Volume 4
Number 3

Fall 1999

The Journal of Construction Education

K. C. Williamson III, Ph.D., ***Editor/Publisher***

Thomas H. Mills, ***Associate Editor***

A TRI-ANNUAL PUBLICATION OF
THE
ASSOCIATED SCHOOLS
OF
CONSTRUCTION

ISSN 1522 8150

Host Journal of
The Associated Schools of Construction

Colorado State University
102 Guggenheim
Fort Collins, Colorado, 80523
Tel: 970.491.7353
E-mail: asc@taz.tamu.edu

Publication Software by

Ulinawi Publishing
2719 Sandy Circle
College Station, TX, 77845
Tel: 979.764.0785
E-mail: turtles@tca.net

Journal Published by

Texas A&M University
Langford Building A, Room 427
College Station, TX, 77843-3137
Tel: 9979.458.4782
E-mail: jsmith@archone.tamu.edu

Editor/Publisher

Associate Editor

Editorial Assistant

Editorial Advisory Board

The *Journal of Construction Education* (ISSN 1522 8150) was founded in 1996 by the Associated Schools of Construction, an association of 94 international colleges and universities with construction education programs. The purpose of the *Journal* is to provide an important process necessary for the preservation and dissemination of manuscripts that report, synthesize, review, or analyze scholarly inquiry. The *Journal* is an important way of our focusing international attention on and contributing to the understanding of the issues, problems, and research associated with construction education and training. The recognition of scholarly work within the realms of curriculum information, contemporary educational practices, educational research and instructional application development within construction departments, schools and colleges, and industry are the reasons for the *Journal's* existence. The *Journal's* mission is to provide construction educators and practitioners with access to information, ideas, and materials for improving and updating their understanding of construction education and training. It is also intended to help its constituency become more effective in developing the talents of learners within construction programs. This *Journal* is not only a living textbook of construction education, but also a perpetual and dependable learning source for construction professionals whether they are within academia or within industry. The *Journal* will be published tri-annually (Spring, Summer, and Fall issues). The divisions of the *Journal* include invited and editorially reviewed Book Reviews and Teaching Profiles, and blind peer reviewed Educational Practice and Research Manuscripts.

Any requests, suggestions, questions, or reports regarding this service should be directed to:

Editor/Publisher
Kenneth C. Williamson III, Ph.D.
Langford Building A, Room 427
College Station, TX, 77843-3137
Tel: 979.845.7052
E-mail: jce@taz.tamu.edu

Author Instructions for Submitting

Submission to the *Journal* implies the manuscript is original and is not being considered nor has been published in whole or part within another journal. It is encouraged that author(s) present their works at annual conferences and other conferences. In that papers submitted, reviewed, presented or published within conference proceedings are considered a "work-in-progress," it is expected that manuscripts submitted to the *Journal* will reflect changes resulting from that presentation process. Manuscripts not modified in part by this process will not be considered to represent an original work and the *Journal* will not consider the manuscript publishable. Manuscripts accepted for publication will require authors to sign the Assignment of Copyright Agreement. This agreement must be signed and submitted with the manuscript's review documentation.

Authors should prepare manuscripts according to the Publication Style Guide, which conforms to the Publication Manual of the American Psychological Association (4th ed). All manuscripts must include an abstract, which is limited to one paragraph, containing a maximum of 200 words. Immediately following the abstract, a maximum of five key words must be included. Typing instructions and instructions on preparing headings, paragraphs, text body citations, tables, figures, references, appendices, and abstracts appear in the Publication Style Guide. All manuscripts are subject to editing for personal, university, program and sexist language. Manuscript length per se is not an issue, although length should be relate to the manuscript's "information value."

The *Journal* considers it unethical for authors to withhold the data on which their conclusions are based from other competent professionals who seek to verify the substantive claims through reanalysis and who intend to use such data only for that purpose, provided that the confidentiality of the participants can be protected and unless the legal rights concerning proprietary data preclude their release. JCE expects authors submitting to the *Journal* are expected to have available their data throughout the editorial review process and for at least five years after the date of publication.

Manuscripts being submitted for review by the JCE Board of Reviewers must be submitted electronically from the JCE Website. The work submitted by authors will be circulated to review board members electronically and all correspondence with the authors, editors, and review board members will also be handled in this manner. The Editor and Associate Editor are responsible for managing the electronic review process.

Educational Practice and Research Manuscripts that appear in the *Journal* are subjected to a blind review by a minimum of three members of the JCE Board of Reviewers. All contributions, whether invited or unsolicited, are critically reviewed. Manuscripts must demonstrate clear communication and authority of knowledge of the topic to ensure acceptance. Authors are encouraged to make liberal use of multimedia to visually present data and ideas. Reviewers are selected from those having content knowledge concerning the manuscript's topic. This review process generally takes from four to six weeks. Authors are notified upon receipt and completion of the review process.

The Journal of Construction Education

Fall 1999

Volume 4
Number 3
pp. 217 – 345

Editorial

Educational Practice Manuscripts

Educational Research Manuscripts

General Manuscripts

Other

Journal of Construction Education
Fall 1999, Vol. 4, No. 3, pp. 223-225

1522-8150/99/$3.00/General Manuscript

Editorial
Annual *Journal* Entries

Once again I provide the reader with an analysis of manuscripts submitted for review and publication. This year has demonstrated the difficulty with trying to use graduate students for the Administrative Assistant position. In December and January of this year I hired four Assistants and three of those terminated within a three-week period. I would like to announce Ms. Rashmi Menon as our new Administrative Assistant.

Within the current programming of the *Journal* much of the information is entered as HTML and created by hard typing information into its pages. This cannot continue as a standard within the *Journal's* architecture because it is extremely difficult to maintain format uniformity, information accuracy and currency. I will in the next year attempt to re-write the Journal's web pages to by more dynamic. It needs to be database and ASP programming controlled.

Inventory

The following equipment and software is being carried in inventory by the ASC/JCE:

ASC/JCE Server

QTY		**Inventory #: 0001 23720-9853**
2	_168_Pin_SDRAM_Memory	128Meg [SDRAM] 3.3v w/Eprom LX
1	MOTHERBOARDS	MB_Pentium II Dual (SuprMicro)SCSI PE DLS440LX
1	Controllers___KB_s___Floppy_s	101 Keyboard Microsoft Natural
1	Controllers___KB_s___Floppy_s_3	1.44 [Teac] 3 1/2" Floppy (white)
1	VIDEO_CARDS	ATI All-In-Wonder PCI 8Meg PRO AGP
2	HARD_DRIVES	4.50 GIG [Qntm] Viking 8.5ms WIDE
1	CASES___MISC._ITEMS	Full Tower w/250 UL (ATX_FULL) 6004
1	CD_ROM_Drives	CD_ROM 24X Speed IDE (Toshiba)
1	Sound_Cards___Speakers	SOUNDBLASTER 64 PCI (Creative) PnP
1	Sound_Cards___Speakers_3	Table Microphone Twist or Straight
1	CABLES___MICE	MOUSE (MICROSOFT) PS/2 Style
2	CPU_PRICES	Pentium II 333MHz 512k (Boxed)w/fan
1		SMC 9432 TX
1		Iomega ZIP Drive 105Meg (USB) Internal
1		5.25" Bay Fan (HD-100) Dual Fan Kit

ASC/JCE Computer

QTY	**Inventory #: 0005 23720-9853**
1	Full Tower ATX w/250 UL (Atx 6004)
2	128MG [SDRAM] [pc66] 3.3v 10ns
1	Iomega ZIP Drive 105Meg (IDC) Internal
1	CD-Recorder 4x-8x (Mitsumi) IDE OEM
1	MB_P-II BX (P6SBU) (SuperMicro) UW/SCSI
1	Pentium III 450Mz 512k (Boxed)w/fan
1	1.44M [Teac] 3.5" Floppy (White)
1	Speakers [BW-2000] Sub Woofer Flat Panel
1	Intel Pro 100b/t PCI (Mdl#8460)
1	Microphone (audio) Twistable Style

1	Microsoft IntelliMouse (Ser or PS/2) OEM
1	5.25" Bay Fan (HD-100) Dual Fan Kit
1	104 Keyboard MS Elite (PS/2 or USB)
1	ATI Rage Magnum 32Meg AGP (OEM)
2	9.10 GIG [IBM] 68pin 8.5ms UWide
1	SoundBlaster LIVE Value (Creative) OEM

ASC/JCE Monitors

QTY	
	Inventory #: 0002 23720-9853
1	17" MEGA PLUS 1280x1024 .28 N-I
	Inventory #: 0005 23720-9853
1	19" ADI Micro 5yr Warranty 1600x1280 .25 N-I

ASC/JCE Printer

QTY	
	Inventory #: 0003 23720-9853
1	HP 1120C DeskJet, ON: #326534, SN: SG83C120PJ
1	3 yr. On-site warrantee

ASC/JCE Scanner

QTY	
	Inventory #: 0004 23720-9853
1	HP5100 Scanner, ON: #311817
1	Omni Page, ON: #267795
1	3 yr. On-site warrantee

ASC/JCE Software

QTY	
1	NT Server v.4.0 Single Licence
1	NT Server v.4.0 Manuals
1	NT Server v.4.0 CD ROM
1	NT Server v.4.0 Client Access Licence
1	MS Windows 98 (CD) OEM
1	MS Windows 97 (CD) OEM
1	MS Windows 95 (CD) OEM
1	MS FrontPage 97 (CD) OEM
1	MS FrontPage 98 (CD) OEM
2	MS Office 2000 (CD) OEM
1	Norton AntiVirus Win 98
1	Norton Utilities Win 98
1	Norton AntiVirus NT
1	Norton Utilities NT
2	Adobe Acrobat 3.0
1	OmniPage Pro 8.0
1	Partition Magic
1	AspQMail
1	AspUpload
1	FolderTree
1	Adobe Photoshop 5.1
1	Ulead Photo Exporer

Vital Statistics

Number of manuscripts accepted vs. rejection. There were twenty-seven manuscripts published during the past year. Twelve of the publications represent those that were grandfatherd in by the ASC Board of Directors and will not be included in the statistics. A total of the twenty-five manuscripts submitted for review, ten were rejected as not being acceptable for publication. This provides the Journal with a forty percent rejection rate. This is similar to that reported last year (see Figure 1)

Average number of pages per published manuscript. There was no significant change in the number of pages per manuscript. The average was 10.66, which was a positive change of 0.5 from the previous year.

Average number of images, tables, and appendices. This is where the stats get even stranger. I predicted that the number of images would increase as authors learned the media. This does not seem to be the case. This volume averaged only 2.22 images per manuscript that is 0.66 less than that of the prior year. Tables increased 0.67 per manuscript to an average of only 0.70. Attachments increased from .09 per manuscript to 0.74. Last year I mentioned the number of attachment pages as a potential factor to be measured. Some of the attachments were five to six pages in length and this was at 10-point font. The Figure 2 is a graph of the statistics from 1996 to 1999.

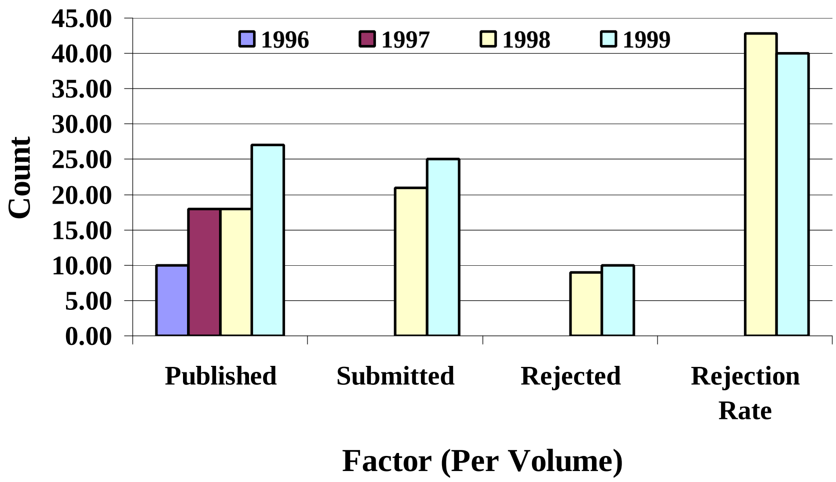

Figure 1. Publication and Submission Data

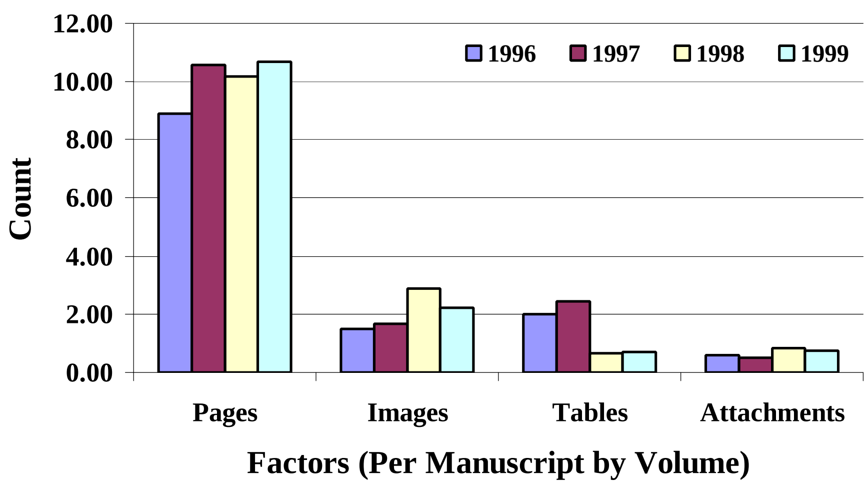

Figure 2. Manuscript Description Data

Journal of Construction Education
Fall 1999, Vol. 4, No. 3, pp. 226-232

1522-8150/99/$3.00/Educational Practice Manuscript

The Canary in the Mine Shaft: A Writing-Across-the-Curriculum Experience in the Construction Science Department

Linda Ginter-Brown and Jo Diamantes
University of Cincinnati
Cincinnati, OH

Writing skills are a necessary requirement for success on the job. However, many undergraduate construction management students feel that since they are in construction, building and engineering skills supersede any need for improving writing. The University of Cincinnati has developed a Writing-Across-the-Curriculum program, which focuses upon strategies for incorporating writing skills into all classes, not just English classes. This paper is a narrative of a pilot project just completed as a collaborative effort between the College of Applied Science's Construction Science Department and the Department of Humanities, Social Science, and Communication. Because there were pre-existing writing requirements, the course chosen for this project was *Personnel and Safety Management*. The paper describes the collaborative effort and planning, the assignments given, the student's responses, the reactions of the two teachers, and suggestions for future improvement.

Key Words: Writing-Across-the-Curriculum, Written Communication, Writing Skills, Construction Management

Introduction

In the mid-1970's writing-across-the-curriculum programs began in response to the generally agreed upon notion that students' writing and thinking abilities definitely needed improvement. As a movement, WAC (Writing-Across-the-Curriculum) sought to strengthen undergraduate education by specifically addressing these issues in tangible ways. As Toby Fulwiler and Art Young, both experts in the WAC movement, note:

> For students, writing-across-the-curriculum-programs promote general literacy, critical thinking, improved writing, and active learning. For faculty, the programs address issues such as disciplinary isolation, teacher training, curricular coherence, writing skills, midcareer burnout, and institutional morale (Fulwiler, Young 1).

Traditionally, these programs have had more impact with liberal arts faculty than with engineering faculty. As Flynn, et al note in their report on the WAC program at Michigan Technological University:

> They have been trained to solve technical problems efficiently, and they see their job as helping their students attain similar skills. Often they value calculating and computing over writing, and they are resistant to the idea of "expressive" writing because they don't

> see their role as encouraging students to explore attitudes or values. They want their students to become efficient problem solvers, not introspective evaluators (Flynn, et al 166).

Research shows that when engineering faculty find ways to incorporate writing assignments into their courses without the additional burden of extra grading or other time consuming activities, they often re-examine their teaching strategies and student learning taking place within the classroom. When they realize that they need not necessarily “give up” their traditional pedagogical approaches, their perspective on what place writing can have in the curriculum often is modified or changed.

Recently, at the University of Cincinnati’s College of Applied Science, two faculty members, one from the Humanities, Social Science, and Communication Department, and one from the Construction Science Department, teamed up to offer the traditional *Personnel and Safety Management* course within a WAC approach. Both instructors were in strong agreement that they wanted to strengthen the writing abilities of these construction management students. The challenge then became how to structure assignments within the course content which would realize the WAC goals of strong writing and critical thinking skills.

Personnel and Safety Management is one of the required courses within the Construction Management curriculum. The majority of the students taking it are at the sophomore level. The objectives of the ten-week course (quarter system) are to acquaint students with health and safety aspects of industry generally, with particular emphasis on the construction industry; to identify various safety problems and how to make management decisions to avoid them; to examine legal ramifications of safety on the job. Successful completion of the course results in students receiving OSHA course completion cards for the 10 hour Construction Outreach course. The course provides safety awareness for many issues in the industry and background for future study of safety issues in later courses in the curriculum.

