providers and government officials.

Overall, the Green Team is a dense network (73%) given the diversity and size of the network (see Table 1). Recall that the density is the number of relationships divided by all possible relationships. For all relationships other than "Know," we have also calculated an "adjusted density" dividing the possible ties by the number of ties to people they marked who were known to them. The adjusted density should be understood as the proportion of existing relationships that included support, learning, or leadership.

**Table 1. Density of Relationships in Complete Green Team Network**

| Relationship | Density | Adjusted Density |
|---|---|---|
| ***Know***<br>Please mark all those people whom you know, have met in person, been in a meeting with, or spoken with on the phone (those people whom you know more than just by name) | **.73** | |
| ***Leader***<br>Please mark all those names that you see as leaders in this change process | **.50** | **.69** |
| ***Supported Me***<br>Please mark all those that supported you to make the changes regarding energy conservation | **.55** | **.76** |
| ***I Supported***<br>Please mark all those that you supported you to make the changes regarding energy conservation | **.54** | **.74** |
| ***I Learned From***<br>Please mark all those names that you learned from about energy conservation | **.45** | **.63** |
| ***Learned from Me***<br>Please mark all those that you helped to learn about energy conservation | **.38** | **.53** |

The densest relationship is "Supported Me", with a density of 55%, followed by "I Supported" with a density of 54%. These two statistics indicate that members of the Green Team network perceived that

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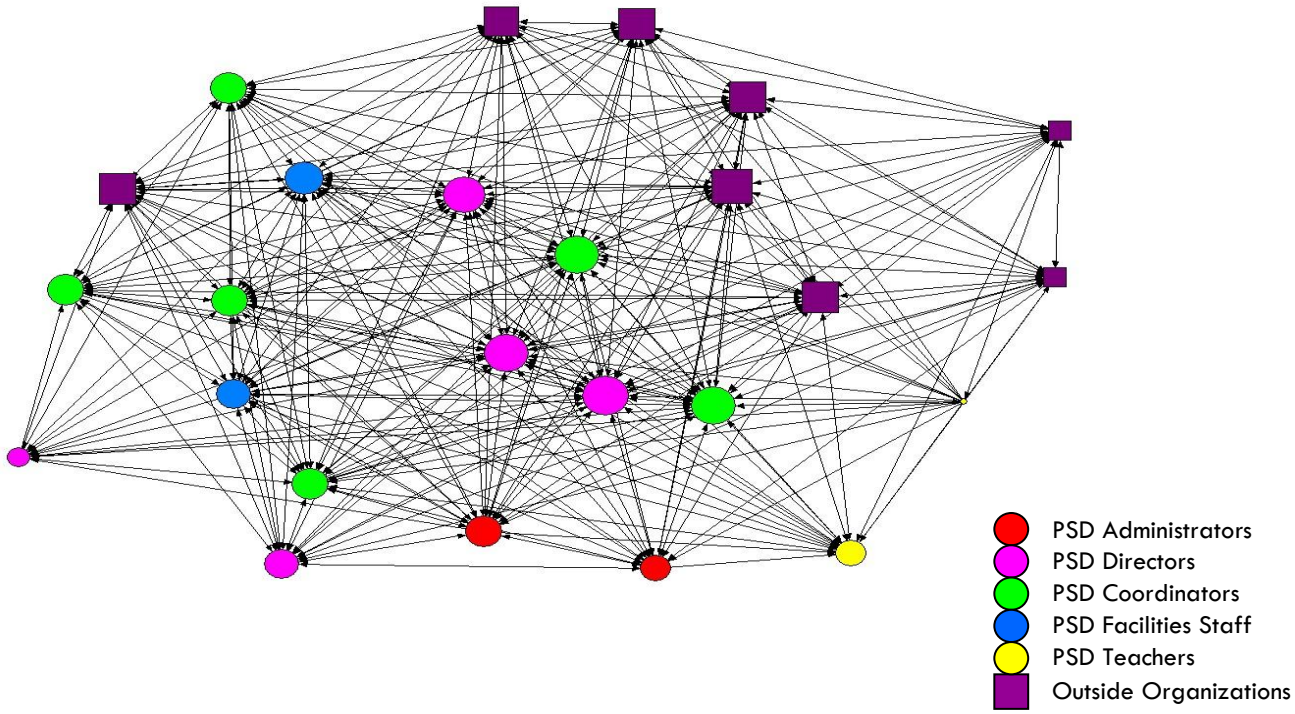
they both gave and received support as part of the effort to design high performance buildings and adopt energy conservation practices. The learning relationships are slightly less dense. "I Learned From" has a density of 45% while "Learned from Me" has a density of 38%, indicating that participants more readily recognized what they have learned than their role in teaching others (See Table 1). Leadership has a density of 50%, indicating that members of the network see leadership across the network.

