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1522-8150/00/$3.00/Educational Practice Manuscript

"Best" Practice Suggestions for Custom Building a Technology Class Web Site and Administering the Class

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This paper discusses a custom-built web site, http://www.ou.edu/architecture/dcns/cns4913/, used to deliver the University of Oklahoma, Construction Science Division cns4913online Construction Equipment and Methods class. The cns4913online class has been taught in conjunction with a lecture class meeting twice a week at the University of Oklahoma. Course content, sequence and assessment have been the same for the web-based and lecture classes. The purpose of this parallel delivery was for direct performance and administration comparison between the two instructional strategies. Using this unique opportunity for comparison and assessment "best" practice suggestions were developed for custom web site design and construction and administration of an online technology class.

Key Words: Construction, Construction Equipment, Distance Learning, On-line Classes, Technology, Web Based Instruction

The Need for "Best" Practices

Successful teaching of technology content (practical or applied science topics) in a distance-learning format is more difficult than teaching most courses offered on-line today. The teaching/learning strategy in current web based classes typically requires individual assignments routing the students to various reading resources in order to complete a paper for submission or to memorize specific answers. Self-paced online assessment can be done quickly and without faculty intervention using simple fill-in-the-blank, true/false or multiple-choice answers. Practical technology courses typically require a more interactive visual based problem solving teaching/learning environment than this. Many times the correct answer has to be determined by formula or understanding a process. Learning the formula or process is the objective of the exercise and the correct answer is a product of this understanding. In many problem-solving exercises, assessment must be based on the approach to the problem and the steps taken in the solution, not just the correct answer. This required assessment and feedback requires much greater effort and communication than simple online assessment. To successfully provide this required teaching/learning environment on-line, technology courses must incorporate more resources, more elaborate learning exercises and more communication between the class instructor and participants. The initial effort required for course development and administration, combined with limited funding, resources, manpower, expertise or a combination of these, is a great motivator for university technology curriculums to create and share on-line courses. These common constraints magnify the need for establishing “best” practices for efficient, economical and effective on-line course development and administration.

Using Courseware or a Custom Built Class Web Site

Collection, creation and organization of content and construction of the class web site incorporating this content are required to develop a class web site. Most online classes offered today are developed by a party other than the instructor or by placing suggested information into courseware to create a class web site. The drawback to this process is that the site builder or course software has no "feel" for the content. To compound this shortcoming, the content expert doesn't understand the platform in which the class web site is being authored, the capabilities of the medium and how these capabilities can be incorporated into a class. Ultimately this will breed mediocre products that will be used mostly for simple information transfer or communication. Without understanding the delivery medium's capabilities, these classes will be "rubber stamped". Having a basic understanding of both content and construction will greatly enrich the style and delivery format that can be incorporated into a web based class. This understanding will lead to better crafting of exercises and use of web-based resources and capabilities.

Available courseware such as CourseInfo or WebCT can be used to create, post and manage classes on the Internet, but they promote setup of class information delivery in a standardized traditional lecture format. Delivery of information is categorized, sequenced and posted to the user as if it was delivered and discussed in sequential class settings. Prepared and grouped PowerPoint notes can be easily converted to html script and posted on the web in the courseware shell. Selection of material for review is linear by order of presentation like a lecture class and delivery is much like looking at overheads or a slide show during a lecture.

This is a rather non-creative approach, but the delivery technique paces the learning rate of the participants. The paced delivery optimizes the participant's building of knowledge on previously learned information. Email, chat and bulletin board features can be automatically included in the class site using the courseware.

A custom-built web site can promote information delivery in a more creative, non-linear and self-paced format. An example of this format is the University of Oklahoma, College of Architecture, Construction Science Division cns4913online Construction Equipment and Methods class. The class web site, http://www.ou.edu/architecture/dcns/cns4913/, is a collection of categorized information and resources organized for exploration at any time by the user. The web site is used in conjunction with other traditional resources, including a text and a manufacturer's specification manual for the class. Exercises are used to promote exploration of all of the information resources to learn principles and applications. This less regimented and sequenced presentation of information in the web site is very suitable for classes with problem solving or evaluation components and promotes a more self-paced format for the class.

Because of the necessary interactive problem-solving environment required for technology courses, effective communication is essential. Participants require effective feedback communication in order to understand how to correct mistakes. Sufficient explanation has to be done online in a distance-learning format without the benefit of face-to-face communication. Successful communication about formulas and processes requires greater effort from the online class instructor and greater responsibility is placed on the participant to communicate reactions, shortcomings and misunderstandings in a timely manner. More elaborate means of communicating, such as desktop video conferencing or streaming video must be crafted into class administration and learning exercises to promote communication.

“Best” Practice Suggestions

The cns4913online class has been taught in conjunction with a lecture class meeting twice a week at the University of Oklahoma. Course content and sequence have been the same for both classes. Both classes completed the same homework assignments and exams at approximately the same times during the semester. The purpose of this parallel delivery was for direct performance and administration comparison between the two instructional strategies. The January 2000 Technological Horizons in Education Journal (T.H.E. Journal) has more information about the instructional strategies comparison. The article discusses findings using the University of Oklahoma College of Architecture lecture class evaluation criteria as a basis for comparison. "A necessary step toward online class quality assurance is determining how classes are to be evaluated by participants. Regardless of the delivery method, issues of quality are the same. Recognizing that online classes should be evaluated the same as lecture classes is a necessary step to establish standards for quality." (Ryan, T.H.E. Journal, 2000). Using this unique opportunity for comparison and assessment, the following "best" practice suggestions were developed for custom web site design and construction and administration of an online technology class.

The Class Web Site

Setup Web Site File Storage Directories for File Manipulation, Editing and Server Uploading

Proper storage directory structure for web site files is mandatory for authoring, implementing and maintaining a large class site with many resources. Create a "master" directory structure, including the directory in which all of the class site files will be located, subdirectories and sub-subdirectories. Base this structure upon the content categories and subcategories listed in the class syllabus. Create the menu on the web site, the directory structure on the authoring computer and the directory structure on the web server to match this "master" directory structure. This will make manipulating, editing and uploading frequently revised or updated files to the server very efficient for the site administrator. By matching the web site menu selections to the content topics in the syllabus, the syllabus serves as a site map to help users navigate through the content of the web site (see *Figure 1*: Storage Directories).

Use a Consistent Page Format

Create a "master" page. Include appropriate graphics, heading(s), title area and tables for text, images or other types of resources. Build-in typical internal links; such as "return to top of page" and typical external links, such as alternate menu links or links to supplemental sites. Contact, copyright and page author information about can be placed in a table at the bottom of the "master" page. Use this page as a template for subsequent pages that are created. Pages can be edited or customized easily with fonts, colors and page format remaining consistent. Using the "master" page simplifies and streamlines the web site construction process. The consistent page design and format will help users navigate through information more efficiently.

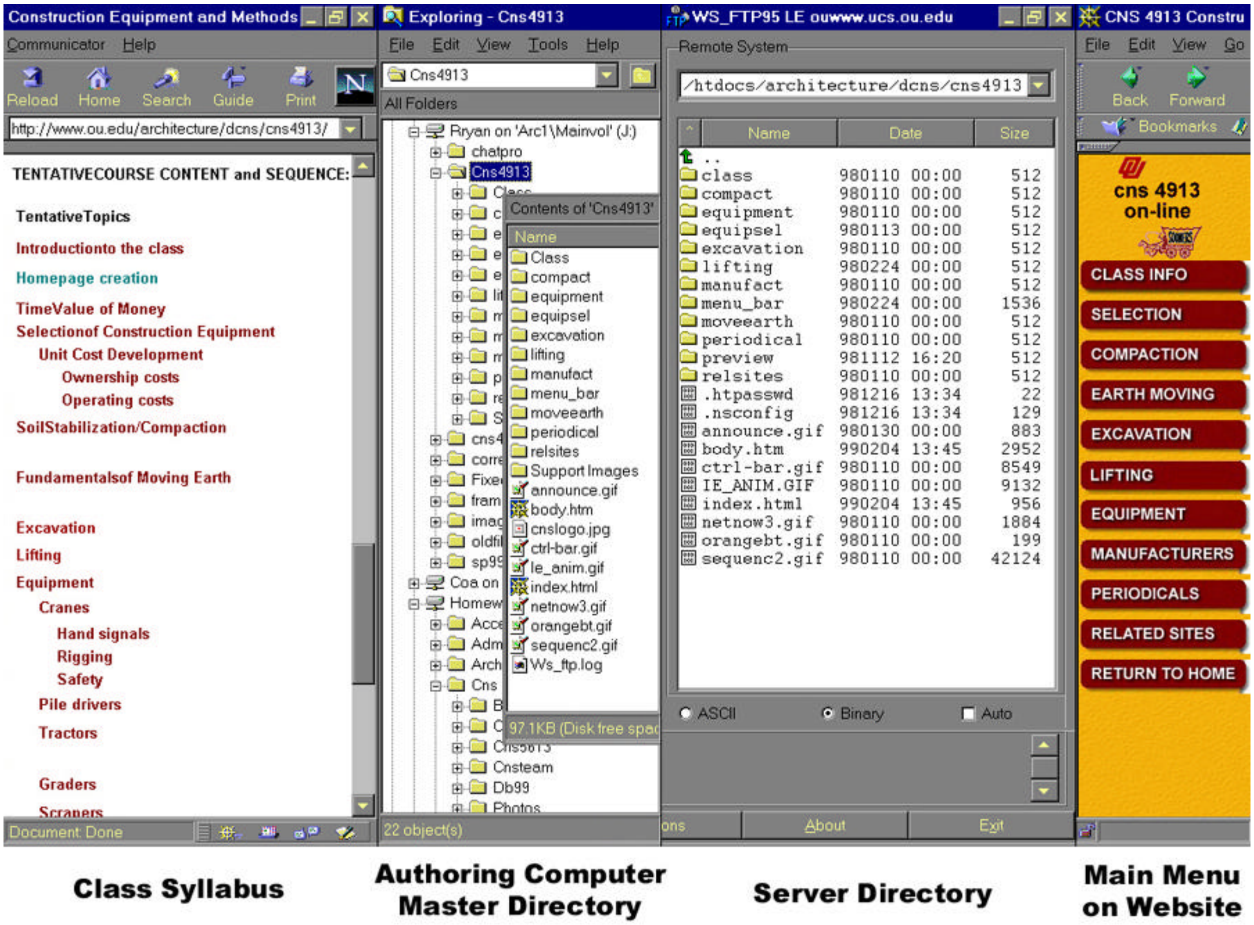

Figure1. Storage Directories

Use a Consistent Page Format

Create a "master" page. Include appropriate graphics, heading(s), title area and tables for text, images or other types of resources. Build-in typical internal links; such as "return to top of page" and typical external links, such as alternate menu links or links to supplemental sites. Contact, copyright and page author information about can be placed in a table at the bottom of the "master" page. Use this page as a template for subsequent pages that are created. Pages can be edited or customized easily with fonts, colors and page format remaining consistent. Using the "master" page simplifies and streamlines the web site construction process. The consistent page design and format will help users navigate through information more efficiently.

Use tables to structure the content in a page. Tables that resize to fit the viewing screen automatically and resources included in the page will remain in the same location regardless of the viewing screen. It is easier to organize information for printing or for constant editing in a table (see *Figure 2*: Consistent Page Layout).

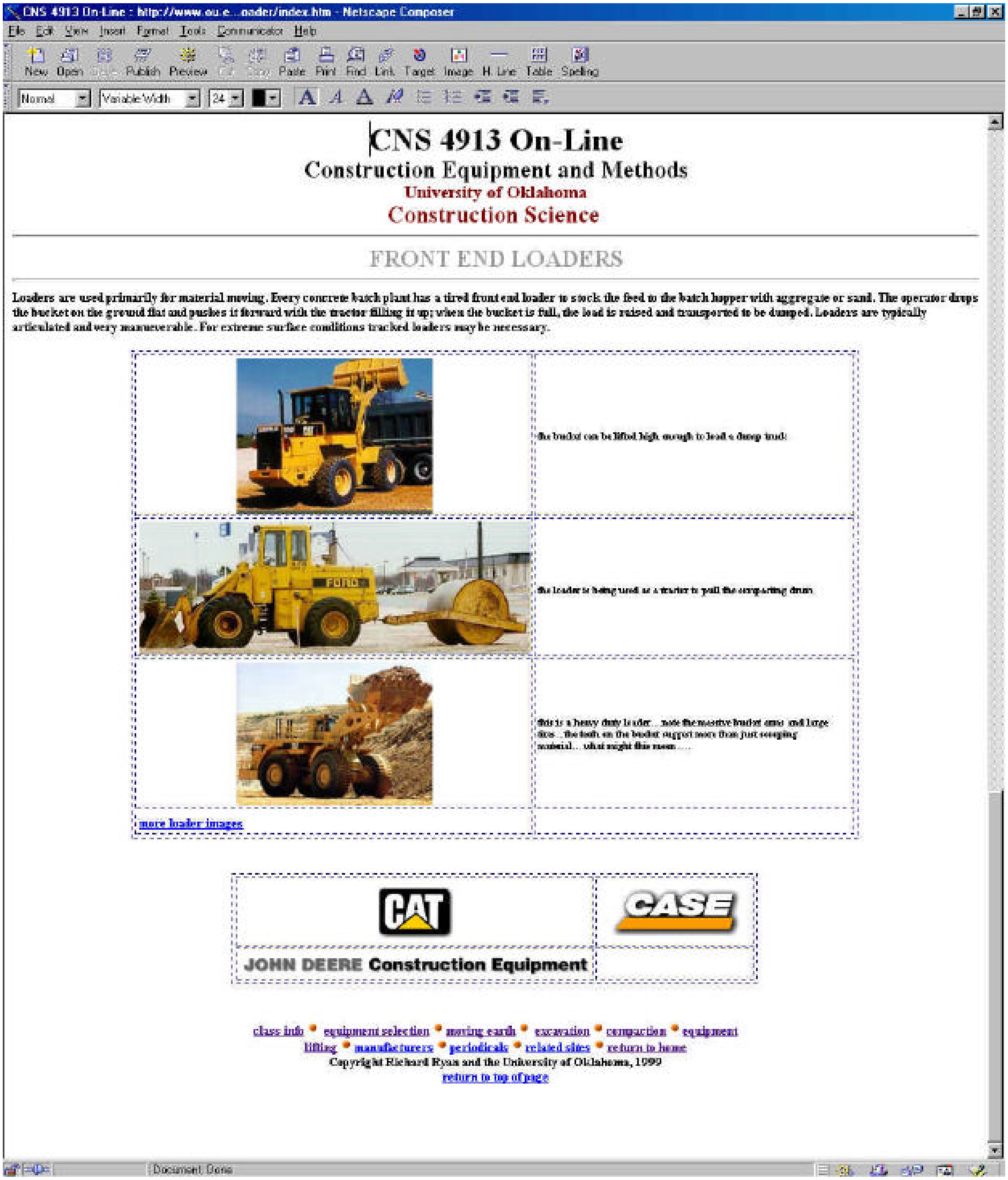

Figure 2. Consistent Page Layout

Frames can be used effectively to setup online exercises (see *Figure 3*: Equipment Watch 2). This example is two frames. Both frames have been setup as templates to be edited and used again (the third frame shown on the left of the image is the web site menu). The left frame is the questions and the right frame is an answer submittal form. Frames proportion themselves to the viewing screen and scroll up or down independently of the rest of the screen. Once the answers are completed online they are submitted directly to the instructor by email. Upon receipt, the instructor opens the email, grades it online and makes comments in a reply email to the sender. The text from the original email is included in the reply email for reference by the user.

Organize the Web Site as an Information Resource

Organize the web site as an information resource with built-in communication capabilities. Searching for information within the content of the web site should be the primary reason that a user visits the web site. The class web site can be a custom information resource used to supplement traditional class resources. Development of the web site is an excellent opportunity for the instructor to use self-collected resources and to express observations and suggestions about specific topics not covered in other class materials. The cns4913 web site addresses topics that the instructor felt were not addressed or were inadequately addressed in the textbook and other course resources. The instructor collected most of the images and video included in the web site to address specific topics about construction equipment and methods not covered in other class materials. The web site is not intended to replace the textbook, but to compliment that information in a visual, interactive and less formal manner.

Use Linked Industry/manufacturer Web Sites to Supplement Available Information

One of the greatest advantages of the web as a medium for delivering a technology class is the ability to greatly enhance and increase the information that can be included in class content. Industry and manufacturer's web sites contain images with explanations, process descriptions, catalogs of products with their specifications, periodicals, service organizations, testing sites and codes and standards. Manufacturers' web sites are created to market and provide services. They typically contain organized quality information created and maintained by responsible parties for industry users. With very little effort, exploration of information contained in these linked web sites can be incorporated into learning exercises (see *Image 4*: Caterpillar Crane Table).
As the internet flourishes as a medium for advertising and providing services, a company sponsoring an academic class containing information about their products or services offers a new kind of opportunity for industry and academia to partner. Sponsoring a web class has great potential for advertising to a very focused audience of emerging potential customers in numerous geographic markets. Generated funds can help support the offering program's recruiting effort and pay for the maintenance and improvement of the web site and class. The potential to create a resource that can be used for simultaneous teaching and promotion by both parties is not explored.

Create and Use the Web Site as an Extension of the Instructor's Personality

An image with appropriate explanation is an effective means of communicating a process or other visual based information. The use of images with text, video and audio is one of the greatest benefits that the World Wide Web offers to construction education. Write image narratives or other discussion in the first person when it is appropriate. Relate personal observations and experiences if appropriate. Students typically enjoy hearing about these practical experiences. This style of information delivery is common in traditional construction lecture classes. The same style can be used in the web site.