Although the course has had a written component for many years (referred to here as the major project paper) a new approach for this project was definitely needed. From the beginning both instructors decided to require writing assignments that would emphasize technical writing skills as well as technical knowledge in the subject area. They devised the following written communication requirements:

Summary Cards

The purpose of this assignment was to provide frequent opportunities to practice summarizing and writing skills. Each student was given a 4x6 card during the last five minutes of each class and asked to summarize the class by answering the following two questions:

1. What are the main points you learned today?
2. What further questions do you have about today’s class?

Short Proposal

This two-page proposal needed to persuade both instructors that the major project investigation for which they were responsible would work. Students had to show evidence they understood audience analysis and rhetorical purpose and had narrowed their topic to a manageable size.

Major Project Paper

This 10-20 page document reported the results of their on-site investigation in written and visual form. In addition to the writing portion of the paper, the students were to use pictures they had taken and include other materials such as sketches, charts, tables, as appropriate to their topic. The students could work in small groups for this project.

Short Research Paper

In this 4-5-page paper students were to address an ethical issue dealing with safety in the construction industry. Students were to use at least three outside references from scholarly journals.

Student Responses to The Writing Assignments

This section of the paper briefly describes the various writing assignments and how they were both accomplished and modified during the ten-week course. At the end of the course an evaluation form was given to the students for feedback on the entire course. Several questions specifically targeted the writing assignments. The responses and comments from these evaluations are incorporated into the discussions of each of the writing assignments.

Summary Cards

Using summary cards at the end of each class has been suggested in many writing-across-the-curriculum workshops. These cards can be used for various purposes, but they are a way of forcing some writing to take place each day without taking a lot of time from class. Our instructions to the students were to write several sentences on a 4x6 card, which summarized what they had learned in class that day. They were also to write one question they had about covered material. In this class, the cards served a dual purpose as we also used them to record attendance. We were able to give feedback about sentence construction and use of commonly misspelled words because of the cards. We were also able to identify early on any students with significant problems that needed early intervention. Incorporating suggestions, which focused on actual errors of the group, was more helpful and less time-consuming than having periodic grammar reviews. We felt, and research literature in business and technical writing supports this view, that it was more helpful to work with actual problems of grammar and sentence construction than to teach writing through a traditional “grammar lens.” The questions students wrote on the cards also provided helpful feedback regarding what technical aspects of the material were comprehended and what ones needed further clarification. Because of the number of students and the time it took to read each card, we feel we would concentrate more on the summarizing skills and less on the questions each student had. There simply was no time to answer each question the next class period. However, the students did feel the cards helped.

In response to the question, "Did the cards help you retain more information by focusing your thoughts in class?" Twelve responded affirmatively, nine responded negatively, and four were undecided. Thirteen students recommended that we continue the cards. Nine felt they should be discontinued, and six felt their use should be continued with some adjustments. Their comments were:

1. Pass out cards with key questions on them, test questions
2. More defined on what you want
3. No more cards
4. Less (?) frequently. Perhaps random and unannounced.
5. Good way of getting students to think about topic
6. I feel the test should cause enough focus
7. I guess it is a good way to keep attendance
8. Ask for answer to a different specific question each day
9. Just take attendance
10. Attendance sheet -- maybe class outlines for each day so we are able to follow all topics covered

Short Proposal

Part of one class period was devoted to discussion of the written short proposal detailing the major project paper the student groups would write. Before students could begin their project, they had to have their proposal approved by both instructors. About half of the groups had to rewrite their proposal at least once. One group had to rewrite it three times. Most of the rewrites centered around two issues. First, the students had to convince us that they had thought about the project and narrowed it down to a manageable topic area. Second, they had to show us they had thought about how to manage the project and make the most of their time. Since most of the projects consisted of job site interviews, this meant they had to develop cogent questions beforehand, and they had to be ready for a focused discussion when they arrived on-site. In answer to the question, "Did the preliminary work you did on preparing the proposal help you write a better final product?" seventeen responded that yes it had. Only two responded negatively. Comments accompanying these questions were:

1. Made the experience seem more joblike
2. It got me thinking about the paper much earlier
3. It cleared up mistakes in my writing instead of many small ones over (repetitive)
4. Helped focus on what we needed to do; how we were going to attack the paper
5. Although this proposal was used and graded, I felt I had a good idea of the type of paper to write anyway
6. Gave me several different ideas
7. Proposals are a very important part of the construction industry. The exposure was good. Many people just sit down and write; they don't plan.

8. It was just something else that had to be turned in. We usually brainstorm and think of all the steps--it was a pain to write it down.

Major Project Paper

The approach to the major project paper was different than the approach normally used by students in writing papers. They are used to writing papers by doing library research to familiarize themselves with a topic, quoting sources and coming to a fairly obvious conclusion. This paper, however, requires them to do as much research as necessary, find and visit a job-site, familiarize themselves with a specific construction process (e.g., erection of scaffolding), know the pertinent regulations and laws, interview workers and supervisors and draw their own conclusions. They are to explain what they learned, identify both positive and negative aspects of what they experienced on-site and in the interviews and draw conclusions about how things might be done differently. Their paper is to demonstrate what they learned and has to tie their pictures and text together.

Prior student reaction to this paper has always been that it is a lot of work. The students in this class reacted no differently. Although the requirements (both technical and writing) had not changed from previous quarters when this class was offered, the students voiced their comments about the pressure they felt to write well. Both teachers received many visits from students asking questions about both the technical and writing aspects of the paper. Surprisingly, the students asked questions of other faculty and the library staff as well. This had not happened in previous quarters, and we felt was a positive sign.

One of the evaluation questions asked what type of paper would be the most valuable learning experience. The options given were a paper such as the one just completed, a typical research paper or several short papers. Seventeen students voted for the paper format just completed, five voted for a typical research paper and only three felt they would get more out of several short papers. Student comments in the suggestions area included:

1. Good as is
2. Papers dealing with specific information
3. Writing is addressed in English I, II and III, not in safety class
4. The last paper should be divided into many little assignments

Short Research Paper

The short research paper was originally designed to be a typical research paper in which the students were assigned an ethics case, did library research, wrote up the case and provided a complete bibliography. The Humanities instructor prepared the students for writing this paper by presenting a class on how to conduct research, differentiate between primary and secondary sources, identify scholarly journals and trade journals. The students completed a homework assignment requiring them to categorize three journals, based on a matrix of criteria, as either scholarly or trade. However, the pressure of the ten-week course completion requirement forced modification of the assignment. The final paper required them to find an ethics case in construction, identify the ethical issue, propose a solution to the problem or a way it could have been avoided, provide arguments to bolster their choice of solution and state legal and moral ramifications of their solutions. The revised paper did require writing but the emphasis on research was dropped. Once the students started writing their papers they got involved in it and again both instructors received numerous visits about both technical and writing issues.

The ethics paper itself was not addressed in the course evaluation since we modified the requirements toward the quarter’s end. However, students did indicate interest in the subject and the instructor from the Construction Science department was asked to proof read two of the papers before they were turned in and answered questions about how to cite references. We feel this is an indication they were acknowledging the importance of good writing. From several conversations with students both instructors felt that the introduction of ethics into this class was a further complication in the course requirements. We spent time discussing ethics itself and the abstract nature of possible responses in their papers. For purposes of increasing writing skills within the course we felt the ethics topic was a deviation using up too much time and in the future we would pick specific safety related issues.

Conclusion

Although we did not set this up to record data in an empirical fashion, we both feel the experience was successful. Overall, student response was positive. When asked, “Will the emphasis on writing in this class help you in future classes, ten responded positively, and only four responded negatively. Thirteen were undecided on the issue. However, when asked, “Do you feel your writing has improved since the beginning of the quarter, two responded positively, nineteen responded negatively, and seven were undecided.

At first, these two responses seem at odds with one another. The reaction of the instructor who has taught this course for many quarters is that the writing did improve quite significantly. This reaction is based on the following observations. First, greater student interest in writing well was apparent. Both instructors were contacted outside of class to answer questions about the writing process, grammar, research resources, and other issues connected with writing. Second, the college librarian reported an unusual level of activity in the library. Librarians were receiving queries about how to put a paper together and just what constituted primary and secondary sources. Third, the quality of the papers was much better than in past quarters. Since these papers are sent to an outside panel for judging for scholarship purposes, students have always turned in the papers for revision. After the revisions are made and a final version is turned in, students receive their grade. In past quarters, the first paper usually needs much work in organization, format, sentence construction, and grammar. This time, these problems were at a minimum in most of the papers, and efforts could be focused on making fairly strong papers even stronger. The students voiced a sense of accomplishment, and even, in some cases, excitement, when their final papers were turned in to us. We heard comments, which indicated a certain level of ownership about the writing process--comments which focused upon strategies they might have used and what they might do differently if they had even further opportunity to revise.

We feel confident the students did improve their writing by being challenged in specific ways to produce writing, which focuses on revision, and, thereby, produces a much improved product.

Most of them arrive at the beginning of the quarter with the very pronounced attitude that "I'm just a construction worker; I don't have to know how to write." By seeing that both instructors valued and required the writing assignments and weighted them accordingly, students realized that they needed to do well with the assignments in order to achieve success in the class. By emphasizing and incorporating assignments where they could practice writing, they were able to improve their writing skills incrementally, if not dramatically.

Future Recommendations

One strategy we used in this class, which we feel, worked really well was feedback from both instructors. Both instructors graded each written assignment, but only one grade was assigned. The comments were word processed to maintain this sense of unity. To integrate writing into student work, we felt it was important that writing be a part of, rather than separate from, the technical aspects of the course. In the future, we would prepare course materials and handouts to reflect this position as well. We would spend more time at the beginning of the course, making sure everyone was at the same level of understanding regarding basics such as title pages, abstracts, correct incorporation of material into the text and bibliographic resources. We would also keep all the writing assignments focused upon technical and safety aspects of personnel management. We diverged from this focus in the last assignment when we assigned the students to investigate an ethical issue in the safety area. The introduction of ethics was an abstract idea with which many students had no experience. As a result, many of them had difficulty with the assignment. In future courses we would require that this short research paper focus on some aspect of safety in construction.

In summary, we both feel that this collaborative initiative was successful and that our experience was positive. We feel we have achieved what we set out, granted on a small scale, to do: to promote a greater awareness of the importance of writing in a construction management class and to promote collegiality among faculty of different disciplines. Both of us feel we have learned valuable insights, which can be used to help other faculty promote further learning in their classes through writing. We plan to propose a future collaborative effort to both our department heads and plan to consult with other faculty members who may want to explore WAC strategies in their own courses.

References

Fulwiler, Toby and Art Young. *Programs that Work: Models and Methods for Writing Across the Curriculum.* Portsmouth, NH: Boynton/Cook Publishers, 1.

Flynn, Elizabeth A., Robert W. Jones with Diane Shoos and Bruce Barna. (1990). Michigan Technological University. *Programs that Work: Models and Methods for Writing Across the Curriculum,* Portsmouth, NH: Boynton/Cook, 166.

Journal of Construction Education
Fall 1999, Vol. 4, No. 3, pp. 233-259

1522-8150/99/$3.00/Educational Practice Manuscript

Using the Law Class to Teach Problem-Solving and Writing Skills

Nancy J. White
Texas A & M University
College Station, Texas

Problem solving and writing skills are vital to an understanding of the law and how it applies to situations arising in the construction industry. The law class can be used to teach both skills. This paper presents a process for teaching students how to make a legal argument supported by premises. It also outlines a method to use in preparing a complete stand-alone paper containing the argument. The Appendix contains a set of three assignments with suggested solution. These assignments introduce the students to the problem-solving skills necessary to prepare a legal argument and show them how to make an outline in preparation for writing out a complete legal argument. These assignments can be completed during a class session and immediate feedback given to the students. Also included in the appendix are homework assignments requiring written arguments and samples of actual student work handed in response to the homework assignment.

Key words: writing, analytical thinking, education, construction law

Introduction

Problem solving, also called analytical thinking, is one of the most important aspects of the law class. That is, requiring students to solve legal problems or hypothetical cases is extremely important to gaining an understanding of the law. Most law professors and lawyers will use the term “hypotheticals” rather than the terms “legal problems” or “hypothetical cases”. Another important skill to be learned by college students is writing (Ray, 1998). Both can be effectively combined in law classes, particularly law classes contained in construction science curriculums. By teaching students how to solve a legal problem, and then requiring them to write out the solution, they will gain practice in both problem solving and writing.

Learning how to solve a legal problem will give the student experience in solving any problem based upon a fundamental law or principle. For example assume the problem is overpopulation. The fundamental principle to be applied is: populations grow or decline through a combination of the birth rate, the death rate and migration. Different factual scenarios can then be analyzed, using this rule, to determine how to solve overpopulation.

Taking a management example, assume the problem or issue to be solved is, how to motivate employees. One rule or principle that could be used in developing a solution to the problem is the theory of Maslow’s Hierarchy of Needs. Under that theory a person will strive to reach the next level of need. The problem solver then needs to determine what level the employees are at, and set goals geared toward the next higher level. Just as in the law, other principles could be used instead of this one. For example, Herzberg’s Motivation/Hygiene Theory is used as the principle from which solutions will be derived and a different solution to the problem will be produced. This is exactly what happens in the law – different solutions are reached depending on the law used.

Argumentation/Analysis

In order to solve a legal problem it is necessary for the student to prepare an argument in support of a conclusion. In law school this process is usually called "analysis", which has a slightly different meaning than the dictionary definition. The dictionary definition of analysis would be something like, "to separate into parts or basic principles so as to examine the nature of the whole or to examine methodically". This is not what legal analysis is. Legal analysis is the application of the law to the facts to come to a legally valid conclusion. Because of the confusion between the dictionary definition of "analysis" and the specialized definition used in the legal profession, the word can cause confusion. By using the term "argument", a term with which most students are familiar, and one that is also used in the legal profession, students can more easily and quickly grasp the concept being presented.

Though familiar with arguments and the concept of arguing, the term "argument" has several meanings and it is necessary to clarify the meaning used in the assignments. For the purposes of the assignments in this article, the definition of the term "argument" is "a passage or discussion composed of premises, used to support a conclusion". This is the definition given the word by the science of logic. A common definition of argument may be "disagreement". Another definition is "a highly emotional interaction or emotional exchange between two or more people". The term argument may be used to describe "a situation where one person tries to dominate another through the use of emotions such as fear or anger". These are ***not*** the meanings used in this article.

An argument is a passage or discussion purporting to prove something. Not all passages are arguments. A passage may be only informational or be an opinion. For example, the statement, "I am an honest person" is not an argument. It may be true, but it is not an argument. It is not an argument because it has not premises in support of a conclusion. The statement, "I am an honest person because I have never cheated on a test and I returned a lost wallet to the owner" is an argument. This statement contains premises in support of the conclusion, "I am an honest person". In order for a passage to qualify as an argument, the passage must contain at least one premise to support the conclusion. The premises in this argument are "I have never cheated on a test" and "I returned a lost wallet to the owner." A conclusion unsupported by any premises is not an argument.

In most construction law classes the amount of material to be covered prevents a detailed study of logic. However, even a basic understanding is extremely useful and can be used to make the types of legal arguments they are likely to come into contact with on the job.

To prepare an argument students must have a basic understanding of logic, the science that evaluates arguments. A small amount of time can be spent reviewing fallacious arguments such as "appeal to pity", "begging the question", and "attacking the person". Many students find this very interesting and it has proved effective in preventing students from making fallacious arguments when attempting to support a conclusion.

In addition to the premises and conclusion, every argument contains an issue, though most arguments assume the reader will recognize the issue from the passage. Most arguments do not contain a sentence stating, “The issue here is…” Students often find it difficult to define the issue being raised and to tell the difference between the premises of the argument and the conclusion. Practice is necessary.

It is often best, and even fun, to start with non-legal arguments. Students usually have some familiarity with these. This also has the advantage of being able to relate something new to something already known. Here is an example of a very simple argument to get students started on learning how to dissect arguments:

> *“Homework stifles the thrill of learning in the mind of the student. It instills an oppressive learn-or-else discipline. It quenches the desire for knowledge and the love of truth. For these reasons homework should never be assigned.”* Colman McCarthy, Homework’s Tyranny Hobbles Promising Minds).

This argument can be dissected as follows:

> <u>ISSUE:</u> Should homework be assigned?
> <u>PREMISES</u>:
> 1. Homework instills an oppressive learn-or-else discipline.
> 2. Homework quenches the desire for knowledge and the love of truth.
>
> <u>CONCLUSION</u>: No

Here is a sample of a slightly more difficult argument that can be given to a student to dissect.

> “…If a work plan falls behind schedule, the standard reaction is to somehow increase the production effort in order to get back on schedule. When the production effort is increased, accidents have an increased chance of occurrence. That effect demonstrates the need for the work to progress smoothly and in an organized fashion so that the scheduled work activities take place as planned With the many different tasks involved in most construction projects and with the large number of subcontractors that participate in the construction effort, it is clear that a great deal of coordination is required to deliver project in the specified period of time.” Hinze, Jimmie W., *Construction Safety*, Prentice Hall, 1997, p. 283.

This argument can be dissected as follows:

> <u>ISSUE</u>: Is coordination of the construction project important to safety on the project?
> <u>PREMISES</u>:
> 1. If a work plan falls behind schedule, the standard reaction is to somehow increase the production effort in order to get back on schedule.

2. When the production effort is increased, accidents have an increased chance of occurrence.

CONCLUSION: Yes. Can also be worded: Coordination and planning of the work are necessary for a safe project.