The density of the network is illustrated in Figure 5. The color and shape of nodes indicate organizational position while size represents the number of in-degrees (other nodes who indicated a relationship with that node). One notable feature of this network is that it comprises five levels of organizational hierarchy within the school district (circles) and three outside organizations (purple squares). For a network of this size and diversity, it is surprisingly densely connected with no peripheral groups who are isolated or less connected than others. The members of this network are all giving and receiving support across the network as well as learning from each other in a way that is uncommon in organizational networks of this size.

**Figure 5. Green Team Network**




One of the concerns expressed by participants in this study was about future changes in personnel and leadership. The structure of the network shown in Figure 5—a dense, tightly connected, distributed network—however, indicates that changes in one or two people will likely have little impact on the ability of the network to sustain its innovative practices. Notice that all the nodes are connected to multiple other nodes, thus indicating that information exchange can continue even after the exit or removal of one or more nodes.

The strength in this network developed from the integrated design-build process. This process, not the actions of individual leaders, created a network that is resilient because of the number of people who

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regularly have contact with each other, share information, and coordinate the complex tasks of building design and construction.

> *It's all about partnerships and working with these different resources…It's really about stopping and thinking every time you're ready to go into a meeting about, "Don't let my ego get in the way of my common sense and listening skills." So, I think what I've learned as an individual is, I can learn from anybody, and they can help me make good decisions and help protect me if I just stop my ego and my mind from thinking and my own knowledge base from getting in the way of learning something new.*

One of the interviewees explained how building design in the district used to be a very linear process that resulted in inefficient buildings:

> **Historically, I think, the architects would design a building and we would design this great-lookin' little building that you kind of wanted to get on the cover of a magazine or something, and then we would hand it to our electrical engineers and tell 'em, "Hey, light this up, make this look good." Consequently, we ended up with buildings that were characteristically not thought out for exposure, which direction you went, how you were facing the windows, and so forth. No consideration of bringing in natural light… We were putting probably too much light in and generating heat, having to cool more. So the cycle went on and on. But we did it in a very linear fashion.**

*"We came together as one team and said, 'What can we do right?' And then every building we built, there was an evaluation of that and then, 'How can we do it even better?'"*

In contrast, the integrated design-build process that the district adopted with the 2000 bond created a new process where many voices and diverse knowledge were brought to the design stage:

> **So, back in the '90s, with the bond issue, none of the maintenance guys were allowed onsite, were allowed any input into building new buildings. So when we hit the bond in 2000 and started integrated design work, all the maintenance people had an opportunity to put input into the buildings, into the design of the buildings. They each had their own expertise from their trade specialties, and we also challenged them to go out on the Internet, if possible go visit manufacturing plants, other schools, go out and find out what is the best products.**

As many of the interviewees described, this new process, integrated design-build, not only engaged more people than was typical with new building design, but resulted in more ideas, better solutions, and more efficient buildings. One long-time district employee said:

> *We were excited about what we were doing, all of us, all the teams, from the contractors to the designers to the architects to the maintenance people, so our elementary schools, starting with Zach, Bacon, Rice, Bethke, each model got better and better. We'd take those lessons learned and apply them to remodels to junior high or high school or just general maintenance. "What can we learn from what we've been doing building new?" And allowing the guys to be a hands-on part of that.*

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A member of the Green Team Network, not employed by the district, echoed the same sentiments as seen in the quote to the right.

> *"So these guys came to the table excited. They tell us, **"That's a good solution, but it's not sustainable. We could do better."** That's what we want to hear. So there was a whole different thinking along those lines. And it's worked on all our jobs, very well."*

Part of the success of the Green Team is the commitment from the administration of the Poudre School District to commit the time of so many staff members to the integrated design-build process. As one of the outside companies said, Poudre School District is more committed to the design process than other districts they have worked with:

