In the "Online Classroom": Teaching Communication for Technical Leadership

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***Abstrac**t: The authors developed "Communicating Technical Information," a 3-credit course delivered as part of the on-line Master of Engineering in Professional Practice (UW-Madison). The course is based on "engagement theory"; the methods of the course draw both on the capabilities of current technologies (WebCT, Placeware, PowerPoint) and the virtues of the traditional classroom. An emerging theme is that of "Technical Leadership" and its relationship to the success of engineers in their careers and in their sense of personal fulfillment. This course in "technical communication" is recommended as an essential contribution to the professional development of engineers at the graduate level and to their future leadership roles.*

I. THE OPPORTUNITY AND THE OCCASION

"Take off [your] engineering hat and put on [your] management hat."

For better or for worse, the *Challenger* disaster continues to provide substantive material for the accelerating debate between technology and society, between scientists and non-scientists – and between engineers and management (Werhane, 1991; Herkert, 1991; Ethical Decisions, 2002).

The infamous quotation above was a kind of insult to both engineers and managers; yet the thinking behind this defensive excuse bespeaks a well established dichotomy between what engineers do and what managers do (or what they are thought to do!).

So be it: perhaps the realm of "technical leadership" is different from traditional "management" - and "technical leadership" is founded on skills that are well suited for development in an advanced technical communication course; additionally, the "online classroom" – that is, web delivery of a technical communication course within the context of an online degree program, can exploit both the best of the traditional classroom and reveal new freedoms and possibilities.

The time is ripe for new perspectives on the significance of engineers as "technical leaders."

A. Teaching Communication - an Opportunity in Engineering

A few years ago (1994), the Office of the Dean of Engineering at the University of Wisconsin - Madison reported on a questionnaire sent to alumni asking about their experiences, professional careers, and education. A key question on the survey asked

alumni to identify the most important subjects they had studied in their undergraduate engineering programs. Another section asked what they thought they needed more of in their education. In short, these questions asked alumni to reflect on their own education as it affected their professional careers. More than 9,000 alumni responded to this survey (*Perspective*, 1994).

In the list of subjects "which have been most useful in your career," the top two vote getters were "Written communication" and "Oral Communication." The next three were "Basic Engineering Science," "Core Math Courses," and "Design Courses."

The top five choices for "which subjects you wished you'd had more exposure to" were, in order, "Management Skills," "Oral Communication Skills," "Finance/Economics," Total Quality Management Principles," and "Interpersonal Skills."

The Dean commented:

> *We were very interested to see that so many of you had chosen communication-oriented courses as contributing to your career. This is a message we will share with our current engineering students as we continue marketing them to our Technical Communication Certificate Program.*

The Technical Communication Certificate Program at UW-Madison is outlined in Appendix A. It is a unique opportunity for engineering students to develop their communication skills as part of their technical education in an engineering department – Engineering Professional Development (EPD) – and in the Engineering College.

The results of the UW Alumni survey in 1994 can be compared with more recent surveys of engineering graduates. Sageev and Romanowski (2001), for example, conclude in their "lessons learned" about the value of technical communication skills in the workplace:

> *Technical abilities are a given: communication and leadership differentiate.*

Clearly, engineering education must include the essential technical skills and knowledge, problem solving, and management abilities expected for technical competence and demanded for practical success. There is also an essential role for education in technical communication which can provide both skills and enduring attitudes for career-long success in technical leadership (Pappas and Hendricks, 2000).

Wheeler and McDonald (2000) write:

> *Four years is an insufficient time for students to achieve a high level of proficiency in all these areas. Rather, undergraduate engineering education should form the basis for a lifetime of learning.*

And, a little later:

> *Writing can help achieve these goals in unique ways, and we argue that most courses should incorporate writing in some fashion.*

"Writing" may be too limited a word; "communication" better covers the range of skills which can serve engineers well to avoid obsolescence and to maintain a technical competitive edge – or, in short, to build and maintain the skills, knowledge, and attitudes for technical leadership.

B. MEPP Overview

As of May, 2002, the Masters of Engineering in Professional Practice (MEPP) has graduated two classes of about 30 each. The third class began the summer of 2001 and the fourth class, the Class of 2004, begins this summer (2002). Designed for completion over the internet in two years, MEPP is intended for working engineers sited at their individual geographical locations and provides considerable flexibility in daily and weekly schedules. An overview of MEPP is provided in Appendix B.