The following argument comes from the *A Guide to Successful Construction – Effective Contract Administration*, Arthur O'Leary, 1997. BNI Building News, p. 3:

> In recent years, informed opinion has reverted once again to favor the architect's traditional role of monitoring the construction contract. This has several advantages which outweigh the disadvantages. With the architect more intimately involved in the conversion from drawings and specifications to physical reality, there is a greater chance of preventing contractor misconceptions and misinterpretations in a timely manner. It also affords the architect an opportunity to correct errors and anomalies in the documents before the construction progress makes them impossible, impractical or too costly to rectify.

This argument can be dissected as follows:

ISSUE: Should the architect monitor the construction contract?

PREMISES:

1. Though there are disadvantages to the architect monitoring the construction contract, there are more advantages.
2. The architect can prevent contractor misconceptions and misinterpretations in a timely manner.
3. The architect can detect errors in the documents before the construction progress makes them impossible, impractical or too costly to rectify.

CONCLUSION: Yes. Can also be worded: The architect should monitor the construction contract.

Another useful exercise to practice recognizing and dissecting arguments is to have them find actual arguments. The following exercise gives them practice in this skill, plus gives them practice in using the Internet to find information:

1. Using the Internet, find two arguments from books, magazines, newspaper articles, etc. Good sources of arguments are letters to the editor, editorials, and political commentary. These arguments DO NOT have to be related to the construction industry or even law, though you will be making legal arguments in the future. Attach a copy of the argument to your return memo.

   For each argument, answer the following questions:

   a. What is the issue being raised by the argument?

   b. What is the argument trying to convince you to believe? In other words, what is the conclusion of the argument?

c. What are the premises of the argument?

Legal Argumentation

Once the students have reviewed arguments in general, and can dissect them, the concept of the legal argument can be introduced. Legal argumentation, which can also be called legal analysis, is merely a specialized form of argumentation using facts and law in the premises of the argument.

Facts

When confronted with a legal argument it is not uncommon for students to have difficulty determining the difference between facts, rules, issues and conclusions. It takes practice. In general a fact will answer a question such as:

> Who are the people involved in this claim?
> What happened?
> Where did it happen?
> Why did it happen?
> How much did it cost to fix?
> What does the contract say?

Note the contract is a fact, not a rule or law. This is because the law does not uphold every provision of the contract and therefore no legal conclusion can be reached merely by referring to the contract. In order to uphold a provision of a contract in a court of law, a law must be found that will support the contract provision. Of course the basic premise of contract law is: A party must uphold its contract. This premise can be used to support any contractual provision, unless another, more specialized rule contradicts it. A special rule will prevail over the general rule.

Another concept related to facts that causes some confusion is the concept of proof. In a court of law no fact can be used to support a legal conclusion unless it is proved by admissible evidence. For example the contract is 'proved' by admitting it into evidence, or by testimony of the parties, if the contract is oral. For purposes of most classes the students must be told all facts given are assumed to be proved, unless specifically told otherwise.

Enumerating the issue in a legal argument can be difficult. There are always many, many ways to phrase the issue in any legal problem. Simplistically a legal issue can always be worded as, "Who will win this lawsuit?" In the legal profession legal issues are usually more specifically enumerated. For example, "Was the general contractor negligent when he lent a broken ladder to the employee of a subcontractor?" or "Is the ambiguity in this contract patent or latent?" Note that in legal argumentation or analysis, the issue is ***always*** worded as a question, with the conclusion being a short answer to that question.

Many undergraduate students will need practice in formulating more specific issues. For this reason it is recommended that several problems be given to the students with the issue clearly enunciated. After some practice students should be able to state the issue.

Here is an example of a hypothetical containing the facts and issue. The issue is pulled out of the hypothetical for the student, and the student is given the rule to apply:

> <u>FACTS</u>: General contractor submits bid to owner using subcontractor's bid of $100k for the concrete. General is awarded contract. Subcontractor determines it made a mistake, and the actual cost to do the concrete work will be $125k. The subcontractor refuses to do the work for $100K, and the contractor pays the subcontractor $125K because it cannot get anyone else to do the work cheaper.
>
> <u>ISSUE:</u> Can the subcontractor rescind (revoke) it's bid without incurring any liability to the general contractor?
>
> <u>RULE #1</u>: A party must honor its contract. (Basic premise of contract law)
>
> <u>RULE #2</u>: "Justice demands that the loss resulting from the subcontractor's carelessness should fall upon him who was guilty of the error rather than upon the principal contractor who relied in good faith upon the offer that he received." *Drennan v. Star Paving Co.*, 333 P.2d 757 (Cal. 1958).

Most students can come to the correct conclusion in the above problem. However, preparing a convincing argument in support of the conclusion is the point of the writing exercise. The method used to enable students to do this is discussed below in the section "How to FIRAC." FIRAC is similar to the process called IRAC (Issue, Rule, Analysis, Conclusion) used in law school. FIRAC stands for Facts, Issue, Rule, Argument and Conclusion. By making sure each of the FIRAC elements is included in the written paper, the student will have a complete, stand-alone document that can be understood by a reader unfamiliar with the situation.

Premises

Developing the premises of the argument will be difficult for students. Several different types of premises exist. Four will be reviewed here: the simple premise, basic premise of contract law, premises based upon opinion and creative thinking, and last, premise based upon lack of evidence.

Almost every legal argument employs what a type of premises herein termed the "simple premise" which consists of the application of a rule to the facts. Only two simple premises exist. The first is: Facts = Rule, therefore the Rule applies. The second is: Facts ? Rule, therefore the Rule does not apply. For example, an extremely simple argument on the issue of whether a drunk driver hitting a pedestrian is negligent would look like this: Driving while drunk (fact) is unreasonable (rule), and therefore the driver was negligent. Only when the law is entering previously uncharted or new legal territory are these types of premises NOT used. In introductory law-related classes the simple premise should always be used.

In all legal arguments discussing contracts one of the rules or laws applied is ALWAYS the Basic Premise of Contract Law: "A party must honor its contract." All arguments involving contract interpretation start from this basic premise. However, since this basic premise is so fundamental, most legal authors and judges just assume people reading their work or legal opinions realize its existence and may not discuss it at all.

Some of the most difficult premises for students to use are premises based upon opinion and creative thinking. Unless a legal argument is based upon a case containing <u>exactly</u> the same facts as the one under discussion, any argument must contain the author's opinion that the facts of this case are similar to the applied case and therefore the applied case does apply. An example of such an opinion premise is in the example below dealing with the Wrights home. Creative thinking arises when the author looks at the facts in a slightly different way to support the result. This is extremely challenging for undergraduate students and is not discussed in this paper. Though many can develop extremely creative arguments as to why late assignments should be accepted, this skill is more difficult to employ in abstract classroom situations where the author of the argument has no personal stake in the conclusion.

How to FIRAC

In order to get the argument down on paper a process herein termed FIRAC is used. FIRAC is similar to the process called IRAC (Issue, Rule, Analysis, Conclusion) in law school, but is more effective to quickly teach students how to prepare a well-written stand-alone legal argument. FIRAC stands for Facts, Issue, Rule, Argument and Conclusion. By making sure each of the FIRAC elements is included in the written paper, the student will have a complete, stand-alone document that can be understood by a reader unfamiliar with the situation.

The following hypothetical case will be analyzed using the FIRAC process:

> <u>FACTS</u>: Mr. and Mrs. Wright are the owners of a home recently built by Revel Contractors. The Wrights have a performance/payment bond with Slow Pay Insurance Co. guaranteeing Revel Contractor's indebtedness for all "labor and material furnished " in connection with the work. Shortly after the work on the house is completed, Best Hardware sends the Wrights a copy of an invoice for hammers, pliers, and screwdrivers which Best claims were purchased by Revel for the Wright job, and in fact Revel did use these items on that job site. Revel did not pay Best. The Wrights turn the claim over to Slow Pay to pay pursuant to the performance/payment bond.
>
> <u>ISSUE:</u> Is Slow Pay required to pay the invoice of Best pursuant to its bond with the Wrights?
>
> <u>RULE:</u> The surety on a performance bond must pay for all materials and equipment actually consumed in performing a construction contract.

Approach the preparation of the argument using this FIRAC model. The words in red would be those expected to be written or hi-lighted by a student in preparing his/her answer.

1. Read through the information given at least twice.
2. Fill in the conclusion to be supported. The LAST paragraph will be built around this word.
   Last paragraph: <u>*CONCLUSION:*</u> *No.*

Notice this conclusion is a ***one-word*** answer to the ISSUE: Is Slow Pay required to pay the invoice of Best pursuant to its bond with the Wrights? A "yes" conclusion could also be supported. For learning purposes, it makes no difference which conclusion a student has come to: yes or no. It is only the argument that is important.

3. Determine the legal issues and find the applicable legal rules. (Note to instructor: This is always difficult and takes study and practice. In introductory law-related classes the legal issues and rules are generally given. Toward the end of the class a problem just containing facts could be given to students.)

4. Prepare the premises of the argument. To do this, review the rule. Circle or hi-lite <u>***all***</u> of the elements or important words in the rule. These words <u>***MUST***</u> be repeated in the argument section. In this example the most important rule words are: *materials/equipment*, and *actually consumed.* (Note to the instructor: Many students find this repetition difficult to do.)

5. Put each unrelated rule word into its own paragraph. For this problem there will be:

   Paragraph discussing: *materials/equipment* (Note: each item, pliers, hammers and screwdrivers could be discussed in a separate issue, however, to simplify matters all are included in one issue).
   Paragraph discussing: *actually consumed*
   Last paragraph: <u>*CONCLUSION:*</u> *No.*

   Notice an outline of the argument is starting to appear. Presently it has three paragraphs; a paragraph discussing "materials/equipment", another paragraph discussing "actually consumed" and the final paragraph restating the conclusion.

   (Note to the instructor: <u>***The entire***</u> rule must be <u>***completely***</u> discussed. Students have a tendency to only discuss parts of the rules, particularly parts of rules that have more than one element. For example, assume the rule being used is the following: Negligence is the failure to act with reasonable care to others, which failure causes injury. (Note this is only a simplified rule of negligence, not the complete rule). The student must discuss both the failure to act with reasonable care AND injury. It is not uncommon for students to discuss only part of the rule. While it is true not all of the facts must be discussed, ALL of the rule, or more accurately all of the elements of the rule, must be discussed.)

6. Review the facts. Circle or hi-lite all of the facts dealing with the rule words in the argument. Fact words dealing with "material/equipment" in the hypothetical are:

hammers, pliers, and screwdrivers. Fact words dealing with "actually consumed are: "*Humm, I can't find "consume" the closest word, or most similar word is "use"*.

7. Develop the Simple Premises. Copy or paste the above fact words in the paragraphs discussing the rule words. Put an "equal" sign [=] between the fact words and the rule words or a "not equal" [?] sign between them. The outline now looks like this:

Paragraph: *FACT WORDS hammers, pliers, and screwdrivers ? RULE WORDS: materials/equipment.* What is being said is: "hammers, pliers and screwdrivers *do not equal* materials/equipment" or more simply "facts do not equal rule". Note if the writer of the argument is supporting a "yes" conclusion an equal sign is placed between "hammers, pliers and screwdrivers" on one side of the equation and "equal materials/equipment". The facts then equal the rule.

Repeat the above for each element of the rule. Paragraph*: FACT WORDS: use ? RULE WORDS: actually consumed*. This is stating: "using" something (facts) is not the same as "actually consuming" something, or the facts do not equal the rule.

8. The writer of the argument should then add an introductory paragraph(s) telling the reader of the argument the facts and issue. The writer of the argument may want to include the rule here also so the reader can better follow the subsequent paragraphs where the rule will be applied to the facts. The following outline containing four paragraphs now exists:

Paragraph #1: Introductory paragraph summarizing facts and telling reader what the issue is.
Paragraph #2: *hammers, pliers, and screwdrivers ? materials/equipment* (rule)
Paragraph #3: *use* (facts) ? *actually consumed* (rule)
Paragraph #4: *Conclusion: No*

9. Finally, write out a complete argument using complete sentences and paragraphs. (Note to instructor: This example has an added sentence discussing the Basic Premise of Contract Law in the final paragraph. Also, the issue, facts, rule and premises are indicated in bold in parenthesis to help the student recognize how these elements interact in the argument):

The issue in this case is whether or not Slow Pay must pay for the hammers, pliers and screwdrivers purchased by Revel Construction for use on the Wrights' construction project (**issue**). These hammers etc. were supplied by Best Hardware, and used by Revel on the Wrights project, however, Revel did not pay Best for them. Best has submitted the invoice to the Wrights for payment. The Wrights have turned over the invoice to Slow Pay, the bonding company, to pay because they have a performance/payment bond with Slow Pay (**facts**).

The law requires Slow Pay to pay for all materials and equipment actually consumed in the project (**rule**). However, hammers, pliers and screwdrivers are not materials or equipment. (**This is a simple premise**). In the construction industry materials are such things as paint and wood that are used in a particular construction job and cannot be reused. (**This is an opinion premise**). Since the hammers etc. are not material or equipment, Slow Pay does not have to pay for them (**conclusion**).

In addition to paying for materials and equipment, the rule requires Slow Pay to pay for them only if they were "consumed" in the construction. (**The rule is repeated**) The facts indicate the hammers etc. were not consumed, but were merely used in the construction. (**This is a simple premise**). There is no evidence the hammers were consumed. (**This is a lack of evidence premise**). Slow Pay is not required to pay for items merely used (**conclusion**).

In this matter Slow Pay is not required to pay Best's invoice. While it is true a party must generally honor its contract, that rule is not applicable here. (**This is the Basic Premise of Contract Law**). This is because there is no contract between Slow Pay and the Wrights to pay for hammers and similar items used on the site. The rule requires Slow Pay to pay only for materials/equipment actually consumed. However, in this case Best's invoice is neither for materials nor equipment. Additionally, Best's invoice is not for items consumed on the Wrights' project, but only used. (**This is a summary paragraph**).

Teaching Methodology

Attached in Appendix A is a series of three FIRAC assignments, which can be given to students to help them learn this process. These can be completed during a class period and immediate feedback given to the student. Reviewing this process in the classroom is extremely helpful to students. A more difficult written homework assignment can then be given. A copy of such an assignment, together with an actual student answer is also attached in the appendix.

Checklist for Arguments

Once the argument is finished, completing the following checklist is useful to the writer of the argument:

1. Change the conclusion to the opposite of what was discussed. For example, in the above argument change "no" to "yes". Only a few words should need to be changed to support the opposite conclusion, for example "Hammers and pliers are materials or equipment" and "Use is the same as consume". Does this argument sound unfair, unethical, illogical or immoral? If yes, the original conclusion is probably correct. If no, look more carefully at the original conclusion. Is it the best one?

2. Is the argument complete? That is, can the reader of the argument understand the situation without having to refer to anything other than this argument? In other words, the reader of this argument should be able to understand it without needing to refer to the homework assignment.

3. What are the premises(s) of the augment? Is there at least one Simple Premise? Will a Premise Based Upon Lack of Evidence help me? If yes, use it.

4. Have the rules been COMPLETELY discussed? Even if a rule, or part of a rule, does not apply, it must be explained to the reader why not.

5. The following words should appear in the writing of a beginning writer: "the issue is..", "the rule is…" "The rule applies because..." "The rule does not apply because..." While it is not necessary for an argument to contain exactly these words, when learning to write an argument, it is a good idea to have them.

Summary

Problem solving sometimes also called analytical thinking, and writing skills are vital to an understanding of the law and how it applies to situations arising in the construction industry. By teaching the students how to solve a legal problem, and then to write it down, they will learn both. In order to solve a legal problem students must understand the concepts of an argument and a legal argument. FIRAC is a method that can be used by students to write out a legal argument so that a complete, stand-alone argument is produced. This same method can be used to solve any type of problem in which some guiding principle is the source upon which an issue is to be resolved.

By requiring students to write a complete argument they will learn valuable writing and problem solving skills, skills that will help them in their future employment.

References

Ray, Christopher S., *An Action Research Plan for Developing and Implementing Writing Skills in Construction Project Administration*, Proceedings of the 34th Annual Conference of the Associated Schools of Construction, April 1988

Appendix A

Contents of Appendix

In-Class Assignment - Worksheet: How to FIRAC #1

Student Number: _________________
Graded by Student Number: ____________
Grade: (Circle 1) Pass, 65-Redo, 0-Redo

Go through the steps outlined in the section entitled, "How to FIRAC" in your text. YOU DO NOT HAVE TIME TO WRITE OUT A COMPLETE FIRAC IN CLASS. DO AN OUTLINE ONLY. If you follow the steps on "How to FIRAC" you will get an outline.

(Note to instructor: Students could be required to prepare a complete legal argument from the outline as a written homework assignment).

Use reverse side or additional sheets if necessary.

Hypothetical #1

FACTS: Caffey Construction, the prime contractor, utilizes Bon Fire Tile's, (subcontractor) bid of $85,000 for acoustical tile in preparing the prime's bid on a contract dated 2/1/98. Assume this is proved by the evidence and is **not** an issue. THIS JOB IS TO BE PERFORMED IN KENTUCKY. Correspondence dated 12/1/97 between the prime and sub defined the exact nature and price of the work required by Bon Fire, and the contractor confirmed this in writing. However, on 2/3/98, after the contract has been awarded to the prime, the prime bid shops and gives the acoustical tile work to Sippers Tile, another subcontractor. Bon Fire's lost profit on the job is $15,000, and it had no other job during that time, nor could it get another one.

ISSUE: Can the sub get the $15,000 in lost profit as damages from the prime?