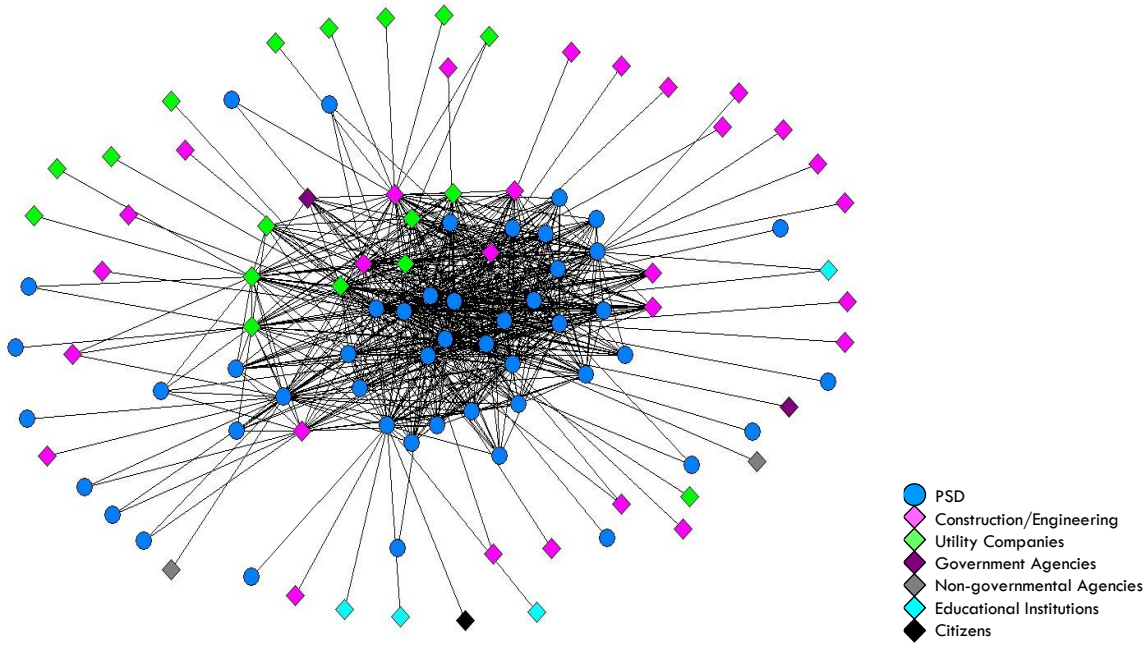
> **We do it in the districts as much as their time allows, and their time is very constrained. Districts are really short on money. It's hard to have [that time commitment and participation]—Poudre finds a way to do it—but we don't generally have that same level in the [other] districts…They rely on us for what works the best.**

As one participant said, "It takes a lot of time." However, this time pays off in the timely exchange of information, improved design, and better decision-making. It is the time spent together sharing information that built the densely connected network which is resilient to changes in membership.

### Resource Network

Social network studies have revealed that innovation is enhanced by extensive ties to diverse groups (Anklam 2007). This is exactly the structure that we see in the Resource Network. The core of the Resource Network is made up of 42 nodes (the Green Team Network plus an additional 17 people) who are highly likely to interact with each other, and an additional 60 nodes that the core nodes relied on for information, support, and learning (see Figure 6). In Figure 6 colors and shapes of nodes indicate organizational sector and all nodes have the same size.

**Figure 6. All Relations in the Resource Network**

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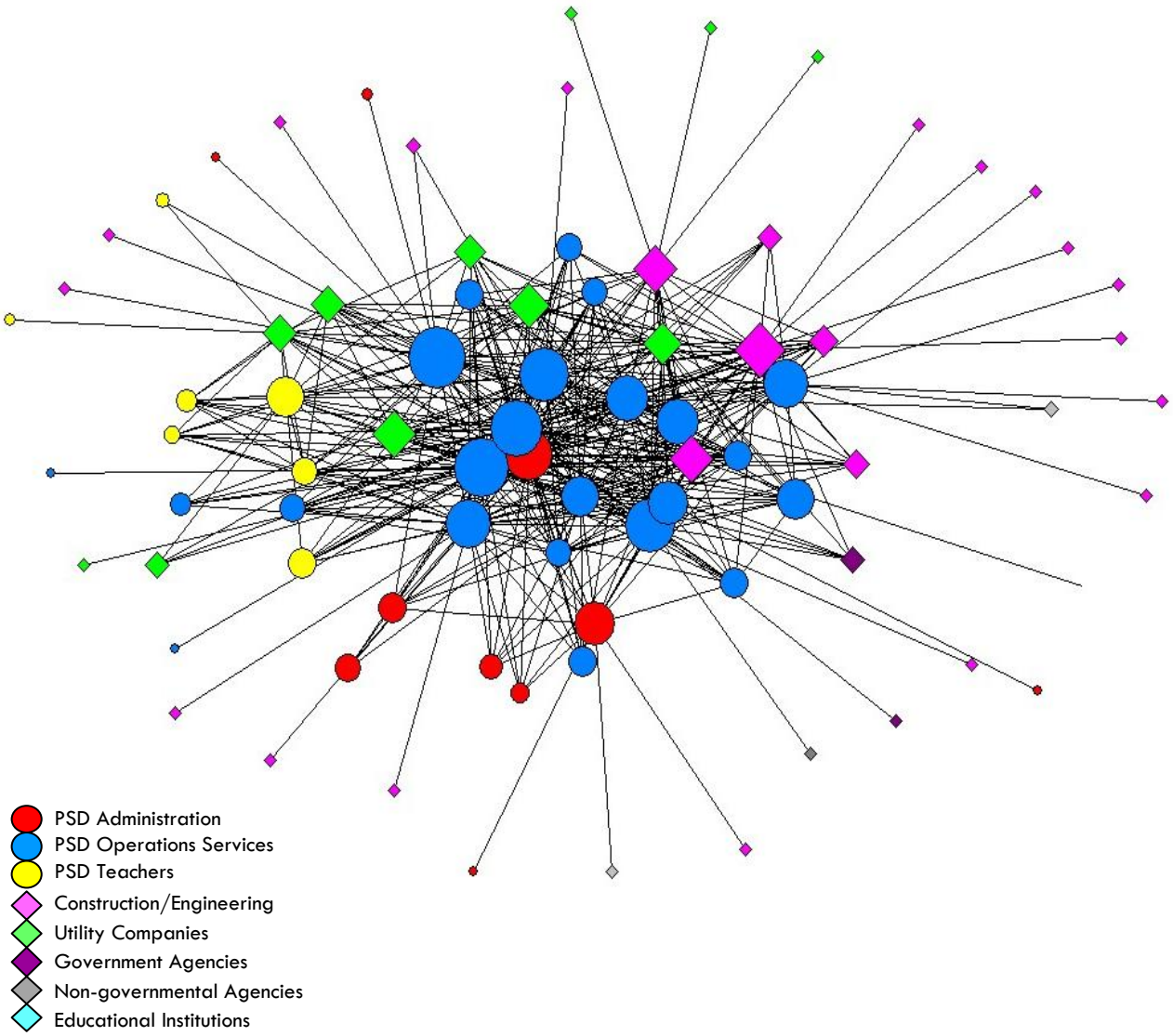
The accomplishments of the Green Team Network related to high performance buildings were made possible in part by their interactions with each other in the integrated design-build process, but also with dozens of other professionals in private, governmental, and non-profit organizations who contributed to their learning. Figure 7 illustrates only those members of the Resource Network that were identified as contributing to learning (78 nodes). In Figure 7, colors represent organizational sectors and size represent the number of ties connected to the node.