The program boasts several important successes:

First, participants express surprise and delight at how well they get to know their fellow students – "Better than I got to know students in person as an undergrad," said one MEPP student.

Second, the completion rate is about 99%. Participants benefit from excellent institutional support, personal and moral support from their peers, and a well-planned program that encourages success.

For the most recent MEPP graduation (May 2002), ALL MEPP graduates attended the ceremonies on the UW-Madison campus, involving for some travel from Seattle, Houston, and even Mexico. A lively and active alumni group is taking shape for MEPP.

Appendix B provides an overview of the MEPP course sequence.

C. "Communicating Technical Information" (CTI)

The authors were invited to be part of MEPP and to design and deliver "Communicating Technical Information" (EPD 617). The design of the course was based on the authors' experience in the TCC at UW-Madison plus their experience with working engineers.

The course has undergone a steady evolution. The principle has been to simplify some awkward complexities, to increase emphasis on the participants' engagement, and to make better use of the tools and online environment available. The authors decided from the beginning that the "virtues" of the traditional classroom should not be sacrificed; the model of the "correspondence course" or of the computer based "page turner" were rejected from the start.

What was not clear from the start was that new attitudes, new uses of old tools, and a new and clearer "theme" would evolve for CTI.

D. The Virtues of the "Classroom" for Engaged Participants

The virtues of the real " classroom" encourage engagement and participation by all students. These "virtues" can be captured in a few goals for the effective classroom. However, it must be noted that this classroom is optimized for the field of technical communication, for project based education, and for participation in general. In "information intensive" classes, the emphasis may be on covering a certain large area of knowledge adequately in a given length of time, and the "virtues" of that type of classroom may be somewhat different.

1. Classroom goal: Avoid the sense of "isolation" which could result from students working more or less on their own.

"People Skills" are an essential part of the hidden agenda for a traditional classroom. Students learn to deal with each other, sometimes cooperatively and sometimes competitively. Students and teachers interact, in various ways; in advanced classes, the relationship is never simply "superior" to "inferior." This observation is especially true in dealing with adult learners who are technically highly competent, professionally ambitious, and usually stressed because of their commitment of time and energy to home and family, job, and degree program.

2. Classroom goal: Facilitate practical communication related to the class.

"Practical Communication" is a related feature which the traditional classroom values. Student have the opportunity and obligation to communicate with each other. Such communication may include informal "small talk," formal discussion or seminars, presentations, interactions and intellectual debate, and after-hours discussion or consultation on class assignments or projects.

3. Classroom goal: Engage participants by making them "shareholders."
Karl Smith gave the example of Sisyphus in one of his lectures on creating engagement in the classroom. Poor Sisyphus pushes a boulder up a hill every day, and it always rolls back down. According to Smith, this is the situation many teachers put themselves into. They push the rock up the hill for their students, the students watch, and the rock rolls back down the hill (Smith, 1990).

According to Smith – the students should be pushing the rock up the hill!

E. Engagement Theory as a basis for MEPP Course Design

The work of course design for MEPP has benefited from the direct assistance of Greg Kearsley as a course consultant. In "Engagement Theory: A framework for technology-based teaching and learning," (1999), Kearsley and Shneiderman summarize the basis for engagement as "Relate-Create-Donate." This simple formula captures the essence of the effective on-line course and explains the fundamental principles of CTI.

1. ***Relate*** – "Emphasizes team efforts that involve communication, planning, management and social skills."

2***. Create*** – "Students have to define the project (project domain) and focus their efforts on application of ideas to a specific context."

3. ***Donate*** – "Stresses the value of making a useful contribution while learning. Ideally, each project has an outside 'customer'…."

Engaged students help "create" the class – through their efforts they are responsible for the quality of the class experience. They also "create" a new identity and set of attitudes for themselves – all of which contribute to new abilities in "technical leadership."

II. ENVIRONMENT AND TOOLS

The challenges of maintaining the best of the "real" classroom result from the nature of the web-based environment through which the online course is delivered. A lesson learned is that new methods affect old ways of thinking and that the expected outcomes are not always the "only" or the "best" possibilities.

In short, the environment and tools affect the "culture" of a class and the practical activities that can be incorporated. Four major factors determine the nature of "Communicating Technical Information."

A. Synchronous and asynchronous environments.

WebCT

WebCT is a well-known course environment for online course management. Its familiar features include internal email, discussion forum management, calendar and scheduling functions, and gradebook maintenance.