RULE: In order for a contract between two parties to be formed there must exist an offer, and acceptance of that offer, and valid consideration. A subcontractor's bid is an offer. [*Finney Co. v. Monarch Constr. Co., Inc*. 670 W.W.2d 857 (Ky. 1984)]

Suggested Solution to In-Class Assignment - Worksheet: How to FIRAC #1

(Note to instructor: There is no "right" or "wrong" answer to this problem.
Students could be required to prepare a complete legal argument from the outline as a written homework assignment).

FIRAC Outline supporting "Yes" conclusion should look something like:

FACTS: Caffey Construction, the prime contractor, utilizes Bon Fire Tile's, (subcontractor) bid for acoustical tile in preparing the prime's bid on a contract dated 2/1/98.

ISSUE: Can the sub get the $15,000 in lost profit as damages from the prime?

RULE: In order for a contract between two parties to be formed there must exist an offer, and acceptance of that offer, and valid consideration. A subcontractor's bid is an offer.

ARGUMENT:
Offer (rule), Subcontractor's bid is offer (***rule***). = Bon Fire Tile gives bid to Caffey for acoustical tile (***fact***). This is an offer.
Acceptance (***rule***) = utilizing subcontractor's bid in preparing the prime's bid (***fact***).
Valid consideration (***rule***) = $85,000 (***fact***).

CONCLUSION:
Yes

FIRAC Outline supporting "No" conclusion should look something like:

FACTS: Caffey Construction, the prime contractor, utilizes Bon Fire Tile's, (subcontractor) bid for acoustical tile in preparing the prime's bid on a contract dated 2/1/98.

ISSUE: Can the sub get the $15,000 in lost profit as damages from the prime?

RULE: In order for a contract between two parties to be formed there must exist an offer, and acceptance of that offer, and valid consideration. A subcontractor's bid is an offer.

ARGUMENT:
Offer (rule), Subcontractor's bid is offer (***rule***). = Bon Fire Tile gives bid to Caffey for acoustical tile (***fact***). This is an offer.
Acceptance (***rule***) ? utilizing subcontractor's bid in preparing the prime's bid (**fact**).
Valid consideration (***rule***) **=** $85,000(**fact**).

CONCLUSION:
No

In-Class Assignment - Worksheet: How to FIRAC #2

Go through the steps outlined in the section entitled, “How to FIRAC” in your text. YOU DO NOT HAVE TIME TO WRITE OUT A COMPLETE FIRAC IN CLASS. DO AN OUTLINE ONLY. If you follow the steps on “How to FIRAC” you will get an outline.

Use reverse side or additional sheets if necessary.

Hypothetical #2

FACTS: Caffey Construction, the prime contractor, utilizes Bon Fire Tile’s, (subcontractor) bid of $85,000 for acoustical tile in preparing the prime's bid on a contract dated 2/1/98. This is proved by documentary evidence and is not an issue. THIS JOB TO BE PERFORMED IN MASSACHUSETTS. Correspondence dated 12/1/97 between the prime and sub defined the exact nature and price of the work required by Bon Fire, and the contractor confirmed this in writing. However, on 2/3/98, after the contract has been awarded to the prime, the prime bid shops and gives the acoustical tile work to Sippers Tile, another subcontractor. Bon Fire’s lost profit on the job is $15,000, and it had no other job during that time, nor could it get another one.

ISSUE: Can the sub get the $15,000 in lost profit as damages from the prime?

RULE: In order for a contract between two parties to be formed there must exist an offer, and acceptance of that offer, and valid consideration. A subcontractor’s bid is an offer.

The subcontractor’s bid is an offer inviting acceptance by an act, and that use of the bid in the proposal for the prime contract was that act. [*Roblin Hope Industries, v. J.A. Sullivan Corp*,, 413 N.E.2d 1134 (Mass.Ct.App. 1980)].

Suggested Solution to In-Class Assignment - Worksheet: How to FIRAC #2

Note: There is only one right answer to this problem. Students could be required to prepare a complete legal argument from the outline as a written homework assignment.

FIRAC Outline supporting "Yes" conclusion should look something like:

FACTS: Caffey Construction, the prime contractor, utilizes Bon Fire Tile's, (subcontractor) bid for acoustical tile in preparing the prime's bid on a contract dated 2/1/98.

ISSUE: Can the sub get the $15,000 in lost profit as damages from the prime?

RULE: In order for a contract between two parties to be formed there must exist an offer, and acceptance of that offer, and valid consideration. A subcontractor's bid is an offer.
The subcontractor's bid is an offer inviting acceptance by an act, and that use of the bid in the proposal for the prime contract was that act.[*Roblin Hope Industries, v. J.A. Sullivan Corp*,, 413 N.E.2d 1134 (Mass.Ct.App. 1980)].

ARGUMENT:
Offer (rule), Subcontractor's bid is offer (***rule***). = Bon Fire Tile gives bid to Caffey for acoustical tile (***fact***). This is an offer.
Acceptance (***rule***), utilizing subcontractor's bid in preparing the prime's bid is acceptance = Caffey utilized Bon Fire Tile's bid in preparing Caffey's prime bid (***fact***).
Valid consideration (***rule***) = $85,000 (***fact***).

CONCLUSION:
Yes

In-Class Assignment - Worksheet: How to FIRAC #3

Go through the steps outlined in the section entitled, "How to FIRAC" in your text. YOU DO NOT HAVE TIME TO WRITE OUT A COMPLETE FIRAC IN CLASS. DO AN OUTLINE ONLY. If you follow the steps on "How to FIRAC" you will get an outline.

(Note to instructor: Students could be required to prepare a complete legal argument from the outline as a written homework assignment).

Use reverse side or additional sheets if necessary.

Notes to instructors using this example and answers to the questions appear in red.

<u>*Preliminary Questions:*</u>

1. This case is a good example of one in which all of the important issues are issues of law. There ARE a few factual issues. Can you find them? One has been labeled in the text for you. Can you find others.

Answer: Factual issues are labeled in red the text below.

2. What testimony from Chernoff would be necessary to raise any factual issues regarding whether or not he said and did the things Dey complained of? Notice this testimony is NOT here, therefore there is no factual issue concerning whether or not he said and did these things.

Answer: In order to raise the factual issue of whether or not the four incidents or the daily comments occurred, Chernoff would have to testify that they had not. However, he never denies that they occurred, so no factual issue is raised. The reader cannot assume he would have denied that the events took place. In fact in the actual case he did ***not*** deny that these facts took place – only that these facts amounted to sexual harassment.

PROCEDURAL POSTURE OF THE CASE:

Colt Construction has filed a motion for summary judgement claiming that the following facts do not support a claim for sexual harassment. A summary judgement is a method of avoiding a jury trial and allowing the judge to decide the case. It occurs when there are no major issues of material fact.

The procedural posture of the case tells the reader where in the legal system the case is.

FACTS

Anne Dey began working for Colt Construction Company in April 19, 1982. She was hired as the company's bookkeeper, but she was thereafter given the title of "controller." She was responsible for maintaining Colt's payroll, its payables and receivables, for making disbursements to subcontractors and construction material vendors, for paying office expenses, documenting project costs, and preparing affidavits, waivers of mechanic's liens, union reports, and reports for the Department of Housing and Urban Development. She also prepared payroll tax returns for Colt; although Colt's income tax returns and its year-end financial statements were prepared by an outside accountant based on data and schedules compiled by Dey.

Giving the students the facts with a wide margin allows them to make notes and comments.

The office in which Dey worked primarily housed Colt's management personnel and not its field staff. Other personnel at this office included:

Robert Irsay, Colt's president and owner. Has final decision making authority on all company matters.

James Ferguson, Colts VP. He was Dey's immediate supervisor, though Dey occasionally completed projects for Chernoff

and Irsay.
Michael Chernoff, general counsel (attorney)
Sullivan – salesperson
Other Salespeople and/or estimators (1 or 2)
Other support staff (1 or 2)

Beginning in late 1982 or early 1983 Dey claims that Chernoff began subjecting her *to almost daily comments, gestures, and innuendo that she considered sexually suggestive and harassing.* Although she worked directly with Chernoff only on occasion, she had limited daily contact with him whenever he was in town because of the size of the offices.

Students: Hi-lighted fact supports element #3 of rule, the frequency of the discriminatory conduct.
Giving the students one fact which supports one of the legal elements helps them find others. The yellow hi-lighted fact at the left tends to support element #3 – The frequency of the discriminatory conduct (rule) is daily (fact).

Dey is unable to remember the specifics of much of the alleged harassment, but she recounts in some detail the following four incidents:
(1) In talking with Dey sometime in either 1983 or 1984, Chernoff referred to a female attorney with whom he was then working on a Colt project as a "flat-chested cunt";
(2) When Dey returned from a Phoenix vacation in January 1983, Chernoff suggested she had not gotten a tan because she had spent the week on her back in bed;
(3) In March or April 1985, after more than two years of alleged harassment, Dey and Chernoff were riding alone on the elevator from Colt's fourth-floor offices to the basement parking garage when Chernoff asked Dey to hold some papers for him; he then unzipped his slacks, whereupon Dey turned her back until the elevator reached the basement; Chernoff did not say anything and did not touch Dey during this incident; she later indicated that she felt trapped and "very afraid"; and
(4) In September or October 1985, Chernoff said to someone on the telephone that "there is a girl in my office going down on me" as Dey leaned down to put some documents on Chernoff's floor.

Student: You may refer to the four incidents listed as “the four incidents” in your outline.
Referring to these four incidents as “the four incidents” tends to lessen the offensive nature of this example and make class discussion easier.

Does Chernoff deny that he subjected Dey to daily comments or that the four incidents took place?
Answer: No

Dey claims that these four incidents stand out in her memory as the most blatant but that Chernoff made similar harassing comments on almost a daily basis. She is unable, however, to remember specifics. There was no physical component to the alleged harassment. She was never touched at any time, nor was it intimated that sex was required of her in order for her to keep or maintain her job position.

What affect does this have on the litigation?
Answer: There is no factual issue as to whether or not these four events took place.

Dey reported Chernoff's conduct to Ferguson in early 1985, and indicated that she was uncomfortable and embarrassed by Chernoff's comments and that she intended to start a log, recording those incidents she considered particularly offensive. Ferguson admits that Dey appeared upset during the conversation. Dey and Ferguson had other conversations in connection with Dey's complaint.

Dey also complained directly to Chernoff, indicating that his comments and other conduct made her very uncomfortable, that she intended to keep a log and she hoped her objections would discourage any similar behavior in the future.

Chernoff denies that the above conversation took place. (Note: this is the first factual issue raised by these facts. Be on look out for others).

Students: Here is a factual issue. **Factual issue**:
Did Dey complain to Chernoff that his

comments and conduct made her uncomfortable? Giving the student one factual issue makes it easier for them to find others.

Dey admits that she just wanted the comments to stop. She considered everyone in the office, including Chernoff, to be her friends, and she characterized the office environment as professional, with the exception of Chernoff's consistent sexual commentary. Dey stated that the sexual banter did not prevent her from fulfilling her responsibilities in a timely fashion, but merely that the conduct upset and embarrassed her, and made her feel uncomfortable. Chernoff's comments caused her to walk out of his office on more than one occasion.

Dey occasionally had lunch with Chernoff and attended office luncheons and other office social functions where Chernoff was present.

On two occasions Dey received personal, legal advice from Chernoff during office hours.

Dey once requested Chernoff's assistance when a woman appeared at the office demanding to speak with Dey about Dey's alleged relationship with the woman's husband. When Dey could not get the woman to leave, she called upon Chernoff to help her. Chernoff was able to convince the woman to leave.

Dey received a salary increase at the end of April 1985.

In mid-May 1985 Irsay held a closed-door meeting with Chernoff and Sullivan and they agreed that Dey would be terminated. Irsay maintains that he made the decision to terminate Dey independently, that he merely asked Chernoff and Sullivan for their opinions, and that they concurred in his decision.

Factual issue:
Why did Irsay terminate Dey?
Dey says because of her complaint. Irsay says because of problems with Dey.

Irsay states that the decision was based on Irsay's personal assessment of Dey's performance, as well as on complaints Irsay had received about Dey from Sullivan, Ric McCoy (a Colt field superintendent) and other office personnel. The complaints ranged from comments about Dey's uncooperative attitude to charges that she was unable to complete her required work promptly. It is undisputed that Dey had difficulties with both Sullivan and McCoy.

Factual Issue:
Was Dey uncooperative?

Irsay insists that he knew nothing of Dey's sexual harassment charges when he decided to terminate her employment. Both Ferguson and Chernoff maintain that they never mentioned Dey's complaints to Irsay. Both are still working for Irsay at the time the lawsuit was filed in 1986.

Although Irsay decided to fire Dey in May 1985, she was not notified of this until November, after Irsay had found her replacement.

Dey asked Irsay in September 1985 if her job was secure because she was contemplating the purchase of a new automobile, and Irsay assured her that it was and added that she did not even have to ask.

On November 15, 1985 Chernoff met with Dey and told her of her immediate termination. Chernoff explained to Dey that he, Sullivan

Fact issue:

and Ferguson had found her increasingly difficult to work with in the past six months and that the company's business had slowed. No one ever suggested to Dey that she was fired in response to her sexual harassment complaints.

Why was Dey fired?
Dey: Threat to Chernoff
Colt: Business slowed.

Although he was Dey's immediate supervisor, Ferguson did not participate in the decision to terminate Dey. Chernoff told Dey when firing her that Ferguson found her difficult to work with, but Ferguson maintains that he never complained to Irsay about Dey, and he further attests that Dey was adequately performing her duties at the time of her discharge and that he knew of no problems with Dey and other Colt employees. With regard to specific conflicts between Dey and Sullivan or McCoy, Ferguson corroborated Dey's version of those events and indicated that she acted appropriately, and Sullivan and McCoy were difficult to work with. Ferguson is no longer an employee of Colt. [*Dey v. Colt Construction***,** 28 F.3d 1446 (7^{th} Cir.1994)].

Factual Issues:
Did Dey act appropriately?

Were Sullivan and McCoy difficult to work with?

ASSIGNMENT: ***PREPARE A VALID LEGAL ARGUMENT DISCUSSING THE FOLLOWING ISSUE.***

ISSUE: Has Dey been sexually harassed?

RULES: (Note: I suggest you use the numbers indicated below when reviewing the facts, however this numbering is only a tool to make it easier/faster to match up the facts with the law. If it is not easier for you, do not do it.)

Rule #1: Sexual harassment occurs when the (1) *conditions of the victim's employment are altered* and (2) when an *abusive working environment is created.* (*Meritor*, 477 U.S. at 65)

Rule #2: The courts and the juries should look at *all of the circumstances* to determine whether or not a work environment has been rendered hostile or abusive. The court has developed the following non-exhaustive list of factors relevant to the somewhat elusive question of whether or not a work environment has been rendered hostile or abusive:
(3) The frequency of the discriminatory conduct;
(4) Its severity;
(5) Whether it is physically threatening or humiliating or
Merely an offensive utterance;
(6) Whether it unreasonably interferes with an employee's work performance. (*Harris,* 114 S.Ct. at 371).

Notice you have been given TWO rules, the Meritor Rule and the Harris Rule. You must discuss BOTH, COMPLETELY in your argument. (However, for the FIRAC outline you may abbreviate. For example: "alters employment" for "when the workplace alters the conditions of the victim's employment".

This assignment is designed to help you learn how to prepare a legal argument in the FIRAC format. The first thing to do is to take out a sheet of paper and begin your FIRAC outline. The first words on the paper should be:
FACTS:
What should the next word be? See below for some information you need to complete your FIRAC.

Preparing your premises of your argument is the most challenging part of the argument. The following steps will help you. Remember an argument is a set of premises that support a conclusion. To prepare the premises of your legal argument do the following:

1. **Go through the facts and determine which element of the law that fact supports or disproves.** Determine if a fact supports an element of the law, or supports lack of that element. Example: Fact: Dey was given raise, then fired. This fact supports element #1 of the rule, "alters conditions of employment". Here employment was altered (rule) because she was fired (fact).
You have space in the margins of the fact statement to indicate which element of the law is supported or repudiated by a fact.

2. On a separate sheet of paper prepare simple premises (and others if you are able) to support a "yes" conclusion.

3. Repeat above to support a "no" conclusion.

Suggested Solutions to In-Class Assignment - Worksheet: How to FIRAC #3

FIRAC OUTLINE SUPPORTING A "YES" CONCLUSION TO THE ISSUE OF "HAS DEY BEEN SEXUALLY HARASSED?"

NOTE TO INSTRUCTOR: It is unlikely students will find *all* of the facts that support each element. In addition, there will be disagreement over how the facts can be interpreted. This is common in legal problems and is part of the learning experience. Some students might be able to make creative arguments for how certain facts or combinations of facts tend to support the existence or deny the existence of an element. This list should not be considered complete.

There is no "right" answer to this problem. This case was an appeal from a summary judgment in favor of Colt. Colt lost the appeal and the case went back to the trial court for a trial. However, the case does not again appear in the case law so we do not know whether or not Dey or Colt won. For this reason no student who argues this case can be "wrong", which is one of the reasons it was chosen for this exercise. It is likely that the case was settled sometime after it was ordered back to the trial court.

FIRAC Outline
FACTS: Dey is fired from employment after complaining of sexual harassment.

ISSUE: Has Dey been sexually harassed?

RULES: (Students will not likely have time to copy here during an assignment completed in class).

