

An International Case for Sharpening the Focus on Facilitation Skills in Undergraduate Engineering Curricula

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Many institutions worldwide are exploring organizational change approaches that promote organizational effectiveness and innovation. At the University of Wisconsin, the Engineering Professional Development (EPD) Department conducted a two-year study to develop an organizational change strategy for the Wisconsin Department of Natural Resources (WDNR). Insights from this investigation, and from a review of literature, signal an emerging recognition of facilitation skills as critical for organizational success. This effort presented an opportunity to consider how university curricula prepare engineers to facilitate and lead in the workplace. A review of undergraduate curricula suggest that activities that are designed to build teamwork and leadership skills may underemphasize facilitation skills. This suggests that universities could better prepare engineering students for the workplace by sharpening the focus on facilitation skills in undergraduate curricula. Programs like the new Center for the Integration of Research, Teaching, and Learning (CIRTL) at the University of Wisconsin-Madison, are building a learning community of faculty, staff, and students who can respond to this kind of need. Because links with similar projects in the Netherlands and New Zealand were germane to the investigation, project results can inform similar efforts in other countries to augment engineering curricula.

Introduction

In an effort to cultivate an organizational culture that supports performance improvement and innovative stakeholder collaboration, the Wisconsin Department of Natural Resources (WDNR) and other natural resources agencies worldwide are exploring organizational change approaches. The University of Wisconsin, Engineering Professional Development (EPD) Department conducted an investigation to develop an organizational change strategy. The goal is to empower WDNR staff to support internal performance improvement and innovation, and stakeholder collaboration. This investigation and a literature review of workplace trends highlight how facilitation skills are key to this kind of organizational change and to stakeholder community building. The authors then review how the University of Wisconsin-Madison, College of Engineering helps students develop leadership, teamwork, and facilitation skills. Based on this case example, authors suggest areas for further research.

Investigation

Investigators focused on the following objectives: defining project goals and objectives, investigating similar approaches worldwide, and investigating change strategies.

Defining Project Goals and Objectives

The WDNR vision is for an "Environmental Performance Network" of WDNR pilot participants and stakeholders who collaboratively develop agreements that protect the environment beyond regulatory standards. During interviews and listening sessions WDNR staff identified issues at individual, team, organization, and state (regulation) levels that are barriers to working effectively on internal teams and to collaborating with stakeholders¹. Based on these results and on the vision of WDNR team members, the WDNR-EPD project team developed a description of the desired project outcomes. They include 1) a learning community of networked stakeholders and staff, 2) management of activities through process teams, and 3) systematic use of information to improve process effectiveness².

To translate outcomes into goals and objectives, investigators solicited opinions from "experts," an international list of professionals experienced in environmental management, performance excellence, innovation, collaborative learning, and community building. Investigators developed a project concept description and distributed it to these experts. Experts emphasized that facilitating staff and stakeholder participation is critical for identifying meaningful goals, directions, solutions, and integrated evaluation approaches. A shared project vision should identify why and how the WDNR is doing this, identify core values, and describe what the Environmental Performance Network will look like. Based on these comments, the project team developed a goals and objectives statement, meant to be refined during participatory project design.

GOAL: Empower staff to support performance excellence (continuous quality improvement) and lead innovative projects with stakeholders. *NOTE: To be empowered, an employee needs information, training, tools, inclusion and participation in decisions affecting their responsibilities, and supportive, accountable leadership.*

OBJECTIVES:

- Define skill sets for organizational learning (to support continuous quality improvement and innovation) and for stakeholder community building.
- Develop a strategy for organizational change that will support (provide a "safe place" for) acquisition and evolution of these skill sets.

Investigating Similar Approaches Worldwide

To learn about how others have promoted similar project goals and objectives, investigators are tracking several initiatives worldwide. These efforts are the Netherlands' National Environmental Policy Protection (NEPP) program, the New Zealand Ministry for the Environment's environmental management improvement effort, and the California Environmental Dialogue.