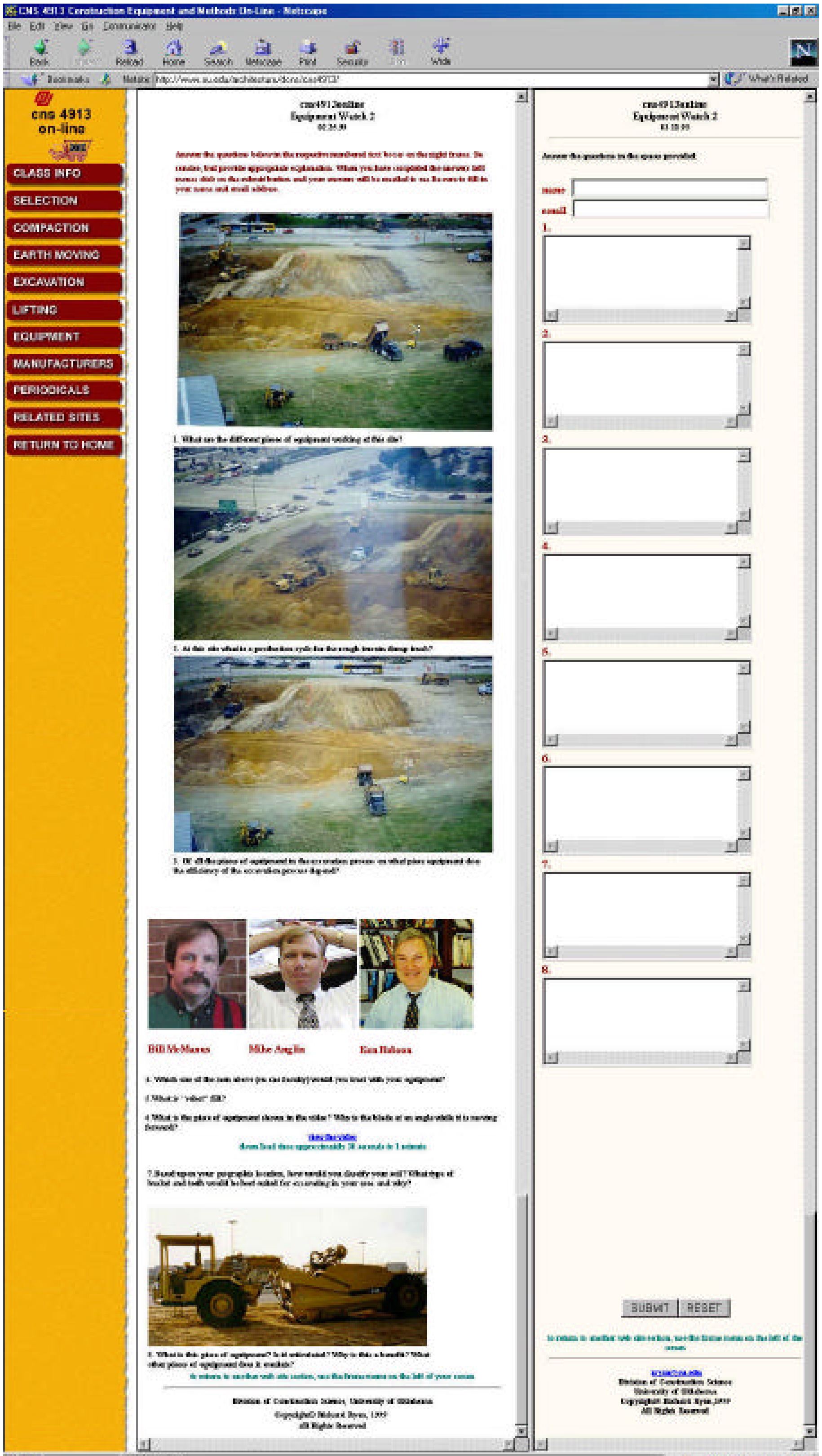

Figure 3. Equipment Watch 2

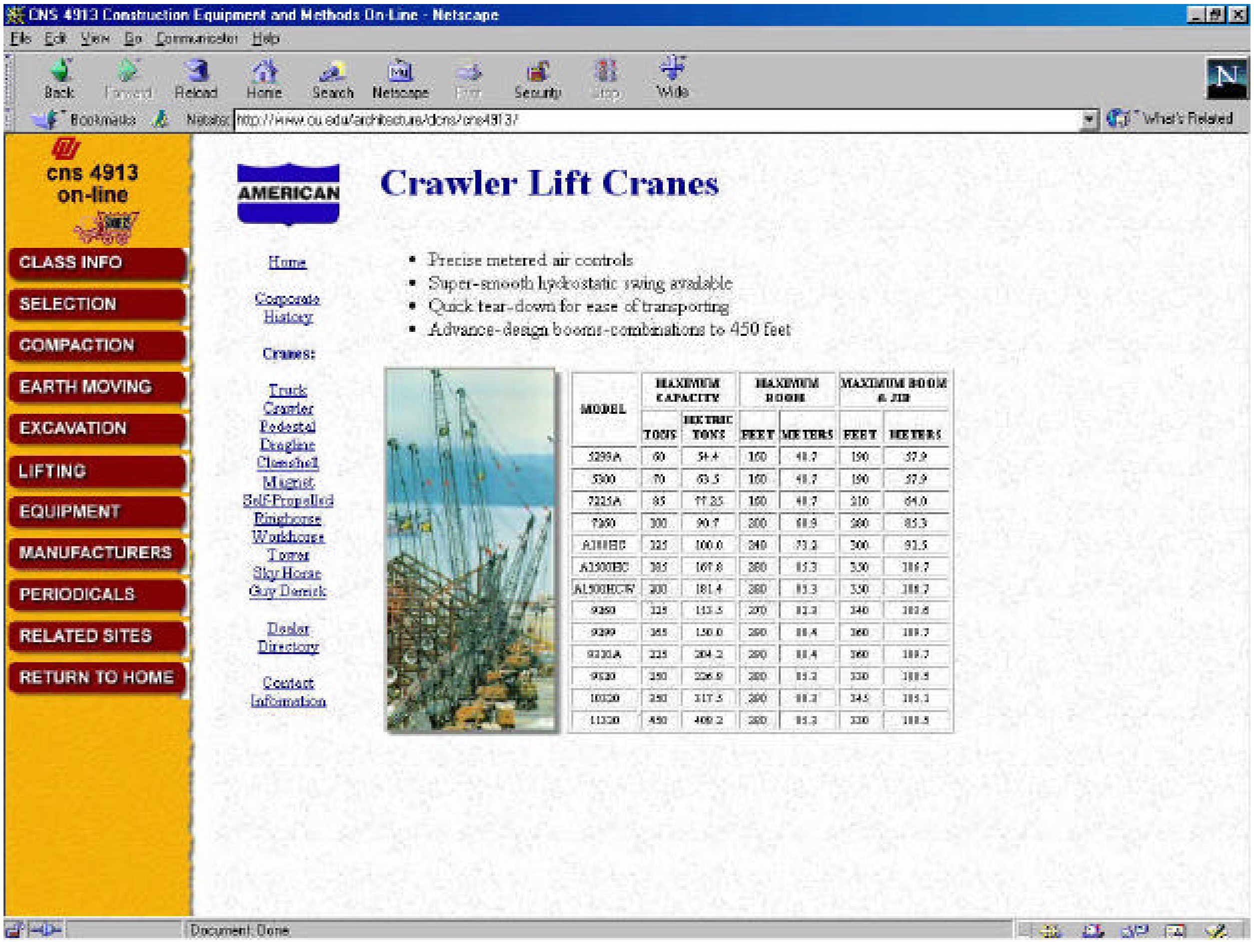

Image 4. Caterpillar Crane Table

Creative ways of using web site communication features can be incorporated into class administration and communication. Scheduled or random chat discussions with the instructor can be informal and used to minimize the distance learning anonymity. A chat feature can be used to post extra credit work notices or specific answers to questions on upcoming exams. Students will not see the posting unless they visit the web site. Only the ones that go to chat while the message is posted will get the extra credit or know of the potential test question. These examples are small incentives to encourage students to visit the web site and use the chat feature to check for announcements and to post and discuss questions and other topics associated with the class.

Unusual icon graphics or animated files can be used to personalize or make the site more "friendly". Graphics can be used to promote humor, highlight critical points and make navigational associations to a specific class activity or section of the web site. Animated files create a sense of motion or activity that can help understanding and be enjoyable if used appropriately. "Entertainment" graphics require greater download time than text and should be used sparingly.

Class Administration

Standardize Required Technology and Software

Minimum hardware and software requirements for all work in the class should be included in the class syllabus as part of the resources required for class participation. Software compatibility for downloading files from the server, opening and editing files on the user's computer, and transferring the files back to be graded is extremely important. Other hardware needed, such as a desktop video camera, should be also specified in the syllabus. Recommending a camera for purchase by class participants was addressed in the cns4913online syllabus by placing a link to a recommended manufacturer's web site for specific product information and ordering if desired. An agreement with a bookstore to supply the required text can be made and an online order form that is automatically sent to the bookstore can be linked to the name of the textbook in the syllabus. The bookstore receives the online order with a credit card payment and the book is shipped to the class participant.

Use Simple Consistent Administration of Assignments

Post assignments for downloading in a designated area of the class site (see *Figure 5*: Assignments Page). The user can go to this page and download the assignment when desired on any computer that has an Internet connection. It is good practice to notify participants that a homework assignment has been posted and this can be conveniently done using an email listserv for the class. Name the downloadable file posted on the assignments page the same as the subdirectory (folder) in which it is to be stored for grading and return (hw1.doc is the file and hw1 is the folder). The user saves the file when it is downloaded and opens it in the appropriate software for completion when he or she wants to work on it. The file is setup in a traditional question/answer form to be edited by the user and resaved. The edited file should be renamed by the user with the first four letters of the their last name and the original file name (example: ryanhw1.doc: Richard Ryan is the participant; hw1 is the assignment designation and the folder in which the file is stored). If the completed homework is returned as an email attachment use the subject line of email form to designate the subdirectory in which the attachment should be stored (hw1).

Grade and Communicate Assessment Systematically

Exercises that require showing work or calculations for partial credit, fill in the blank or short narrative answers and discussion answers are often necessary in technology classes to evaluate how well students understand what they are learning. This style of assessment places much greater demands for effective and efficient communication on the user and the grader than traditional hard copy testing and assessment. The lack of face-to-face oral communication must be replaced with text comments.

Figure 5. Assignments Page

Use of Microsoft Office 97 Word (document) and Excel (spreadsheet) software is required as stated in the class syllabus. Both software offer the capability of color highlighting and colored fonts. Incorrect answers or portions of the answers can be highlighted in yellow and as with traditional grading, red can be used to designate point deductions and comments by the grader. Using a consistent coloring and comment format for grading will minimize confusion about notations.

Grading digital assignments is much more time consuming than grading the same hard copy assignments. Communicating assessment based on typed comments is much more demanding than returning and discussing the assessment in a lecture setting. More time and effort must be spent crafting concise, yet adequate assessment comments, due to the lack of face-to-face oral communication that typically takes place when the assignment is returned. Being able to orally address a class all at once and a specific participant face to face to discuss grading and correct answers greatly reduces the need for specific comments to be written on the returned exercise. The lack of face-to-face communication places much more responsibility on the participant to communicate if they do not understand. Participant reluctance or lack of effort to communicate about misunderstandings or misinterpretations is magnified. Face to face communication requires less effort than email or the telephone and emotional feelings can be expressed and viewed by both parties. Emailing or calling on the telephone in an anonymous format requires effective communication without the influence of visual contact.

When assignments are received by email the email letter should be printed for hardcopy verification of receipt and permanently filed. The attached file (assignment) is saved to the appropriate assignment subdirectory for opening and grading later. Then the email is filed to the appropriate email subdirectory for storage and verification of receipt if necessary. Individually each of the saved attachments is opened, reviewed, graded, the grade is recorded and the file is resaved under the same file name. If a hardcopy of the assignment is printed, then the cover email sent with the assignment can be stapled to it for permanent storage. Students can use the cover email to discuss problems that they had with the assignment to alert the grader about possible areas of focus and better explanation. Individually the stored email from each participant is reopened and reply is selected from the email software menu. The return email is automatically configured and the graded file is attached and sent back to the participant.

Minimize the Use of Off-site Faculty

Online classes should be formatted and administered to minimize the need for off-site faculty intervention. Using off-site faculty intervention is contradictory to what is appealing and beneficial about online classes. Determining the need for off-site intervention will be greatly influenced by the appropriateness of the class content for delivery in the web medium. An important role that off-site faculty can play is the promotion of online classes to prospective participants at their universities. An email announcement was sent to all member programs of the Associated Schools of Construction announcing the cns4913online class. To aid in the class marketing a limited preview site, http://www.ou.edu/architecture/dcns/cns4913ol/preview/, was placed online so prospective students could get a feel for the class web site and administration of the class. The current need for specific class marketing will change as online courses become cataloged in university curriculums and promoted at the national level.

Match the Testing Format to the Appropriateness of the Class Content

One of the determinants of the appropriateness of class content for delivery using the web is the degree and method of testing that is suitable to access participants' understanding. The anonymity of the distance-learning format places a large responsibility on the participant to follow specified guidelines and to do work independently when required. The instructor has to rely on the participant to do this, unless some other verification mechanism is used. Off-site faculty can be used to proctor exams and verify compliance of rules if this is determined to be necessary. This places an extra coordination burden on the class instructor. As part of the syllabus for the class it might be required that the participant enlist a responsible party at their location to insure and verify compliance. Eventually universities may have centers dedicated to proctoring assessment exams for online classes and verifying compliance of participants to course requirements. Developing effective and reliable assessment methods for online class participants perhaps will demand the greatest effort for innovation and departure from traditional practices.

Relate Practical Exercises to the Diverse Geographic Locations of the Participants

Practical exercises can be crafted to explore and compare conditions of participants' possible diverse geographic locations. This is especially suitable for technology courses. Diverse work environments and local market customs and standards can be incorporated into problem solving exercises. Exercises can be fashioned for self-exploration of a specified topic or set of questions and collaboration required for comparison and analysis. Class participants' best reports, findings or observations can be posted on the class web site for all class participants to review, conveniently adding to the available information about the topic.

Class Interaction and Communication

Work to Overcome Limited Personal Instructor Interaction

The limited personal interaction between the instructor and class participants is a perceived major weakness of online classes. In a typical online class the instructor has never had the participants in a previous class and background information regarding their typical effort and performance is not available. Participants have never had the instructor for a class, so they are unfamiliar with the instructor's mannerisms and communication preferences. This creates a natural awkwardness in the online communication process between the instructor and the class participants, especially about assessment issues. This awkwardness has to be minimized for effective communication to take place. The instructor can take the lead to minimize this awkwardness by being less formal in emails, announcements and chat room postings to participants. Sharing interests about class content and how presented information can be used practically are good topics for informal discussion. National or regional items or events relating to class content provide common ground for discussion also. Using the class listserv an email discussing the past weeks events, the current class status and upcoming class activities can be conveniently sent at the end of each week to each participant. This email can also be used to openly encourage communication between participants.

Work to Promote Participant Communication and Collaboration

Another of the primary determinants of the appropriateness of class content for delivery using the web is the amount of independent learning or collaborative learning that needs to occur in the class. In a traditional lecture class many participants are reluctant to contact other class participants for help or social interaction. Email, chat and video conferencing are the primary ways that this interaction can occur online. These communication methods have an anonymous quality that makes interaction more difficult. Participants' typical reluctance to communicate can be magnified or minimized by the impersonal nature of Internet communication. Those needing to have face-to-face interaction may communicate less, while those preferring anonymity may communicate more.

The opportunities to work independently at one's own pace and to communicate anonymously are two of the primary advantages of an online class. Special effort must be made to promote necessary communication and interaction in classes utilizing problem solving and team exercises. To do this effectively online demands much greater effort than a traditional class setting.

A communication page should be created with all participants' linked email addresses and a link to the class chat feature. Links to participating universities' web sites and participant's home pages, pictures or short bios containing background information and interests are a simple means of removing some of the anonymity about the participants.

Use the Telephone, Desk-top Video Conferencing and Chat

Online class participants need encouragement to communicate regardless of the medium. Though not the most economical, the telephone is still the most efficient and easiest means of communicating person to person. A desktop video camera is affordable technology that extends the concept of the telephone to include visual communication. The concept and technology is effective, but the Internet's current ability to transfer data is not sufficient. Point to point visual and oral communication using web based video conferencing is not real effective because of poor quality audio and video transmission. Trying to have an online session for explaining assessment of an exercise or an online office hour during high internet traffic times will greatly decrease the quality of the transmission. Today web based video conferencing is not as effective as communicating via the telephone. However exploring and developing a strategy for communication in an online class using desktop video cameras is essential. Current web based video conferencing is a primitive form of the future telephone and television and will be an essential element for communication in future online classes. The medium's affordability and ease of setup make it appropriate for effective and economic communication.

A text chat feature can be used for real time communication or threaded discussion like a bulletin board. The major drawback to Internet real time text communication is the speed of the process. This process is often dictated by how fast the user can assimilate and type thoughts to the other party. Communicating in this manner requires much greater effort than oral communication, because of the required typing. As users become familiar with the chat process, their typed comments become more efficiently worded.

Require On-line Common Time for Interaction

Regardless of the delivery strategy for the class, participants want the instructor to be accessible for questions, feedback and general expressions of feelings. Meeting in a classroom at the required time is the primary catalyst for this communication typically. This traditional expectation of the classroom experience is more difficult to meet in a distance-learning format. Even if lectures are videotaped and posted for review on the web site, participants still require interactive time for clarification and discussion. Online office hours in the chat room or video conferencing at a designated time several times each week can help provide this catalyst for communication.

Quality Instruction Verses Class Convenience

The quality of content and administration of an online class should be at least as good as for the traditional lecture class. This quality should not be compromised for the sake of posting the class online or for the convenience that using the Internet brings. The opportunity for enhancing the teaching process using web-based resources and capabilities is just beginning to be explored and the opportunities are great. This discussion hopefully highlights several “best” practices that will promote the quality of online technology courses.

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Student Teaching Evaluations: Options and Concerns

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Student teaching evaluations attempt to provide information about an instructor's teaching effectiveness. While the majority of evaluations consist of written questionnaires administered at the end of the academic term, mid-term evaluations can provide timely and useful feedback. Many instructors regard the use of evaluations for personnel decisions with distrust, especially since concerns have been raised about the validity and bias of these instruments. Although many articles have been written about teaching evaluations, this topic still needs to be researched and discussed in construction management education. This article discusses the most common approaches to student teaching evaluation, as well as the concerns that have been raised by educators and researchers about their use. Further research needs are discussed in its Conclusion.

Keywords: Teaching evaluation, Instructional improvement, Grading leniency, Dr. Fox effect.

Introduction

The vast majority of American higher education institutions require some form of student evaluation of teaching (Newport, 1996; Wachtel, 1994). These evaluations have substantial influence in administrative decisions such as faculty tenure, promotion, and post-tenure reviews. On the other hand, teaching evaluations provide feedback to instructors about their pedagogical strengths and weaknesses (Marsh and Roche, 1997). With such important issues at stake, literally thousands of articles have been written about student evaluations (Marsh and Dunkin, 1992). This vast amount of information has not yielded a consensus about how they should be used, or even whether they should be used at all (Wachtel, 1998). Opposing views are manifested clearly and loudly in the literature. For example, a full section of *American Psychologist* (Vol. 52 (11), November 1997) devoted to the topic had rebuttals and counter-rebuttals of the very articles presented on the issue.

The ongoing, passionate debate over student evaluations has not been apparent in construction management education literature. A review of the ASC Conference Proceedings reveals articles on related issues such as faculty tenure and promotion (e.g., Christensen et al., 1992, Ciesielski, 1997), outcomes assessment (e.g., Segner and Arlan, 1991, Slobojan 1992, Yoakum, 1994, Hauck, 1998), and student peer evaluations (Feigenbaum and Holland, 1997), but no article has had a primary focus on teaching evaluations. This article discusses the most common approaches to student teaching evaluations, as well as the concerns that have been raised by educators and researchers about their use. To provide a context within construction management education, examples of teaching evaluation items and a mid-term evaluation session at Colorado State University are included here.

Written Questionnaires: Basic Building Blocks of Student Evaluations

Student questionnaires are, by far, the most popular form of teaching feedback (Simpson, 1995). These paper-and-pencil tools are easy to tabulate and economical to administer, but they are also the most controversial evaluation tool, due to common problems in their design and implementation.

One of the most quoted questionnaire designs is the Student's Evaluation of Educational Quality (SEEQ), developed by Marsh et al. (Marsh, 1987, Marsh and Dunkin, 1992). It identifies nine factors that should be probed: Learning / Value, Instructor Enthusiasm, Organization / Clarity, Group Interaction, Individual Rapport, Breadth of coverage, Examinations / Grading, Assignments / Readings, and Workload / Difficulty. The number and phrasing of questions is left open to the needs of each college, but since questions are often drafted by non-specialists in pedagogical issues (Newport, 1996), poorly structured items can slip into a questionnaire. A recent questionnaire in a mid-western university asked construction management students to rate from "Strongly Agree" to "Strongly Disagree" the statement "Overall, I would rate this instructor as excellent." If the instructor were good, but not excellent, how would a student answer this question? The author contacted the university and the actual drafter of the question. She explained that the original question was "How would you rate this instructor," with answers ranging from "Excellent" to "Poor." The magic of an administrative committee created its final published form. The drafting of teaching evaluation questionnaires by administrative committees has been frequently criticized in the literature (e.g., Lin et al., 1984; McKeachie, 1997), since the resulting material tends to emphasize summative applications.

Newport (1996) recommends limiting student questionnaires to low-inference items such as "The instructor began class on time," "The course syllabus included the course objectives," and "The instructor was prompt in returning tests and written assignments." Newport also advocates the elimination of high-inference items such as "The instructor was skilled at observing student reactions and modified his instructional strategies when needed" and "The instructor served as a good model of a reflective decision-maker." While low-inference items refer to facts or behavior readily observable by students, high-inference items require more sophisticated judgment.

High-inference items are ubiquitous in the questionnaires reviewed by the author. At Colorado State University, for instance, one mandatory survey includes the questions "Course assignments are consistent with the objectives of the course", and "The assessments / assignments / examinations were appropriate and clear" (CSU Student Course Survey). Another mandatory questionnaire at CSU asks students if "The grading system was fair", "The instructor utilized a variety of teaching styles", and "The instructor created an atmosphere conducive to learning." (Teaching Evaluation Instrument, CAHS). These questionnaires were introduced on fall 1998. A tabulation of answers to these items was not available for analysis when this article was written.

Mid-term Evaluations: Valuable Alternatives

A mid-term evaluation can consist of only a conventional student questionnaire, but this feedback technique is very commonly augmented with interviews, debriefing sessions and follow-up questionnaires. From a pedagogical perspective, there is evidence that mid-term evaluations are substantial improvements over end-of-term questionnaires. Studies by Abbott et al. (1990) and Wulff et al. (1985) showed that students are more satisfied with mid-term evaluations. Furthermore, Cohen (1980) concluded, "Instructors who received midterm feedback were subsequently rated about one-third of a standard deviation higher than controls." Even with such positive comments, most faculty do not use mid-term evaluations. Jacobs (1987) found that 82% of instructors only use end-of-term evaluations, and that 28% of them administered the evaluation on the last day of class.

The most common form of mid-term evaluation is the Small Group Instructional Diagnosis (SGID). It is an open-ended technique developed at the University of Washington's Biology Learning Resource Center from a model created by Melnik and Allen, University of Massachusetts (Clark and Bekey 1979). The essential procedure for SGID is described in the following section. Many other mid-term feedback instruments have been developed. For example, Fabry et al. (1997) describe a series of continuous feedback instruments that were administered regularly during a semester. The most effective (for formative purposes) and popular (among students) of these instruments was The Muddiest Point, where students wrote, anonymously, the most unclear point at the end of each lecture. Fabry et al. consider that because grades are still unsettled, student anonymity is essential for mid-term evaluations. In contrast, Timpson and Bendel-Simso (1996) encourage the full and public participation of students in the feedback process.

Effectiveness of Mid-term Evaluations: An Example

The author was involved in a difficult situation where a mid-term evaluation was of great help. He was co-teaching a capstone project management course at Colorado State University, and there was a subtle but unmistakable negative environment in the class. On his request, the Center for Teaching and Learning at CSU conducted a mid-semester student feedback session that essentially followed the SGID model, but included elements developed at CSU. The session was completed in less than one hour of regular meeting time. The facilitator explained to the students how the meeting would be conducted, and that it had been voluntarily requested by the instructor. It consisted of three parts. First, the instructor left the classroom, and the conventional questionnaire form used at CSU for teaching evaluations was administered. Each student also included three positive comments about the instructor, and the three main concerns about the course. The second part was also conducted without the instructor's presence, and consisted of a discussion of the students' concerns, including recommendations to the instructor. In the third part, the instructor returned to the classroom and was debriefed about the concerns and recommendations.

It turned out that the students did not question the instructor's level of knowledge, and consistently appreciated his sensitivity towards them as individuals. The main concerns were a perceived disorganization and a tendency to stray to unrelated subjects during the lecture (both issues coming as total surprises to the instructor). It was relatively simple to improve the manifested concerns, and the end-of-term evaluations were only slightly below the instructor's average.

As a result of this experience, the author has continued conducting a modified mid-term evaluation in other courses. A questionnaire is administered after the first six weeks of the semester, and then repeated in the twelfth week. The form used contains the same questions used in the university-wide mandatory survey, and also requests three positive comments about the course and / or the instructor, three concerns about the course, and open-ended comments. The survey is administered at the beginning of the class period, and takes fifteen minutes to complete. The results are discussed at the end of the next session, and students provide specific recommendations to the instructor. In one case, a follow-up questionnaire was used to preserve anonymity, but students have been very willing to voice any negative issues despite the lack of anonymity in this part of the process.