ARGUMENT:

1. *Conditions of the victim's employment are altered* (Rule)
Facts tending to support this element:
Dey was fired for making the complaints. She was doing a good job. (Supported by Ferguson's testimony also).
Daily comments, gestures and innuendoes of a suggestive nature started some months after employment started.
She was uncomfortable and embarrassed by Chernoff's actions.
Dey had several conversations with Ferguson concerning Chernoff's actions.
Dey complained to Chernoff.
Office environment was professional EXCEPT for Chernoff's behavior.
Dey was forced to walk out of Chernoff's office on more than one occasion due to his actions.
Chernoff (not in chain of command) helped decide that Dey would be terminated.

2. *Abusive working environment is created.* (Rule)
Facts tending to support this element:
4 incidents.
Almost daily comments, gestures and innuendo.
Ferguson's testimony that Dey was upset.
Dey complained to Chernoff that the comments and other conduct made her very uncomfortable.

3. *The frequency of the discriminatory conduct;* (Rule)
Facts tending to support this element:
Almost daily

4. *Its severity;* (Rule)
Facts tending to support this element:
4 incidents.
Dey tried to discourage Chernoff's behavior.

5. *Whether it is physically threatening or humiliating or*(Rule)
Facts tending to support this element:

4 incidents.
Almost daily comments, gestures and innuendo.
Dey tried to discourage Chernoff's behavior.

Or Merely an offensive utterance; (Rule)
Facts tending to refute the existence of this element:
4 incidents are not merely offensive.

6. *Whether it unreasonably interferes with an employee's work performance*. (Rule)
Facts tending to support this element:
Dey was fired for making the complaints. She was doing a good job. (Supported by Ferguson's testimony also).
Dey had several conversations with Ferguson concerning Chernoff's actions.
Dey was forced to walk out of Chernoff's office on more than one occasion due to his actions.

CONCLUSION: Yes

FIRAC OUTLINE SUPPORTING A "NO" CONCLUSION TO THE ISSUE OF "HAS DEY BEEN SEXUALLY HARASSED?"

FIRAC Outline
Facts: Dey is fired from employment after complaining of sexual harassment.

ISSUE: Has Dey been sexually harrassed?

RULES: (Students will not likely have time to copy here during an assignment completed in class).

ARGUMENT:

1. *Conditions of the victim's employment are altered* (Rule)
Facts tending to refute the existence of this element:
Dey admits the sexual banter did not prevent her from fulfilling her responsibilities.
Really only 4 incidents – the others are so minor as to not be remembered.
It was never intimated that sex was required for her to keep her job.
She never started a log.
Office environment was professional except for Chernoff's behavior.
Dey was not fired because of her sexual harassment complaints.

2. *Abusive working environment is created.* (Rule)
Facts tending to refute the existence of this element:
Really only 4 incidents – the others are so minor as to not be remembered.
She only complained of being uncomfortable and embarrassed.
It was never intimated that sex was required for her to keep her job.
She admits she just wanted the comments to stop.
She considered everyone to be her friend, including Chernoff.
Dey admits the sexual banter did not prevent her from fulfilling her responsibilities.
She sought legal advice from Chernoff.

3. *The frequency of the discriminatory conduct;* (Rule)
Facts tending to refute the existence of this element:
4 incidents only the other items are not discriminatory, only offensive.

4. *Its severity;* (Rule)
Facts tending to refute the existence of this element:
She cannot remember specifics of most things she complains of.
She never started a log so things could not have been that bad.
She admits she just wanted the comments to stop.
She occasionally had lunch with Chernoff.
She sought legal advice from Chernoff.

5. *Whether it is physically threatening or humiliating or*(Rule)
Facts tending to refute the existence of this element:
She was never touched, there was no physical component.
Dey only tried to discourage Chernoff's behavior.
She considered everyone to be her friend, including Chernoff.

Or merely an offensive utterance; (Rule)
Facts tending to support this element:
Most of the things complained of are only offensive utterances.
It was never intimated that sex was required for her to keep her job.
She admits she just wanted the comments to stop.
She considered everyone to be her friend, including Chernoff.

6. *Whether it unreasonably interferes with an employee's work performance. (Rule)*

Facts tending to refute the existence of this element:
She admits she just wanted the comments to stop.
She considered everyone to be her friend, including Chernoff.
Dey admited the sexual banter did not prevent her from fulfilling her responsibilities.
She occasionally had lunch with Chernoff.

CONCLUSION: No

Memorandum

TO: Students

FROM: Nancy J. White

DATE: Spring 1999

RE: Homework Assignment #7 - FIRAC #1

****

Your company, American Construction Services, Inc. (ACS) has been awarded a contract by the Navy to demolish and remove all facilities, including "remaining residue or product," at a tank farm in Mechanicsburg, Pennsylvania. The contract said the Navy would remove the contents of the tanks prior to issuance of a notice-to-proceed. The contract also stated: "Title to materials resulting from demolition, and materials and equipment to be removed, is vested in the Contractor." When ACS commenced demolition, it discovered the Navy had neglected to remove 100,000 gallons of fuel oil from one section of the tank farm. ACS claimed title to the fuel oil under the terms of the contract. ACS said the oil was "remaining residue or product." The Navy claims title to the fuel and removes it.

Your boss asks you to prepare a preliminary memorandum that will be used by the boss and the firm's attorney in deciding whether or not the company should file a claim for the value of the fuel. Your boss tells you to make a legal argument in support of your conclusion (you might call this a recommendation) that either yes, the company appears to have a good claim, or no, the company does not appear to have a good claim. Remember neither your boss nor the attorney has any of the facts, issues or rules. You must supply all in the memorandum so that the memorandum is complete.

You determine this is a scope of contract or interpretation issue. Prepare a memo discussing the following three issues. Refer to chapter in text discussing Scope issues. (Note to users of this hypothetical problem: Facts taken from: *Dekalb County v. Rockdale Pipeline*, 189 Ga.App. 121, 375 S.E.2d 61, 1988 Ga.App. LEXIS 1329.)

Issue #1: Is the contract ambiguous?
Issue #2: Is the ambiguity, if any, patent or latent?
Issue #3: In whose favor should the court rule?
Hint: Ordinary meaning, Clear expression of intention, Conduct of the parties.

<u>Your assignment:</u>

1. Prepare a memorandum to your boss as requested above.
2. Discuss EACH issue SEPARATELY. Refer to Chapter on "How to FIRAC".
3. Issue #3 must contain an argument using ***<u>at least</u>*** three rules from the Scope chapter of the text.
4. Turn in your FIRAC outline(s) for each issue also. The outlines can be hand written.

MEMORANDUM

TO: Nancy J. White

FROM: Matt Hammer, Plano, TX. (Used with permission)

DATE: 4/2/99

RE: FIRAC #1 - American Construction Services, Inc. v. United States Navy

****

The purpose of this memo is to recommend to the management whether or not American Construction Services (ACS) has a claim against the United States Navy (USN).

ACS contracted with USN to demolish and remove all facilities, including "remaining residue or product," at a tank farm in Mechanicsburg, PA. As per contract, USN was to remove the contents of the tank before a notice-to-proceed would be issued to ACS. The contract contained a provision stating "Title to materials resulting from demolition, and materials and equipment to be removed, is vested in the Contractor." ACS began its demolition only to find one-hundred thousand (100,000) gallons of fuel from a section of the farm. ACS claimed this fuel, as per the "titles" clause in the contract and claiming it was "remaining residue or product." USN in turn claims the fuel and removes it.

The first issue in this case is where or not the contract was ambiguous. The rule states that a contract is ambiguous if it is capable of having two relatively reasonable meanings. The contract terms required ACS to remove all facilities including "remaining residue or product," which are the ambiguous terms in this contract. "Residue" by Webster's definition is "something that remains after a part is disposed of or removed" or "remnant." This definition does not specify quantities, however. One party (USN) assumed that "residue" was only small quantities of product. The other (ACS) assumed Webster's definition as ALL quantities. Given the two relatively reasonable meanings here, the contract is ambiguous.

The second issue is to determine whether or not the ambiguity is patent or latent. A patent ambiguity is an ambiguity obvious to a reasonable person given the circumstances of the situation. A reasonable person may not view the ambiguous terms "remaining residue or product" as obvious. There is no quantifiable way to determine whether or not the meanings of words are obvious. Since the ambiguous terms are not obvious, the ambiguity is latent.

The third issue is, in whose favor should the court rule? Here, we will discuss three different rules: ordinary meaning, clear expression of intention, and conduct of the parties.

The ordinary meaning of "remaining residue or product" in the construction industry is that of small quantities. It is obvious that a demolition job will have remaining residue and wreckage. The drafter of the contract, ACS, was aware of this meaning. In other words, they knew they would be taking materials for their own use. Given the ordinary meaning in quantities of "remaining residue or product," ACS should have been aware that they would only be taking small quantities of materials back, and not 100,000 gallons of fuel oil.

Contract rules state that a contract drafter's expression of intention must be stated with clarity. Given ambiguous terms in the contract, ACS could not have expressed their intentions clearly. United States Navy believed that ACS would only leave the site with small portions of usable wreckage. ACS believed they could take any and all wreckage or items left on site for their own. This ambiguity negates the "clear expression of intention" doctrine.

The conduct of the parties involved show specifically what they believed the contract meant. ACS claimed title to the total amount (100,000 gallons) of fuel oil left on site. United States Navy, realizing they had made a mistake leaving it behind, came back to take it. If the USN had not made a mistake, they would have let ACS claim the oil. A court must give allowances for some mistakes. Given the extreme quantities of oil left on the farm, a reasonable contractor would recognize this mistake and report it.

American Contracting Services, Inc. did not heed an ordinary meaning of "remaining residue and product." They did not clearly state their intention to remove any and all material left on site by the United States Navy. The USN, by their conduct, recognized the mistake in the contract by returning for the left oil. In conclusion, evidence does not exist to allow ACS to collect the 100,000 gallons of fuel oil that the USN mistakenly left on site.

Journal of Construction Education
Fall 1999, Vol. 4, No. 3, pp. 260-277

1522-8150/99/$3.00/Educational Practice Manuscript

A Road Map to an effective Graduate Construction Education Program

Kenneth C. Williamson III and David L. Bilbo
Texas A&M University
College Station, Texas

This manuscript presents a model for graduate construction education that is responsive to the current issues in the construction industry and the academic environment. It provides a review of literature from the faculty of the Associated Schools of Construction in the form of an historical perspective demonstrating little change over the past decade. Master's and Ph.D. programs are discussed and outlined in response to the suggested graduate education model in conjunction with program coordination and academic rigor.

Key Words: Graduate education, Program model, and Graduate program history

Introduction

The intent of this paper is to provide a historical review of construction's graduate education, to propose a graduate education model that responds to the current and future needs of the construction academic or industry professional, and discuss programmic options available for meeting the requirements of the model. The model being proposed goes beyond the traditional delivery methods currently used by most graduate programs. The paper discusses the options available for graduate programs to affect changes necessary for the implementation of the proposed model.

Over the last twenty years, there has been a significant paradigm shift in the concept that defines a construction professional, within both academia and industry. As early as 1989, there was a call-to-meeting proposed to define the goals and topics for graduate education in the field of construction (Moss, 1989). However, this call was never responded to and over the years since this call, no one has provided consistent leadership in graduate education within the Associated Schools of Construction (ASC). The strategic planning session at the ASC Mid-year Board Meeting identified the need for more Masters and Ph.D. programs and the necessity for expanded involvement by the ASC in graduate program guidance (ASC, 1998). The Board's discussion, concerning faculty development towards tenure and promotion, identified the need for higher academically qualified construction educators as a response to the universities' ever-increasing requirement for research. Support for academic qualification also came from Rogers, and Christensen (1992), who reported that not only was a graduate program a necessary requirement for research productivity, but that the ASC faculty believes a strong graduate program is necessary to be productive in research. Within their survey on inhibitors to research productivity, the lack of a graduate program was ranked second of sixteen questions. It is hoped that this manuscript will create some discussion and leadership in support of the ASC's mission of enhancing graduate education and faculty development. The discussion below will first give the reader a brief historical review of the literature concerning graduate education within the academic programs aligned with the ASC. Following this, the authors will define the graduate education model and discuss the implications of this model on the design of both Masters and Doctoral programs.

Literature Review

This review is limited to works published within the ASC Annual Meeting Proceedings and The Journal of Construction Education. A listing of ASC graduate programs is provided first to give the reader an understanding of graduate program growth over the past ten years. An in-depth literature review, spanning the same period, found four major categories of work concerning graduate education. The earliest writings centered on program development and program identification, the second major grouping involved course content descriptions, the third discusses the tie between graduates and research, and finally the fourth, academic justification and industry acceptance.

Programs

Construction undergraduate programs have historically emerged from or have been affiliated with Colleges of Agriculture, Industrial Technology, Architecture, Engineering and Business. A current analysis of program orientation finds that this is still the case even at the graduate programs level, i.e., Agriculture – two, Industrial Technology – fourteen, Architecture – six, Engineering – eight and Business – one. Fifty-two percent of construction education undergraduate programs are affiliated with the Applied Science and Industrial Technology colleges, as well as, forty-six percent of the graduate programs. These facts are quite counter to the common thinking of construction educators as reported by Hauck (1998) and has not changed since 1992, as reported to the ASC Board of Directors (Williamson, 1993). Marshall (1990) provides us with an historical snapshot of construction programs and related curriculums offering graduate construction education. These included: Colorado State University, University of Florida, Purdue University, University of Northern Iowa, Pittsburgh State University, Worcester Polytechnic Institute, Michigan State University, Polytechnic Institute of New York, State University of New York, East Carolina University, University of Oklahoma, Clemson University, and Texas A&M University. Marshall's work, however, did not provide information such as program level or degree title/emphases. Table 1 represents the current status of ASC programs in graduate education. Of the thirty-four member schools reporting masters degrees, seven are technology, and twelve are engineering, thirteen are construction management, and one is business. Four Doctoral degrees are reported as being engineering, three are technology, one is education, two are architecture and one building construction. While the above information demonstrates diversity of location and program emphases there is still a significant lack of construction programs identifying their degree as being separate and uniquly different than the allied discipline in which they reside.

Table 1

1998 Survey of ASC Graduate Programs

University	Masters Degree	Doctoral Degree
Arizona State University	M.S. in Construction	
Auburn University	Master of Building Science	
Bowling Green State University	Masters of Industrial Technology	Ph.D. in Technology Management
Bradley University	M.S.C.E. (Construction Management option)	
Brigham Young University	M.S. in Construction Management Pending	
California State University - CHICO	M.S. Construction Management	
Central Connecticut State University	M.S. In Industrial Technical Management	Ph. D. in Technology Management
Central Missouri State University	M.S. in Industrial Technology, M.S. in Industrial Management	
Clarkson University	M.S. in Civil Engineering, M.E. in Civil Engineering	Ph.D. Civil and Environmental Engineering
Clemson University	Master of Construction Science and Management	
Colorado State University	Master in Manufacturing Technology and Construction Management	Ph.D. School of Education
Eastern Michigan University	M.S. in Construction Management	
Fairleigh Dickinson University	M.S. Pollution Studies, M.S. in Electrical Engineering	
Georgia Institute of Technology	M.S. in Building Construction	Ph.D. in Building Construction
Iowa State University	M.S. Civil Engineering - Construction Engrg & Management	Civil Engineering - Const. Engrg & Management
Michigan State University	M.S. in Construction Management	
Montana State University	M.S. Construction Engineering Management	
Oregon State University	M.S. Construction Engineering Management	
Purdue University - BCM	M.S. School of Technology	Ph.D. School of Education
Southern Polytechnic State University	M.S. in Construction	
Stanford University	M.S. in Construction Engineering & Management	Ph.D. in Civil and Environmental Engineering - Construction
Temple University	M.S.E. Civil Engineering, M.S. Environmental Health	Ph.D. Engineering
Texas A&M University	M.S. Construction Management	Ph.D. in Architecture
Texas Tech University	M.S. in Civil Engineering, M.S. Engineering	
University of Denver	Masters in Real Estate & Construction Management, M.B.A. with specialization in RE/CM/RECM	
University of Florida	Master of Building Construction, M.S. in Building Construction	Ph.D. in Architecture (Building Construction)
University of Nebraska - Lincoln	Masters of Engineering (start Spring 1999)	
University of Nevada - Las Vegas	M.S. Engineering - Construction	
University of New Mexico	M.S. Civil Engineering, M.S. Construction Engineering & Mgmt.	
University of Northern Iowa	M.A. in Technology	Doctor of Industrial Technology (DIT)
University of Oklahoma	M.S. in Construction Administration	
University of Southern Mississippi	M.S. in Engineering Technology	
University of Washington	M.S. in Construction Management	

Curriculum Development Philosophy

Considering that graduate education has been included within our curriculums for more than twenty years, little writing has occurred in this area. Most curriculums were developed and organized based on the educational philosophy and technical experience of the person developing the academic curriculum. "Typically the graduate curriculum was not validated, either within academia or industry because the developers of the coursework did not know how nor have time to do this important task" (Newitt, 1987, 23). In 1988 an industry survey was conducted by Arizona State University to determine the viability of a new graduate program at ASU and to validate the existing graduate program at Texas A&M University. The survey included clientele identification, academic background accommodation, curriculum development, industry acceptance, academic viability, research identification, and employment prospects for graduates. Interestingly, it was found that thirty-six percent of the firms were not aware of a graduate program in construction and seventy-one percent expressed the opinion that a graduate program was needed (Badger & Segner, 1989). At the same time, the University of Oklahoma provided insight into their development of a second graduate degree offering, the MBA/MS degree in Construction Management. Their existing graduate degree, initiated in 1986, was a Master of Science in Construction Science. The MBA/MS dual degree was an integration between the College of Architecture and the College of Business (Conner & McManus, 1989). In 1989 Purdue University proposed a master's degree program that would be an extension of an undergraduate degree in construction (Moss, 1989). However, this proposed degree program within the Department of Building Construction and Contracting never came to fruition.