The Netherlands

To understand Dutch approaches investigators established a dialogue with the Gelderland Department of Environment and Water in Arnhem, the environmental agency for the eastern Dutch Province of Gelderland. Through meetings, teleconferences, and emails, it became clear that the Netherlands very recently (2002) started implementing its Quality Circles program. This program is an approach for implementing the National Environmental Policy Protection (NEPP) program. Through stakeholder collaboration, the NEPP program has reached some ambitious milestones, including establishing covenants and other agreements with industry that provide environmental protection that sometimes surpass existing environmental regulations.

The goal of the Quality Circles program is to approach environmental permitting and law enforcement in a more client-oriented and results-based way. A long-term goal is to eventually have an effect on the environmental attitudes and accomplishments of the companies. Gelderland and the other Netherlands provinces have developed a list of "skills" to help them promote more customer-oriented work: flexibility, openness, cooperation, reliability, ability to obtain results, ability to manage projects, ability to manage change, and ability to motivate colleagues and employees. Gelderland representatives also emphasized the importance of a continuous effort by management to promote Quality Circle values through all media, from meetings to email to one-on-one interactions. Peer training and "coaching" are also germane to their approach.

New Zealand

The New Zealand Ministry for the Environment recently commissioned a (May 2002) report that describes approaches to effect behavioral change that improve environmental management³. A salient point in the report highlights how "Transformational change requires individuals and groups to develop the capacity to move beyond the completion of task-bounded activities. They must catalyze change within their immediate membership first, and spread that culture to others in their communities over the long term." The report also offers a list of skills that support stakeholder collaboration: Facilitate participation, manage conflict/ debates, managing meetings, documenting progress, innovation, motivation, networking, data and information gathering.

California Environmental Dialogue

The mission of the California Environmental Dialogue (CED) is to engage California business, corporate, environmental, and government leaders collaboratively to produce timely and improved environmental protection, while reducing costs to business, government, and society. CED representatives attribute their success, in large part, to two individuals who have been effective agents for change. They see the CED adding value to environmental protection in California in the following ways.

- They have established a meaningful dialogue process.
- From adversarial beginnings, the valuing of relationships among many parties has emerged.
- Stakeholders are beginning to think of themselves as a community, and talking about "we" at meetings, rather than "us" and "them."

- CED has become an important "sounding board" for government about how to work with industry and non-government organizations.
- Government appointees seem to be catching the "dialogue disease."

Investigating Change Strategies

Next, investigators reviewed change strategies for designing the Environmental Performance Network. The aforementioned expert comments on the Environmental Performance Network concept included salient points about change strategies that are relevant to designing and operating the pilot project. Based on these comments, summarized below, investigators turned to the fields of organizational culture change, organizational learning, and stakeholder community building.

- Identify leadership that has influence, familiarity with overcoming process "roadblocks" at WDNR, and skilled facilitation skills
- Build on what already works by using appreciative inquiry, a question-based approach for organizational change⁴
- Understand and leverage barriers and enablers for change with social marketing
- Use organizational learning to promote employee motivation, performance excellence, and innovation
- Use community building and other inter-organizational approaches to collaborate with stakeholders
- Focus on systems, process, and customers to improve performance excellence.
- Integrate assessment into change processes to demonstrate success and promote continuous improvement

Organizational Culture Change

Reconnaissance literature reviews and discussions with researchers show that organizational culture change is a complicated process that can take years and major resources to design and implement^{5,6}. The high time and financial investment required for organizational culture change is not practical for the WDNR in this era of diminishing resources; therefore, investigators turned to the change processes of organizational learning and community building.

While resource-intensive, organizational culture change approaches can inform the WDNR project. One prominent consultant perhaps best captures the WDNR's desire for an adaptable, innovative organization by suggesting a change-capable organization⁷. She says that the qualities of change-friendly organization are: link the present and the future, make learning a way of life, support and encourage day-to-day improvements, ensure diverse teams, encourage mavericks, shelter breakthroughs, integrate technology, and build and deepen trust. A review of these characteristics reinforced the focus by investigators on organizational learning and community building.

Organizational Learning

Many professionals believe that a "learning organization" culture promotes continuous performance improvement, innovation, and stakeholder community building^{8,9,10,11}.

Further, several studies *demonstrate* that organizational learning can promote improved

financial performance, collaboration, continuous improvement, customer focus, employee commitment, and overall work performance^{12,9}.