Concerns about Student Evaluations: A Serious Issue

Despite all the benefits that student feedback can bring to the classroom (Marsh, 1987), the use of student evaluations for instructional improvement is dismally infrequent. A survey by Spencer and Flyr (1992) found that only 23% of faculty made changes to their teaching based on student evaluations, and that the majority of these changes were superficial, such as altering handouts, modifying presentation habits, and changing assignments. Reasons for the infrequent use of student evaluations to improve teaching can probably be traced to the concerns that many instructors harbor about the fairness and usefulness of these surveys. Ryan et al. (1980), found that the mandatory use of student evaluations led "to a significant reduction in faculty morale and job satisfaction." They also reported cases where instructors lowered standards and workloads, developed easier examinations, and probably inflated students' grades. Baxter (1991) found that in cases where evaluations are left to the instructor's discretion, such negative impacts were much lower. The following sections explore some of the most common concerns about student evaluations raised in the literature, without claiming to be a comprehensive review of such concerns. Extensive reviews have been written by Wachtel (1998) and d'Apollonia and Abrami (1997), among others.

Formative and Summative Applications: at the Heart of Concerns

Formative applications are those where student evaluations are used as a tool for instructional improvement. In contrast, summative applications make use of evaluations for administrative purposes such as decisions about faculty retention, tenure, promotion and salary increases.

The use of ratings for personnel decisions has been criticized by many authors (e.g., Murray, 1984, Ramsden and Dodds, 1989). The worst scenario comes when instructors are ranked from "best" to "worst" based on their student ratings. D'Apollonia and Abrami (1997) point out that this approach implies that 50% of the faculty fall "below the norm," even if they are excellent teachers. Imagine a baseball team where all players are batting over .300. Ranking all players from best to worst would imply that 50% have averages “below the norm,” even though the worst player would be quite competent The opposite case could also happen. A team’s “best” player could average .250, which by most standards is low. As McKeachie (1997) points out, small numerical differences are “unlikely to distinguish between competent and incompetent teachers.”

The antagonism to the summative use of student evaluations has resulted in caustic articles and commentaries. For example, Newport (1996) writes that:

> “Few of the higher education administrators in the USA who rely on amateur raters to assess teaching performance [...], would allow untrained and inexperienced students to cut their hair, [...] or to make investment decisions involving a few thousand dollars of their personal funds. [...] Yet, in the USA, untrained, amateur student raters are routinely used in making salary adjustments, tenure and promotion decisions - decisions that sometimes have severe consequences for those who are affected.”

Consistency of Student Ratings

There is substantial agreement among researchers that student evaluations provide consistent feedback of general areas of an instructor's strengths and weaknesses, and can result in substantial improvement of specific target areas (e.g., Marsh and Roche, 1997, d’Apollonia and Abrami, 1997). Furthermore, Feldman (1988) found that students and faculty generally agree on what constitutes effective teaching and rank similarly its most important components.

Despite the generally positive reports on the consistency of student ratings, other accounts yield a less favorable picture. For example, Greenwald (1997) describes how he received the highest marks on a course, only to receive an appalling rating (lower by eight points on a scale of ten) on the same course the next year. He points out “the two juxtaposed ratings contained more than a mild hint that my students’ responses were determined by something other than the (unchanged) course characteristics or the (presumably unchanged) instructor's teaching ability.” Contradictory results are also reported by Follman (1983), who found in his study that when students were asked to name their best and worst teachers, 15% to 20% of the instructors appeared in both lists.

The Dr. Fox Effect

To demonstrate that a highly entertaining and expressive instructor can receive unduly high ratings, Naftulin et al. (1973) designed an experiment in which a professional actor introduced to the students as “Dr. Fox” gave a “highly expressive and enthusiastic lecture that was devoid of content, and received high overall ratings” (Watchel, 1998). This bias is commonly referred to as the Dr. Fox effect, and has been re-examined and fiercely contested in later studies (e.g., Abrami et al., 1982; Leventhal et al., 1976). The current consensus is that although the Dr. Fox effect does influence ratings, it is a relatively minor bias (Marsh, 1987).

Grading Leniency

One of the most researched issues in teaching evaluations is whether an instructor can increase his/her ratings by giving undeserved high grades to students. The topic is critical because if such bias is true, the use of student evaluations for administrative decisions is fundamentally undermined. Despite numerous studies on the effect of grading leniency, this issue is far from settled. Some researchers have found that a moderate correlation between grade leniency and ratings does exist (e.g., Chacko, 1983; Vasta and Sarmiento, 1979, Powell, 1978).

Opposite findings on grade leniency bias are reported by Greenwald and Gillmore (1997). In their article, a section is entitled "Yes, I can get higher ratings by giving higher grades." They present the results of their own research at the University of Washington, which included the collection of data over three or more semesters on university-wide samples of courses. Their conclusion was that for their sample, a grade increase from one standard deviation below the university mean to one standard deviation above the mean could increase an instructor's rating from half a deviation below the university mean rating to half a deviation above the mean university rating. In such case, using a normal statistical distribution, the instructor would get a boost from the 31^{st} percentile to the 69^{th} percentile.

Other Biasing Factors

Hewett et al. (1988) found that good grades on the first examination correlates positively to the ratings given to instructors, and that subsequent examinations have less effect on ratings. McKeachie (1979) and Gigliotti (1987) report that a very important biasing factor is the students' expectations about the instructor, i.e., the instructor's reputation affects his/her ratings. Feldman (1979) has found that the instructor's presence in the classroom tends to increase his/her rating, and that anonymous questionnaire responses tend to be more critical than those where the rater is identified. Rubin (1995) found that instructors with attractive physical appearance but authoritarian attitudes had less negative reviews of such authoritarian attitudes than similar instructors with less attractive physical appearance. Non-native speaker instructors with attractive physical appearance were less criticized for their accent than other non-native speaker instructors with less attractive physical appearance.

Feldman (1979) asserts that smaller class sizes lead to better ratings. He also concludes that elective courses usually have better reviews than required courses, as well as higher-level courses. Centra (1993) found that science and mathematics instructors receive lower rates than their liberal arts counterparts. Other findings include that the correlation between research activity and teaching effectiveness is near zero (i.e., one does not influence the other) (Centra, 1993), and that course difficulty correlates positively with ratings (Marsh, 1987).

Conclusion

This article has shown how teaching evaluations are intrinsically double-edged swords, one edge being their formative applications, and the other their summative applications. The mid-term evaluation example described here shows how student feedback can be formatively used to bring dramatic, immediate improvements to the classroom. Even considering the bias factors and other concerns discussed here, the majority of studies show that evaluations can provide insight into an instructor's basic strengths and shortcomings. If the formative edge is sharp, the other edge of the evaluation sword seems equally cutting. Summative applications, such as for salary adjustments, are repulsive to many faculty members (e.g., Newport, 1996). The author's anecdotal experience is that many instructors have faced a situation where a difficult assignment or an honest mistake while grading an exam disgruntles a couple of students, who then create a negative classroom environment. Common sense would indicate that the rating given to the instructor for such course would be lower than deserved. In fact, Jacobs (1987) found that 40% of surveyed students said that they have heard of "students plotting to get back at an instructor by collectively giving low ratings." It is hardly surprising that an instructor facing this scenario will not take seriously the students' feedback.

This article creates an intellectual baseline for further discussion and research geared to construction management education. What are the teaching evaluation practices used in construction management programs? How should they be shaped to the needs of construction management education? What are the perceptions about teaching evaluations from faculty, student and administrators? Uncritically accepting the results of existing analyses created for other fields of study would be shortsighted. It could be that the evaluation instruments used now have an unjust negative impact for construction management faculty and construction management education in general. It is important and urgent to find answers to these questions.

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The Challenges and Rewards of Outcome Assessment

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This article presents a philosophy of outcome assessment that is based on the premise that the goal of any institution is to have an exceptional reputation and produce graduates that are worthy of that reputation. A menu for achieving excellence and prominence is presented which includes external relations, quality programs, quality faculty, quality facilities, quality students and an optimum enrollment. The interrelationship between these elements is clearly identified. An important step in developing an outcome assessment process is the identification of constituencies served by the program. These may include but are not limited to employers, alumni, students, parents, faculty and staff, advisory board, university administration, and appropriate accrediting agencies. The relationship between these constituencies is discussed in detail in this article. Although it is difficult and impractical to develop a single model that fits all institutions, it is clear that construction programs and civil engineering programs need to implement well-designed assessment programs. Clearly defined assessment plans are needed to foster the development of excellence among faculty, alumni, and students and meet accreditation criteria. The academic community must broaden its thinking, examine changing technologies, consider global issues, define its mission, and establish an appropriate vision. The community must also recognize that the demands and needs of external and internal constituencies are varied and must be taken into account. It is time to move beyond the tired old teaching versus research debate and define what it takes to achieve excellence and quality.

Key Words: Accrediting, outcome assessment

Overview

The assessment of quality in higher education includes the need to have a clear awareness of institutional mission, resources, accreditation criteria, new technologies, and global competition (Al-Khafaji, et al, 1998). It is well known that quality is defined as meeting stated standards and objectives. Consequently, it is critical that a mission statement be the first order of business when developing an assessment program. Subsequently, a set of objectives with appropriate standards and norms must be established to help assess the degree of success in meeting program mission and objectives.

A major thrust of this article is to provide educational institutions with an overview of the assessment process and encourage faculty to improve. However, it is the responsibility of administrators in higher education to provide the proper environment and needed resources to stimulate and energize the faculty in their quest to achieve quality and excellence in meeting stated goals and objectives. Institutions need to place less emphasis on definitions and more on generation of a substantive rewards system for excellence in all areas of faculty work. It is important to note that it is now mandated by accrediting agencies that programs produce evidence of quality through an established assessment program.

Accreditation agencies and well-respected educators have taken the lead to demand greater accountability from educational institutions. While engineers and constructors enjoy admirable reputations, the education of future engineers and constructors must take into account the following factors:

1. Declining admissions standards.
2. Low salaries for construction and engineering graduates compared to business.
3. Global competition.
4. Changing technologies and lack of resources to adjust.
5. Poorly prepared high school graduates.
6. Lack of quality educators.
7. Lack of assessment standards to reward good teaching and service.
8. Grade inflation.
9. Inadequately prepared graduates.
10. Poor performance on standardized tests.
11. Poor communication skills.
12. High attrition rate of faculty in construction and civil engineering.

Although the validity of these and other factors may vary from one institution to another, there is no doubt as to their relevancy and legitimacy (Western Association of Schools and Colleges, 1992). Failure to institute needed changes will invite external regulation and pressures. Several states have already enacted requirements for mandatory institutional assessment. It is prudent and sensible to develop needed instruments to shape the process (Engineering News Record, 1996). It is suggested that each civil engineering and construction program build a program of routine data gathering and analysis that could be used for curricular improvement, strategic planning and resource allocations.

The ACCE Assessment Criteria

Over the years, the American Council for Construction Education (ACCE, 1998) has taken the lead in developing substantive accreditation criteria to insure quality. These criteria have evolved into an assessment-oriented set of requirements to help construction programs achieve stated missions and objectives. That is, ACCE requires a comprehensive and well-defined assessment program that relates to administration, curriculum, faculty and staff, students, facilities, services, and relations with industry (American Council for Construction Education). The specific requirements of the assessment process are summarized below.

1. A description of how outcome assessment results are correlated with program content, mission, goals and objectives to implement change where needed,
2. Provision of copies of all forms used in the program assessment process,
3. Provision of a summary of the most recent assessment cycle, including a description of the process used to evaluate both inputs and outputs, and a summary of the results,
4. A description of programs strengths, weaknesses, and opportunities identified in the assessment cycle, and

5. A statement of the specific plans, including a schedule, for overcoming identified weaknesses and incorporating identified opportunities into the program.

As part of the ACCE accreditation process the program must provide a discussion of future plans which include a description of the change in short and long-term goals and objectives of the construction program as a result of program assessment (American Council for Construction Education). Furthermore, the ACCE accreditation process requires a discussion of specific plans for implementation of program changes identified through the assessment process.

The ACCE accreditation criteria for construction programs include varied sets of requirements. Important issues that must be addressed relate to mission, goals, current size, organizational structure, listing of near and long-term objectives, and how progress or achievement is to be measured. The Construction program seeking accreditation must provide information regarding intra-campus and multi-campus relationships with allied disciplines and summaries of the institutional and construction unit budget.

With regards to faculty, the institution must provide data pertaining to current staff and faculty and their assignments, faculty compensation, evaluation and promotion policies, and professional development activities. Specific items with respect to students include admission standards, quality of new students, enrollment data, grading system, academic success and failure, record keeping and academic advisement, student activities and graduate and placement data. Descriptions of laboratories, classrooms, staff offices, library, audiovisual services, computer facilities, and placement services are also required.

The self-study must cover relations with industry and a description of the advisory committee including their corporate affiliations and the type of construction activity in which they are involved, the advisory committee procedures, and the ways in which the advisory committee has assisted the construction unit. Furthermore, a description of work experience programs including cooperative education and summer job programs with an indication of the number of students and companies involved. A description of the placement assistance activities of the construction unit and number of companies recruiting are required. Finally, ACCE also requires a discussion of student-industry interaction including national construction association interaction, major field trips taken, and guest speakers.

It is clear that for a construction program to be accredited, it must meet many of the metrics and norms established by the ACCE. Consequently, for an assessment program to be useful and relevant, it must consider the specific areas identified in the ACCE guidelines. For example, placement data should be used as a measure of quality in the assessment program because it is also required by ACCE. Additional measures and norms can be developed using input from alumni, students, faculty, parents, employers, and advisory boards.

The ABET 2000 Assessment Criteria

The Accreditation Board for Engineering and Technology (ABET) has followed in the footsteps of the American Council for Construction Education and developed specific metrics for assessing program quality. The ABET 2000 criteria requires that assessment programs be established and implemented. Specifically, ABET requires a total of 8 criteria (Accreditation Board for Engineering and Technology, 1997). Each program must have an assessment process with documented results. Evidence must be given that the results are applied to the further development and improvement of the program. The assessment process must demonstrate that the outcomes important to the mission of the institution and the objectives of the program are being measured. The specific criteria are described below (Accreditation Board for Engineering and Technology, 1997).

Criterion 1. Students

The institution must evaluate, advise, and monitor students to determine its success in meeting program objectives.

Criterion 2. Program Educational Objectives

Detailed published educational objectives that are consistent with the mission of the institution. Additionally, a process based on the needs of the program's constituencies in which the objectives are determined and periodically evaluated. Finally, a system of ongoing evaluation that demonstrates achievement of stated objectives and uses the results to improve the program.

Criterion 3. Program Outcomes and Assessment

Engineering programs must demonstrate that their graduates have an ability to apply knowledge of mathematics, science and engineering, and demonstrate competence to function effectively in a modern society. Specifically, the graduate must be able to conduct experiments and interpret data, be able to design a system to meet desired needs. Furthermore, the graduate must be able to function on multi-disciplinary teams, exhibit an ability to identify, formulate, and solve problems. Student is expected to have an understanding of professional and ethical responsibility, be able to communicate effectively, and have an understanding of the global dimensions of the profession. More importantly, future graduates must possess an awareness of the needs and importance of life-long learning and contemporary issues.

Criterion 4. Professional Component

Students must be prepared for engineering practice through the curriculum culminating in a major design experience. This may involve a senior design course incorporating engineering standards and realistic constraints as well as economic, environmental, ethical, safety, social, and political issues.

Criterion 5. Faculty

The faculty must be sufficient in number and must have the competencies to cover all of the curricular areas of the program. There must be sufficient faculty to provide appropriate levels of student-faculty interaction, student advising and counseling, university service activities, and interactions with industrial and professional practitioners, as well as employers of students. The faculty must have sufficient qualifications and must ensure the proper guidance of the program and its evaluation and development.

Criterion 6. Facilities

Classrooms, laboratories, and associated equipment must be adequate to accomplish the program objectives and provide an atmosphere conducive to learning. Appropriate facilities must be available to foster faculty-student interactions and to create a climate that encourages professional development and professional activities. Programs must provide opportunities for students to learn the use of modern engineering tools. Computing and information infrastructures must be in place to support the scholarly activities of the students and faculty and the educational objectives of the institution.

Criterion 7. Institutional Support and Financial Resources

Institutional support, financial resources, and constructive leadership must be adequate to assure the quality and continuity of the engineering program. Resources must be sufficient to attract, retain, and provide for the continued professional development of a well-qualified faculty. Resources also must be sufficient to acquire, maintain, and operate facilities and equipment appropriate for the engineering program.

Criterion 8. Program Criteria

Those members of civil engineering faculty responsible for the upper-level professional program must provide evidence that they understand current professional practice in their specialty areas. The program must demonstrate that its graduates have the ability to apply advanced mathematics through calculus and differential equations. They must exhibit familiarity with statistics and linear algebra, knowledge of computational practices; competence in experimental design, data collection, and data analysis; and knowledge of chemistry and calculus-based physics with depth in at least one of them.

It is evident that for a civil engineering program to be accredited, it must meet many of the same metrics and norms identified by ACCE. Although the ABET criteria for accreditation varies considerably from the ACCE criteria, both criteria share the common requirement for all programs to develop substantive assessment plans. Consequently, it is critical that any assessment program consider the specific areas identified in the ABET guidelines.

NAIT Assessment Criteria

The National Association of Industrial Technology (NAIT) currently accredits a total of 90 baccalaureate level programs in 50 institutions and a total of 25 associate level programs in 11 institutions. The accreditation criteria require the development and maintenance of an assessment plan for each program. The assessment plan should include at a minimum the following:

1. student enrollment in the program including historical enrollment data,
2. an assessment of the quality of the students entering the program with comparative data,
3. an assessment of the success of students enrolled in the program with comparative data,
4. placement data for graduates,
5. documentation of the career advancement of the program graduates,
6. a validation of the content of the program by advisory committees and the graduates of the program, and
7. a systematic plan for implementation of the assessment program which includes a time-table for updating the information presented in the assessment plan.

The Philosophy of Outcome Assessment

The goal of any university is to have an exceptional reputation and produce graduates that are worthy of that reputation. How a university achieves recognition for being an excellent institution of higher learning is subject to debate. However, a menu for achieving prominence may include superior external relations, quality programs, quality faculty, quality facilities, quality students and an optimum enrollment. These elements are not mutually exclusive, but are interrelated as shown in Figure 1. Also, each component lends itself to being assessed against accepted norms and measures. The purposes of assessment should be to improve, to inform, and/or to prove. The assessment process should help determine whether specific objectives are being met. The process should also provide information and identify issues that affect a program and its future. Generally, the development of an outcome assessment program involves the following steps:

1. Develop a mission statement; identify goals, and what needs to be achieved.
2. Review ACCE and ABET guidelines and requirements.
3. For each goal, specific objectives should be identified.
4. A performance criterion (norm) for each objective should be established.
5. Identify outcomes for an accomplished goal.
6. Activities to be implemented to achieve the identified goals and objectives.
7. Appropriate measures for the achievement of goals and objectives.
8. Well-defined assessment and data collection plan.
9. Identification of appropriate and relevant national and university norms.
10. Mechanisms to modify practices and activities based on outcomes.

Feedback channels are an important component of the assessment plan (Sheehan and White, 1990). The feedback channels provide timely information to facilitate continuous improvement of practices and provide input for decision making. The final aspect of an assessment plan is the evaluation of whether or not the performance criteria were met and the objectives were achieved.

Since evaluation is the process of ascribing value to the assessment results, it usually occurs during the continuous improvement phase (formative evaluation) and at the end of assessment phase (summative evaluation), (American Council for Construction Education, 1998).

In developing a philosophy of outcome assessment, the constituencies served by a program must also be identified. These are employers, alumni, students, parents, faculty and staff, advisory boards, university administration, and appropriate accrediting agencies. Each of these constituencies has its own expectations, needs and desires.

Employers of the graduates of a program are excellent measures of the success of a program. Employers who repeatedly return to hire graduates of a program consider the program relevant to their needs. Some of the characteristics employers seek in graduates are work experience, leadership skills, oral and written communication skills, ability to use state-of-the art software relevant to the discipline, and a design experience (Engineering News Record, 1996). In engineering and construction, the employer would also consider passing the Fundamentals of Engineering or the Certified Professional Constructor examinations an important criterion for the hiring of a student.

One of the most important influences on a student's selection of a university is the parent of the student. Considerations a parent will make include available financial assistance, opportunities for work experience, placement rates of the graduates of the program and their associated starting salaries, the availability of personal attention (measured by class size, tutoring availability, and faculty availability), the quality of the faculty and the quality of facilities.

The success of the alumni is another important measure of the success of a program. Successful alumni enhance the reputation of a program and, therefore, the reputation of the university. Consequently, alumni should be given opportunities for involvement after they graduate. Their input could certainly help improve the quality of the program and help insure that the program has quality facilities through donations and fund raising activities. Alumni involvement can be encouraged through recognition (honors and awards), service on advisory committees, and providing opportunities for visits to the campus.

The students who matriculate at an institution also have a variety of expectations. They want a good education (a quality program) and have an expectation of earning good grades. They want work related experience while they are in school and the guarantee of being employed when they graduate. They expect quality laboratories, quality computer facilities and the opportunity to interact with quality faculty. They seek scholarship funds and other forms of financial support and want to be recognized for their achievements. Finally, they desire safety, stimulating environment, and to have fun. It is the opinion of the authors that a significant portion of the college experience occurs outside the classroom. Involvement in professional societies, joining a fraternity or sorority, participating in intercollegiate athletics, etc. are extracurricular activities which help students develop needed leadership and people skills.