Most existing graduate degree programs were reported to be lateral programs that offer few courses in advanced construction concepts. A lateral program is defined as one in which the student pursues a graduate degree in a different field than the undergraduate degree (Moss, 1989). Some graduate courses at varying instutions are nothing more than an undergraduate course with a term paper requirement to differentiate the graduate from the undergraduate, i.e., the University of Oklahoma. The current thinking at that time was to steer away from both the lateral program and the term paper requirement coursework by instituting more of a specialty graduate program which includes a separate group of leveling coursework and credit for practical experience. Roger Killingsworth (1990) conducted a survey to look at population trends and education. Several adaptive strategies were suggested: 1) developing accredited degree programs for the older, part-time student interested in career enhancement, 2) development of business oriented masters programs to meet industry desires for more training in business, management, and communications that cannot be included in already crowded undergraduate curricula, 3) the development of a few Doctoral programs to fill the demand for personnel trained to perform research activities. Further support for program specialization comes from Feigenbaum, & Pedulla (1991). Their work provides a differentiation between program objectives when preparing construction professionals and construction educators for their personal success. It was suggested that in the construction professional program, efforts should be made to target a construction specialization. Oppenheim (1993), indicated that graduate program should provide these three objectives: 1) provide management training so that the graduate can advance more rapidly in the profession, 2) provide students with appropriate experience and inclination for teaching, and 3) provide innovators to a changing industry.

Coursework

Feigenbaum and Pedulla (1991), were the first to use of the term “Essential Elements” of a profession in describing an educational curriculum within our literature. To date there has been no effort to define a core curriculum in construction's graduate education. Essential to the instructional design and concepts taught at the graduate level are the difficulties encountered by graduate professors when considering the personal differences of graduate students, including educational background, industrial background, and level of technical or practical experience. This is central to offering meaningful instruction that is not merely an extension of undergraduate coursework. The instructor must carefully analyze what is appropriate substantive coursework and determine the level of difficulty needed to furnish meaningful instruction (Maher, 1990). Several papers have been presented on graduate coursework at the annual ASC conferences. The first by Marchman, (1991) concerns scope definition and control within conceptual estimating. Marchman's work suggest that because of concept complexity it is best taught at the graduate level. The faculty at Colorado State University, working with the Center for the Stabilization and Reuse of Important Structures explored the integration of historic preservation with graduate studies at both the master’s and Ph.D. levels. Successful ventures as of 1995 included consultation, reuse studies, facility evaluation, historic nominations, and experiential applications. "Beyond traditional educational benefits, these activities build community support and provide funding for research and a growing number of graduate assistantships" (Griffin, Hauck, & Reidhead, 1995, 95). Finally, Nobe and Berryman (1996, 1) reported that "reserve fund analysis was a logical extension of services for construction management professionals and that there is a growing and untapped market that could be filled by properly trained construction management graduate students."

Research Integration

Segner (1990), began the discussion concerning the connection between graduate education and research. Segner stated that the graduate education programs must integrate a research component. This component would generate and disseminate new knowledge and assist in the establishment of academic credibility. It was hoped that the construction industry would finance graduate research and that this support would assist in the recruitment of top-quality graduate students. It would be difficult to argue that graduate education and research do not go hand-in-hand in today's academic climate. Rounds (1992) argued that research funding is going to the researchers converted from the design disciplines who are experienced and highly qualified researchers, rather than to constructors who may have a better understanding of construction, but are simply not qualified in the research area and do not have a track record to demonstrate competence in research. We must develop construction terminal degree programs that will produce the professional construction educator and who is highly trained in research.

Industry Justification

Construction graduate programs have not observed a noticable change in the problems described above and many would argue that a change must occur for our graduate programs to remain viable and to experience professional growth. Graduate construction education is still an anomaly. The industry has yet to accept that graduate students are more valuable than undergraduates. Most graduate students are considered “retreads” from other disciplines who want to gain the competencies our undergraduates have, but without getting another undergraduate degree. "The ‘90’s must see the growth of true graduate level construction education programs that enable us to feel good about sending our own undergraduates to them" (Rounds, 1992, 145). Moss (1989, 84) stated, "unfortunately, most construction employers are very skeptical. But we should not let their skepticism deter progress. We did not let their skepticism deter us two decades ago (in the formal establishment of the undergraduate degree programs and accreditation process), and we should not now". The expansion of graduate education is necessary for construction education to progress as an academic discipline. Graduate education, research and the expansion of knowledge are part of all other disciplines. "Construction education cannot expect to be accepted as a legitimate academic discipline if it continues to be an exception to the rule. Graduate education is essential to our construction educators" (Moss, 1989, 84). "For construction education to be accepted as an academic discipline it will be necessary for it to exhibit the characteristics found in other traditional university level academic disciplines" (Bilbo & Yeager, 1990, 5).

Graduate Education Model

Even though many of the statements discovered in the review of literature were true ten years ago, sadly, they are accurate today and we within must change not only industry’s perception, but the perception of the academic community. As a result, we submit the following rationale and graduate education model.

Model Rationale

The construction industry and the academic environment have changed markedly since the seventies, both in terms of what is expected of construction education graduates and what is expected of construction educators. The emergence of construction education at universities throughout the nation has resulted in over fifty accredited programs recognized by the American Council for Construction Education (ACCE), and Accrediting Board for Engineering and Technology (ABET). Construction firms now demand that graduates have knowledge, skills, and abilities beyond the traditional technology areas of materials, methods, estimating, scheduling, the architectural areas of design, computer aided drafting, and the engineering areas of mechanical, electrical, geology, and structures. Today’s graduate is expected to have at least an introductory level of knowledge in the legal aspects of construction contracting, alternative contractual delivery methods, financial and economic management, systems communication and integration, and human resource management. Long gone is the expectation that a construction education graduate don a hard hat, steel toed shoes, overalls, and proceed to the field where he or she spends the day toiling in the sun, sleet, rain or snow. Today’s graduate is viewed as a professional manager who enters the industry at a mid-level management position, i.e., project manager, more frequently in shirt and tie than in overalls and hard hat. More emphasis is placed on administrating the construction technologies and the design/construct/manage interface than performing them. Indications are that graduates are gaining acceptance in the industry as professional managers rather than skilled technologists.

As a result of the emergence of construction education as an appropriate collegiate offering, the profile of the construction educator has also undergone changes. No longer will it suffice for a tenure track educator to be engaged solely in the realms of teaching and service to industry. While construction programs will always need to maintain strong ties with the construction industry, this will be best accomplished by the use of adjunct and visiting faculty which bring recent industry experience to curricula. Professional construction educators, in seeking to be recognized by their academic peers, must perform in the realm that their academic peers recognize and respect, specifically research and publication. The thought that construction educators can claim immunity from these expectations because construction education is "different" is not a viable option. In our emerging discipline, with its associated body of knowledge in a seminal stage, academic recognition is essential for continued success. This simply means that to gain academic recognition and respect, construction educators must face the same processes that lead to tenure and recognition of their academic peers in established disciplines. The day is past where Deans should be expected to go to university administration with "hats in hand" to try to explain why the construction educator should not be held to the given standards for tenure and promotion. One of the most important keys to achieve this academic recognition and acceptance is a viable and rigorous graduate program.

Three major facets of concern for graduate education should be addressed by construction programs whether the student holds an undergraduate degree in construction, holds undergraduate or graduate degree from one of the allied disciplines (e.g., Architecture, Engineering, Industrial Technology and Business), or holds a degree from a non-allied discipline. First, there should be a program directed toward career change which would address the needs of students desiring improved ability for: (1) vertical advancement within the industry and (2) the needs of students desiring to move from industry to academia. Second, programs must be able to provide graduate instruction through innovative and non-traditional methodologies. Finally, the emphasis of these innovative career change programs should be the enhancement of existing content knowledge to meet the challenges of a dynamic industry. Advanced knowledge should be provided in construction management concepts and problem solving through investigative research practices.

Model Statement

Graduate programs in construction education should provide students with the opportunity for advanced study in the principles of construction management, science, and technology beyond the level of study within construction baccalaureate degrees. The graduate degree should offer a program of study that is succinctly different in content and methodology from current undergraduate curriculums. In addition to providing study in the management and technical content areas, the graduate program should emphasize experiences in basic and applied research methodology in both scientific and social inquiry. Concurrently, emphasis should be placed on the development and refinement of systems communication and integration as well as the use of current technology in the realm of information management. Skills in inquiry and communication are essential for both academic and industry professionals and will serve to enhance their advancement within their respective vocations.

Career Change Program

There is a definite need to have a graduate program that adequately addresses the needs of students who hold aligned and non-aligned degrees. These students may desire a career move to the construction industry, enhanced advancement mobility, or a move from the construction industry to the academic environment. In trying to develop a sustainable growth pattern for graduate programs, the accommodation of these career change needs should be an integral part of the graduate program. Academic preparation for these students has always been a strong issue of debate - just what content knowledge should be required and what is the best way to enable these students to function and compete with students prepared in the construction discipline? The leveling sequence logic that follows is inherently dependent upon the concept that the graduate program is succinctly different in methodology and content than the undergraduate program. Specifically, this implies that the knowledge, skills, and abilities taught in the graduate program may built upon, but are clearly different from, the knowledges, skills, and abilities taught in the undergraduate program. It is incumbent upon a viable program to move in this direction, whether for a "thesis" option or a "non-thesis" option at the master’s level, or a “dissertation” option or a “project” option at the doctoral level. To do less, virtually assures that the graduate program will remain status quo and not achieve the pre-eminent status sought by construction graduate programs.

Career change students will always face the reality of entering a graduate program with less preparation than their counterparts who hold a baccalaureate degree from the construction or closely allied disciplines. The question that has to be addressed is that of "pre-requisites" and "minimal academic preparation." The most desirable and efficient circumstance is for students to have graduated from a construction undergraduate program, however with career change students their lack of academic preparation often presents unique problems. For example, what program options are available to the career change student with five to ten years of construction management field experience? Does the program require them to take remedial coursework that is of lesser quality than their field experience? Some programs require graduate applicants to satisfy academic deficiencies by taking undergraduate courses. The use of existing undergraduate coursework is probably the most efficient programmatic method for students to meet prerequisite requirements. It requires less of the usually over-extended departmental resources. This undergraduate course option could also provide an efficient deterrent to an industry professional seeking a graduate degree. In the recent past a "leveling" option has surfaced. Currently two construction graduate programs are known to be offering leveling coursework, i.e., Texas A&M University and Colorado State University. Colorado State University offers graduate leveling courses during the summer semester and advertises them nationally.

It can be argued that it is in the best interest of both the departments (graduate funding formulas) and the students to accomplish this through a series of not-for-credit "leveling" courses offered by the graduate program. Only in rare circumstances should a graduate student from a closely allied discipline be forced into an undergraduate course to provide pre-requisite knowledge and skill. It should be incumbent upon the student's advisor to assess the academic needs of each graduate applicant that are unique to that student's academic and experience background.

The coordinator of each course sequence/content area of the undergraduate program should be responsible for the development, monitoring, and evaluation of leveling coursework. If evaluation leads to the conclusion that one leveling course is not enough, as may be the case in structures, methods and materials, or any undergraduate course sequence, then the course sequence coordinator should make recommendations regarding expanding the leveling courses for that sequence/content area. It should be noted that this does not automatically dictate another course, but may involve adding a lab, increasing the semester credit hours from three to four, etc. Even a comprehensive reading list might suffice to alleviate the deficiency. Self-study courses could be offered "on the web" or in similar individually paced programs. Endeavors to provide "pre-requisite knowledge and skills" should be developed at the graduate course level and avoid undergraduate course work (with rare exception). Efforts must be made to maintain a balance between the number of required hours in leveling course work and the needs of the student to complete their advanced education and either enter the job market or realize timely advancement benefit. Regardless of the method, the required outcome of the leveling sequence is certain: the students must be prepared to enter subsequent graduate work in the same courses with the same requirements as their counterparts.

Because of the logistic problems created with continually offering the leveling sequence, thought should be given to teaching these courses sequentially on an annual basis beginning in the fall semester of each year. Essentially this means that all "career change" students would enter a leveling program at the same time each year and complete their pre-requisite program together. This leveling sequence might cause the graduate program to lose a few career change students. However, in order to maintain a sustainable growth pattern and with limited faculty teaching resources this is should be the best option. Advertising these courses internally where the undergraduate program is offered and across the campus would likely provide students from a variety of disciplines needing elective enrollment. This inter-disciplinary approach will increase the visibility of the program as well as keep unprepared students out of the advanced courses contained in the core construction curriculum. Another benefit of having a comprehensive set of "leveling courses" is the opportunity to get more faculty involved in the graduate program. It would be extremely valuable to have all tenured and tenure track faculty teaching a minimum of one graduate course per academic year. The emphasis would be to provide graduate students with more research options on a more dynamic variety of issues. Faculty would benefit by having graduate students directly involved with their research and writing which is necessary for their tenure and post-tenure reviews.

It is in the "career change" program that the optional professional internship requirement could provide further knowledge and skills to "close the gap" between graduates of construction education programs and those from allied and non-allied disciplines. From this perspective, the professional internship would be required of all students, not in the "thesis" or “dissertation” option, who have no meaningful practical experience in construction management. Although an administrative headache, the internship requirement would help alleviate the concerns of many faculty, who accurately voice the fact that a student could graduate with graduate degree in construction without having any work experience in the construction industry. Uniform enforcement of the internship requirements, with clear guidelines for exceptions, would be paramount in the success of the graduate internship program.

Non-Traditional Approaches

One thing is certain; higher education is under pressure to expand the offerings beyond the traditional classroom. Questions to be addressed regarding non-traditional degree programs include residency requirements, faculty commitment to teaching assignments and course loads, travel compensation, fiscal considerations, inter-system agreements, and the level of enrollment necessary to maintain the offerings. While offering continuing graduate education courses through non-traditional approaches is in most cases feasible, the establishment of a non-traditional graduate degree program would require a substantial commitment of departmental and college resources. The guiding tenets and university commitment for this endeavor should be embraced by the college and outlined in the departmental strategic plan. Three instructional delivery strategies are offered for going beyond what has been considered a traditional offering of construction graduate education; (1) distance education through the electronically broadcast classroom and Internet coursework, (2) off-campus training programs for graduate credit using various corporate facilities and satellite system campuses, and (3) consistent evening and weekend course offerings.

Perhaps the best entry into non-traditional offerings is through the delivery medium of the graduate program. Clearly, new instructional media technologies have given providers of higher education unique options for the delivery of course work and instruction that wasn't commonly available five years ago. One of the tenants of distance education is to reach a more diverse and geographically dispersed audience not accessible through traditional classroom instruction. The key to embracing the new technologies of instruction is the systematic planning and design of instructional objectives that fit into the overall strategy and philosophy of the university's graduate program.

The electronic classroom and Internet course offerings are no longer a thing of the future, innovative educational technology is here and available. "If the nation is to benefit from the scientific and technological advances predicted for the 21st century, the educational systems in place must be retooled, according to the presidents of the National Academy of Sciences (NAS), and the National Academy of Engineering (NAE). And the Internet sits at the center of that process" (Citing online document, URL http://www2.nas.edu/whatsnew/2842.html). And at the graduate level, the Internet will provide students with access to the best faculty, no matter where in the world students or faculty are located (Alberts, 1998). The College of Engineering's Center for Distance Learning (ECDL), at the University of Texas at Arlington, provides educational opportunities for graduate students in several disciplines, currently offering programs in Aerospace Engineering, Computer Science & Engineering, Electrical Engineering, and Mechanical Engineering. Since 1977, ECDL has offered 1231 courses to 10,920 students and is currently delivering graduate classes to students electronically in three formats: videotape, closed-circuit television, and via the Internet (Citing online document, URL http://engineering.uta.edu/).

The electronic classroom is much like an ordinary traditional classroom. Students and professors interact through the spoken word, see each other and may interact by employing audio, video and computer technology (e.g., whiteboards) in the classroom which are linked over the Internet or uplink system. The essential difference between ordinary classrooms and electronic classrooms for the users is the students and the instructor may be at different locations; e.g., the professor and one group of students may be in one classroom while another group of students is in another classroom - perhaps on the other side of the country (Pedersen, 1998). The students participating at those distant sites can both see and hear the professor or presenter and the people in classrooms other than theirs. The electronic classroom is designed with the goal of allowing users to communicate much as they would have done had they been in the same room. The electronic classroom and Internet coursework will require a substantial startup effort and will possibly require the retraining of faculty. A concerted effort in marketing a distance education program through these non-traditional strategies would be essential if this approach was to become an integral part of the "sustainable growth" for the graduate programs.