**Figure 7. "I Learned From" and "Learned From Me" Links in the Resource Network**




In Figure 7, we also see how members of the Green Team Network learned from others inside the school district as well as a variety of people in the broader Resource Network. These outside members include governmental workers, private companies, equipment vendors, architects, consultants, and utility companies among others. One member of the Green Team Network commented on the influence of one of the outside partners:

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*THEIR ADVOCACY AND THEIR EXPERIENCE AND JUST—THEY'VE GOT A REAL GOOD WAY OF WORKING WITH YOU AS AN ORGANIZATION THAT IT'S LEARNING, IT'S GROWING, IT'S ENCOURAGING, IT'S ALL THESE THINGS. THEY'VE BEEN TO ME A VERY INSTRUMENTAL PART OF HOW WE OPERATE.*

One of the ways that new information was brought into the Green Team network was through sending individuals to trade shows and other sites to learn about new technologies or to learn from buildings using new energy efficient systems. One member of the Green Team said this about learning:

*Since I've been here, they've allowed me to go to four different lighting shows where I learned new technologies. So the support that I've gotten, that's what's enabled me to find things. Like with LED lighting, I went to a lighting show in Las Vegas 10 years ago, when we first started the Green Team, and that's where they were just starting to come out with some of these LED technologies.*



The expansion of existing knowledge was accomplished through gathering information from diverse sources, and members of Green Team emphasized the importance of seeking out information from many sources:

*If somebody says, "This is the best thing since sliced bread," you say, "OK, I'll take it and use it, but we want to know first, has it been tested anywhere? Is there other school districts or comparable businesses using it that we can go visit, talk to their facilities people? 'How do you like your new condensing boiler? Had any issues with it? Are you really getting the savings the factory says you'll get over a cast-iron boiler?'" So there's that freedom to explore what's best and make wise decisions as opposed to gut-level decisions.*

This focus on learning placed value on allowing everyone to expand their knowledge through research, sharing, and discussion:

*[We had goals but not policies.] It's like, "We want to reach 20% reduction in X amount of years." But there wasn't a directive that said, "This is what you have to do and this is how you've got to do it." We all know why we're doing it, but we still had a free hand to be able to say, "We take that challenge. What can we do to improve our equipment?" Again, see what's on the market, what's changing in the industry, really allowing the guys to take the time to search the internet, to—a lot of my guys did visit manufacturing places, even after the bond was set and we were moving forward, because there was always new and better innovation coming on. Being on the cutting edge as opposed to the bleeding edge.*

The importance of learning is showcased in the Operations Services central office using a map of the United States with push-pins in all the places that Green Team members visited in their quest to learn about sustainable design and energy efficiency:

*You could take this map out here, it's got pins everywhere, and that's every place somebody has gone and met with other school districts, other manufacturers, developers, designers. We all went there to learn something. There's a lot of pushpins there… By the same token, some of those people learned from us, too, because once we had our full design of our buildings and*

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*components done, we were willing to share anything…We actually went out trying to gather information and learn.*

Learning was central to the Green Team's process and it was supported by the integrated design-build process as well as an intentional effort to expand knowledge through research, site visits, trade shows, and discussion with buildings owners, architects, and equipment manufacturers. Both the central Green Team Network and the larger Resource Network created both a structure (the team) and a process (information-based and group decision-making) for bringing new information into the design process, thus allowing for creativity and innovation based on knowledge rather than habit, familiarity, or personal preference.