For any assessment program to be successful, it must have the support and active participation of the faculty. It is assumed that faculty members are typically very independent and want to be left alone so they can pursue their research and other professional interests. Preferably, they would like a low teaching load accompanied by a high salary. They also would like to be appreciated by receiving recognition and, perhaps, honors for their achievements. These factors must be considered when developing an assessment plan to insure that quality faculty are retained and the appropriate environment is maintained.

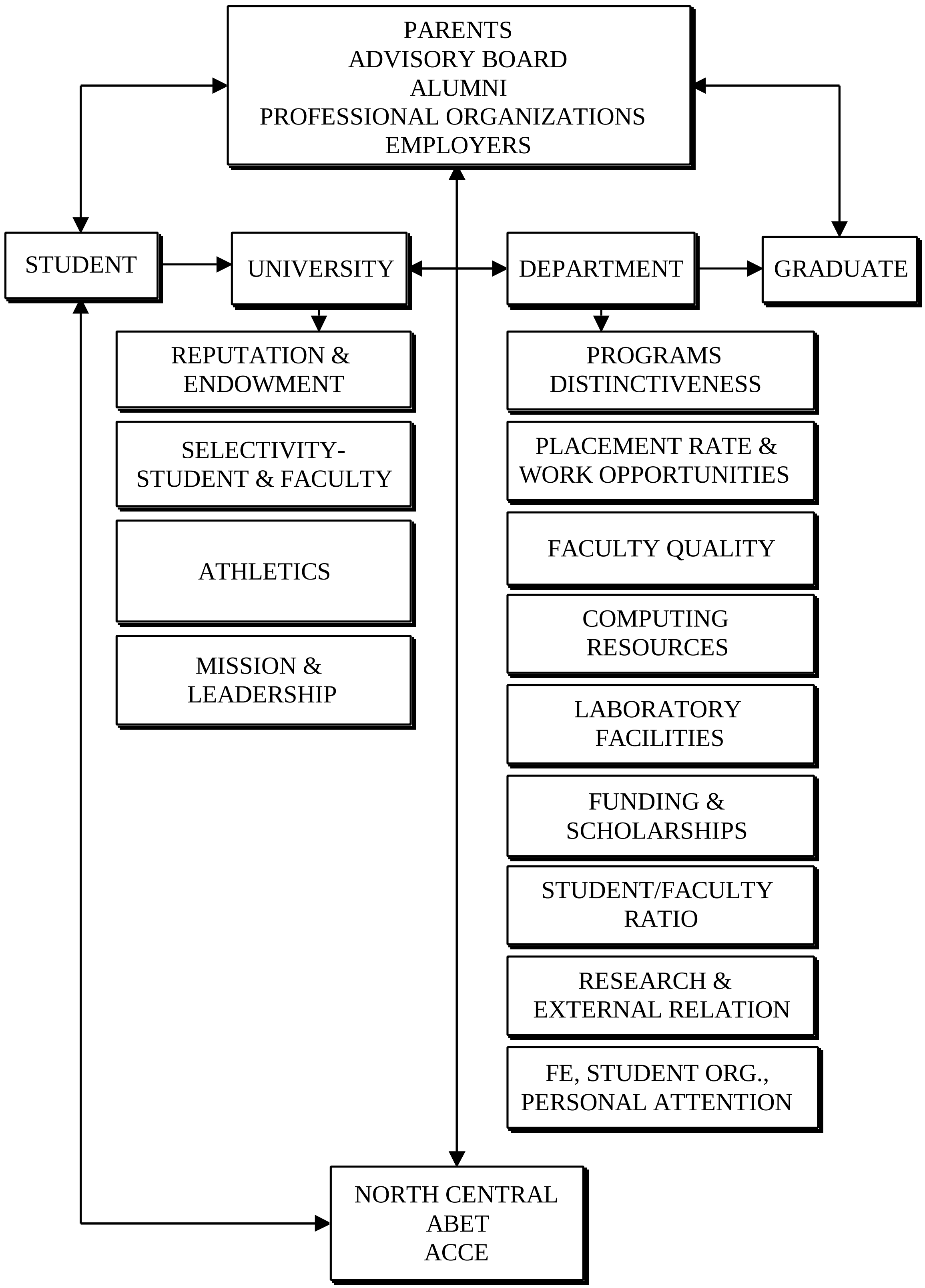

Figure 1. Interrelationships between constituencies found in higher education.

Each program should have an advisory board to help provide external perspectives on the quality and substance of the program. This is one way to involve alumni, employers of the program's students, and other leaders in the workplace related to the discipline. It is important the advisory board be asked to provide input and play a role in achieving program objectives and stated assessment standards. Members of the advisory board also like to be recognized and appreciated for their participation. This expectation can be met through honors banquets and special reunions of alumni and friends of the department.

The final constituency of a program is the administration of the university. They desire to have the program have national prominence. They want high enrollment in the program and expect the faculty to be willing to accept low salaries. They also expect the program to raise funds to support its activities. The administration expects the consensus of the faculty in response to their directives. In all cases, they expect a program to meet the minimum standards required to receive accreditation. Furthermore, they expect an assessment of objectives and implementation of needed improvements.

Establishing Assessment Plan and Norms

Institutions in higher education need to develop assessment plans consistent with their missions and objectives while meeting accreditation requirements. As educators look to a future of change and increasing internal and external pressures, new paradigms for assessing quality will be necessary. Failure to reform and redefine from within will invite unnecessary change from beyond (Al-Khafaji, et al, 1998). Regardless, change is on the horizon. The performance of construction and civil engineering programs will not and should not be exempt from change. In fact, assessment programs are now mandated by accreditation agencies. Generally, an assessment plan may include a variety of measures and norms to evaluate the degree of success in meeting stated objectives. These measures may include.

1. Number of students seeking admission to graduate or professional schools.
2. Success on the Fundamental of Engineering Examination (FE).
3. Success on Professional license Examination (PE).
4. Success on the Certified Professional Constructors Exam (CPC).
5. Placement Rate and ease of finding appropriate employment.
6. Salaries of graduates.
7. Student performance on standardized exams.
8. Student performance on senior comprehensive exams.
9. Senior theses.
10. Awards, honors, and fellowships received by students.
11. Awards, honors, and fellowships received by faculty.
12. Number of publications and research dollars generated.
13. Student to faculty ratio.
14. Student polls and questionnaires.
15. Employer polls and questionnaires.
16. Alumni polls and questionnaires.
17. Accreditation results.

18. Expenditure on equipment.
19. Faculty salaries.
20. Student course evaluations.
21. Faculty annual evaluations.

Clearly these measures must be assessed relative to accepted standards and norms. Although many of these measures may be valid, a program of assessment must reflect the objectives and mission of the department for which it is intended. It is not necessary to measure all of the above nor measure them annually. The assessment program should be a systematic plan that links program goals and objectives to the mission statement (Western Association of Schools and Colleges, 1992). It should articulate clear statements of intended outcomes and describe the procedures to be used to assess whether goals are being met. More importantly, the assessment program must demonstrate how assessment findings are used for instituting needed improvements. Feedback should be should be an ongoing process and provide useful insights to the institution and student with faculty participation and support.
The department of civil engineering and construction (CEC) at Bradley University has developed and implemented an active assessment program as shown in Figure 2.

The CEC assessment program is viewed as comprehensive and has been used as a model for others to emulate. More importantly, it has impacted the CEC department profoundly by making it one of the largest departments on the Bradley campus. Enrollment increased from the lowest to the highest in the college of engineering. The degree of support received from industry as reflected by number of endowed and annual scholarships that has increased from 5 to more than 35 since the implementation of the assessment program. The CEC assessment program involves the following components:

1. Questionnaires to entering freshman.
2. Questionnaires to entering seniors.
3. Questionnaires to graduate students.
4. Questionnaires to alumni.
5. Questionnaires to advisory board.
6. Questionnaires to employers.
7. Questionnaires to faculty.
8. Questionnaires to administrators and support personnel.

Additionally, the department holds an annual retreat to which the officers of the four student organizations in the department are invited. During this one-day meeting, each student and faculty is asked to raise issues and concerns that the department may need to address. The retreat continues to be a valuable instrument for faculty and students to solve problems that may otherwise go unnoticed. Over the years, students have become agents of change and the propulsion needed for continuous improvement.

Impact of Assessment

A well designed outcome assessment plan should enable the user to identify and enhance strengths, identify and address weaknesses, educate the respondents, development strategies to achieve excellence, meet accreditation requirements and improve the assessment process. A assessment questionnaire was administered to the faculty in the Department of Civil Engineering and Construction late in the fall semester of 1998. When reviewing the results of the assessment questionnaire it is several conclusions were drawn that provided insights into needed corrective actions. The Chair of the Department formed task forces to study and make recommendations relative to the teaching evaluation process, the role of the departmental advisory board in departmental activities, and the scholarship and research activities of the department. The first task force was an Advisory Board Task Force evaluated the assessment process, participate in data collection and identify appropriate strategies. The second task force dealt with the Faculty Evaluation to review the faculty and teaching evaluation processes and come up with specific recommendations for improving and enhancing these processes. Finally, a third Task Force dealt with faculty Scholarship and Research. The charge to this task force was to provide specific recommendations for improving the environment for scholarly activities by the faculty.

An interesting result of the assessment process was that the seniors in the department's Civil Engineering and Construction programs indicated they felt that the student course evaluations which are administered near the end of each semester for all faculty were not used for any significant purpose.

Steps were immediately taken by the Chair to insure that the students were made aware of how their course evaluations were used in the annual faculty evaluation process. Presentations were made which educated the students on how the evaluations were used and how the faculty were required to provide self-evaluations of their teaching effectiveness each semester where the faculty are required to identify their three major weaknesses and the steps they plan to correct their deficiencies.

Clearly the assessment program can be very effectively utilized on a real-time basis to address issues that are raised by the respondents. Ultimately, it is the goal of a well-designed assessment plan that enables a program to have quality programs, faculty, facilities and students with an optimum enrollment to satisfy their various constituencies.

Conclusions

Although it is difficult to develop a single model that fits all needs and requirements, it is helpful to consider the issues, norms, and metrics required for an effective assessment program. The most important first step is to develop a mission statement and a related set of realistic objectives taking into account needed resources for successful implementation. An effective assessment program must have a clear set of norms by which outcomes are measured and define how the conclusions are to be utilized or implemented.

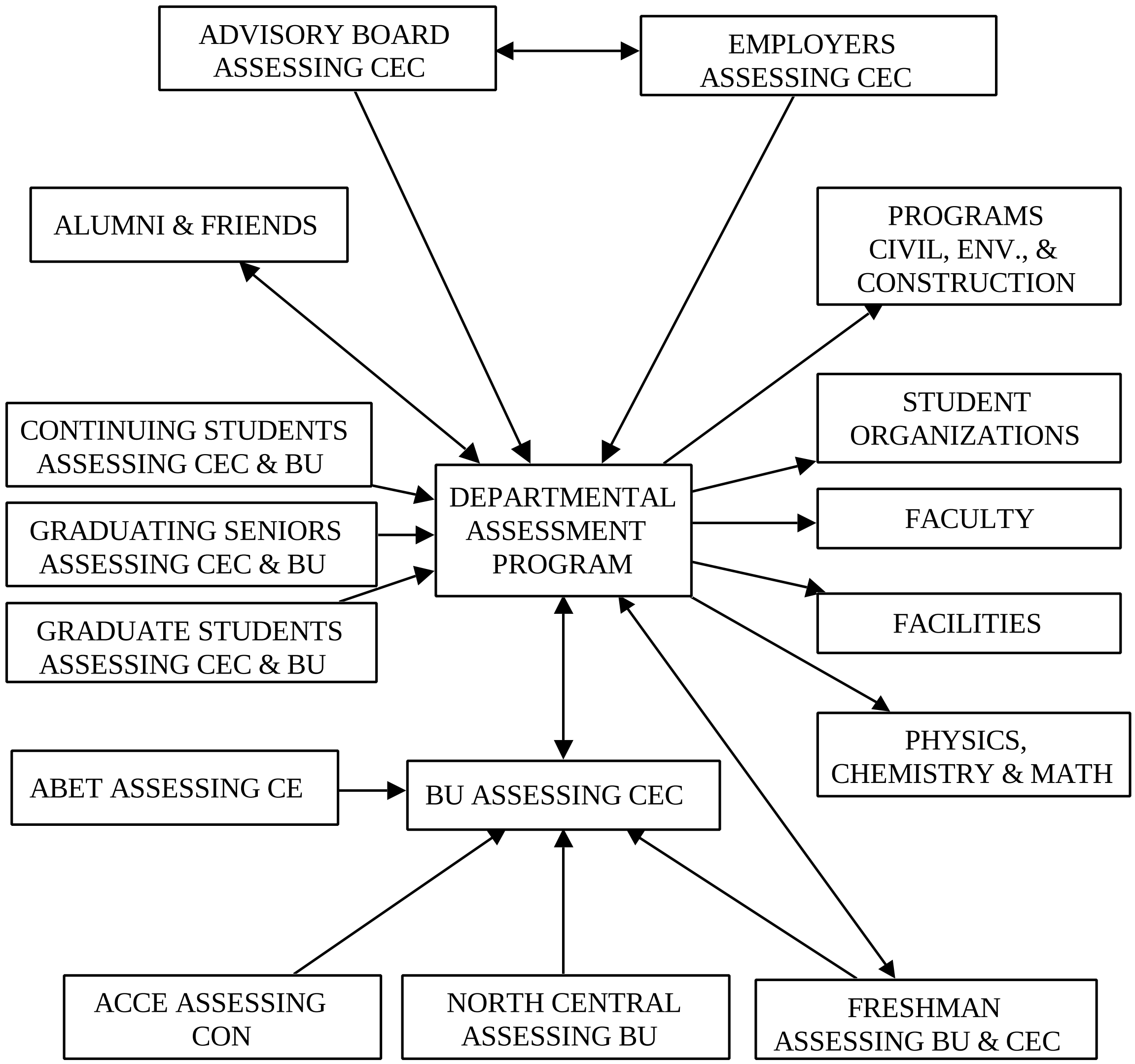

Figure 2. The Civil Engineering and Construction Assessment Program at Bradley University.

Programs in construction and civil engineering will need more than policy manuals and clearly defined objectives. The programs must embody the concept of quality and excellence in all of its forms and at all levels. Hence, guidelines and clearly defined assessment plans are needed to foster the development of excellence among faculty, alumni, and students. More importantly, departments must develop appropriate instruments to implement needed changes identified through the assessment process. The academic community must broaden its thinking, examine changing technologies, consider global issues, define its mission, and establish an appropriate vision. The academic community must recognize that the demands and needs of external and internal constituencies are varied. It is time to move beyond the discussion and procrastination phase and ask what does it take to achieve excellence and maintain quality.

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The Quest For Excellence and Faculty Assessment

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A generalized definition of faculty work in higher education is unrealistic and would not achieve wide acceptance because of varied institutional missions (Al-Khafaji, et al, 1998). An ASCE Task Force proposed a "wheel" model that provides complete flexibility through interfaces that allow for scholarly work to be integrated into research, teaching, and service and professional development activities. The proposed model links scholarship, teaching, service and professional development with the equally important values of Excellence, Integrity, Leadership and Ethics. The model also provides opportunities for faculty to play an active role in the formulation and implementation of appropriate policies for assessing faculty performance. The major issues raised today in evaluating faculty scholarly contributions includes the need to have a clear awareness of institutional mission, resources, size of the institution, accreditation criteria, collective bargaining, disciplinary objectives, new technologies, and research. A fundamental objective of this article is to address these issues and to help educational institutions create an environment in which faculty are encouraged to produce their very best. However, it is the responsibility of leaders in higher education to provide a concurrent and stimulating paradigm for their own faculty assessment. Institutions need to place less emphasis on definitions and more on generation of a substantive rewards system for excellence in all areas of faculty work. The time has come to put an end to the notion that research is more important than teaching and that service is not as critical as teaching. Administrators and faculty need to recognize that excellence in all areas of faculty work is critical to the fulfillment of institutional mission. It is hoped that this article will help energize and stimulate the profession in the development of new approaches and policies in assessing faculty performance.

Key Words: Assessment, faculty, teaching

Background

The Carnegie Foundation book *Scholarship Reconsidered: Priorities of the Professorate* by Ernest Boyer, 1990 began the call for a redefinition of scholarship and faculty work throughout the academic world. Boyer proposed a new paradigm of scholarship with multiple interfacing elements. Several scholarly associations took the next step in the form of a major publication by the American Association of the Higher Education in 1995. Syracuse University initiatives launched a sweeping examination of the faculty rewards system as it related to institutional missions, a report in response to a call from Center for Instructional Development at Syracuse University. This article summarizes the conclusions and recommendations made by a task force from the American Society of Civil Engineers (ASCE) to redefine faculty work in engineering and construction.

Early in 1989, Syracuse University initiated a project to enhance the importance and quality of teaching in higher education (National Science Foundation, 1992). The project's main focus was academic deans and department chairs because of their pivotal role in shaping the assessment and rewards system. Project activities were expanded to include faculty from across campus to help modify promotion and tenure guidelines to improve the status and rewards for good teaching. These initiatives launched a sweeping examination of the faculty rewards system as it relates to institutional mission. External funds helped extend the Syracuse University initiatives to other institutions.

The Redefinition and Assessment of Scholarship was funded by the Lilly Endowment, Inc. with support from the Fund for the Improvement of Postsecondary Education (FIPSE). The main thrust behind this project was to expand the range of activities that qualify as scholarly or creative faculty work (National Science Foundation, 1992). An expanded range of scholarly activities affects the priorities at educational institutions and would.

1. Improve teaching quality.
2. Improve the quality of graduates.
3. Improve the quality of curricula and courses.
4. Increase faculty participation in service oriented activities.

The project provided support to associations to establish task forces that would develop and disseminate definitions of scholarship for their respective disciplines. Included in these statements are lists of activities that academic departments are encouraged to consider as scholarly work when developing tenure, promotion, merit, or reward system guidelines. The reports from these groups were published in 1995 by the American Association for Higher Education. Phase II of the project extended this initiative to the American Society of Civil Engineers and other associations.

The Syracuse study for evaluating faculty scholarly contributions raised many common issues and concerns. In addition to the common threesome of scholarship, teaching and service, any assessment program must include a clear awareness of the following factors: institutional mission, departmental mission and resources, size of the Institution, accreditation criteria, professional organizations, collective bargaining, classification of the institution, disciplinary objectives, new technologies, and research (Al-Khafaji, et al, 1998). While policies vary significantly from teaching institutions to research institutions, the main factors in granting tenure appear to be based upon past performance, temperament, and long-term potential for success (National Science Foundation, 1992). Promotion, on the other hand, tends to be based solely upon past performance. In all cases, a sustained and solid performance in teaching is expected. Presently, it is obvious that institutions of higher education need to develop sound policies and procedures and that these be applied equitably and with consistency (Boyer, 1990).

The pace of change in the future is bound to accelerate and academic departments must develop the appropriate environment to help the next generation of graduates understand the global context of their professional activities. A premise of our present effort is that the next few decades will be more creative, demanding and rewarding for engineers and constructors (American Society for Engineering Education, 1987). At the same time, there exists uncertainty as to an appropriate definition of the Work of the faculty. Hence, it is now necessary to reconsider and revise the conventional definitions of scholarship in light of contemporary and steadily changing standards of assessment (Hall, Focht, Michael, Paulson, Saville and Lowe, 1998).

The State of the Profession

The profession of Construction and Civil Engineering provides opportunities unrivaled by any other in terms of its distinguished history and extraordinary future (Al-Khafaji, et al, 1998) From our well-known ancient monuments to our exciting future, the flame of mankind's hope and intellect lives on as symbols of our profession's greatest achievements.

Unlike any other engineering profession, ours has always provided mankind with enduring monuments and lasting legacies. From the 5000 years old Ziggurats of Ur, Iraq to the wall of China to the Parthenon of Greece to the Sears Towers, the Hoover Dam, the Golden Gate Bridge, and the freedom space station being built by the United States, our legacies endure as beacons of excellence and triumph. These structures reflect the exceptional skills and abilities of constructors and civil engineers throughout the ages (Al-Khafaji, et al, 1998).

Our graduates work in the smallest of towns and in the largest cities anywhere in the world and not necessarily where the big companies are. This is a profession that knows no boundaries or language barrier. Our graduates must possess vision, leadership, and skills needed to meet future challenges. Consequently, it is our responsibility to develop the proper environments in which educators excel and thrive (Taylorient, 1987). Although construction and civil engineering educators have served the nation well and contributed significantly to the global society, there is a mounting demand for change to meet future challenges.

Construction and civil engineering departments must provide their faculty and students with opportunities for intellectual development, technical capacity, teamwork, communication skills, and leadership ability. Students need to develop the appropriate understanding of the economic, cultural, environmental, and international context of their profession (Diamond and Bronwyn, 1993). Consequently, it is the responsibility of administrators that faculty must be rewarded for their effort in all appropriate areas and not in terms of the number of research dollars generated (Taylorient, 1987). Furthermore, it must be clear that service to our students organizing and helping reshape their careers is a critical activity and must be valued and rewarded (Elman and Elman, 1985).

The Philosophy of Assessment Practices

The past three decades witnessed the evolution of new technologies and advancement of civilization at a scale unmatched in human history. A thousand years from now, historians will attest to the fact that this period of remarkable progression in human civilization was led by the United States of America (Al-Khafaji, et al, 1998). From the enormous platforms used to launch the Saturn V rocket to the moon to the structural design of the Space Shuttle, the construction and civil engineering profession has played a profound role.

The successes achieved thus far would not have been possible without the solid educational foundations existing at our engineering colleges and departments (Al-Khafaji, et al, 1998). This conclusion reflects the never-ending quest to improve and question every aspect of our educational programs. With this spirit, a national debate is underway to reconsider conventional definitions of scholarship and perhaps espouse new standards for assessing faculty professional achievements. The Boyer-Rice model suggests multiple forms of scholarly work as a basis for a new paradigm (Boyer, 1990).