The off-campus program offers the easiest opportunity to enter into a "non-traditional" approach to graduate education. Certainly, in today's market, it makes more sense to have one professor travel to teach a course, rather than twenty students travel to take a course. This involves changing not only the existing mindset that the graduate program is only for full-time students, but also that graduate coursework should be offered only at the major university campuses. It should be noted that an evening and Saturday masters curriculum has been developed and implemented at Southern Polytechnic State University. Quickly, the question of "Where do we offer the program?" enters the equation. There has been much discussion of using various corporate facilities to teach off-campus courses for graduate credit. In keeping with the tenet of "sustainable growth", an off-campus program would be better served if the program was offered at a college or junior college campus rather than a corporate facility. In the corporate environment, it is inherent that the program could become identified with the specific company rather than the host department's program. If a major construction company wants to offer their facilities for a graduate course, it can be done; however, it should be done to include students external to their organization. In the large metropolitan markets, there will be several corporate office locations available of suitable size and adequate facilities.

The graduate program, if offered on another campus, could serve the same corporate needs and would appeal to a broader market. This could easily be done at satellite campuses. The graduate program could easily be offered on the campus where the residency requirement could be met, and through their established contact in the junior college venue. Graduate programs at these satellite campuses are already established to meet the needs of the full-time employees in the large metropolitan markets. Some of these campuses are known to have indicated a strong interest in having a construction graduate program offered in conjunction with their own undergraduate program. Faculty have indicated that potential students have requested graduate courses in construction, but the current departments do not have the resources to offer them.

The simple act of reaching out to potential students that are full time employees would add an aspect to the graduate program that has generally been ignored. Little effort has been made to provide industry practitioners, who must remain gainfully employed, with an opportunity to pursue advanced graduate work. If the program is within a large metropolitan area, course scheduling can be one possible solution. A simple shift from morning to late afternoon or evening scheduling would be sufficient. Another strategy would be to offer weekend courses. A weekend course offering could begin with three hours on Friday evening and include all day Saturday. The major concern with this option as well as the off-campus strategy, would be course rotation. Courses would have to be rotated in such a manner that a student could eventually receive all the required coursework.

Graduate Programs

The remainder of this manuscript is dedicated to a description of how the proposed graduate education model can be integrated into the Master's and Doctoral programs in construction education. In addition, attention is drawn to the activities of a Program Coordinator and finally, academic rigor.

Masters Program

It is expected that students would be entering the Masters program from the construction industry, construction baccalaureate programs, other closely aligned disciplines and non-aligned disciplines. In the case of the first two sources, very little, if any, pre-requisite or leveling coursework would be required. However, this is not the case with students from the aligned and non-aligned disciplines. Many of these students will have limited content knowledge in construction management and will most likely require additional coursework to bring them up to the same level as their industry or construction graduate counterparts. Evaluation of their content knowledge could be conducted by the graduate advisor on an individual-by-individual bases or simply requiring the passage of the Certified Professional Constructor (CPC) exam as a prerequisite for entry into the core graduate curriculum from the leveling coursework.

All Master's programs, whether career change or not, should require the mastery of a "core of knowledge" for the graduate level of construction education. This core should be twelve to fifteen hours and be required of all students in the graduate program. It should be unique enough that students coming directly from undergraduate study discover new knowledge, skills, and abilities, without repetition of the content of the undergraduate course-work. There has been much discussion over the years of the necessity of requiring that students entering the Master's program have significant work experience in the construction industry. While the value of such experience is evident, this should not be a requirement for entrance into the program. As part of the sustainable growth, entrance from undergraduate programs should be encouraged. These inquiring minds should be welcomed as part of a viable Master's program.

Beyond the "core of knowledge," the program should be structured to allow students to seek a "specialty area" of interest such as facility management, project controls, information management, project finance and development, etc. These specialty areas should meet the objectives of the departmental strategic plan and be compatible with the expertise of the major professor(s) who will provide guidance to the graduate student. However, the committee chair should determine each student’s specific curriculum content or degree plan. Complementary course-work from outside the department should remain an integral part of the Master's program.

The Master's program should offer both a thesis option and a non-thesis option. Regardless of the option undertaken, methods of scientific and social inquiry should be an integral part of any degree-awarding curriculum. A research methods course specifically developed to address research design and methods, population parameters, sampling techniques, data collection, proposal writing, and academic publications in the construction industry, should be required of all students seeking a graduate degree. This research core course should be taught as a method of assisting students in identifying a specific construction industry problem and establishing a systematic plan for investigation. Coupled with the research methods course, all graduate students should be required to complete a minimum of three additional hours in quantitative research statistics. Students taking the thesis option should also be required to take six hours of research statistics from a statistics department, three of which should be a course in qualitative research methods and data analysis. This emphasis on problem identification, information collection, data analysis, and solution communication will be beneficial to all graduate students whether they are industry or academia bound, regardless of thesis or non-thesis option.

For the non-thesis students with no prior extended period of construction management experience, a professional internship option would be an excellent way to assure that all students, upon graduating with a Master's degree, have at least some exposure to work in the construction industry. As long as the non-thesis option is clearly the easiest path to graduation, few students will choose the thesis option unless the student has entered the doctoral path. The internship, if required for the non-thesis option, would help to alleviate the discrepancy in effort required between the two options. In concept, the internship would require a full semester, or full summer term, working within the construction industry, or a closely allied industry. Before the internship, the student would be required to complete the “research core” and establish their graduate advisory committee. With direct guidance from the committee chair and approval of a majority of the committee, a proposal is written outlining the internship criteria, i.e., the sponsoring firm, the problem statement, the method of investigation, and data collection. While serving the internship, the student would be responsible for gathering the data necessary to analyze the proposed problem and support its conclusion. Upon returning to campus the student would complete the remaining coursework, analyze the data, and write a journal-ready manuscript ready for submission. This would enable the non-thesis graduate student to address "actual construction management" problems, validate time spent in the construction work environment, and demonstrate that they have developed effective analytical problem solving and communication skills; all of which will serve as program-marketing tools to promote graduate education in the construction industry and academia.

Doctoral Program

It is unlikely a construction Ph.D. program would receive approval without a Master's program that was flourishing. If the needs are such that a Ph.D. program cannot wait for the three to five years it would take to develop a departmental program from the ground up, then the obvious strategy is a collaborative effort with an established Ph.D. program. As found in the literature review for this manuscript, it is quite apparent that the construction industry sees very little "value added" in the Master's program for employment purposes. It is also unlikely that a great deal of support can be expected from the industry for a Ph.D. program.

The demand for construction Ph.D. graduates is in academia, and it should be noted that this demand has been extremely high for several years. Given the nature of expanding construction education programs across the nation, this demand will likely remain steady for many years. It is this demand, and the corresponding opportunity for construction graduate programs to take the lead in preparing the next generation of construction educators, that prompts the immediate call for a "collaborative" program. Given the demands of higher education, a program that jointly produced Ph.D. graduates with a technical content base from a construction program and the educational preparation from a education program would be well received by the institutions which have faculty openings that require or prefer candidates with an earned doctorate. This type of program would also enable departments to provide a Ph.D. with minimal added resources. To begin from scratch to establish a Ph.D. program for many construction education programs would take far too long to take advantage of the current opportunity and demand.

Program Coordination

Uncontrolled growth which stretches faculty resources beyond a suggested ratio of one full time equivalent (FTE) per ten graduate students should be avoided, if possible. When the ratio of graduate students begins to exceed this figure, it is unlikely that a quality program can be sustained without additional resources. Out of necessity, a large part of a graduate student's degree program is the responsibility of graduate student. The individual graduate student must assume the responsibility for their degree program (Oppenheim, 1993).

Comprehensive coordination of the graduate program is essential, especially in a period where increased enrollment and changes in the scope and offerings of the graduate program is expected. The very nature of the Master's degree is one of "time compression"; that is a student may expect to graduate from 1.5 to 2.0 years from the time he or she enters the program. This places a great deal of emphasis on the guidance, counseling and coordination of each student. Specific guidelines established in a "Graduate Procedures Manual" should be provided each student upon their beginning the graduate program. In this manual, specific information, including timing, should be covered for:

- selecting a graduate committee
- degree requirements
- residency requirements
- filing a degree plan
- changes to degree plans
- petitions
- final examinations
- applying for graduation

Information and guidelines for the non-thesis option should be included, as well as information regarding internship requirements. Thesis options should be addressed as well as information about core requirements and selection of electives. In short the graduate manual should be a handbook of standard procedures for all aspects of the Master's degree program, a self-help guide for students.

One of the major services that the Program Coordinator should provide is assistance in selection of committee members and committee chairs. Students should have their committee chair selected before entering their second semester of coursework. A concerted effort needs to be made to involve more faculty in graduate programs, both through teaching and through mentoring/chairing of student graduate committees. The graduate curriculum needs constant evaluation and tweaking as a dynamic entity, not as a static entity. The program coordinator should see that this is accomplished, while ensuring that curriculum matters remain the purview of the faculty. This is not always an easy task. It could be argued that the more actively involved faculty is in teaching graduate courses, the easier this will become.

Beyond these matters, the Program Coordinator should focus on student recruitment and admissions, marketing strategies, evaluation and feasibility analyses of expanded and non-traditional graduate offerings, and maintain the effort toward developing a Ph.D. in construction while maintaining a customer focus necessary for the development an effective graduate program strategy (Feigenbaum,1993). Perhaps the key word here is "coordinator". Delegation of responsibility and authority is a vital element of the "Coordinator" position. No one person can accomplish all that needs to be done and remain active in teaching and research. As the program expands and new options are offered, the graduate program cannot be a "one-person" show. A shift in the commitment of resources is essential in moving the program to "pre-eminent" status. Expanded involvement of existing and new faculty is imperative in developing a successful team of graduate educators.

Quality and Academic Rigor

And finally, a word about quality and academic rigor. Programs where there is a substantial differential in the amount of effort required of students enrolled in the graduate programs should be avoided. The line of "academic freedom" for professors should never be breached. However, all professors should insist on a standard of quality that has been endorsed by the graduate faculty for all graduate students. Standards for the non-thesis option should be consistent and applied uniformly to avoid inequities. All theses or professional papers should require a proposal, submitted and approved by the student’s graduate committee, before the research is conducted. All research papers, whether a thesis or professional paper, must be more than a regurgitation of previous research; each should include a unique contribution to the body of knowledge in construction education. Academic rigor, proper documentation and format, should be an integral part of the research component of all graduate programs. Each department’s graduate faculty should develop and implement guidelines, with appropriate standards of rigor and quality. Research and inquiry as presented in non-thesis papers need to focus on the creation of new knowledge or the solution of a specific problem. Research efforts, whether they are theses or professional papers need to use appropriate methods of inquiry and be presented using proper academic format. Traditional graduate programs, non-traditional approaches, and all offerings by graduate construction education should be characterized by standards of high quality and academic rigor as benchmarks of performance.

Conclusions

There is a lack of direction and leadership concerning graduate education programs identified by the review of literature within this manuscript. The model presented here is intended to provide a general framework for graduate construction education that is responsive to the current issues in the construction industry and the academic environment. However, additional work needs to be undertaken to establish not only the current state of construction graduate education, but where specifically graduate education needs to adapt to be responsive to the identified needs. First, an in-depth survey and accounting of current construction graduate programs including their history and current curriculum must be identified. Second, the ASC graduate education committee and graduate education providers need to identify and establish a consensus concerning the essential elements of instruction (EEI) for the core of a construction graduate program with specific outcome designs adapted to both industry and academic. Finally, this group must identify construction-related specializations that industry and academics would recognize as value-added graduate education.

References

Alberts, B. (February, 1998). *Presidents opening address to the National Academy of Sciences.* [WWW document]. Presented at the Annual Meeting of the American Association for the Advancement of Science, Philadelphia, PA. URL http://www2.nas.edu/new/217a.html.

Associated schools of construction. (1998, October). *Strategic planning session.* Estes Park, CO.: Author. URL http://ascweb.org/dironly/strategic_plan/plan_report.htm.

Badger, W. W. & Segner Jr., R. O. (1989). The challenges in establishing a master’s degree program in construction. *Proceedings of the 25th Annual Conference of the Associated Schools of Construction, Lincoln, NB,* 1-8.

Bilbo, D. L. & Yeager, L. D. (1990). Is construction education a university level academic discipline? *Proceedings of the 26th Annual Conference of the Associated Schools of Construction, Clemson, SC,* 5-7.

Conner, H. C. & McManus, B. (1989). A dual degree MBA/MS in construction management. *Proceedings of the 25th Annual Conference of the Associated Schools of Construction, Lincoln, NB,* 23-28.

Feigenbaum, L. (1993). Using TQM concepts in the recruitment of graduate students. *Proceedings of the 29th Annual Conference of the Associated Schools of Construction, Fort Collins, CO,* 83-87.

Feigenbaum, L. & Pedulla, A. (1991). The dual function of graduate construction education. *Proceedings of the 27th Annual Conference of the Associated Schools of Construction, Provo, UT,* 1-5.

Griffin, S., Hauck, A. J. & Reidhead, J. D. (1995). Historic preservation: New opportunities in graduate education. *Proceedings of the 31st Annual Conference of the Associated Schools of Construction, Tempe, AZ,* 95-99.

Hauck, A. J. (1998). Construction management curriculum reform and integration with a broader discipline: A case study. *Journal of Construction Education, 2*(2), 127-140.

Killingsworth, R. (1990). The effects of population trends on construction and construction education. *Proceedings of the 26th Annual Conference of the Associated Schools of Construction, Clemson, SC*, 27-33.

Maher, R. P. (1990). The problem of 'leveling' instruction in construction management education. *Proceedings of the 26th Annual Conference of the Associated Schools of Construction, Clemson, SC*, 1-3.

Marchman, D. (1991). Conceptual estimating as a topic in a graduate construction curriculum. *Proceedings of the 27th Annual Conference of the Associated Schools of Construction, Provo, UT*, 7-10.

Marshall, J. A. (1990). The growth of graduate education in construction management. *Proceedings of the 26th Annual Conference of the Associated Schools of Construction, Clemson, SC*, 19-21.

Moss, D. D. (1989). Proposed master's degree program for constructors. *Proceedings of the 24th Annual Conference of the Associated Schools of Construction, West Lafayette, IN*, 84-85.

Newitt, J. (1987). Validation of construction management curriculum. *Proceedings of the 23rd Annual Conference of the Associated Schools of Construction, West Lafayette, IN*, 23-27.

Nobe, M. D. & Berryman, C. W. (1996). Incorporating reserve fund analysis into graduate construction education. *Journal of Construction Education, 1*(2), 10-14.

Oppenheim, P. (1993). A student manual for a construction masters program. *Proceedings of the 29th Annual Conference of the Associated Schools of Construction, Fort Collins, CO*, 69-75.

Pedersen, G. (October, 1998). *Distributed Electronic Classrooms.* [WWW document]. URL http://munin.uio.no/English/intro.html.

Rogers, L. & Christensen, K. (1992). Perceptions of construction management faculty regarding factors which impact their research productivity. *Proceedings of the 28th Annual Conference of the Associated Schools of Construction, Auburn, AL,* 123-128.

Rounds, J. (1992). Construction education: On the brink. *Proceedings of the 28th Annual Conference of the Associated Schools of Construction, Auburn, AL,* 145-150.

Segner, R. O. (1990). Graduate construction education: A means to construction research. *Proceedings of the 26th Annual Conference of the Associated Schools of Construction, Clemson, SC,* 13-17.

Williamson III, K. C. (April, 1993). Unpublished report to the ASC Board of Directors. *ASC support for a journal of construction education.* 29th Annual Conference of the Associated Schools of Construction, Fort Collins, CO.

Journal of Construction Education
Fall 1999, Vol. 4, No. 3, pp. 278-288

1522-8150/99/$3.00/Educational Practice Manuscript

Vertically Integrating a Capstone Experience: A Case Study for a New Strategy

Thomas Mills and Yvan Beliveau
Virginia Tech
Blacksburg, Virginia

Global complexity is forcing a modification in project management from a typical task management approach toward a people management approach. Achieving success in complex projects is becoming more a matter of implementing people management linked to project task management. Construction education is involved in teaching project management and uses teaming in capstone simulations as a teaching strategy. A new strategy of teaching a capstone course involves vertically integrating upper and lower division undergraduates into senior led teams. This course teams sophomores, juniors, and seniors into a senior directed enterprise with the objectives of developing critical thinking, leadership and communication skills. The concepts and strategy for incorporating vertical integration is expressed in the context of a common course with varying experience levels and varying task assignments creating varying outcomes. The concepts of team formation, lead and support faculty, and leadership readiness matching are presented in detail. The internal structures and collaboration strategies are also presented. Student evaluations, assessment tools and course policy guidelines are described.

Key Words: Capstone Course; Construction Education; Undergraduate Curriculum; Course Integration; Project Management; Teams; Team Building; Vertical Integration; People Management; Situational Leadership

Introduction

Construction education programs frequently utilize a senior level capstone course as a finale to a student's academic development. The purposes of capstone courses are multi-fold with each program approaching them differently. Many of these programs use the concept of a project simulation involving student teams in company and job organization, bidding and award simulation followed by simulating the construction process through planning, scheduling, construction and close-out.

Among the goals and objectives of the capstone experience is to give students an opportunity to demonstrate the breath of their learning while instilling a sense of confidence prior to beginning professional careers. The learning objectives of honing previously learned skills and developing new skills focuses on team problem solving experiences. This is intended to establish the foundation for organizational and procedural understanding in project management.