# WHAT'S NEXT?

## Places for Improvement

PSD is an exemplar for the educational community in terms of high performance building and sustainability initiatives. As discussed above, important actions that supported these changes were organizational change including increased participation and communication, as well as appropriately framing the issues to align with participants' motivations. With this success, only one area of improvement developed from the interviews, which was how to engage teachers and building occupants in the sustainability mission. We discuss this concern in light of the above organizational changes within the operations department and then conclude with a discussion of fully institutionalizing sustainability.

### Engaging Teachers

Although we interviewed only a few teachers, the discussion of occupant behavior arose in almost all of the interviews with teachers, operations and facilities staff, and outside consultants. Occupant behavior modification was perceived as the next major area to address by many interviewees, but was seen as a new challenge: "Once you get past that initial stage, it reaches a point where you not only have to work on your buildings, but you have to work on the building occupants. That's sometimes a little bit more difficult."

Encouraging behavior change of the building occupants was understood in light of a "mission conflict," where teachers are focused on the district mission, "educate every child, every day" while the business side of the district supports that educational mission by designing, operating, and maintaining the buildings. Yet, this mission conflict is only one piece of the story. Interviewees noted how teachers, overburdened with heavy course loads, have little time to worry about energy, illustrated by the quote to the right.

> *"Everything that's on [teachers and principals] plate that they're responsible for accomplishing, then to have this on there, it's difficult, and we recognize that…. We went out there saying, 'We just built this building and it's a building that teaches, these opportunities are there. Just use them.' And somebody would say, 'Why don't you just teach French?' We weren't talking the same language. To us, it seems so simple, but we're not teachers, so we didn't know what we were really asking."*

While teachers' responsibilities were well known, Operations Services interviewees discussed changing occupant behavior differently than they discussed the changes *within* the Green Team. For example, interviewees discussed the ability of occupants to understand the buildings, a need for more training, or a desire to force occupants to care about energy.

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The following quotes represent these views:

> ***So what we first tried to do is make buildings idiot-proof.***
>
> ***We built the high performance schools to be energy-efficient despite the human factor. It's gonna operate at a certain level even if people are not energy-conscious at all.***
>
> ***We have to do Facilities 101 every year to a whole new group of people and see how they work. It could be four or five years before they actually understand the system.***
>
> ***I think for some people, it's not really a big part of their consciousness, not part of their world….I don't know if it's more, 'I don't really care about saving money,' it's more, 'I would rather just get everything turned on and do whatever.'***

While the Green Team described learning in a team atmosphere, there is not yet enough integration across the district where facilities staff and educational staff consider themselves part of a team working towards sustainability and learning from each other.

Currently, Operations Services provides a Facilities 101 course to all new staff that instructs them about the buildings. Also, they provide data feedback in numerical form on energy use. Those working from and with the educational side emphasized the importance of relationships, rather than training and information, in affecting behavior.

> *So instead of looking at this barrage of numbers, we would say to the teachers, "You saved this much. Good work!" That took a lot of time…. What works is just a lot of personal contact, getting them things right away when they ask, like, if they want something for a poster, give it to them. If they need incentives for kids, help them get it… And then giving them ideas. 'This worked at this school, do you want to try this? This worked at this school, can I help you do that?' So it's a lot of ideas and constant interaction…. [Operations is] very engineering-focused. Numbers, that's what's important to them. It's hard to convince people what's important to you isn't important to other people, and* ***we need to fit into what they do, not have you try to force them to do what you want them to do.***

Recalling that framing of "high performance design" played a key role in the initial stages of the change process, the diagnostic frames that would resonate with educational staff should be considered. For example, saving energy (environmental motivation) or saving money (financial motivation) may not be the main motivation for most teachers. While saving money on energy does, theoretically, mean more money for educational purposes, this reverse incentive only works for a short time period and does not generate long-term behavior change, as noted in the quote to the left.