Unquestionably, the criteria and procedures used in assessing construction and civil engineering faculty work vary from institution to institution depending on the mission, goals, and backgrounds of the faculty. However, in all cases, tenure and promotion considerations involve committees of senior faculty (National Science Foundation, 1992). These faculty members are normally responsible for the development of the specific list of activities considered relevant in annual assessment, promotion, and tenure.

Promotion and/or tenure are normally earned by a positive demonstration of effective performance in the traditional areas of Teaching, Research, and Service (Hall, Focht, Michael, Paulson, Saville and Lowe, 1998). In some construction and civil engineering departments, mentoring and scholarship are listed as separate categories. Some institutions cited mentoring of graduate students, mentoring of faculty, service on strategic planning committee, and other hard to define areas. That is, certain departments, with justification pointed out the need for including activities that don't fit into teaching, scholarship, or service. This is appropriate to the particular mission and goals of the department and university.

Boyer maintained that it was time to move beyond the tired old teaching versus research debate and ask, *What does it mean to be a scholar* (Hall, Focht, Michael, Paulson, Saville and Lowe,1998). In response to that question he proposed a new paradigm of scholarship, with four interlocking parts. He contended that the work of the professorate involves

a. the scholarship of *discovery*, as in research,
b. the scholarship of *integrating* knowledge, to avoid pedantry,
c. the scholarship of *applying* knowledge to avoid irrelevance, and
d. the scholarship of *transmitting* knowledge, to avoid discontinuity.

Boyer stated that such a paradigm broadens the work of the professorate and recognizes the breadth of the campus mission and the breadth of talent within the academy today (Al-Khafaji, et al, 1998).

Critical Factors in Assessment

Consideration of current practices in construction and civil engineering education reveals a state of uncertainty over the appropriate definition of faculty work and especially scholarship. Administrators need to empower faculty to deliver the graduate needed to successfully compete in the international arena. The challenges ahead are enormous but the rewards are bound to be worthy of the effort.

Consideration of current practices in construction and civil engineering education reveals a state of uncertainty over the appropriate definition of faculty work (Al-Khafaji, et al, 1998). Furthermore, many departments and faculty are confounded by the many sets of mixed signals and conflicting recommendations being advanced by well-intentioned organizations and groups (Al-Khafaji, et al, 1998). These groups include administrators, parents, alumni, government, professional organizations, accrediting agencies, legislators, the National Science Foundation (Rice, 1991), the American Society of Civil Engineers (American Society for Engineering Education, 1987) and American Society for Engineering Education (Taylorient, 1987). Additionally, changing technology, budget cuts, legislative pressures, changing institutional missions, and a dubious reward system contribute to the state of uncertainty (Al-Khafaji, et al, 1998).

In construction and civil engineering, the major issues associated with faculty scholarly research, and professional activities may be summarized as follows:

a. Institutional and Departmental Mission
b. Resources and Endowment
c. Accreditation Standards
d. Size and Background of Faculty
e. Public versus Private Institution and Collective Bargaining Units
f. New and Changing Technologies

Additionally, the focus and expertise of the faculty in a given institution is extremely critical in the development of sound policies. In this context, a distinction must be made between so-called teaching and research institutions. The Carnegie Foundation classification system provides the following eight categories:

Research Universities I (research expenditures > $40 million & #Ph.D. grads> 50)
Research Universities II ($15.5 <research expenditures <$40 & #Ph.D. grads > 50)
Doctoral Universities I (#Ph.D. grads > 40)
Doctoral Universities II (#Ph.D. grads > 10)
Master's Universities I (#MS grads > 40)
Master's Universities II (#MS grads > 20)
Baccalaureate I (> 40% of degrees in liberal arts; restrictive)
Baccalaureate II (< 40% of degrees in liberal arts; less restrictive)

Irrespective of the factors involved, faculty must be willing to adapt to change and renewal. Current tendencies reveal significant external pressures being applied to affect change in faculty duties and assessment practices (Al-Khafaji, et al, 1998).

The Wheel Model

The notion of developing one model that fits all programs is not realistic, practical, nor beneficial to the construction and civil engineering professions. Instead, what is needed is the development of sound policies and procedures and applying them fairly and consistently. An ASCE Task Force developed a model that meets these requirements (Al-Khafaji, et al, 1998).

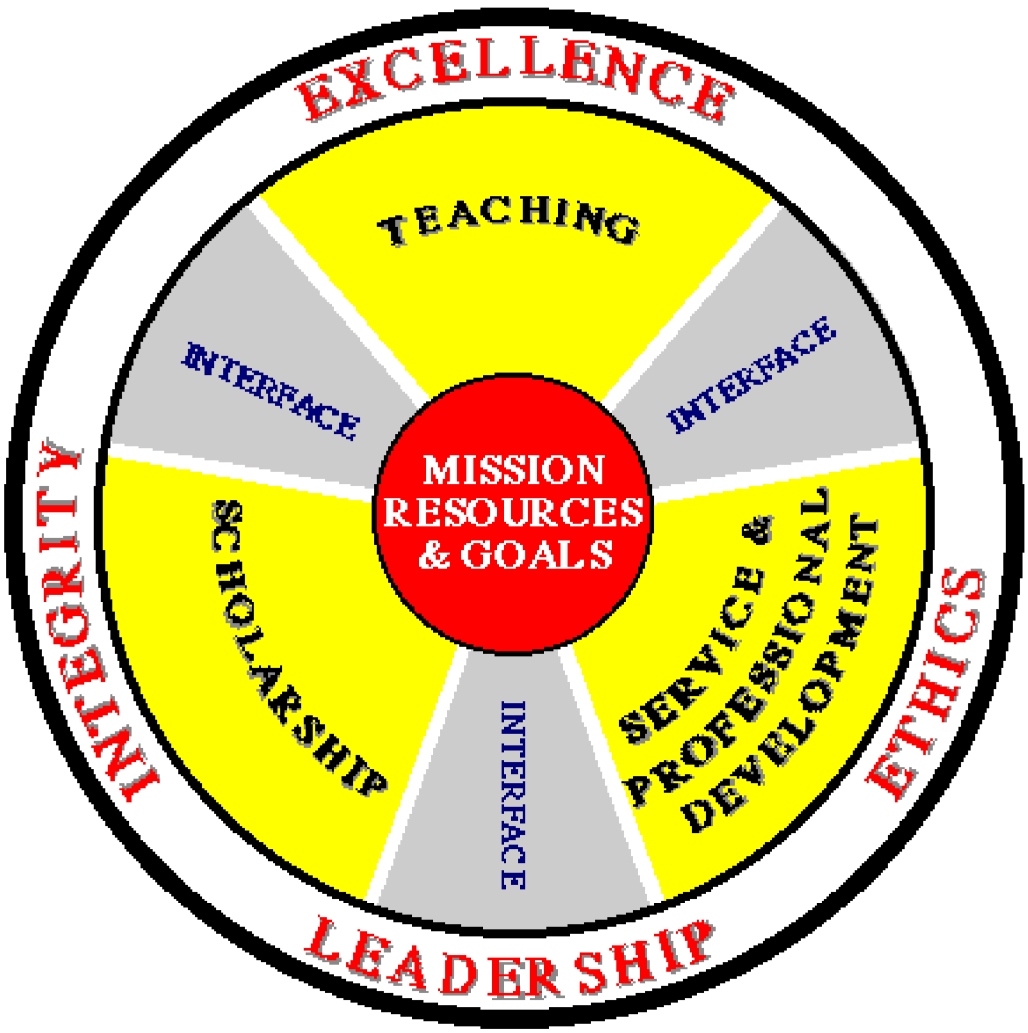

Figure 1. Faculty Work (Al-Khafaji, et al, 1998).

The wheel was selected because it symbolizes movement and action. It is one of mankind's first symbols of progress, which marked the earliest Sumerian civilization of Iraq dating to more than 6,000 years ago. The hub of the wheel gives direction and power to the wheel. So too, the mission, resources, and goals of the academic community must provide the direction and vitality to the work of the faculty (Al-Khafaji, et al, 1998). The body of the first model is composed of three sectors representing the three common area of faculty work: teaching, scholarship, and service/professional development. The tire defines the quality of the ride in the same manner that *Excellence, Integrity, Leadership, and Ethics* establish the quality of faculty work.

Ultimately, it is *Excellence* that drives institutions and faculty and not the mere definition of scholarship. It is *Excellence* in all that we do and envision that contributes to society's progress and evolution. It is the responsibility of institutional leaders to encourage and nurture change by clearly defining faculty expectations and rewards. Such institutions can achieve extraordinary results by pooling the talents of faculty, students, alumni, and professional societies (Al-Khafaji, et al, 1998). Consequently, educational institutions and faculty have unique opportunities to provide such an environment.

In this model, the Interfaces represent areas that can be defined by individual departments based on perceived needs. In some cases, these Interfaces may designate an overlap between Teaching, Scholarship, and Service/Professional Development. Alternatively, they may represent transient or sustained discretionary activities meeting the changing demands of the profession, legislature, students, and society. An example of a sustained discretionary activity is mentoring of graduate students and/or faculty. An example of a transient discretionary activity may involve service on strategic planning committee or development of a new course.

Balance to the wheel is imparted by the recognition of scholarly work at the interfaces of the other two work areas of the faculty; that is, teaching and service/professional development. Further, scholarly activities must include the four types of scholarship suggested by Ernest Boyer: *Discovery, Integration, Application, and Transmission*.. All four of these types of scholarly activities can be nicely included in the three interfaces. In this complicated and interconnected world, new discoveries and breakthroughs are made at the interfaces of traditional disciplines and that interdisciplinary cooperation is necessary for these discoveries and breakthroughs (Al-Khafaji, et al, 1998).

Defining Faculty Work

The policies and procedures used in the assessment of faculty performance at several institutions were examined by an ASCE Task Force (Al-Khafaji, et al, 1998). These included Bradley University, Marquette University, Michigan State University, Ohio University, Purdue University, University of Minnesota, and Wayne State University. The selected departments were different in size, mission, and programs offered. The policies and procedures used reveal a wide range of activities with different weights applied to teaching, research, and service. A list was complied as a useful inventory of activities deemed appropriate and may provide some insights in developing policies and procedures for faculty assessments. A summary of the lists of activities and categories are shown in Table 1.

There appears to be a consensus that the principal duties of the construction and civil engineering faculty are the creation of new knowledge, transmission of knowledge, and service to the university, profession, and community. However, the relative weighting of these activities in determining promotion or tenure vary significantly from one institution to another. Generally, the principle factors used in granting *tenure* appear to be based on past accomplishments, temperament, and long-term potential for success. *Promotion* tends to be based on past accomplishments.

Table 1

List of activities defining faculty work in Engineering (Al-Khafaji, et al, 1998).

Teaching	**Scholarship and Research**	**Service & Professional Development**
Activities:	*Research:*	*Students*
Undergraduate Course Credit hours	Active grants	*Department*
Graduate Course Credit hours	Proposals funded	*College*
Undergrad. Laboratory Credit hours	Proposals submitted	*University*
Graduate Laboratory Credit hours	Interdisciplinary activities	*Profession*
Number of Students impacted	Academic year salary support	*Community and Alumni*
Independent Study Courses		
New Course Development	*Publications:*	
Laboratory revision	Technical reports	*Consulting*
Teaching proposals funded	Abstracts	Professional
Teaching proposals submitted	Research publications	Expert witness
	Refereed journal papers	National and international media
Evaluation:	Other journal papers	Other universities
Future plan	Magazine publications	Short courses
Student evaluation	Books & textbooks	
Peer evaluation	Book chapters	*Leadership*
Alumni evaluation	Edited books	Professional organizations
		Student organization
Honors:	*Conferences:*	Strategic planning
University awards	Refereed conference paper	New journals & editorship
Student awards	Other conference proceedings	Recruiting students to major
Invited lectures	Chairing sessions at conferences	Helping junior faculty
Attitude		Senior projects & field activities
Devotion	*Mentorship:*	Alumni relations
	Doctoral students supervision	New scholarships & funding
	Masters student supervision	Continuing education
	Internships	Professional registration
	Thesis advisor/co-advisor	
	Junior faculty	*Vision*
		Innovations in World Wide Web
	Honors & Awards:	Globalization & Competition
	Sabbatical activities	Setting National Agenda
	International & national recognition	Study Abroad Programs
	Patents	New Ideas in Construction
	Keynote speaker	

Interface Activities

The Interfaces in Figure 1 provide a richly diverse set of possibilities and alternatives to develop sound criteria for faculty assessment. Furthermore, these "Spokes" furnish educational institutions with the appropriate mechanism and needed flexibility to meet their dissimilar needs and missions (Al-Khafaji, et al, 1998). The three interfaces permit institutions to place less emphasis on definitions and more on rewarding substantive faculty activities.

The Interface concept permits a department to focus on setting and achieving goals rather than worrying about defining a suitable category for a useful and needed activity by faculty, students, and industry. More importantly, it provides faculty with a fair system of evaluating their work and recognizing the value of their contributions.

Teaching and Scholarship Interface

Mentoring of graduate students with thesis work and undergraduate students involved in research, the sponsorship of short courses and quality seminars are included in this interface. Additionally, one may chose to attend special seminars in new research areas of interest and develop contacts and skills needed for future research activities.

Service and Teaching Interface

Passing the AIC, FE and PE exams and other activities that will enhance faculty's understanding of his/her field. Serving the professional community through continuing education and consulting. Outreach programs with high school students provides an excellent opportunity to help high-school students achieve a higher level of competence in engineering and science.

Scholarship and Service Interface

Reviewing journal articles, textbooks, and helping colleagues with proposals and research. Also, activities selected from Table 1 are acceptable.

It is hoped that administrators approach the task of faculty assessment with better clarity and understanding of the fundamental component involved. It is not what the activity is called that matters, it is whether the activity is critical to fulfillment of the mission of the department and university. Note that faculty may select appropriate activities for any of the three interfaces from the list of activities identified above or come up with their own. This degree of flexibility is required if educators are to be given opportunities to be creative and innovative rather than sticking to the status quo.

Feedback From the Faculty

Boyer also mentioned "*credibility of the process*" by revealing that we "must have clear standards and good documentation, but what counts the most is the degree to which professors have confidence in the arrangements, feel the process to be fair, and believe that those who make the critical decisions can be trusted."

As suggested by Dr. Robert M. Diamond, Director of the Center for Instructional Development at Syracuse University, actual data from real faculty was needed to demonstrate the validity of the proposed Wheel Model (Al-Khafaji, et al, 1998). Consequently, the Civil Engineering and Construction faculty at Bradley University was selected as the first test case. The faculty members were asked to provide the actual amount of time and the preferred amount of time spent on Teaching, Scholarship, and Outreach, Professional Development and Service (OPS). A summary of the results is given in Table 2.

Table 2

The CEC faculty response relative to actual and preferred time spent on Teaching (T), Scholarship (S) and Outreach, Professional Development, and Service (OPS).

	Actual time spent			**Preferred time**		
Faculty Name	**T**	**S**	**OPS**	**T**	**S**	**OPS**
1	70	5	25	50	10	40
2	20	30	50	20	40	40
3	60	20	20	60	20	20
4	30	45	25	40	40	20
5	80	10	10	45	35	20
6	60	15	25	60	20	20
7	45	20	35	45	20	35
8	60	20	20	40	40	20
9	60	30	10	40	50	10
10	60	10	30	40	30	30
11	35	45	20	35	45	20
12	80	10	10	70	20	10
13	60	15	25	50	30	20
14	50	20	30	40	30	30
Averages	**55%**	**21%**	**24%**	**45%**	**31%**	**24%**

The data suggests that the faculty spend approximately 55% of their time teaching and wish to reduce it to 45%. Furthermore, they feel that spend 21% of their time on scholarly activities and 24% on service, outreach, and professional development (OPS). Based on the above data, the department adapted ranges with the following strategy to accommodate faculty interests and meet the mission of the department and University (see Table 3)

Table 3

Faculty time by factor

Teaching	45%	to	55%
Scholarship	25%	to	35%
OPS	15%	to	25%
Interfaces	0	to	15%

Clearly, it is the faculty desires to spend more time on scholarly activity but curiously enough wish to maintain their level of involvement in OPS activities. Consequently, the range between the actual and desired weights in each of the three categories defines the desired magnitude of the Interfaces. A faculty member doing predominantly teaching could use their teaching aspects of the interfaces with scholarship to essentially increase the percentage assigned to teaching oriented activities, whereas a predominantly research faculty member would do just the opposite without being penalized as much with a large percentage assigned to teaching only.

Faculty Perspective and Self-Assessment

Obviously, one advantage to the proposed model is that faculty members have a role in determining the desired weights in the categories that are used in the evaluation process. It becomes a collective effort to judge the quality of performance in the areas of teaching, scholarship, or outreach, professional development, and service. This faculty participation helps provide incentive for faculty to achieve their best rather than having a policy imposed upon them from above. Thus, it leads to greater acceptance of the process as well as promoting the esprit de corps within the department itself.

The faculty also benefit from a redefinition of scholarly activity. It has been a longstanding argument that the definition of scholarship as research that produces publication in respected journals is too narrow. Likewise, scholarship that increases the knowledge of the individual alone is of little use. A broadening of this terminology to include activities as identified in Table 1 guides the individual faculty member to endeavors that expand their opportunities and at the same time help to achieve the expectations of the department and the broader goals and mission of the institution.

Identification and definition of categories is only one step in individual faculty assessment. For the faculty member to feel a greater degree of affinity to the process and to be able to provide input, it is good for the faculty to turn in a self-assessment to the department chair. This allows the faculty member to report on areas that the chair may not even be aware of, but even more importantly puts the faculty member's mind in the framework of looking at the big picture of how he/she fits in the department. Faculty typically submit annual activity reports or prepare information that updates their resume, but by doing a self assessment in the form of the proposed model, one is forced to examine their own performance in many different areas.

Meeting With the Chair

There is probably some apprehension on the part of both the department chair and the faculty member when the time comes for the annual evaluation. However, it need not be a confrontational experience if both comes into the meeting in a manner suggested in this paper. The use of the wheel model and a self-assessment as mentioned earlier is a good preparatory approach. When this is accomplished, both the faculty member and the department chair already identify issues relating to strengths and weaknesses. In addition, it is suggested that the faculty member bring with them their own scoring of their performance in the different categories in which they are being evaluated. Experience of the authors with this methodology, the comparisons between the chair assessment and the faculty self-assessment has proved to be valuable in insuring that both understand the policy and expectations. Over the years, such approach produced better understanding, trust, and a more positive environment to meet stated objectives. Furthermore, a high degree of correlation was evidenced which helped identify strengths and weaknesses. When questions of what the faculty member is going to be criticized about are removed, the meeting is a much more positive experience to go through.

With much of the groundwork prepared ahead of time, the meeting can concentrate on recognition of areas of excellence as well as an examination of weaknesses. Moreover, an examination of weaknesses is really a feedback mechanism from the chair to help the faculty identify things to address and offer suggestions on how to achieve success. The meeting offers guidance on how an individual faculty member can develop and ultimately achieve the quality and excellence identified in the outer part of the wheel model of Figure 1.

By following clear and objective guidelines, the meeting between the faculty member and the department chair becomes a time of renewal. Goals are focused on how the faculty member fits within the department and provides input on how they can help achieve departmental goals through their own actions. Finally, each faculty must develop a future plan of action that he/she can share with the chair to insure continuity of purpose and minimize misunderstanding.

Affecting Change

There must be a willingness to change. The wheel model emphasizes the quality of faculty performance in order to achieve excellence, integrity, leadership, and ethics. By being flexible, it encourages the faculty member to be creative in a manner that fits the mission of the institution. This model allows the faculty member to "buy into" the method and helps bring about change. The rewards system through the evaluation encourages them to examine future plans, and thus they participate in providing the vision and leadership for the future. This provides an enormous help to the department and the program by beginning with each individual faculty member.

The end result though, is a team effort. Each individual faculty member begins to look at the wheel model in a macro, overall sense. They look at how things will help the program and the department. They begin to look at their contribution to the goals instead of as an individual competition of trying to come out on top. By examining how they can develop, they also look to help other faculty.

In construction education, opportunities for scholarly activity have often been considered to be limited. As the discipline matures, scholarly activities will continue to expand. Such changes are expected, and indeed, should be encouraged. Expanded scholarly activity helps to improve teaching, and may positively impact the courses being taught and the quality of the graduates. When knowledge is expanded, it is integrated into the classroom and laboratory. Such changes are welcome.

Conclusion

The construction and civil engineering education in the future will require more than policy manuals and clearly defined and applied procedures, it must embody leadership throughout the ranks of the professorate (Al-Khafaji, et al, 1998). Hence, guidelines and support programs need to be put into place to foster the development of leadership among faculty in Civil Engineering and Construction.

To adopt the model proposed by the ASCE task force and presented in this article, the academic community must broaden its thinking, examine changing technologies, consider global issues, define its mission, and establish an appropriate vision. The academic community must recognize that faculty activities are varied and develop the necessary means to recognize and reward all activities equitably. The stale and archaic contention that a research faculty is better than the most outstanding teacher needs to be abandoned. Questions need to be raised whether a teacher is of a lesser value than a researcher or visa versa. We must ask if a researcher can do his/her job while serving as an advisor to AGC and become involved in community projects? As was stated in the article, Dr. Ernest Boyer maintained that it was time to move beyond the tired old teaching versus research debate and ask "What does it mean to be a scholar?"

"As educators look to a future of change and increasing internal and external pressures, new paradigms for evaluating faculty performance will be necessary. Failure to reform and redefine from within, will invite perhaps unnecessary and unwarranted change from beyond. No matter what, change is on the horizon. Faculty performance, i.e. the work of faculty, will not and should not be exempt from change. (Al-Khafaji, et al, 1998)"

The application of the proposed model is particularly appropriate for small departments because of its inherent flexibility. Larger departments may use several wheels to graphically and coherently define the work of its faculty. The model allows for the work of faculty to be considered when it satisfies the needs and mission of the department.