To become a learning organization, some researchers suggest beginning with assessment, which provides "a basis for moving from a traditional bureaucracy to a learning organization, thereby improving the way in which organizations function"⁸. Many practitioners have developed assessment tools¹³; however, few articulate the proficiencies needed to promote organizational learning and effective stakeholder collaborations. Therefore, investigators established a dialogue with a network of organizational learning experts to gain real-world insights. The ensuing conversations produced a description of the characteristics and skill sets of an organizational culture that supports learning.

Stakeholder Community Building

Community building models differ from organizational development models for many reasons, and especially because they aim to address agendas of the various organizations involved. While employees (ideally) collaborate toward the organizations' mission, stakeholders generally have different organizational missions and often have very different reasons for collaborating on any given effort. Researchers concur that the first step in cultivating collaboration among government, business, environmental advocates, and affected communities is to acknowledge and respect distinct, and sometimes contradictory, attitudes, beliefs, and values among these groups^{14,15}. Many studies offer models and lessons for effective collaboration^{16,3}.

Results: Desired Skill Sets Emphasize Facilitation

The investigation produced proficiency skill sets for organizational learning and stakeholder community building. The skill set for organizational learning came from guided dialogues with learning organization experts. Skills are working in teams, using information to improve results, linking work activities to organizational mission, engaging customers and stakeholders, and facilitating meetings. The skill set for stakeholder community building is a synthesis of skill sets from the Gelderland and New Zealand environmental management projects as well as lists of principles and values from other performance improvement models, including the national Baldrige Award. Skills are facilitating participation, managing conflict, charting and evaluating progress, motivating and empowering participants, and managing systems and processes.

The previously mentioned interviews and listening sessions suggest that WDNR staff lack many of these skills 1. Recognizing that their organization is challenged by mistrust and inconsistent accountability, WDNR team members want a "safe place" to hone these skills. The WDNR-EPD team continues to investigate approaches for developing this supportive organizational climate. Given that the skill sets emphasize facilitation skills, researchers also investigated how university curricula prepare engineers and scientists to facilitate and lead in the workplace, as described below.

Linking Workplace Facilitation Skills and University Curricula

Each skill set (above) that WDNR wants its staff to acquire emphasizes facilitation skills. The authors wanted to know whether other organizations see facilitation skills as important and how universities prepare engineering students to facilitation and lead in the workplace. To pursue this line of thinking, investigators reviewed literature about facilitation skills in the workplace and reviewed curricula and programs at the UW-Madison.

Facilitation Skills in the Workplace

Many recognize that "people who are technically excellent tend to have consciously specialized in those particular skills" and therefore often lack the "softer" people-handling skills of effective leaders¹⁷. Efforts to address this include business-university alliances like that between the Parke-Davis pharmaceutical research and development division and the University of Michigan Executive Education Center to train scientists to lead¹⁸. The training program emphasized skills that support facilitation: understanding of self, coaching, understanding and working well with others, communication and change, creativity, and motivation. Another example is the WDNR's recent (January 2003) debut of "Meeting Pro," an intranet site that offers resources to prepare for and facilitate meetings. Meeting Pro resources include an on-line questionnaire, agenda-helper, checklists, as well as access to experts in every region of the state.

It is no surprise, then, that leadership training programs at major organizations such as the NASA Academy of Program and Project Leadership are placing facilitation skills front and center. Likewise, a study of a large government-contract engineering firm demonstrates that "facilitative behaviors can be mapped onto practices of leaders at their best"¹⁹. Even more relevant to the WDNR desire for organizational change, is a study on the results of "transformational," or "facilitative," leadership training²⁰. This training program focuses on "four dimensions that comprise *transformational* leadership behaviors: idealized influence, inspirational motivation, intellectual stimulation, and individualized concern." The study describes the positive impact of this leadership training on bottom line outcomes at 20 Canadian banks. Another intriguing observation by the researchers was that "an increase in transformational leadership 'trickles down' through the organization, raising the level of performance at all levels." This suggests that initiating organizational change first with managers, and later with staff, like the Quality Circles used by Gelderland Department of Environment and Water, is a strategic way to improve organizational performance. Also relevant to the WDNR Environmental Protection Network project are observations by some researchers that "at the very heart of *managing change* in corporations is the concept of facilitation²¹."