"Docushare" has recently been incorporated into WebCT. Primarily facilitating homework submissions and the return of feedback or corrected papers by instructors, Docushare serves as an electronic filing cabinet with areas reserved for handouts "owned" by instructors and students, special documents as resources, and folders for each student. Docushare provides version tracking, permissions for access and controls on how various documents can be used, and date stamping. It provides a more convenient method for document exchange for the class than email or attachments.

As an asynchronous component of the online course, WebCT is always available.

Placeware

Placeware is the browser-based meeting manager which facilitates live on-line class meetings. Participants need a computer connection to the internet plus a phone line for audio link.

For CTI, meetings were scheduled almost every week during the semester at two times, usually morning and evening on different days, to accommodate the real-life scheduls of the participants. Another benefit of the "two-meeting" schedule, of course, is that splitting the synchronous meetings into two groups usually limits the number of participants to between 12 and 18, a more reasonable number than 30, for "engaged" participation by students during the hour-long online class.

The most useful Placeware features utilized in CTI were Powerpoint for the informational and seminar-style subject content of the meetings; white boards and on-the-fly text boards for capturing spontaneous discussion, student responses, and emendations; and poling slides for quick takes on attitudes, knowledge, and opinions. Placeware sessions can be recorded for later review or as a reference for participants who might miss a meeting.

A major feature of Placeware is the ability to "share" a live web-based session. One person can lead a demonstration which all participants can see and hear. This feature was especially powerful in CTI for the teaching of electronic research methods. The involvement of the academic research staff at Wendt Engineering Library cannot be overstressed in adding sophistication and new abilities to the CTI participants for the use of modern research tools. Academic staff at Wendt conducted Placeware demonstrations of search strategies and use of the electronic library catalogue, commercially produced research databases, library reference tools, and full-text materials available as electronic books and journals. The library researchers usually tried to become familiar with student research problems and projects so demonstrations were conducted for specific practical research tasks.

B. Tools and their evolving applications.

Word and Acrobat

Basic and advanced word processing skills and the electronic management of documents for the purposes of collaborative work, team review, and peer editing are essential. The use of templates, the knowledge of the advantages and disadvantages of styles, and other document handling experience are not always skills that CTI students have at the beginning of the course. Document design as made possible by the use of layout, font choice, graphics, charts, and visuals is a part of effective communication skills.

Acrobat is not well understood by students in all cases at the beginning of CTI; most students come to appreciate the utility of this program in collaborative work, in editing and markup, and for electronic document handling.

PowerPoint

This almost universal "presentation" tool acquires a new personality in Placeware sessions. Whereas the usual situation is for the "presenter" to use PowerPoint as a way to convey information (in a rather one-sided monologue), PowerPoint becomes a true communication tool in Placeware. If the student (or instructor!) conducting a Placeware session using PowerPoint fails to create a "dialogue," she or he will immediately know it

by the lack of participation, the dreary response to any attempts at discussion, and the fairly obvious attitudes of inattention or boredom that become apparent.

So instead of just a "presentation tool," in Placeware, PowerPoint can be an effective "seminar" tool, organizing, stimulating, and summarizing technical ideas and well-organized complex thoughts while inviting discussion, questions, and contributions form the other participants. This is a valuable addition to the participants' understanding of this well established communication tool that may be essential as MEPP graduates are increasingly called on to lead or moderate on-line meetings in jobs. Today's skills in communication must prepare for the new standards of the near-future.

III. THE WORK OF "COMMUNICATING TECHNICAL INFORMATION"

An effective course must work on several levels:

> Program: MEPP has well-defined goals, a clearly identified audience, and a focus on engineering.
>
> Course philosophy: CTI is founded on the Program's commitment to "engagement theory" plus the course authors' extensive experience with classroom teaching.
>
> Tools and environment: web-based synchronous and asynchronous tools determine many aspects of what can and what cannot be done.
>
> Credit course requirements: Graduate professional education for adult learners has numerous well-understood requirements and imposes clear obligations on students and instructors.

However, it would be a mistake to limit the possibilities of a course such as CTI to the obvious limitations of a current technology.