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Managing and Motivating Students' Performance in the University Classroom

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The paper will discuss key factors involved in managing and motivating the performance of university students. Some of the common problem areas will be outlined (attendance, in-class participation, completing work on time, quality of work) and potential solutions will be discussed. The ideas presented are backed by decades of research conducted in the field of behavior analysis, have been applied in a wide variety of settings, and have been used with individuals of all ages and backgrounds. Specific techniques that can be used in Construction Science courses will be described and data supporting the effectiveness of some of the techniques will be presented.

Keywords: Motivate, Manage, Performance, Learning, Students, Classroom

Introduction

To say that a person is motivated to do something is simply to say that the person has a reason to be doing that activity. People are motivated to do the things they do because doing those activities pays off for them in some way. The pay-off can be in something the individual gains (like praise, appreciation, a sense of satisfaction, promotions, points, money, etc.) or the pay-off can be that the individual is able to avoid something undesirable (e.g. reprimands, criticism, demotions, suspensions, etc.)(Skinner, 1968, Daniels, 1989).

Many people are what we call "self-motivated". These are people who are able to find and enjoy their own rewards in doing their work. In essence these are people who have learned to recognize their accomplishments and who are able to enjoy the feelings of satisfaction that accompany their achievements (Skinner 1953, Skinner 1968, Kazdin, 1980). Overall, they have little need for motivation to be provided from others.

Other people, those whom we think of as being "lazy" or unwilling to work, show, by their lack of work or their lack of enthusiasm for the work, that they are not internally motivated. They perhaps have not experienced many successes and, thus, they have not learned to relish their successes. These are individuals whose motivation comes mostly from others. Further, their pay-offs are probably most frequently avoidance pay-offs. They do the things they do in order to avoid the criticism, complaints, reprimands that they frequently receive from others (Mager & Pipe, 1970, Skinner 1968, Skinner 1974).

All people, at times, experience conflict over having more than one thing that they need or want to do at the same time. In those situations, the individuals eventually make a choice to do one activity. When they do this, the activity they choose is the one they are most motivated to do. They choose the activity that has the biggest or most significant pay-off.

Classroom performance is motivated in the same way that any other behavior is motivated. Whatever it is that each student does in the classroom, pays off for the individual student in some way. Whether the student sleeps or actively participates in discussion, that is what the student is motivated to do.

Every class is also comprised of both self-motivated students and students who appear to be lacking in motivation. Casual observation leads to a belief that those students who we think are self-motivated are students who are motivated by learning, by completing objectives and by achieving high scores and grades. Students who appear to lack in motivation do not enjoy the same satisfaction from these consequences. They also do not obtain these pay-offs very frequently, and probably do whatever academic activities they do simply to avoid failing individual assignments and to avoid failing the course.

Students also quite frequently have competing demands on their time. They must choose to do one activity over another. Choice is a complex act determined by many factors (Pierce & Epling, 1983). Relative to the classroom situation, students have daily choices. They choose whether or not to come to class at all; they choose whether to show up on time; they choose whether or not to participate in discussions; they choose whether or not to take notes, etc. Many activities that take place outside of the classroom also affect the classroom performance. For example, the amount and the type of studying that students do influences their scores on assignments and tests as well as their willingness and ability to take part in discussions. Thus, in order to perform well in the classroom, students must also be motivated to work on their academics outside the classroom.

The primary role of a professor could be viewed as one of 'managing learning'. In other management positions, to be highly effective, the manager must be successful at motivating the performances of those she or he manages (Daniels, 1989, Daniels, 1994, Mager, 1970). Thus, it follows that professors can and should make efforts to motivate their students. If professors make it pay off for their students to engage in the activities that the professors believe are important to learning, the professors can, minimally, influence some of the choices that students make. Professors can increase the likelihood that students choose the learning activities over whatever other activities are competing for the students' time. Further, if students are engaging in more learning activities, they are likely to be learning more. This can be a pay-off for both the students and the professors.

For professors to effectively manage learning in their classrooms they must do at least three things. First, they must identify the activities that they want their students to be doing, both within the classroom and in their out of class studying. Professors should select activities that not only put the students in contact with the information to be learned, but which also result in the student thinking about and interacting with the new material. Second, professors need to motivate students to do those activities; they must set up pay-offs for the students to do those activities that the professor has deemed important. Third, the professors must track students' performance to see if the techniques they are using are, in fact, working. Doing these things should result in more students learning, and learning more effectively (Daniels, 1994).

The remainder of this paper will discuss learning activities, performance management, and motivation strategies that have been implemented in my courses. The rationale for selecting certain learning activities will be outlined, specific motivational tactics used to manage student learning will be described, and the effects of using those tactics will be discussed.

Selecting Performance Activities

If we, as professors, defined the primary goal of our teaching endeavors, we would likely agree that our main purpose is to enhance the skills of our students in such a way that they can do things upon leaving our courses that they could not do when they entered our courses.

We want students not just to gain some knowledge, but to be able to apply their knowledge. This is true whether we are teaching technical courses within Construction Science, or we are teaching courses such as Psychology which are included in baccalaureate curricula to ensure that students receive a broad, well-rounded education. There are many activities that professors can include in their course requirements that will make the application of the course content more likely. Further, there are many activities that professors can include which will help in developing desirable learning habits and work habits that are ancillary skills that will benefit the individual in the long run. Below are several of the course requirements included in my courses and a discussion of their potential value.

Discussion Question

Discussion questions are defined as primarily "How?" or "Why?" type questions that provoke or at least promote discussion of the relevance, importance, or validity of concepts. Discussion questions that are geared toward this type of thinking move students away from simply memorizing concept definitions. They move students into thinking about whether or how they may be able to use this new idea.

Concept Summaries

These summaries are not intended to be general chapter summaries that hit the highlights of the chapter. Instead, students are to select single concepts from a chapter and then discuss/explain the one concept in depth. Students are discouraged from copying information directly from the text and are encouraged to explain their understanding of the concept and to relate examples that help clarify the concept. This is another activity designed to discourage rote memorization and to encourage an understanding of the concept.

Examples

One way of enhancing the application of new concepts and ideas is to get students to relate the concepts to their life experiences. Very often, students have either already experienced situations that illustrate or are indicative of the idea, or they can think of situations that they are likely to encounter in which they will be able to apply the concept. Having students describe personal experiences that illustrate concepts is likely to get the students to relate to the specific concept in the example. Also, the requirement is likely to prompt students to think about examples as they are reading or listening to lectures in which other concepts are presented.

Synopsis Papers

Synopsis papers are one page discussions in which the student summarizes the concept, analyzes the concept and discusses its relevance or importance, and illustrates the concept with a personal example. Since the analysis needs to be well thought out, the synopsis papers are relatively challenging learning activities, and thus, are used only in upper division courses. Writing the papers not only enhances the students' knowledge and ability to apply the concept, but also enhances critical thinking and written communication skills.

Study Questions/Answers

Self-quizzing techniques are recommended widely as an effective study method. Thinking in terms of questions and answers not only addresses course content, but encourages a problem solving approach to learning and likely enhances problem solving abilities. Students are required to write challenging, integrative questions that fall into one of three categories: compare/contrast, exemplification, or explanation questions. Compare/contrast questions must be answered with direct statements about how two concepts are similar and how they are different. Exemplification questions involve relating a personal (workplace) experience that illustrates the concept. Explanation questions must be answered with thorough summaries of the concept identified. All of these question types are designed to get students relate new concepts to other concepts and/or to personal experience such that students may better understand and apply the new concepts. The study question/answer tasks that are included in my courses are included as a self-quizzing tool, and also, they are typically used as a class quiz/discussion instrument in oral quizzes.

Oral Quizzes

The study questions/answers described above are used in conjunction with oral quizzes. This exercise is set up more as a learning event than as an evaluation process, although each student does receive a score for the quiz. The quiz is structured such that each student asks at least one of his or her questions and each student has at least one opportunity to answer or respond to another student's question. The result of this exercise is that students interact with one another in discussing the answers to the questions. Also, because many questions involve examples, students are exposed to other illustrations and applications of the concept in addition to the examples or uses they may have thought of individually.

Participation

In order to get students involved more in thinking about the material being presented in class, a participation requirement is also included as a course requirement. On a weekly basis, each student must ask, answer, and/or discuss questions over the material being covered. This helps to keep students mentally present and helps to keep them relating to the information being presented or discussed.

Attendance/Promptness

Two ancillary habits that are emphasized in my class are attending class regularly and being prompt in arriving to class. If students are to get the most out of in-class lectures or discussions, they must be present in class and not simply rely on notes that others take. Also, important announcements and clarifications typically occur during the first five minutes of class, thus making it beneficial for the student to be present. Further, employers frequently complain about employees who are routinely tardy or who frequently miss work. Establishing appropriate habits in college may help to decrease this problem in other settings.

On-time Assignments

Again, in an effort to establish good work habits, a strong 'on-time' policy is implemented for all assignments. Students are required to turn in assignments at the beginning of the class hour on the day it is due. The due time is set at the beginning of the class hour in order to reduce the likelihood that students will try to do their assignments in class or that they will skip class in order to complete their assignment by the end of class.

Performance Management and Motivation

In an effort to motivate students to complete the course requirements, points and verbal comments are used extensively. Students earn points for every requirement. They earn points for attending class and for being on time for class; they earn points for speaking in class; and they earn points for each homework assignment that they turn in. Students also receive scores on tests and quizzes, but the tests are actually de-emphasized relative to the learning exercise requirements. Also, extensive written comments are provided on all written assignments. Comments emphasize what students did correctly and an effort is made to point out at least one thing that each student did well on each assignment. In addition, corrective or directive feedback is given so that students are alerted to what to work on when completing future assignments.

Although points and verbal comments do not seem like "big" pay offs, they are effective for several reasons. First, students know exactly how to earn points in that the course syllabus details the requirements and the point system. Second, students receive the points and comments frequently. Most students earn points every class period. Third, students generally receive points immediately after doing the course requirement (e.g. immediately after arriving to class, immediately after speaking in class). Written comments are also personalized since they are written directly on the students' assignments and they are specific as to what was done well or what corrections need to be made. Because students receive the points and comments reliably, the pay-off is more apparent. Students experience these consequences, these pay-offs, weekly, if not daily. Thus, because they are more aware of the pay-offs, the students are more directly and more strongly motivated by these seemingly trivial consequences.

The overall course grade is also a motivator in that it is the ultimate pay-off for the work the student puts in during the quarter. However, the course grade is really too 'distant' to have much of an effect on daily learning. Giving points and comments daily allows students to have a sense of their current course grade and their progress throughout the duration of the course. Also, the points earned for assignments, attendance, and participation generally comprise around 70 percent of the points allotted to the course. Most students learn very quickly that in order to earn a good grade in the course, or in order to avoid a poor grade, they must complete the routine weekly requirements. This generally results in students forming a more regular and consistent habit of studying and preparing their course work.

Evaluation

The performance of students in class and on their assignments suggests that the learning activities and the point system are having the intended effects. Attendance (and promptness) rates in all of my classes are very high, generally above 85%, and sometimes averaging above 90%. Approximately 85% of the routine assignments are also turned in on time and generally over 90% of the larger project assignments are turned in on time. These completion rates are as good as, if not higher than, the rates of students taking scheduled, in-class quizzes. The quality of the work turned in also is generally high. Specific criteria, which are detailed in the syllabi and in handouts, are used to evaluate each type of assignment. Students who turn in the assignments on time generally average above 80% when graded based on the assignment criteria. These rates all indicate the value of both the assignments and the corresponding point system.

Although it is extremely difficult, nearly impossible, to evaluate the long term effects of using these techniques, there are some anecdotal data that suggest that the learning activities are having the intended effect, at least with some students. In casual conversation, several students have commented on how they have used concepts/ideas at work, with their kids, at home, etc. Further, former students have commented on how they have used concepts learned in my courses in other courses and on the job. Students have also followed up course work with independent study projects in which they applied techniques learned in the courses. Further, former students have sought my advice or assistance in using concepts and techniques in their post-graduate jobs.

Conclusion

We could enjoy a lengthy debate on whether or not professors should have to motivate their students to do the things the students ought to be doing anyway. Quite possibly the general consensus would be, "No, professors shouldn't HAVE to motivate their students." However, whether or not we should "have to" is not really the issue. The fact is that many students are not self-motivated, or at least are not motivated enough to put much effort into their learning. There are not enough pay-offs for them to attend class, or to do their assignments, at least not enough relative to the pay-offs for the other things competing for their time. Knowing this, it seems that we have two choices. One alternative is to take a somewhat evolutionary, "survival of the fittest" approach and let all of those who lack the motivation and/or the skills just fall by the wayside. The other option is to take a more revolutionary approach, provide some direct intervention, and perhaps change the future for some individuals who have potential, but not the history to drive them to succeed.

Perhaps professors shouldn't have to motivate their students, but the reality is that professors CAN motivate their students. By making it directly, frequently, and immediately pay off for students to do the things professors want them to do, professors can alter the choices that students make and ultimately alter what and how students learn. Further, many students may learn how to motivate themselves from observing the professors and from experiencing the successes in completing what they were motivated to do. Instead of making people more reliant upon others for their motivation, using motivation to help others succeed tends to lead to less dependence upon others. Success and accomplishment, themselves, become the pay-offs.

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Tenure And Promotion: A Comparison Between Construction Management And Civil Engineering

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This study investigated tenure policies and criteria, and promotion considerations for full professor in Construction Management (CM) and Civil Engineering (CE) schools in the United States. The purpose of the study was to identify differences, if any, between the two disciplines. Questionnaires were sent to over 200 CM and CE programs. Responses were collected and comparisons were made between the two disciplines. Statistically significant differences were found in certain areas. Principally, research holds a more prominent place in CE schools than CM schools. It is more important when making both tenure and promotion (T&P) decisions. Teaching holds a more important place in CM schools; it is more important than research in making tenure decisions, and equally important as research in making promotion decisions. Service, the third classic consideration for tenure and promotion, was ranked very low in importance by both disciplines. With regard to promotion to full professor, other considerations ahead of service include national reputation, peer evaluations, grantsmanship, and student evaluations. Only international reputation was of lesser importance. Other findings include: (a) fewer CM schools require a doctorate for tenure than CE schools, (b) fewer refereed articles are needed to attain tenure in CM programs, and (c) most CM schools feel tenure is outmoded; most CE schools do not.

Key Words: Tenure, Promotion, Criteria, Construction Management, Civil Engineering

Introduction

Years ago universities offered only basic engineering degrees in mechanical, civil, electrical and industrial engineering. Then several other engineering disciplines were added such as aerospace, architectural, environmental and others. In time, as our knowledge base expanded to meet the demands of progress, so did specializations in engineering. One such specialization was the development of the construction management curriculums.

Engineering may be considered the “applied” arm of science where the laws of nature are used as the basis for specifying materials and how these materials come together. Construction management may be considered one step further removed from pure science. The CM professional plans, organizes, directs and controls the construction of that which is ‘designed’ by the engineer or architect.

Construction Management (CM) is a relative newcomer to the academic venue. As such, it does not have an extensive history or tradition of either standard operating procedures or policies. In academia, CM’s policies and criteria for tenure and promotion (T&P) may naturally follow those of Civil Engineering (CE), one of its primary precursors. However, because of its apparently more practical nature, policies and criteria for T&P in construction management schools may differ significantly from those in civil engineering curriculums.

Tenure exists to provide academic freedom to university faculty. The American Association of University Professors (AAUP) says the purpose of tenure is to assure freedom in teaching and research activities without fear of loss of position, thereby guaranteeing financial security and making the profession attractive to qualified candidates (Savoie & Sawyerr, 1991). It is a prime goal of most new faculty to achieve tenure and thereby feel confident that their research and creative activities may continue with minimal interruption.

A continuing issue with faculty however, especially new faculty, is the clear identification as to what is required to achieve tenure. As Shofoluwe, Kashef, Egger & Varzavand (1995) stated, "the rigorous and sometimes nebulous requirements for tenure and promotion make it difficult and sometimes frustrating for many faculty members to achieve this goal." Tenure requirements may not only be unclear to faculty in traditional areas of study like Engineering, but even more so in relatively new disciplines such as Construction Management.

Classically, achievement of tenure and promotion has been based on three principal considerations: research/creative activity, teaching, and service. Christofferson and Newitt (1994) state that "the criteria used to evaluate faculty performance are teaching, scholarship, and service." Others agree (Bott 1988; Dugger & Paige 1988; and Israel 1984) that the three most important factors used as a basis for awarding tenure and promotion are (a) teaching proficiency, (b) service contribution to university, and (c) scholarly activities such as research.

The importance of research and publishing in attaining tenure and promotion is exemplified by the commonly accepted cliché "publish or perish". The importance of teaching is also recognized. Universities perform self studies to recognize teaching effectiveness (Leigh & Anderson, 1992) and present annual teaching awards to outstanding faculty in this area. Bott states that teaching carries the most weight in decisions of tenure and promotion. Service on the other hand, has not been recognized as important as teaching and research. A study performed by Kasten found that faculty perceived service having almost no impact on tenure decisions (Kasten, 1984).

Tenure and promotion criteria are not the same from university to university, or from department to department within the same university. Considerations and criteria are developed by each department, and by each university. Perceptions of tenure and the criteria used to grant tenure are influenced by an individuals' experience and background. Several factors of interest may include age, years of industry experience, years of teaching experience, and whether or not the respondent is tenured.

Purpose

The primary purpose for this study was to identify differences, if any, between the policies and criteria for tenure and promotion (T&P) between construction management (CM) and civil engineering (CE) schools in America. Tenure is granted based on considerations and criteria established by each department, school/ college, and university. The criteria and policies may be different between CE and CM schools because of the differing nature of the studies involved. Secondary goals of this study were (a) to investigate how clearly T&P policies and criteria are documented, (b) to obtain an idea of how subjective the T&P process is, (c) to corroborate the relative importance of teaching, research and service as reported by others, and (d) to shed some light on how a faculty member's position, age, tenure status, and background influence his/her perspective about the process and criteria for tenure and promotion.

Methodology

Questionnaires were sent to 128 Civil Engineering schools in America, and to faculty at all 86 member schools of the Associated Schools of Construction (ASC). The engineering schools were selected from Peterson's *Graduate Programs in Engineering and Applied Science*, 1994; the construction management schools are listed in the *1995 Membership Directory*, Associated Schools of Construction, 1995.

Only *one* questionnaire was sent to each CE school. However, *all* faculty and administrators at each ASC school received questionnaires. The reason for this was that the questionnaires sent to the construction schools were part of a larger survey, much of which exceeds the scope of this paper. Regarding the construction schools where multiple questionnaires were sent (one to each faculty member listed in the ASC directory), only one respondent from a school was used for analysis in this paper. That respondent was either the administrator of the department or the apparent senior faculty respondent at the school.

Virtually all the CE schools included in this study are accredited by ABET (American Board of Engineering Training); most of the construction schools are accredited by ACCE (American Council for Construction Education).

An approximate two month period was given for questionnaires to be completed and returned. Completed surveys were compiled in two master Excel spread sheets. Several additional spread sheets with auxiliary tables were developed to illustrate trends in the results.

The Chi Square method of statistical analysis was used to identify significant differences between the CM and CE schools regarding questions about tenure. With regard to promotion considerations for Full Professor, a "t" test was used to identify significant differences between the two groups.

Findings

General

Table 1 shows the partial results of the study regarding tenure issues, and demographics of the respondents. Column 1 lists the issues or type of information requested; columns 2 and 3 show the average or most frequent responses for Construction Management (CM) and Civil

Engineering (CE) schools; and column 4 indicates whether or not the difference between the CM and CE schools' responses are statistically significant at two different confidence levels. Results with regard to promotion considerations are presented later in this section.

Table 1

Partial Results of the Study

Item	CM Schools	CE Schools	Significant Difference?
About the Questionnaire:			
1. Questionnaire Return Rate	52%	24%	Not analyzed
About the Respondents:			
2. Age, average	50 yrs old	54 yrs old	no
3. Teaching Experience, average	15 yrs	21 yrs	yes, at 95% level.
4. Professional Work Experience, avg	14 yrs	7 yrs	yes, at 95% level.
5. Are you Tenured?	80% yes	97% yes	no
6. Highest Degree Earned	56% Ph.D.	90% Ph.D.	yes, at 99% level.
7. Academic Rank	42% Full P.	94% Full P.	yes, at 99% level.
About Tenure:			
8. Wt. of Teaching in Tenure Decisions	51% hvy rating	23% hvy rating	yes, at 95% level.
9. Wt. of Research in Tenure Decisions	27% hvy rating	58% hvy rating	yes, at 99% level.
10. Wt. of Service in Tenure Decisions	56% slight rating	74% slight rating	no
11. Number of Refereed Articles needed?	38% say 4+	77% say 4+	yes, at 99% level.
12. Number of ref. art's needed in Journals?	27% say 3+	71% say 3+	yes, at 99% level.
13. Do presentations of papers count?	78% say Yes	84% say Yes	no
14. Is a Ph.D. required?	31% say Yes	84% say Yes	yes, at 99% level.
15. How much do Peer Evaluations count?	78% mod/hvy	97% mod/hvy	no
16. How much do Student Eval. count?	73% mod/slight	77% mod/slight	no
17. Does Grantsmanship play a role?	76% Yes	94% Yes	no
18. Most common probation period	6 years	6 years	no
19. Is Tenure process >20% subjective?	89% say Yes	68% say Yes	yes, at 95% level.
20. Is Tenure process >40% subjective?	49% say Yes	39% say Yes	yes, at 95% level.
21. Tenure Policy/Criteria Clearly Doc'd?	84% say Yes	94% say Yes	no
22. Is Tenure Outmoded?	60% say Yes	23% say Yes	yes, at 99% level.
23. Should CM criteria = others'	49% say Yes	13% say Yes	yes, at 99% level.
24. Time since last tenure process review	67% say 3- yrs	68% say 3- yrs	no
25. Does tenure process impact relations?	62% no 13% yes, pos 24% yes, neg	65% no 23% yes, positive 13% yes, negative	no

Questionnaire Return Rate

Eighty six (86) construction management schools were contacted, 45 returns were received yielding a 52% return rate. One hundred twenty eight (128) civil engineering schools were contacted, 31 returns were received; a 24% return rate.