These and other examples show why "facilitative leadership" has become the preferred leadership style of recent decades, replacing "instructional leadership" of the 1970s. David Conley and Paul Goldman define facilitative leadership as the behaviors that enhance the collective ability to adapt, solve problems, and improve performance²². It is worth recognizing the challenges of embracing the radically different assumptions of facilitative leadership, which include the resulting ambiguity and discomfort, along with the blurring of accountability²³. Some describe it as a delicate balance between supporting and challenging the status quo; others describe it as "managing tension."

Facilitation Skills for Undergraduates

Influenced by these developments in the private sector, educational researchers are shifting their attention to transformational/ facilitative leadership models that emphasize collaboration and empowerment²³. To understand how universities help engineering students acquire the facilitation skills that they will need in the workplace, the authors reviewed curricula and programs at their institution, the University of Wisconsin - Madison, College of Engineering. While the leadership and teamwork elements of the UW-Madison Engineering curriculum are typical of similar curricula at other schools, the emerging learning community supported by university programs and infrastructure is visionary.

UW - Madison, College of Engineering Curriculum

The University of Wisconsin-Madison, College of Engineering offers several courses that focus on teamwork and leadership. These courses and course types, listed below, offer students an opportunity to experience simulated and real-world projects.

- Engineering Professional Development (EPD) 160: Introduction to Engineering is a three-credit course for first year students. From its inception, the goal of the course has been to involve students in real projects where they collaborate with bona fide clients. Active learning is central to the teaching style²⁴.
- EPD 690: Special Topics in Engineering Professional Development. This course, offered by the Dean of the School of Engineering, has a primary focus on leadership skill. This course evolved out of a pilot course for facilitation skills, which was discontinued after one (well-attended) semester because of a staff shortage. Later it was revived with an emphasis on leadership.
- Design Courses: Each engineering department at the University of Wisconsin - Madison requires one or more design courses, which require students to work in teams. Examples include Hydraulic Design, Wastewater Treatment Plant Design, and Circuit Design courses.
- Capstone Design Courses: Each engineering department requires a capstone design course, which is structured around real projects for bona fide or imaginary clients.

While engineering curricula at the University of Wisconsin-Madison, and many other universities, offer opportunities to practice teamwork and leadership, many students enter the workforce unprepared to facilitate and lead^{17,18}. ***This, along with the foregoing investigation results and literature review about the importance of facilitation skills in the workplace, suggests that university engineering curricula underemphasize facilitation skills, which many of today's technical professionals need.***

How can universities address this? An effective approach would need to pinpoint facilitation skills needed in the workplace, develop programs and courses that teach these skills, and place a higher priority on teaching at research universities. UW-Madison has been developing programs and infrastructure that focus on this type of continuous improvement in teaching and learning, including their new Center for the Integration of Research, Teaching, and Learning.

UW-Madison Programs and Infrastructure

College of Engineering faculty, teaching assistants, and students can draw from several programs to hone their teamwork and leadership skills outside of class. One example is the Student Leadership Program, a growing group on campus that works to develop personal leadership skills of all UW-Madison students. Also, each semester they can attend the College of Engineering Teaching Improvement Program, which offers a selection of workshops during a one-day event at the beginning of each semester. The Teaching Improvement Program is part of the UW-Madison College of Engineering's endeavor to "help meet the needs of society in the 21st century by ... creating the next generation of engineering leaders (UW-Madison College of Engineering's Dean Bollinger as quoted in the College's Vision 2000 brochure)."

This focus on leadership skills for engineering students emerged over the last 15 years as part of a longstanding effort to link curricula with workplace skill sets. The technological explosion of the 1980's brought with it an urgent need for technical professionals with communications skills, and the College of Engineering responded by launching a Technical Communications Certificate program in 1988. More recently, the Engineering Learning Center was established to foster effective student-centered teaching and learning within the College of Engineering. Major programs include the Teaching Improvement Program, a New Educator's Orientation Program, and a K-12 Outreach Program, as well as links with national programs like the annual, week-long Leadershape leadership training for selected students.