> *[Operations] were so supportive and they wanted it so badly, they just wanted it soon. [laughs] They wanted the changes to happen faster than they were, and that's I think where some of the problems were coming in. They were like, 'Why can't we just shut it all down for them?'* ***This is behavior change. It doesn't happen over one school year.***"

Teachers, parents, and students may not fully understand how important the educational mission is to the operations department, and emphasizing these qualities of high performance design (e.g. improvement of test scores, student health

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and attention) may encourage more support than a financial or environmental approach. Thus, creating a frame and implementing congruent messages that are pertinent to teachers and occupants is necessary to encourage behavior change. For example, one interviewee, not usually interested in environmental issues, specifically recalled a message from Operations Services because it was light, funny, and focused:

> *A few years ago, when we had the droughts, and they stopped watering, and then they put out this funny video, "It's not dead, it's dormant," I just will never forget that… it was like, "Well, we don't really need to have these lush green lawns leading up to our schools." It looks nice, but it was just kind of—you know, they made light of the situation.*

**Engaging the Educational Side of the District**

In light of the major organizational changes that occurred within Operations Services, similar efforts should be undertaken *with* the educational side. For example, **establishing a team** (not just gathering input during a building phase), valuing opinions, creating participation and communication mechanisms are starting points for supporting behavior change. Top-down approaches will not work, as noted by this interviewee: *"Growing the relationship. Going to their principal meetings. That's what I mean. There's a lot behind the data. There's the data and there's those relationships."*

Obviously, the same level of interaction is not possible for teachers who cannot just walk over when they have a question as Operations Services employees do, but the important thing is communication channels. Current collaboration efforts were well-received and teachers were thankful for the effort: *"He's a pretty busy guy. It was nice that he would go out of his way to make sure that he came over and make sure we'd visit from time to time to make sure we were whittling away at it here and there…. I think he's been very supportive."* This effort will likely take more time, because it is supplemental to teachers' responsibilities, than the change process within Operations Services.

As discussed in the Framing section above, Operations Services Department employees did not need explicit incentives. Participation, communication, professionalization, the team, and the ability to see one unified goal was incentive enough. But for teachers, who are expected to add something that appears tangential to their core responsibilities, an **incentive may be useful.** What this incentive should be was debated in the interviews as well as in the academic literature on behavior change. The discussion of incentives in the interviews ranged from those wanting to continue giving schools a percentage of their cost savings; others were unsure if financial incentives were helpful at all, and some were certain that both incentives *and* disincentives or negative consequences were necessary.

> *I think the principal needs to assign a teacher, just like they say, "You get paid $1,000 extra to coach the volleyball team. You get $1,000 extra to be in charge of energy education at the school, and you're the go-to person for the students and the teachers to keep it fresh, keep it on our minds." So an incentive, a position kind of thing, I think it should be that kind of incentive. It isn't there. Money incentive is not necessarily enough.*

As Wirtshafter and Denver (1991) stated, financial incentive programs show mixed results, as they often encourage people who are on the fence of behavior change and further encourage those who were already going to change. Thus, the importance of an energy champion cannot be overstated. Current champions should be further supported, because they are also busy and overburdened as noted by this

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educational energy champion: *"I don't always have the time to go around and look at all the bills or to look at the energy consumption. I don't see it on a day-to-day basis. I don't have time to do that…. Our teaching load has gone up. So I feel like I have less time to think about energy conservation as compared to having my next lesson ready."*

A couple of interviewees suggested incentives that **reward existing champions**, like other forms of extra work in the school (e.g. being a coach). While budgets are tight, funding energy champions should not be considered an expense, but an investment. Like all other energy investments, the long-term payback should be considered. Having one person dedicated to energy in each school could easily generate a payback in energy savings that outweighs the cost of the incentive (Schelly, Cross, Franzen, Hall and Reeve 2010). The energy champion position could also help address the gap discussed in the following quote that individual actions have little effect on energy savings:

> **…a lot of schools don't see that there's anything that they personally can do to save energy or utilities. They're gonna go to the bathroom the same number of times a day and wash their hands the same number of times a day, regardless of whether we ask them to save water. I don't think they get the impression that if they try, it'll make a big difference anyway.**

Finally, by placing control in the hands of school staff, they can generate pride and ownership of their accomplishments, hopefully encouraging more change and addressing the gaps in awareness discussed above. Teachers and school occupants are untapped resources who have ideas that can and should be encouraged. Some schools have existing environmental clubs, which can serve the dual missions of education and sustainability. However, no existing structures or processes support and include teachers, students, and parents in systematic ways. For example, one school occupant discussed creating an assignment in which the students analyze the energy data themselves and generate the reports for the schools. However these efforts are currently haphazard and teachers don't have the support they need to student club development or curriculum integration:

> **I would love to be able to collaborate with someone at the district that could make that a reality—to be able to focus on a particular lesson that could be taught with regard to energy use. I have some goals in mind, but getting there, especially with this new school year, the new challenges that we have just integrating the students; it may not be this year. But it's certainly on my list of to-do's.**

Accomplishing these behaviors changes is going to take time and energy, thus the expertise in energy education from area partners could be especially valuable. We recommend both the establishment of mechanisms for sustainability integration in schools systematic and increased work with partners in this area who might include Colorado State University Extension agents or Fort Collins Utilities.