Demographics of Respondents

The average age of the Construction Management (CM) respondent was 4 years younger than the Civil Engineering (CE) respondent. The average CM respondents had seven less years of teaching experience but seven more years professional work experience than the CE respondent.

Tenure

Classic Criteria for Tenure. Three traditional areas of performance considered when making tenure decisions are teaching, research (which includes publishing and creative activity), and service (Christofferson & Newitt 1994; Bott 1988; Dugger & Paige 1988; and Israel 1984). Percentage wise, over twice as many CM respondents counted Teaching a heavy factor (over 40% weight) compared to CE respondents. Conversely, over twice as many CE respondents counted Research a heavy factor compared to CM respondents. Service was ranked low by both groups. The difference between ratings for teaching and research are seen in table 2.

Table 2

Relative Weights of Teaching and Research as Factors in Tenure Decisions

Weight Factors for Tenure Consideration							
Teaching ...(1)				***Research …(2)***			
Raw Data		Percentages, %		Raw Data		Percentages, %	
CM Resp.	CE Resp.	CM Resp.	CE Resp.	CM Resp.	CE Resp.	CM Resp.	CE Resp.
5	2	11%	6%	12	1	27%	3%
17	21	38%	68%	21	11	47%	35%
23	7	51%	23%	12	18	27%	58%
45	30	100%	97%	45	30	100%	97%

NOTES:

(1) Differences in responses for 'Teaching' between CM & CE groups are significant at the 95% confidence level.
(2) Differences in responses for 'Research' between CM & CE groups are significant at the 99% confidence level.
(3) Due to some non-responsive answers, some totals do not equal 100%.

Seventy seven percent (77%) of the civil engineering schools require four or more refereed articles to attain tenure. Seventy one percent (71%) of these school said three or more of these articles must appear in journals.

In contrast, only 38% of the CM schools said four or more refereed articles are required for tenure. And only 27% of the schools said three or more of the articles must appear in journals. Figure 1 shows these data.

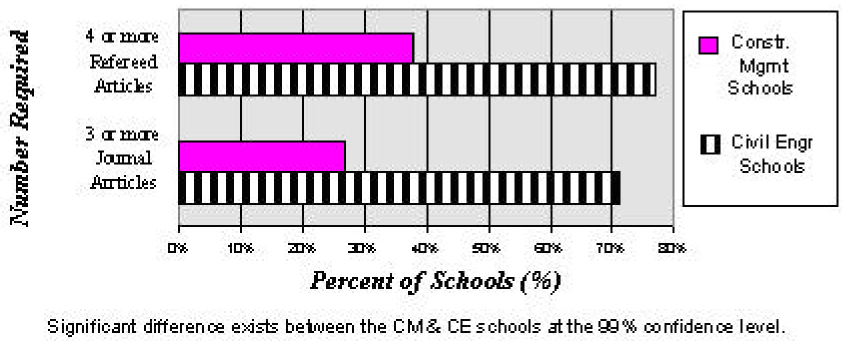

Figure 1. Number of refereed and refereed journal articles required for tenure.

Presentations

Construction schools and engineering schools agree that presentations of papers at conferences count in tenure decisions. Seventy eight percent (78%) of the CM respondents and 84% of the CE respondents indicated this.

Ph.D. requirement

Eighty four percent (84%) of the CE schools said a Ph.D. degree is required to attain tenure; however, only 61% said it should be a requirement. In contrast only 31% of the Construction Management schools said a Ph.D. is currently required for tenure; and only 29% said it should be. Figure 2 shows these data.

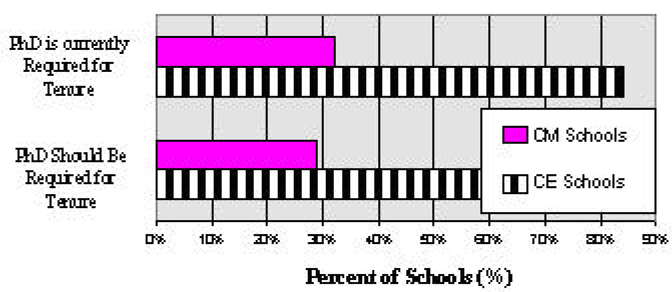

Figure 2. Ph.D. requirement for tenure.

Peer and Student Evaluations

CM and CE schools both rated peer evaluations moderate to heavy as considerations in making tenure decisions. (CE schools rated peer evaluations slightly heavier than did CM schools). Student evaluations were rated less important than peer evaluations. Figure 3 illustrates the survey results.

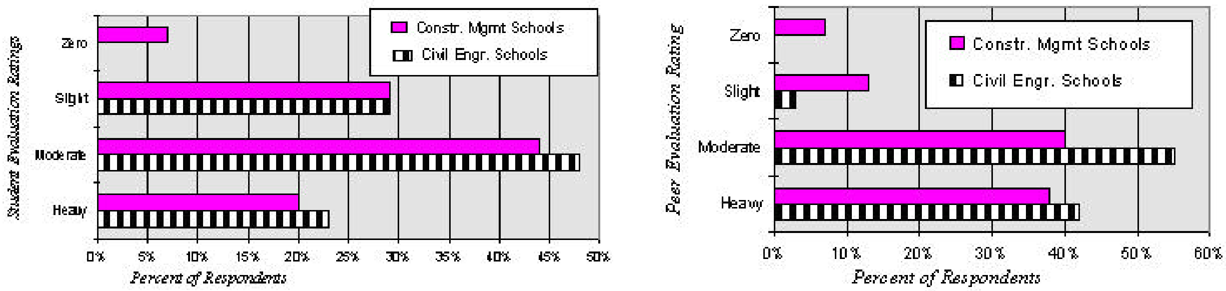

Figure 3. Peer and student evaluations as factors in tenure decisions.

Grantsmanship

Ninety four percent (94%) of the CE schools said grants play a role in attaining tenure. Only 76% of the CM schools agreed.

Probationary Period

The most frequent probationary period (the time it normally takes to attain tenure) was six years. Sixty percent (60%) of the CM schools indicated this; and 74% of the CE schools agreed. Only 11% of the CM schools and 13% of the CE schools indicated longer probationary periods.

A Subjective Process

Almost half (49%) of the construction management respondents said the tenure process *is* 40% or more *subjective*. In contrast, only 39% of the civil engineering respondents felt this way.

Clearly Documented

Overall, 89% of all respondents said tenure policy and supporting criteria were clearly documented at their schools.

Tenure Outmoded or Not

The majority (60%) of Construction Management schools said tenure *is outmoded*. However, only 23% of the Civil Engineering schools agreed with this viewpoint. Figure 4 illustrates these results.

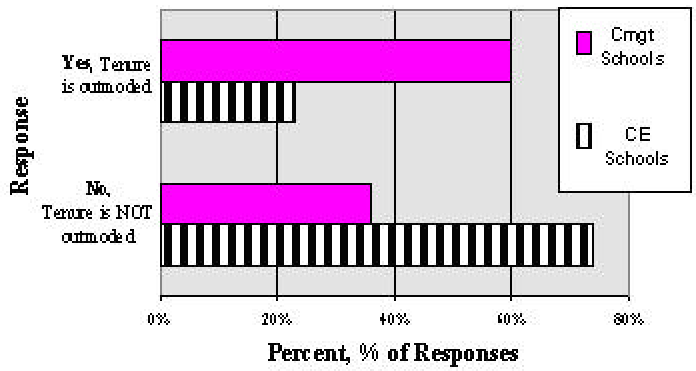

Figure 4. Tenure outmoded or not.

CM Criteria Vs Other Disciplines

One may ponder whether or not tenure criteria for construction management faculty should be commensurate with other disciplines' requirements. A basis for differing requirements might be a perceived less scientific nature of construction management. However, only 47% of the CM respondents said tenure requirements for CM faculty should *not* be the same. In contrast, a surprising 71% of the CE respondents said CM tenure requirements should *not* be the same as other disciplines.

Review Cycle & Impact on Relationships

Two thirds of all responding schools said their tenure policies and criteria have been reviewed within the last three years. Only five of the schools said the last review occurred eight or more years ago.

Approximately 62% of respondents said the tenure process had little to no effect in relationships between faculty and administrator. The remaining respondents were about split, about 18% saying it had a positive effect; about 18% saying it had a negative effect.

Promotion

Schools were prompted to rank eight promotion considerations (listed in the questionnaire) in order of importance. The promotion consideration was from Associate to Full Professor. A number one ranking indicated the most important factors with numbers two through eight indicating lesser importance in turn. A ranking of 'eight' indicated the least important.

Table 3 shows the average rank given by respondents for the eight tenure considerations. The factors are listed in descending order of importance as judged by the CM schools; note the differences between CM and CE schools.

Respondents were also prompted to add a ninth consideration if they felt it was appropriate. 'Write-in' factors included: text book publications, paper presentations, establishment of a consistent record of achievement, and graduate student supervision. No single 'write-in' factor appeared on more than one questionnaire.

Table 3

Average Rank (of Importance) of the Eight Considerations for Promotion Decisions from Associate to Full Professor

Tenure Consideration	Constr. Mgmt Respondents	Civil Engr Respondents
Teaching Skills	3.16	3.0
Refereed Articles	3.19	1.9
National Reputation	4.2	4.2
Peer Evaluations	4.4	4.3
Grantsmanship	4.7	4.0
Service	4.8	6.1
Student Evaluations	5.7	5.6
International Reputation	5.9	7.2

Raw data were manipulated to place responses in a more visual perspective. Each average ranking seen in Table 3 was subtracted from the number eight, the nominal lowest ranking, to produce a 'reversed' ranking. This procedure gave the more important considerations a high(er) number, and the less important ones a low(er) number. Then, each 'reversed' ranking was expressed as a percentage of the sum of all reversed rankings.

For example, consider 'Teaching Skills'. It's average ranking is 3.16. It's 'reversed' average ranking is 4.84 (8.00-3.16=4.84). The sum of the reversed rankings for all eight considerations is 28. The reversed ranking for Teaching Skills, expressed as a percentage, is 17% ({4.84/28}*{100}=17%).

This manipulation permits each factor to be represented by a percentage (%) reflecting its relative importance compared to the other factors. Using this manipulative technique, Figure 5 illustrates the importance of the eight promotion considerations as viewed by the CM schools and the CE schools. Note the differences in the percentages.

The differences for *refereed articles* and *service* are *significant at the 99% level*. The difference for *international reputation* is *significant at the 95% level*. All other ratings differences *are not statistically significant*.

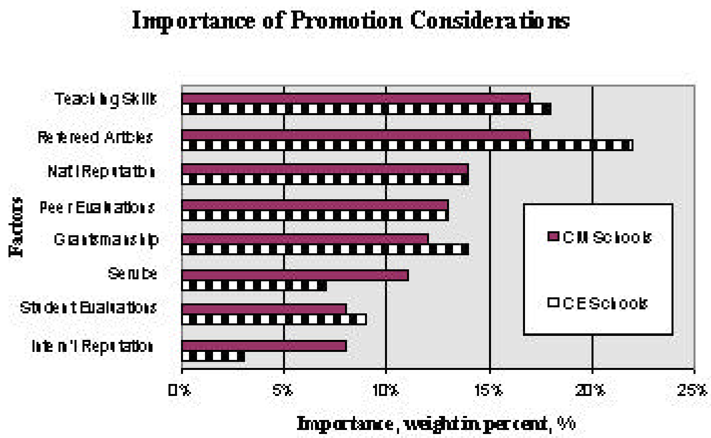

Figure 5. Importance of various promotion considerations (associate professor to full professor) between CM & CE schools.

An effective way to view the relative importance of these eight factors within the same group of schools, either CM or CE, is to view them in a 'pie' chart. This way the relative importance of the factors are seen visually, with the sum of all equaling 100%. Figures 6 shows pie charts for CM and CE schools respectively.

Figure 6. Relative importance of promotion considerations in CM and CE schools.

Discussion

General

General results include return rates and demographics of the respondents.

Return Rates

The higher return rate for the CM schools may be largely due to the fact that all faculty at CM schools received a questionnaire, but only one questionnaire was sent to each CE school. When the administrator at a CM school did not respond, the questionnaire of the highest ranking faculty member with the most time at institution was taken to represent the school. This option was not available at CE schools.

Demographics

CM respondents had more professional work experience and less teaching experience than did their CE counterparts. Also, the academic rank of CM respondents was lower, and fewer had doctorate degrees as compared to CE respondents. The age and tenure status of respondents were not significantly different.

Tenure Requirements

There were several areas where significant differences existed between CE and CM respondents. These, and areas where no significant differences existed, are discussed in the following paragraphs.

Agreement between CM and CE schools

Both CM and CE schools agree that service counts little towards tenure. Most agree that presentations of papers at conferences *are* considered in tenure decisions. Also, peer evaluations are considered to have moderate to heavy weight and student evaluations only moderate to slight weight in making tenure decisions. And both schools agree that grantsmanship plays a role.

Tenure policies and supporting criteria are clearly documented according to both disciplines. Two-thirds of all schools surveyed have reviewed their tenure policies within the last three years. Nearly two thirds of the respondents agree that most of the time the tenure process has little to no effect on relationships between faculty and administration. The remaining respondents are split; half see the process as having a positive impact on relations, the other half see it having a negative impact.

Differences between CM and CE schools

There are several areas where the two disciplines disagree. These include: (a) the weight of teaching skills and research activity, (b) the number of refereed articles needed, (c) requirement for a doctorate degree, (d) subjectivity of the tenure process, (e) whether or not tenure is outmoded, and (f) whether or not tenure requirements/ criteria for CM faculty should be commensurate with those in other disciplines.

Weight of Teaching Skills and Research Activity

CM schools place more weight on teaching; CE schools place more weight on research. This may be due to CE faculty having spent more time in academia and being more sensitive to the research requirements both for tenure and promotion. They may be more accustomed to research proposal writing, conducting research, and presenting results. CM faculty on the other hand may perceive getting results on a jobsite or a project as being more important; they may be more sensitive to the negative effects poor training has on a project. Thus, they may perceive a more pressing need for clarity and effectiveness in teaching skills rather than research ability.

Number of Articles Required

CM schools see less of a need to publish than do their CE counterparts. This may be the result of CM personnel having spent more time in industry and being more practical oriented. It may be that the longer time one spends in industry, the less one views the importance of research and publications. CE faculty have spent more time in academia and thus are acclimated to that environment and expect to publish often. The “need” to publish generates papers. If there is no “need”, one does not publish (as frequently). There is little need in industry; CM’s do not view publishing as important as CE’s do.

Ph.D. Requirement

CM faculty see the knowledge and skills they impart onto the student as being the primary goal of their position at the university. The CE faculty, on the other hand, may view their research and creative activity as their prime contribution to their profession. Considering these two views, it is not surprising that CE’s see a Ph.D. as being much more important in attaining tenure as the CM schools do.

The Subjectivity of the Tenure Process

CM schools see the tenure process to be much more subjective than the CE schools. This may be a result of the CM faculty perceiving their discipline to be less scientific than the CE discipline. If one is in a perceived scientific discipline, one may prove one’s worth on the basis of successes in research. However, if one is in a perceived less scientific field, one may be more sensitive to the less scientific evaluation process. It follows that if CE is viewed to be more scientific, it will also be perceived to have a more objective evaluation process. Likewise, if CM is viewed to be less scientific, it will be perceived to have a more subjective evaluation process.

Is Tenure Outmoded?

The majority of CM schools see tenure as being outmoded, whereas most CE schools do not. CE schools want to maintain the status quo where their jobs are protected regardless of teaching ability. Their prime concern is research and the notoriety and financial reward associated with it. CM schools on the other hand, have more concern about teaching and are more willing to replace ineffective teachers. It may be that to the CM schools, academic freedom is less important than academic effectiveness.

Should CM Tenure Criteria be Commensurate with Other Curricula?

The interesting result here is that CE schools say tenure criteria for CM schools should not be the same as other schools. Yet CM schools were virtually split, some saying the criteria should be the same, some saying it should be different. Overall, most respondents indicated that criteria should be different. And so, one should not be surprised that several significant differences exist between CM and CE schools, as seen in the results of this study.

Promotion Considerations

The eight considerations for promotion to full professor were naturally aligned into three groups by respondents from both disciplines. Group 1, the group considered most important, consisted of (a) teaching and (b) research. Group 2, having the next level of importance, consisted of (a) national reputation, (b) peer evaluations, and (c) grantsmanship. And Group 3, the least important considerations, consisted of (a) student evaluations, (b) service, and (c) international reputation.

Both Group 1 considerations, teaching and research, were viewed virtually equally important by CM schools. However, CE schools ranked research as the clear number one consideration; teaching was a relative distant second (albeit still far ahead of any Group 2 consideration). This difference, significant at the 99% level, may be the most striking difference between the two disciplines.

CE schools rated service and international reputation much lower than CM schools did. This may be due in part to research receiving a very high rating by CE schools. This high rating would have the effect of depressing the ratings of other considerations on the list. However, the other considerations thus depressed should have all been depressed by equal amounts. Since the depression shown up excessively in only two considerations, service and international reputation, one might conclude these two factors to be much less important to CE schools than CM schools.

Conclusions

There are differences in tenure policies and criteria, and in promotion considerations for full professor between CM schools and CE schools.

Tenure

With regard to tenure, CM schools view teaching as more important than research. Conversely, research is more important in CE schools. Fewer refereed articles are required in CM schools; and a Ph.D. is much less likely to be required. CM schools view the tenure process to be significantly more subjective than do their CE counterparts.

CM schools view tenure as being somewhat outmoded; CE schools do not. This may be in part why CM schools' criteria for tenure are not the same as CE schools. CM is more practical oriented; they are more interested in tangible results; teaching is more important than research. From the CM perspective, the research-publication requirement for tenure is an obstacle in attaining tenure and retaining experienced professionals as full time faculty members. Also, CM schools may view tenure as protecting faculty from the consequences of poor teaching skills rather than a method of preserving academic freedom.

CE schools apparently understand the difference between CM schools and other curricula as they feel the tenure criteria for CM should not be the same as for other curricula; presumably it should be less research oriented. Curiously, CM schools are split on this issue, with only half feeling criteria should be different. This is an area for future study. Specifically, should the criteria for tenure for CM schools be different from other curricula, and if so, why and in what way?

Promotion to Full Professor

With regard to promotion to full professor, the emphasis in CE schools is research, while the emphasis in CM schools is both teaching *and* research. All other considerations have a lower place of importance. The two least important factors are service and international reputation; both CE and CM schools agree on this.

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A Study of the Supply and Demand for Construction Education Graduates

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In recent years, the construction industry has become more reliant on accredited construction education programs to supply individuals who are educationally and intellectually equipped to enter into an increasingly complex and demanding work environment. As this dependency grows, the necessity to assess industry needs and educational program production becomes increasingly apparent. The following study was conducted as part of this continual effort. It involved the survey of 54 accredited Construction Programs in the U.S. and over 773 companies which consistently hire graduates from these programs. A time series regression analysis was used to create a mathematical model to predict the demand for construction graduates from accredited construction programs. The model showed that there is in an increase in demand for construction graduates of approximately 600 students per annum. Given the continuation of current market growth and production levels of accredited construction programs, the results suggest a widening gap in the supply and demand of graduates for the near term.

Keywords: construction graduates, construction programs, construction industry, supply, demand

Introduction

The demand for construction education graduates has seemingly increased markedly in the past several years. As a result of this demand, construction education programs are flourishing throughout the nation with over fifty-four programs accredited by the American Council for Construction Education (ACCE) and the Accrediting Board for Engineering and Technology (ABET). Other construction graduates come from the National Association for Industrial Technology (NAIT) accredited programs, two-year construction programs and non-accredited four-year programs. NAIT is not oriented to construction, and accredits only construction programs that are part of an industrial technology program (Dorsey, 1992).

The fact that the construction graduate is a viable product and wanted by the industry is not in doubt. Pilot studies indicate a great demand for the construction graduate. In most construction education programs, institutions report a 100% placement rate, with many indicating that each graduate has three or four offers to select from. The question of "how many are and will be needed?", however, is largely unanswered. No extensive market research has recently been completed on either the supply or demand side for construction graduates. This study endeavors to address this problem by uncovering information relative to the supply and demand of construction graduates in the construction industry. More specifically, this study will attempt to:

1. Quantify the number of construction graduates currently produced nationwide by ACCE accredited construction programs and selected ABET accredited programs.
2. Quantify construction industry demand for construction graduates from ACCE accredited construction programs and selected ABET accredited programs.

Prior Studies of Construction Graduate Demand

Although the age of this study limits the ability to draw inferences for today's market, the findings of Jones (1983, p.49) offered interesting insights into the supply and demand question as far back as 1983. The study noted that statements regarding the construction industry's demand for construction program graduates are "more guesswork than factual". Mr. Jones cited a conclusion by the Business Roundtable's study on demand:

> Attempts to forecast supply and demand for construction and project management are inconclusive. Poor response from architect/engineer and construction management firms which hire considerable numbers of graduate engineers adds uncertainty to the results. The economic recession and in particular the slump in construction makes forecasting more difficult. Even so, the study indicated demand exceeding supply by about 2,500 (25%) over the next five years (The Business Roundtable, 1982, p7).