One innovation of CTI – which in fact grows out of a standard "traditional" classroom feature – is in the delivery of an oral presentation based on the semester's research project before a live and (usually) authentic audience. This fits the "donate" component of "Engagement Theory." Students must to try to arrange the presentation of their written project before their peers, interested persons on the job, and even management. This component of the CTI course is very demanding: many students are hesitant to bring their MEPP projects so directly into their workplace; some find it difficult to find the right "opportunity"; however, the majority do this presentation on the job – have it videotaped, and send the videotape to the CTI instructors for evaluation. For many participants, this is a memorable and challenging event which marks a significance point in their career progress toward becoming a "technical leader."

A. CTI Course Methods

A class structure is maintained through weekly Placeware sessions and WebCT forums on CTI topics; readings are in the textbook (currently Kristin R. Woolever, *Writing for the Technical Professions*, 2nd. Ed., Longmans) and the extensive CTI Study Guide by Kutzbach and Ross; reading materials from Wendt Library may also be used and a lecture CD is under development.

The weekly Placeware netmeetings are seminar discussions including student and instructor presentations, and occasional guest lecturers. Additionally, WebCT faciliatates communication through email (for individual issues) and forums (for public discussions). Grading is based on the satisfactory completion of all assignments plus participation.

B. Minor Assignments During the Semester

Students conduct a Placeware session (usually 15 minutes); they participate in peer reviews and collaborative projects related to their major project; they may summarize a meeting, moderate a forum, and complete a choice of other minor assignments.

C. Major Project for the Semester

CTI is the opportunity for participants to conduct research using the resources of Wendt Library plus other resources and to complete a major research project, ideally job-related.

Besides a written report, students are required to deliver an oral technical presentation, videotape it, and submit it as part of their work for the course. In the past, many excellent presentations have been made on-the-job as brown bags, technical reports to peers and co-workers, or recommendations to peers and management.

Appropriate topics may grow out of problems to solve on the job, improvements in the way things can be done, or assigned tasks that will result in a writing project. Naturally, MEPP and CTI respect any issues of corporate privacy.

D. Transition to IRR

CTI is offered in the Spring of the second semester of the MEPP course sequence. In the following summer, MEPP students complete Independent Reading and Research in Applied Engineering (IRR) – primarily a writing and reporting project stressing the use of advanced research methodologies using the resources of Wendt Library, web resources, and other company, government, or standards resources, to solve a job-related problem. Sometimes the IRR projects grow out of the CTI project or out of other MEPP courses. For IRR, students are required to submit a paper and to make an oral technical presentation at the second MEPP Summer Residency held in Madison on the UW campus during August (Refer to Appendix B for the MEPP course overview).

During the Spring semester, students are required to identify their Summer IRR project; the final CTI assignment is a short first draft of the IRR research project proposal intended for the IRR instructor, the IRR technical advisor, and the IRR technical writing advisor (Paul Ross).

IV. New Motivations for Technical Leadership as a Theme and a Reality

"Reality " provides several approaches to defining "Technical Leadership" as a desirable educational theme in Technical Communication and as a career goal.

A. Interests and Ambitions of Engineers on the Job

Forum discussions and other independent discussions with MEPP students reveal ambivalent attitudes and some frustration about "technical leadership."

"Managers" are sometime dismissed as "TIPS" – "Technologically-uniformed Important People." However, most working engineers are quite aware of the challenges of avoiding technical obsolescence in their own careers and are working hard to prevent that.

Many MEPP participants have expressed frustrations to the authors about their opportunities and abilities to make a difference:

> *"The old and established people don't want to hear about new ideas."*
> *"Suggesting new ways is seen a criticism of the status quo."*
> *"My ideas are not respected."*

However, there are very positive attitudes at the end of the course:

> *"My manager wants me to make my presentation to the 'higher-ups'."*
> *"I never knew how to do a proposal – now I have a new opportunity."*
> *"I showed that the new way will benefit the company and the customer."*
> *"My boss talked to me for an hour about my ideas."*

B. "Bad News on the doorstep"

Besides the professional and personal ambitions felt but imperfectly expressed or realized by many engineers, the news of the day has provided ample evidence that there are significant failures in management sometimes due to a lack of "technical leadership." The *Challenger* disaster was one such case, blurring ethics, technical competence, communication effectiveness, and the issues of power and decision making. A brief bibliography is provided as Appendix C as a starting place for discussing the opportunities for improved technical leadership to meet such problems as new product design and marketing, financial fiascos like Enron and the internet bubble, and the challenges of career development for lifelong learning.