## Institutionalize the Process

The next step for the school district is to institutionalize the process of energy conservation, sustainability, and developing high performance schools. This means moving the processes, education, and knowledge of integrated design and sustainability from Operations Services to others within the school district. To institutionalize the change processes and be a leader for the future, it is necessary to have everyone in the school district focusing on the benefits of sustainability and building high performance schools. A first step includes expanding the Sustainable Management System from business services to the entire district, including all schools. This step requires keeping the current network within facilities intact, expanding it to include those within the district and inside the schools, incorporating integrated design into curriculum development and school district management, and in

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continued building innovation. Why not include teachers, parents, and students, on the next design team?

The steps of organizational transformation as described above can be used inside of the school district, as it was successfully with Operations Services, to effect change in the management of the school district and in the teaching community at every school. It starts with leadership championing change, and empowering school principals who then provide appropriate education for the teachers, as well as empowering them to act on that education as they see necessary. Perhaps a Green Team within the teaching community is needed to determine how best to incorporate sustainability, and if appropriate, into the curriculum. Importantly, the Teacher's Green Team would need to determine whether and how sustainability improves and maps onto improving education. The Teacher's Green Team should include parents, students, and even members of Operations Services to foster communication and support for sustainability throughout the district. Institutionalizing change to support sustainability also means embedding it into the culture, adopting behavioral change, changing reward systems, and training leaders to support the new culture.

## Expand Outreach Efforts

The accomplishments of the Poudre School District and its partners are a model for other organizations interested in creating high performance buildings. Design of buildings that teach, are green, and are energy efficient requires the collaboration of a network of professionals working together to accomplish a complex task. These are the key findings that should be taught and shared with other organizations:

1. **Commitment and Accountability Matter.** Innovation in design and construction of high-performing buildings is the result of a process, integrated design-build, guided by a commitment to sustainability and accountability to sustainability guidelines.
2. **It's a Process.** Becoming a sustainability leader is much the same process as other forms of organizational change, takes time, and requires all 8 steps:
   Step 1. Changing the mindset
   Step 2. Establishing a team
   Step 3. Creating a clear vision
   Step 4. Communicating the vision
   Step 5. Empowering the team
   Step 6. Using early success to continue the process
   Step 7. Learning from mistakes
   Step 8. Embedding sustainability into daily life
3. **Innovation Comes from Diverse Networks.** Use of the integrated design-build was successful because the process builds a robust professional social network centered on learning. By including facilities and maintenance staff as well as design professionals, more knowledge is brought into the system, resulting in more informed design decisions.
4. **Language Matters.** Finding language that captures and includes the many motivations for creating high-performing buildings is required into order to bring a large and diverse groups of professionals into the integrated design-build process.

Sharing these lessons and insights with other organizations is the next logical extension of the process PSD began when it announced its commitment to sustainability in 2000. The processes used by PSD can be replicated by other school districts although they represent a change from current practices.

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## Works Cited


Al-Homound, Mohammad S. 2000. "Total Productive Energy Management." *Energy Engineering* 97:21-38.

Anklam, P. 2007. *Net work: a practical guide to creating and sustaining networks at work and in the world*: Butterworth-Heinemann.

Bagdonis, J. M., C. C. Hinrichs, and K. A. Schafft. 2009. "The Emergence and Framing of Farm-to-School Initiatives: Civic Engagement, Health and Local Agriculture." *Agriculture and Human Values* 26:107-119.

Baran, Paul. 1964. "On Distributed Communications: RM3420PR." Rand Corporation.

Benford, Robert D. and David A. Snow. 2000. "Framing Processes and Social Movements: An Overview and Assessment." *Annual Review of Sociology* 26:611-639.

Borgotti, S., M. Everett, and P. Shirey. 1992. "UCINET IV, Version 1.0 reference manual." Natick, MA: Columbia University Press/Analytic Technologies.

Brendle Group, Inc. and Poudre School District. 2006. *Sustainability Management System*. http://eweb.psdschools.org/documentlibrary/downloads/Operations/SMS_4-20-07.pdf

Bresnen, Mike, Linda Edelman, Sue Newell, Harry Scarbrough, and Jacky Swan. 2003. "Social Practices and the Management of Knowledge in Project Environments." *International Journal of Project Management* 21:157-166.

Brown, T. M. and C. E. Miller. 2000. "Communication networks in task-performing groups: Effects of task complexity, time pressure, and interpersonal dominance." *Small Group Research* 31:131.

Cebon, Peter B. 1992. "Organizational Behavior, Technical Prediction and Conservation Practice." *Energy Policy* 20:802-814.