Jones (1983, p.50) continued with the following observations:

1. "Construction and construction engineering graduates, and the demand for them, must be held distinct from the demand for civil and other engineering disciplines". While ACCE accredited programs do not mix construction graduates with engineering graduates, ABET programs may.
2. "Construction programs are relatively new and therefore unknown to many construction companies". While this observation may have been true in 1983, a pilot study indicated a strong reliance on the graduates of construction programs.
3. "Demand statistics must be tempered by recognition of the fact that contractors will readily promote from within their organization when faced with a scarcity of qualified graduates".

The Jones study concluded there to be a small shortage of 300 to 500 graduates per year instead of the 2,000 to 3,000 shortages that was predicted by the Business Roundtable research (p.52). Mr. Jones acknowledged that a major factor, which might affect his demand projections, was a rise in construction program recruiting by contractors. It was believed that as construction programs became better known throughout the industry, there could be a large impact in demand for construction graduates. Recent reports from construction education programs indicate that increased recruiting has, in fact, occurred in the industry.

A more recent study by Robert W. Dorsey (1992, pp. 35-37) quoted the American Institute of Constructor's projection of 10,000 new managers of construction needed each year. This number included new and replacement positions ranging from assistant superintendents to senior officers. Dorsey found that fewer candidates were being promoted from within construction companies; instead, construction companies appeared to be relying heavily on construction programs to provide recruits.

In addition to these studies, the Occupational Outlook Handbook published by the Bureau of Labor Statistics provides valuable information regarding the expected growth and opportunity in a wide range of industries. According to the 1998-1999 Handbook, construction managers held about 249,000 jobs in 1996. Over 85% were employed in the construction industry, primarily by trade contractors and general building contractors. The Bureau predicts employment of construction managers is projected to increase 10 – 20% between the years 1996 and 2006.

The study goes on to state that graduates with degrees in construction science, construction management, or construction engineering who have previous experience will find increasing prospects in construction management, engineering and architectural services, and contracting firms. This growth, according to the bureau is expected to result from various factors, which include an increase in activity and complexity of construction projects, as well as the need to replace workers who transfer to other occupations or leave the work force.

Addressing the supply of construction education graduates, the handbook estimates that over 100 colleges or universities offered 4-year degree programs in construction science or construction management in 1996 (This study surveyed only the 54 colleges or universities with construction programs accredited by either ACCE or ABET). Graduates from these programs, it says, are usually hired as assistants to project managers, field engineers, schedulers, or cost estimators. In addition, an increasing number of graduates in construction related fields (i.e. architecture, engineering) are entering into construction management, often after obtaining experience in their original occupation, or after completing graduate studies in a construction related program.

A common point expressed by all of these studies is that demand for the construction education graduate will increase in coming years, though the extent of this growth varies between studies. The remainder of this paper describes the study conducted in the Department of Construction Science at Texas A&M University in order to shed light on the supply and demand of the construction education graduate, and to assess the extent of the gap inferred by previous studies.

Research Methodology

Pilot Study

In order to determine the nature of the data, which could be provided by construction companies and universities, a pilot study was conducted. Both the companies and universities participating in the pilot study were sampled "by convenience". Table 1 lists the construction companies and contact persons included in the Pilot Study.

Table 1

Pilot Study Companies

Companies	Contact Person
Brown & Root, Inc.	Cindy Creeden
Centex Construction Group	Cindy DePrater
Fluor Daniel, Inc	Darlene Becker
H.B. Zachry Company	Bill Wemberly
HCB Contractors	Jerry Cooper

These five contractors have annual revenues ranging from 350 million dollars to over 9 billion dollars (ENR, 1997). They were sampled with the simple goal of determining what information would be available from the construction industry. Pilot study companies were able to provide the number of new employees they hire each year and the percentage of the new hires that have a construction education based university education. Additional information was provided in the following areas:

- factors influencing new hires;
- positions filled with construction graduates;
- five year forecasts for new hires;
- names of schools and departments from which they hire

They were not, however able to link the number of new hires directly to an easily quantifiable measure such as company revenue, backlog, or overall economic health. Some contacts were insistent that there was no connection between the number of new hires and the amount of work in progress or expectations of future work.

The pilot study continued by contacting the ACCE accredited construction programs listed in Table 2. Each department was asked to provide the number of graduates produced each year and was asked to provide a list of construction companies who regularly recruited from their programs. Rather than attempt to provide an exhaustive list of all companies, each department was asked to provide a list of the firms that recruited heavily, year in and year out. While most departments were willing to provide this information, the pilot study indicated that some programs would not provide this list without permission of the company. This permission was not sought.

Department heads were asked about their placement percentages and their subjective opinions on industry demand for construction graduates. All but one department reported 100% placement. In their subjective opinions, most department heads felt they could produce from 20% to 50% more students while maintaining 100% placement.

The universities listed in Table 2 were sampled out of convenience for the purpose of determining what information would be readily available from programs producing construction graduates. Information gathered during this pilot study was determined to be suitable for the proposed research, therefore these universities were not re-surveyed during the conduct of the research. The same telephone survey used in the pilot study was used to gather data for the remainder of the universities included in the study.

Table 2

Pilot Study Universities

Auburn University	*Arizona State University*
California Polytechnic University	*California State University, Chico*
California State University, Fresno	*California State University, Long Beach*
Florida International University	*University of Florida*
Southern Polytechnic University	*Boise State University*
University of Northern Iowa	*Purdue University*
Kansas State University	*Eastern Kentucky University*
Northeast Louisiana University	*University of Maryland, Eastern Shore*
Eastern Michigan University	*Central Missouri State University*
University of Nebraska	*Texas A&M University*

University Survey

The study was initiated by polling all ACCE-accredited construction education programs and selected ABET programs. Department heads were asked to reveal their average number of graduates per year for the three years prior to the study. The number of graduates from each program was then summed in order to calculate the current number of construction graduates produced by universities across the nation.

The department heads were also asked to provide a list of companies that recruit their construction students upon graduation. Responses from this question were used to compile a list which would represent the population of employers who hire new construction graduates.

Finally, the department heads were asked to estimate the percentage of the average number of yearly graduates who become employed by those companies listed as construction graduates employers. This question was asked in order to determine the number of students who could not be accounted for on the demand side of the study of construction companies.

Employer Survey

An attempt was made to survey every company on the list of employers established in the university survey. The survey targeted the past, present, and future number of new construction graduate hires within each company. Each employer was asked directly if the supply of graduates was sufficient to meet the needs of the company. If a company indicated there were not enough graduates available for hire, the employer was asked how many graduates would have met the needs of the company. This allowed a calculation of past and present demand for the construction graduate. To assess future estimates in construction graduate demand, several questions asked the employer to predict their hiring needs from 1998 to the year 2000. The employer was asked to make these predictions based on the current trend of steady economic growth.

Research Limitations

Interpretations based on the survey responses should be considered with due care. First, while the ACCE and selected ABET programs create a very large portion of the most desirable construction graduates; there are other sources beyond the scope of this research that provide graduates who are hired by construction companies. This research will not study sources of construction graduates outside of the previously specified ACCE and ABET programs. Likewise, it will not study the effects of other types of graduates on the demand for the construction graduate.

Secondly, the population of companies was limited to the companies identified by the construction education programs. Therefore, companies not identified by construction programs were not analyzed in this research. Finally, it is likely that the schools and companies surveyed have differing sources of historical data and planning processes that vary in completeness and accuracy. The reader should consider these limitations when interpreting the research results and conclusions presented in this paper.

Results

Supply of Construction Graduates

What is the current supply of construction graduates? In an attempt to address this question, a total of fifty-four universities with construction programs accredited by ACCE, ABET, and in some instances both, were surveyed. Results from the survey indicate 2350 construction graduates, as defined by this study, are produced each year. Of these graduates, 2179 students receive a bachelor's degree, and 171 students receive a master's degree.

Each university was also asked to list the companies that recruit construction graduates. The company names were aggregated into a list containing 773 employers. For the purpose of this study, this list is considered the population of companies who recruit construction graduates. Of these 773 companies, 295 responses were received to the employer survey. In summary, the projections within this study were based on responses from 38% of the total population of companies under investigation, and 36% of the total graduate supply as previously defined.

Employer Descriptions

Each employer was asked to identify the size of the company and the type of service the company provides. Figure 2 illustrates the percentage of small, medium, and large companies that responded to the survey. Not surprisingly, the majority of companies that hired construction graduates were large companies (>50M in annual revenue). Small (<25M) and medium sized companies (25-50M), together, make up less than 40% of the population surveyed.

When asked to reveal the type of service provided by their company, the majority of employers indicated commercial construction (48%), followed by industrial construction (18%), construction management (15%), residential (7%), heavy/highway (7%), and “other” (5%). *Figure 1* illustrates the services provided by the surveyed companies.

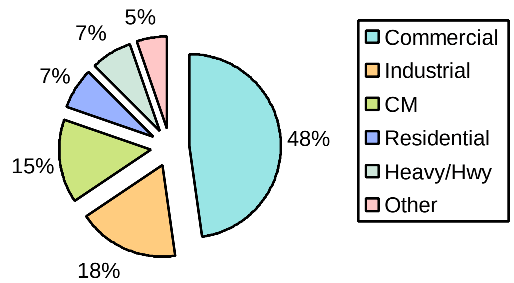

Figure 1 Breakdown of Company Type

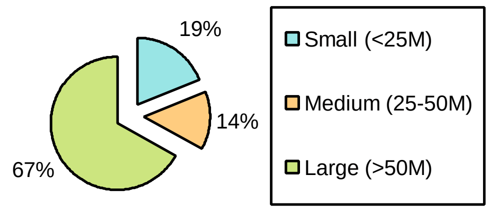

Figure 2 Breakdown of Company Size

Construction Graduate Demand

In the recent past, demand for the construction graduate has traditionally exceeded the available supply. To assess the extent of this supply-demand gap and estimate future trends, companies were asked about the past hiring activities of construction graduates, as well as estimates of their near-term hiring expectations. The next section presents the survey results regarding past, present and near-term demand for construction graduates. The results are followed by a long-term analysis conducted in order to predict trends in demand through the year 2005.

Current and Near-Term Demand for Construction Graduates

The demand for construction graduates was calculated in two ways. For the years 1995-1997 the annual demand was measured by summing the total number of graduates hired by responding companies and the total number of additional graduates companies would have hired had they been available. For the years 1998-2000 annual demands were based on the number of graduates responding companies predicted they would hire. Of all the companies issued with a questionnaire, only 38% of them completed the questionnaire. Taking this response rate into account, the annual demand totals were multiplied by 2.63 (1/0.38). The annual demand totals are set out in Table 3. *Figure 3* summarizes both the reported hiring figures and the predicted hiring figures based on the hiring quantity data.

Results from the survey suggest a steady growth in the hiring of construction graduates has occurred in recent years. Companies reported hiring approximately 2,300 construction graduates in 1995. For 1997, this figure increases by approximately 50% to 3,396 graduates hired translating into an average increase of 540 graduate students per year through 1997. This growth is depicted graphically in *Figure 3.*

The short-term predictions of the responding companies offer some interesting observations. Responding companies estimated there would be a total need for approximately 4,525 construction graduates in 1998. This is more than a thirty percent increase from the figures reported the year before. Between 1998 and 2000, however, the trend flattens with companies reporting an increase of only 9.8% in hiring expectations. It is interesting to note this slight decrease given that companies were asked to base their predictions on a steady growth in the construction market. It should be noted, however, that some companies did not respond to the questions regarding predictions in hiring which could explain, in part, this decrease in expected demand.

Table 3

Demand for Construction Graduates 1995-2000

Year	**Calendar Year**	**Demand for Construction Graduates**
0	1995	2303
1	1996	2708
2	1997	3396
3	1998	4525
4	1999	4800
5	2000	4972

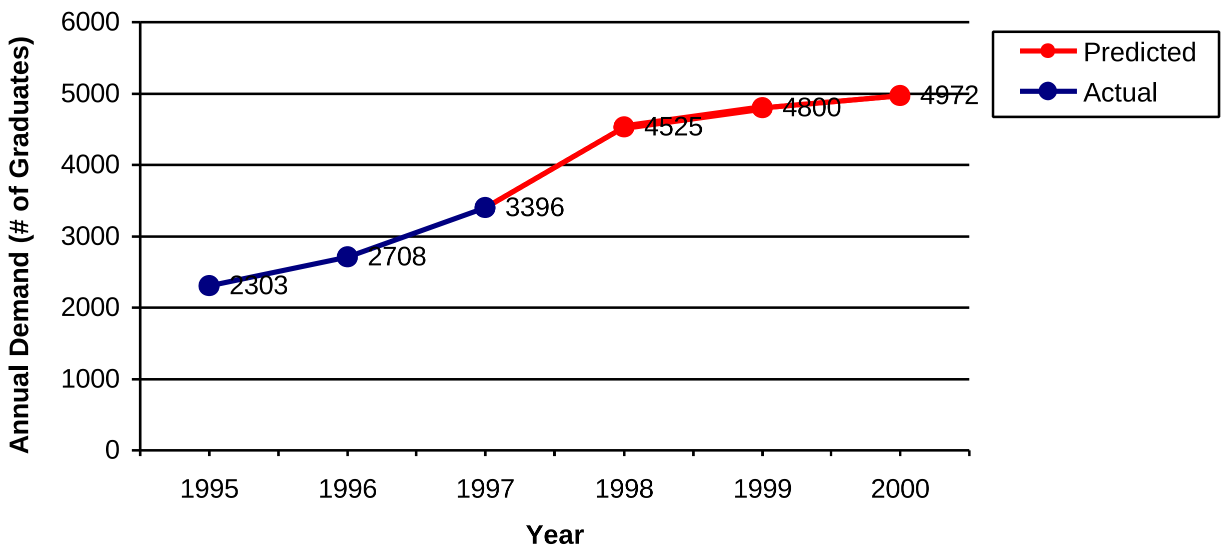

Figure 3. Demand based on employer's actual and predicted data

Long-Term Demand for Construction Graduates

The results from the current and near-term analysis suggest a steady increase in demand has occurred in recent years, and will most likely continue over for the next few years. But the question of long-term-demand remains largely unanswered. Predicting the future demand for construction graduates is a difficult task, and can be approached in several ways. One method of predicting the demand is to extrapolate from past trends. For this study, the historical hiring quantities and the short-term predictions through the year 2000 were used to formulate a simple regression model in order to extrapolate the data through the year 2005. It should be noted at this point, however, that straight-line extrapolations from the past are acceptable only during times of steady growth which was assumed for purposes of this study. The following section summarizes the model used for the data extrapolation and the resulting data.

For this analysis, the dependent variable was the measure of the demand for construction graduates of ACCE accredited construction education programs and selected ABET programs. The independent variable was the number of years from the first year surveyed. The first year surveyed is calendar year 1995, which was designated year 0 for purposes of the study. The final year surveyed (2000) was labeled year 5.

A simple linear regression model was used to predict the demand for the number of construction graduates based on the calendar year. The regression model was defined as:

$$\text{Number of Construction Graduates} = ?_{o} ? ?_{1} Year ? ?$$

Results of the General Linear Model procedure are displayed in Table 4. The R-square value (coefficient of determination), which measures the proportion of variability in the dependent variable explained by the independent variable (Ott, 1993), show that approximately 95% of the change in the number of construction graduates is caused by change in time. This indicates that this regression model would appear to be a good predictor of the demand for construction graduates, if the steady growth of the industry remains constant.

Table 4

Results of General Linear Model procedure

Source	DF	Sum of Squares	Mean Square	F Value	Pr>F
Model	1	6150892	6150892	71.63	0.0011
Error	4	343469	85867		
Total	5				

	R-Square	C.V.	Root MSE		Mean
	0.947113	7.743954	293.0312		3784

The results of the parameter estimates suggest the annual increase in the demand for construction graduates is approximately 600 based on the regression model. The parameter estimates for the linear regression model are shown in Table 5.

Table 5

Parameter estimates for linear regression model

Parameter	Description	Estimate	T for HO: Parameter =0	Pr>? T?	Std. Error of Estimate
? 0	Intercept	2302	10.85	0.0004	212
? 1	Year	593	8.46	0.0011	70

Using the parameter estimates of the linear regression model, the predicted demand for years 2001-2005 was calculated. Table 6 summarizes the demand of graduate students for 2001-2005 based on the regression model. The predicted demand for construction graduates is displayed graphically in *Figure 4.*

Table 6

Predictions for years 2001-2005

Year	Predicted	Prediction Intervals		*Confidence Intervals*	
		Lower 95%	Upper 95%	Lower 95%	Upper 95%
2001	5859	4747	6971	5102	6616
2002	6452	5212	7692	5516	7388
2003	7045	5660	8429	5925	8165
2004	7638	6098	9177	6331	8945
2005	8230	6528	9933	6734	9726

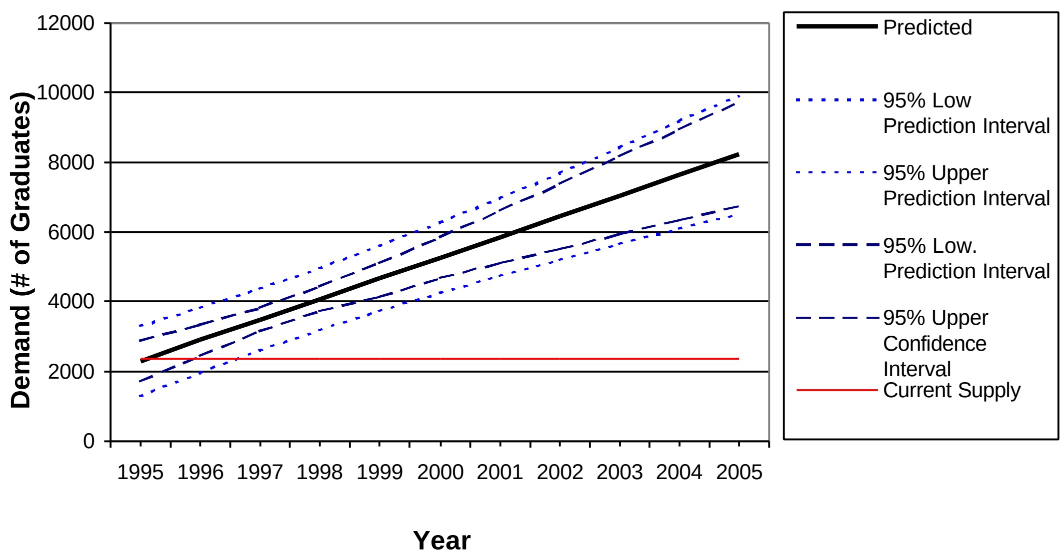

Figure 4. Predicted demand for construction graduates 1995-2005

These results suggest a growth in demand of approximately 600 construction graduates per year through 2005. Using the most conservative estimates, or the lower 95% prediction interval, the results of the analysis indicate the demand for construction graduates will reach approximately 4747 by the year 2001. By 2005, the lower 95% prediction interval indicates this demand will increase by almost 38% to 6528 graduates.

Based on the results, if the current supply of graduates from accredited construction programs is kept constant at 2,350, then by 2001 a shortage of approximately 2,400 graduates will exist. By 2005, the gap increases to 5,880. This "supply-demand gap" is illustrated in *Figure 5.*

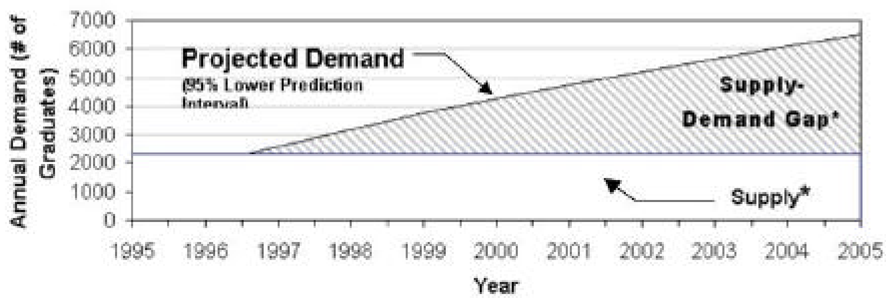

Figure 5 Conservative Prediction Estimates Based on Regression Model and a Constant Supply of Construction Graduates.

* Given the current supply of 2,350 remains constant through 2005

Summary and Conclusions

Based on the survey results, this study concludes that 2350 construction graduates are currently produced each year by ACCE accredited construction programs and selected ABET accredited programs. 773 companies constitute the majority of those who hire construction graduates as defined by this study.

Demand for the construction graduate has exceeded the available supply in recent years, and based on the results, this trend will continue in the near future. Companies have predicted a 9.8% increase in construction graduate demand between the years 1998 and 2000. Results from the regression analysis suggest the annual increase in demand for construction graduates will be approximately 600 per year through 2005. This figure more closely resembles the Jones Study findings which concluded there to be a shortage of 300-500 graduates per year instead of the 2,000 to3,000 shortage predicted by the Business Roundtable Research. From the available supply and demand data, we predict that there will be a sufficient number of construction positions available to match the supply of construction graduates in the near future.

Possibly the most significant results from this study, however, come not from the questions answered, but rather, those unanswered questions. For instance, how are companies satisfying the voids left unfulfilled by construction graduates? Additionally, what non-construction education programs are producing graduates capable of filling construction industry positions? Answers to these questions will require a look beyond the scope of this study into variables both within and outside the construction industry and related educational programs.

In conclusion, Construction Education programs are not meeting the current demands of the construction industry and it is unlikely that this fact will change in the projected future. Research data indicates that there is substantial demand within the construction industry to warrant the continued growth and expansion of construction education programs. An exploration of these issues is necessary if we wish to gain a better understanding of the 'real' supply and demand of the construction education graduate.

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