As Engineering Learning Center programs developed in the 1990s, the College built an Engineering Centers Building to house it, along with the growing Technical Communications Certificate Program, Engineering Career Services Center, and a new Student Leadership Center. The Student Leadership Center will coordinate engineering student organizations and develop opportunities for leadership training.

The most promising effort to support effective teaching and learning in the College of Engineering is the new Center for the Integration of Research, Teaching, and Learning (CIRTL). CIRTL is one of two NSF-funded teaching and learning centers launched in January 2003; the other is at the University of Washington. Development of the CIRTL program is beginning at UW-Madison for its science, technology, engineering, and mathematics (STEM) undergraduate curricula, and will then be phased in at the University of Michigan and Pennsylvania State University.

CIRTL provides the University of Wisconsin with \$15 million over 5 years to build a program for STEM education founded on two powerful ideas: teaching-as-research and learning communities²⁵. The goal is to embed within a learning community of graduate students, postdoctoral fellows, and faculty opportunities to develop skills in five key areas. These areas are classroom teaching, instructional materials, informal education, teaching to diverse student audiences, and internships. Already, a "classroom teaching" course is being designed for Fall 2003 that will help aspiring faculty and other instructors hone their teaching skills. Students will be able to apply this course and other CIRTL

courses towards a certificate in higher education, called a Teaching and Learning Scholarships (TALS) certificate in higher education.

Summary

This investigation of approaches for improving performance and promoting innovative stakeholder collaboration at the Wisconsin Department of Natural Resources suggest an emphasis on organizational learning and community building. The skill sets to support this work that WDNR staff consists of primarily facilitation skills.

These results and reports from organizations in other U.S. states and countries signal an international trend in the increasing importance of facilitation skills in the workplace. The University of Wisconsin College of Engineering offers a number of courses that help students gain experience with teamwork and leadership, yet students enter the workforce ill equipped to facilitate teams and processes. The authors suggest that universities can address this need by sharpening their focus on facilitation skills like decision-making. UW-Madison's new Center for Research, Teaching, and Learning is being designed to address these kinds of issues by building a learning community among faculty, staff, teaching assistants, industry, and students.

This investigation presents questions and suggests areas for further work. Which facilitation skills are most needed in the workplace, and which skills are most often underdeveloped in technical professionals? How can your university begin to phase these facilitation skills into design courses? What curriculum designs are most effective? How can faculty and teaching assistants acquire the skills to model effective facilitation as they teach? How can programs and infrastructure like CIRTL best provide support? How could collaboration with technical companies and with facilitation experts be valuable? Finally, how can we best evaluate whether our students are really acquiring the facilitation skills that will allow them to lead workplace teams and organizations?

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Biographies

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SANDRA SHAW COURTER - Dr. Courter teaches technical communication courses in the College of Engineering. As director of the Engineering Learning Center, she coordinates professional development experiences for graduate students, staff, and faculty.

PATRICK EAGAN — Dr. Eagan is an associate professor at the University of Wisconsin-Madison, Department of Engineering Professional Development and the Gaylord Nelson Institute for Environmental Studies, through which he develops and offers continuing environmental engineering education to practicing professionals. Dr. Eagan has been actively involved internationally in the development of design-for-the-environment tools and education since 1992. He has worked with many companies tailoring educational programs on the emerging topics of environmental awareness, life-cycle management/design-for-the-environment, environmental management systems, and environmental purchasing. Dr. Eagan recognizes the value of quality concepts and has focused on merging environmental perspectives with quality education programs (e.g. design-for-excellence or six sigma). His favorite industrial ecology projects were the global rollouts of design-for-the-environment curricula at Motorola and Johnson & Johnson. In addition to his research in industrial ecology, his outreach courses include a range of topics including wastewater and stormwater treatment and restoration of water resources. He uses collaborative learning techniques and class exercises to meet these goals. Dr. Eagan has been active in the Institute of Electrical and Electronics Engineers. He was conference Co-chair for the 1999 International Symposium on Electronics and the Environment. In 2000 he was conference co-chair of the international meeting “Electronics Goes Green” in Berlin, Germany and in 2001 was on the program committee and a keynote speaker for the “Going Green” Eco-design meeting in Tokyo. He is conference co-chair for the “Going Green” 2003 meeting scheduled for Boston.