Charmaz, Kathy. 2001. "Grounded Theory." Pp. 335-352 in *Contemporary Field Research: Perspectives and Formulations*, edited by R. M. Emerson. Prospect Heights, IL: Waveland Press.

Cornfield, Daniel B. and Bill Fletcher. 1998. "Institutional Constraints on Social Movement "Frame Extension": Shifts in the Legislative Agenda of the American Federation of Labor, 1881-1955." *Social Forces* 76:1305-1321.

Cross, Rob and Andrew Parker. 2004. *The Hidden Power of Social Networks*. Boston, MA: Harvard Business School Press.

Diekmann, Andreas and Peter Preisendorfer. 2003. "Green and Greenback: The Behavioral Effects of Environmental Attitudes in Low-Cost and High-Cost Situations." *Rationality and Society* 15:441-472.

Doppelt, Bob. 2003a. *Leading Change Toward Sustainability: A Change Management Guide for Business, Government and Civil Society*. Sheffield, UK: Greenleaf Publishing Limited.

—. 2003b. "Overcoming the Seven Sustainability Blunders." *The Systems Thinker* 14:2-7.

Dunlap, Riley E. and Araon M. McCright. 2008. "A Widening Gap: Republican and Democratic Views on Climate Change." *Environment* 50:26-35.

Energy Star. 2010. "ENERGY STAR Labeled Buildings & Plants: ENERGY STAR Labeled K-12 Schools."

Fernandez, Sergio and Hal G. Rainey. 2006. "Managing Successful Organizational Change in the Public Sector." *Public Administration Review* 66:168-176.

Hoffman, Andrew J. and Rebecca Henn. 2008. "Overcoming the Social and Psychological Barriers to Green Building." *Organization Environment* 21:390-419.


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Hulme, Mike. 2009. *Why We Disagree about Climate Change: Understanding Controversy, Inaction, and Opportunity*. Cambridge, UK: Cambridge University Press.

Johnson, Scott D. 2000. "The Economic Case for "High Performance Buildings"." C*orporate Environmental Strategy* 7:350-361.

Katz, N. and D. Lazer. 2003. "Building effective intra-organizational networks: The role of teams." *Unpublished manuscript. Available at http://www. ksg. harvard. edu/teamwork*.

Kotter, John P. . 1995. "Leading Change: Why Transformation Efforts Fail." *Harvard Business Review* 73:59-67.

Krackhardt, D. and J. R. Hanson. 1997. "Informal networks: the company." *Knowledge in organizations*:37-50.

Kulakowski, Susan L. 1999. "Large Organizations' Investments in Energy-Efficient Building Retrofits." Energy Analysis Department Ernest Orlando Lawrence Berkeley National Laboratory, Berkeley, CA.

McCright, Aaron M. and Riley E. Dunlap. 2000. "Challenging Global Warming as a Social Problem: An Analysis of the Conservative Movement's Counter-Claims." *Social Problems* 47:499-522.

Patton, M. Q. 1990. *Qualitative Evaluation and Research Methods*. Newbury Park, CA: Sage Publications.

Poudre School District. 2005, "Sustainable Design Guidelines", Retrieved Nov. 1, 2010. (http://eweb.psdschools.org/documentlibrary/downloads/Plan_Design_and_Construction/Sustainable_Design_Guidelines_2005.pdf)

—. 2010. "Sustainability", Retrieved November 1, 2010. (http://www.psdschools.org/about-us/district-operations/sustainability).

Poudre School District and The Brendle Group Inc. 2006, "Sustainability Management System: 2006 Edition", Retrieved November 1, 2010 (http://eweb.psdschools.org/documentlibrary/downloads/Operations/SMS_4-20-07.pdf).

Reed, B. 2009. The integrative design guide to green building: redefining the practice of sustainability: US Green Building Council.

Schelly, C., J. E. Cross, W. S. Franzen, P. Hall, and S. Reeve. 2010. "Reducing Energy Consumption and Creating a Conservation Culture in Organizations: A Case Study of One Public School District." *Environment and Behavior*. doi: 10.1177/0013916510371754

Snow, David A., E. Burke Rochford, Jr., Steven K. Worden, and Robert D. Benford. 1986. "Frame Alignment Processes, Micromobilization, and Movement Participation." *American Sociological Review* 51:464-481.

Stern, Paul C. 2000. "New Environmental Theories: Toward a Coherent Theory of Environmentally Significant Behavior." *Journal of Social Issues* 56:407-424.

Strauss, A. and J. Corbin. 1990. *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory*. Thousand Oaks, CA: Sage Publications.

Yudelson, J. 2008. *Green building through integrated design*: McGraw-Hill Professional.

Wirtshafter, R. M. and A. Denver. 1991. "Incentives for Energy Conservation in Schools." *Energy Policy* June: 480-487.

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