C. Significance for the engineer's culture

Wheeler and McDonald (2000) write:

> *Engineers are now largely absent at the top levels of government and industry. If this is to change, we will have to educate a new breed of engineer – one that is comfortable and effective in the executive suite as well as at the construction site or at the computer. Marshall M. Lih, former director of the National Science Foundation's Division of Engineering Education and Centers, states: "We do not educate enough of our students with the broad perspectives and long-term aspirations to be decision makers, strategic thinkers, opinion shapers, and planners…."*

These observations no doubt must be reviewed, discussed, and critiqued. Future work should define the nature of technical leadership in detail and evaluate the interests and motivations of engineers to develop skills in technical leadership; the relationships between traditional management and technical leadership must be examined; the interests of engineers and of business and industry in career development for "technical leaders" must be assessed. Additionally, the continuing task of improving online education for technical professionals will continue to be a challenging area of development.

Currently, in its context within MEPP, "Communicating Technical Information" is designed to help meet these challenges as they are now understood. This is an age of information, technical innovation, and intense competition. "Communicating Technical Information" and its methods will no doubt continue to evolve, but the importance of communication and the theme of "technical leadership" will be of increasing importance to career development and life-long learning for engineering professionals.

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Appendices

Appendix A: The Technical Communication Program at UW-Madison

The Technical Communication Certificate Program (TCC) at UW-Madison resembles a "minor" degree program, requiring 24-credit hours of work to complete the program. Besides work in general technical communication, editing, and oral presentations, elective courses include web design, teams, electronic publishing and user manuals. Other courses outside technical communication are selected from approved course in communication, computer science, math/statistics, and management/business/economics. Students may also work in all phases of the production of Wisconsin Engineer, the award-winning college engineering magazine; and, as a capstone project, TCC students complete a practical internship which requires substantial "real" technical communication work "on-the-job."

About half the undergraduate students taking the TCC are first and foremost engineers who want to add communication to their technical skill base; about a quarter have a special interest in communication because of a career emphasis on technical marketing or sales; and about a quarter are students who want to make technical communication their primary career. Most students are from the College of Engineering, but a substantial number are from other science and technology areas as well as from English and other liberal arts departments.

The Technical Communication Certificate Program (TCC) is primarily an undergraduate campus based program. In addition, The Technical Communication Program at UW-Madison teaches a graduate course on campus (mostly serving Masters and PhD students and those preparing papers for conferences and for publication). Finally, as part of the Engineering Professional Development department, the Technical Communication Program teaches short courses on campus and in-plant for working engineers on-the-job.

For more information, visit the TCC program at: www.engr.wisc.edu/epd/tc

Appendix B: Overview and Course sequence of MEPP

The Master of Engineering in Professional Practice is a two year program delivered on the web.

Each semester, a class of about 30 participants completes two courses, moving through the program toward graduation after four semesters and two summers.

Week-long summer residencies are required, permitting the opportunity for participants to become acquainted face to face with each other and with their instructors. The summer residencies also permit the opportunity for social and academic activities on the UW-Madison campus at a beautiful time in the summer.

In 2002, the University Continuing Education Association (UCEA) has honored MEPP in two categories:

UCEA's *Distance Learning Community of Practice*
UCEA's *Outstanding Credit Program Award*

For more information about MEPP, visit: http://mepp.engr.wisc.edu/

Year 1 - Summer	**Year 1 – Fall**	**Year 1 - Spring**	**Year 2 – Summer**	**Year 2 – Fall**	**Year 2 – Spring**
Network Skills 1 cr	Engineering Economic Analysis and Management 3 cr	Engineering Problem Solving with Computers 3 cr	Independent Reading and Research in Applied Engineering 1 cr	Engineering Applications of Statistics 3 cr	Quality Engineering a Quality Management 3 cr
First Summer Residency on the UW-Madison Campus	Technical Project Management 3 cr	***Communicating Technical Information*** 3 cr Ross & Kutzbach	Second Summer Residency on the UW-Madison Campus	International Engineering Strategies and Operations 3 cr	Engineering a Business Data Communicatio and the Virtua Office 3 cr

Note the strategic position of Communicating Technical Information at the end of the first year. It provides support for advanced work in other technical courses as well as for IRR in the following Summer.

The authors express their appreciation for the many friends and colleagues who have made MEPP and CTI possible.

Appendix C: A Preliminary Bibliography for "Technical Leadership"

The books and articles on this list provide some starting points for the current increasing interest in technical leadership and its value, especially for engineers and other technical innovators.

The materials on *Challenger*, listed in references, should also be consulted.

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