The significance of a capstone course is that it merges participatory learning with academic inquiry and allows student interaction in a simulated environment organized around activities that require rigid procedures and processes in addition to unique and creative solutions. The typical construction capstone course is team structured and focused toward construction organizations, procedures and operations. Many alumni comment that the simulated capstone experience was the most beneficial course of their collegiate career. These courses typically stand-alone and are composed entirely of seniors. The implementation of an integrated, lower and upper division, capstone course is rare. Integrated senior capstone courses have been discussed in the literature as a pedagogical strategy stressing participatory learning and creative problem solving. (Lonsdale, Mylrea, and Ostheimer, 1995)

The Building Construction Department at Virginia Tech has been engaged in curriculum integration and began a curriculum restructure in 1995. Incorporated into this restructuring is a revision to the capstone course creating a vertically integrated course. Rounds (1992) recognized that construction programs can be leaders of educational change and that team integration is a reflection of the realities of the construction industry. Improving the capstone experience by modifying the focus from project management to people management using teaming skills for self-directed actualization is one of the department's goals. An overall pedagogy for the department's curriculum restructure is described by Mills, Auchey, Beliveau, (1997).

Vertical Integration

One of the motivations for vertical integration was necessitated by a need for integrated student/ faculty contact throughout the curriculum and a desire to holistically improve student communication, leadership and people skills. The ultimate goals of the curriculum and the integration are to foster critical thinking, "out of the box" problem solving," and improved decision-making. One of the outcomes of this strategy is the development of a vertically integrated laboratory experience with common participation by sophomores, juniors, and seniors. This lab is intended specifically for construction undergraduates and occurs during a common period to allow all students to participate. Students of varying skill levels participate in responsible roles involving student led interactive team learning. Therefore the goal of vertical integration is for seniors to facilitate the learning process thus enhancing the student facilitator and other students learning by teaching and team building. The immediate objectives are:

- Recognition and capitalization on varying student skill levels to teach management, leadership, and team building skills.
- Development of an improved and integrated faculty/student team teaching concept.
- Improved communication skills among faculty and students to prevent dis-jointed teaching approaches. (Mills, Auchey, Beliveau, 1997)

The significance of this approach is that it moves away from the capstone "project management" approach and into an interdisciplinary "people management" approach. As a simulation technique this is more realistic involving multiple participants with separate agendas and goals striving to manage not only the technical aspects a project but also the diverse people and resources that create the construction. There is only one certainty in Pick up most any text on construction and/or project management and immediately the emphasis is on technical, procedural and process solutions to the enterprise. How many construction management texts fail to grasp the essence of the top skills needed by future constructors? Additionally how many construction departments or programs are proactively structuring a curriculum to addresses the creation of leaders and not managers?

The need to be social constructor's first and physical managers second is increasingly being recognized. Using an industry survey, Mead and Gehrig, 1995 identify the top three skills needed by future constructors as communication, business management, and leadership. Andersen and Andersen, 1992 has identified that the construction industry must become proactive in its efforts to implement and manage the change from a "project system" to a "people system." A major role of a university environment is to contribute a legacy of individuals, who understand people, understand motivation and communicate as leaders in a continually competitive and changing world.

The challenge to university construction programs is shall they take the less risky role of creating project managers or encourage "out of the box" thinking to create visionary leaders of the construction enterprise. We need both, but a leader is able to develop managerial talents easier than a manager can rise to the uncharted roles of leadership. Dingle's "Project Management, Orientation for Decision Makers" addresses early on a need to understand the culture of an organization and the distinctions between managers and leaders. "Leaders are said to be innovators, while managers are optimizers. Leaders seek change, which they see as improvement. Managers aim for continuity. Leaders strive in circumstances of ambiguity, uncertainty, rapid change, and risk Managers strive for stability…" (Dingle, 1997)

Using Dingle as a model for teaching within a leadership environment necessitates a curriculum that creates open-ended problem sets that contain elements of "ambiguity, uncertainty, rapid change and risk." This is the world constructor's strive to tame. The only certainty in project management is uncertainty. (Forsberg, Mooz, & Cotterman, 1996)

The difficulty to university faculty in using this approach is developing readiness skills for both faculty and students. This is not a one-course solution but a focus for curriculum development that reaches maturity at a senior capstone course. Virginia Tech is working to create the leaders of the construction enterprise and is developing the concept of an cross curriculum integrated lab that stresses people skills, directed toward team building, communications, management, decision-making and leadership.

The focus of this as a senior capstone is that the seniors are the leaders of lower division students and mentors this group into a motivated and accomplished team of task managers. As the culture of integration grows so does the increased understanding and proactive contribution of the students involved supporting the success of integration.

Strategy for Integration

To develop an integrated lab experience requires a careful and detailed review of the curriculum. The investigation should reveal a structural model in which integration can or cannot occur. At Virginia Tech a "Learning Outcomes Template" or LOT was developed and used to facilitate the holistic systemization of the curriculum. This allowed a systematic approach and provided an opportunity for altering the pedagogical model of the senior capstone course. (Auchey, Mills, Beliveau, Auchey, 1997) The transition of the capstone course from a "project management" approach to a broader "people management" and leadership approach is achievable with careful planning and dedication from faculty with similar pedagogy.

Organizational Structure

Within the department, faculty is able to schedule a common lab time and space for all second semester sophomores, juniors, and seniors to meet. It is essential to combine the classes at one time in one place for common team building activities and conflict free meeting times. The integrated lab course is a 3-hour, 1-credit course associated with a lecture/lab class referred to as the student's home course. The structuring of a course with distinct credit creates a struggle in establishing the meaningful link to the home course that a zero credit lab directly linked to the home course can retain.

Each of the home courses is consistent with the skill level of the student. The sophomores' home course is a 5-hr, 3-credit lecture/lab on Construction Principles, the aspects of estimating, planning, and scheduling of the means, methods and on the operations of construction covering CSI divisions 2-12. The junior home course is a 5-hr, 3-credit lecture/lab on Building Technology. This involves the construction of mechanical, electrical, plumbing, conveying systems, and special constructions, CSI divisions 13-16. The senior home course is a 5-hour, 4-credit lecture/lab with the internal lab component dedicated to a design-build activity. The 3-hour lecture component is used to develop support structures, critical discussion and preparation for the leadership and problem solving objectives being implemented within the integrated lab.

Organizational issues on scheduled meeting times are important in that a common time for discussion, assignments, feedback, and evaluation is necessary. With an experimental shift of emphasis from project management to people management and efforts to implement leadership skills within students, responsibility and authority must be delegated to the seniors. The seniors, who are essential to implementing the course, are quick to recognize that responsibility requires authority for success to occur.

Faculty Support

Faculty organization is established by having a single lead integration faculty with direct linkage back to the support faculty in the home courses. It is essential that the home course faculty be receptive to the intended objectives of the integrated lab. Acknowledgement of mutual faculty expectations and previous learning must be communicated amongst the faculty to remove any inconsistencies within the integration. In other words, the faculty or a core of faculty must be as integrated as the students are within the integrated lab. The role of faculty is dynamic in that the integrated lab has students with different skill sets and differing assignments that are woven into a whole.

The lead faculty of the integrated lab works in conjunction with the home faculty to develop the assignments and the learning outcomes. A primary role of the lead faculty is to provide the framework for team development. This is accomplished by guiding the growth of situational team leadership from seniors who simply tell groups what to do, to participating in their task achievement, and finally into delegating responsibility, thereby allowing other students to make effective decisions (Hersey and Blanchard, 1993). The seniors are given the authority that allows them to develop leadership that builds their vision for success (Forsberg, Mooz, and Cotterman, 1996) aptly show a visualization of successful project management by piercing the holistic model of situational leadership with the linear model of task management.

An important aspect of faculty leadership success is oriented toward creating a ready and willing team of followers. Andersen and Andersen offer critical insight into the importance of "readiness" in securing productive and successful student participation and growth throughout the integration process. Leaders and managers must walk the fine line of giving a group or team more freedom than they are ready and willing to assume, least they become frustrated and discouraged (Andersen and Andersen, 1993). This is an equally important consideration in both the students to student mentoring and the lead faculty to seniors mentoring.

The great danger in working "outside the box" for a student and the lead faculty is that it's no longer safe. The ambiguity of the problem and the struggle to define management strategies for success are arduous for students familiar with distinctly defined rules that can be followed for measured success. The safe haven of success distinctly measured and awarded as grades is still a controlling motivator for most students. Many students fear uncertainty when ambiguity is used as a teaching strategy. Ultimately there is discovery that as leaders they must establish their own arena for learning and communicating responsibly to their teams.

The faculty role in the home course is to provide educational support that contributes to the student readiness. A fundamental aspect of successful leadership is recognizing the developmental level of each individual team member and matching that readiness level with a matching leadership style. The lead integration faculty will need to be cognizant of a student's readiness level and how a senior is matching this readiness with leadership. Andersen and Andersen (1993) provide excellent analyze of readiness and motivation with leadership match strategies, although their implementation focus is employee training. It is important in an educational context that faculty support the integration concept and allow issues developed and discovered in the integrated lab to be brought back into the home course for additional inquiry and learning.

Teaming Formation

The teaming format used within the integrated course is self established teams of sophomores, juniors and seniors. These teams are joined collaboratively to other teams either by choice or by assignment. The team structure is separate, yet collaborative, co-operative yet competitive. Each home course group is assembled into individual teams and these teams are then grouped with individual teams at the other two grade levels. These three teams then form a collaborative team with senior's providing guidance, mentoring and leadership.

One strategy that may be considered in teaming is the development of learning style evaluations of each student and then assign students to teams based on a diverse group of personalities and learning styles, or as was done in this case evaluations were completed and shared after teams were established. This testing allowed students to recognize that not everyone is the same kind of learner. The need for different communication techniques to support academic security is shared with the students using alternative strategies to enhance their leadership skills and their team's development.

Internal Collaborative Teaming Structure

The internal focus for tasking has been based on a typical capstone simulation. The sophomores act as division 2-12 subcontractors and the juniors become subcontractors for divisions 13-16. The seniors act in the capacity of general contractors and or owners as necessary. Involving second and third year students with seniors allows each student to experience three different capstone projects. This provides the opportunity to use three different types of projects. The project selection is based on a small project that can be easily quantified and scheduled and rotates annually through industrial, commercial, and multi-family residential projects. During a four-year program each student is able to experience all three of these project types.

Each senior team is paired with one sophomore and one junior team. Team size is limited to 2-3 people on each team with a collaborative team of approximately 6-9 students. The assignments or problem sets are created around task commonly associated with a senior capstone course. Among these tasks are conceptual and detailed take-offs, planning and scheduling, company and project organization and financial analysis. The problems are distributed to the seniors who in turn restructure and delegate the task to the soph/jr teams. The first four weeks of the semester are spent in creating the team dynamics and working relationships. This time is used to produce the background material for the balance of the semester. The rest of the semester is spent in analysis, refinement and understanding the previous works relationship to the operations, production and management of construction. The particular assignments will vary depending on the type of projects, with the greatest difference in assignment types occurring in the residential development category.

Tasks are similar for each class level with differing levels of outcomes expected. Coupled with the previously described learning objectives more narrow and discrete task objectives are developed and proposed. These tasks are worked on incrementally over the duration of the course. The detailed learning objectives and task approaches of each distinct class are described and then a more detailed description of representative assignments is presented.

Sophomore and Junior Learning Objectives

- **Team Organization Strategies**
- **Improved Plan Reading & Specification Interaction**
  1. Scope Identification
  2. Detailed Estimate & Bid Submission
  3. Design/Construction Integration
  4. Value Engineering
  5. Pricing (Production rates and man hours)
  6. Execution Process
- **Production and Operational Management**
  1. Trades and Breakout of Scope
  2. Man hours/ Crew Makeup/ Leveling
  3. Productivity
  4. Schedule & Coordination
  5. Change Negotiation

Detailed description of task assignments used to reach the overall learning objectives for sophomores and juniors.

1. Acknowledgment of and participation in roles and responsibilities of team members.
2. Complete Estimate and Bid Proposal including General Conditions.
3. Development of a detailed computer schedule that can be collapsed into the senior produced master schedule. Schedule shall be resource and cost loaded for several discrete phases of the work (examples might be concrete, masonry and mechanical).
4. Written and CAD reports involving site utilization, hoisting, formwork design, embeds, and Mechanical Coordination Plans.
5. Decision-making and negotiating problems involving acceleration, changes in scope, cost of labor and time, increase productivity and/or corrective work issues.
6. A productivity improvement and/or value engineering solution.
7. Presentations and attendance at Presentations.

Seniors Learning Objectives

- **Teaming and communications**
    1. Team readiness preparation
    2. Owner/Contractor/subcontractor relationships
    3. Presentation Techniques
- **Mentoring**
- **Leadership**
    1. Pre-bid estimating/budgeting
    2. Scope Writing
    3. Bid review
    4. Personnel and Crew Motivation
- **Drawing & Specification interaction**
    1. General Requirements
    2. Staffing
    3. Payments and Change Order Management
    4. Control Techniques
- **Overall scheduling and coordination**

Following are basic description of task assignments used to reach the overall learning objectives for seniors.

1. Senior guidance in team organization and team roles and responsibilities. Senior development of a roles and responsibilities matrix for sophomores and juniors.
2. Scope packages and template development for estimates and sub-bid submissions.
3. A scoped conceptual estimate/budget that can be used as a "plug" for sophomore/junior team submissions.
4. Preparation by seniors of a master schedule for the Project. (Either P3 or MS Project). The Master Schedule shall allow roll-ins and is resource and cost loaded for all phases of the work.
5. An understanding of Project general requirements, cash flow, and staffing.
6. Guidance in developing written and graphic solutions for mechanical, formwork, hoisting, embeds, and site utilization.
7. Guidance in decision-making solutions involving productivity improvement on particular aspects of the Project.

8. Change order negotiations.
9. Presentations

Student Evaluation

Evaluation of students becomes a strategy in maintaining student motivation while exerting a focus on non-traditional formulas for demonstrative learning. The measure for the senior capstone students becomes how well they teach and learn. The value of grades as a measure of achievement forces many students into the tradition regurgitation model. What goes in comes out. This appears excellent for short-term measures of information gathering and retention but does little for synthesis of information and subsequent reflection and maturation of this synthesis.

When a problem set is broadly open-ended with varying levels of uncertainty, students may experience difficulty in determining how the outcome will be measured. Some students are slow to realize that it is their arena to create and they are establishing the rules. Faculty are faced with a dilemma of subjectivity evaluating individuals or teams based on their perceptions of the student or team as learners and responders of knowledge. The greatest challenge, in the development of an integrated course with varying skill levels and varying outcomes, is measuring individual performance as members of a team.

Several evaluation strategies have been used during the course. The initial strategy based on the lab being a part of the home course was to assign a percentage of the home course grade to the lab. This presented problems in that some students began doing the math on grading percentages. Depending on viewpoints this strategy is directed at maximizing productivity or as some students suggest, minimizing efforts. This created a mix of students not teams who were calculating how little or how much they had to do in the lab to achieve a particular grade in the home course. In addition, the outcome of problems sets ("inside the box" thinking), were given more weight by students then the developmental process of how well a student functioned and contributed in a team or how well leadership aspects and decision-making skills of team members were developed. Other concerns surfaced including which faculty would be providing the evaluation and exactly what criteria for evaluating abstract qualities such as leadership skills and appropriate decision-making would be used.

Student issues on student evaluations are always relevant and have been given due consideration. In the second year of the program, effort was directed at giving the lab a separate identity from the home course. This allowed a less challenging approach toward student evaluation but nullified the concepts of holistic integration among faculty and students and the home course. By creating a one-credit course the qualitative educational objectives became confused with the quantitative issues of a one-credit course. Simultaneous with the course credit transition was a restructuring of the grading criteria utilizing a holistic approach to student evaluation. Replacing the concept of A-F grading was a recognition of quality and not quantity of response. How much time spent on a problem or the course was not the measure. Achievement became acknowledged as the measure.

Achievement scales were established ranging from excellent to poor. Failure was not an option, though little understanding, failed accomplishment, or an absence of involvement could achieve it. A written criterion for each of the levels of achievement, excellent, good, fair, and poor were given to the students. Creativity, organization, interpretation, understanding, transition, timeliness, depth, detail and execution became points of discussion and foundation for evaluation. Periodic grading and feedback was done on completion of assignments, and evaluation discussions held on teaming, and leadership accomplishments. Peer evaluations were included in the holistic approach to grading student achievement. This contributed to easing the students' anguish over their perception of a less than totally objective faculty evaluation. The use of peer evaluations will increase. Even though there are shortcomings in peer evaluations, they are by and large valid and reliable evaluation tools. (Holland and Feigenbaum, 1998)

Opportunities for excellence were always open and intended to be viewed holistically upon completion of the course. Therefore a student who performed poorly on early problem sets (objective evaluations) could still achieve excellence at the completion of the course. Absent in the evaluation procedures was a completely balanced strategy to objectively grade abstract qualities of readiness, leadership, good decisions and team building skills. Research is underway to develop a consolidated evaluation strategy that balances subjective evaluations with aspects of objective evaluation. It's believed this will help students realize the importance of abstractions of knowledge and achievement as being self-defined and self-discovered concepts.

Assessment Tools

Course assessments are done at multiple levels with a university faculty/course evaluation completed by each student. Results of this evaluation are stratified. The sophomores and juniors rate the course and instructor fair, the seniors rate the course and instructor good. Additionally, seniors participate in an oral exit interview as members of their senior teams. This exit interview is intended to secure the students insights into the overall curriculum and their impressions on the integrated lab experience. The outcome of this evaluation of the integrated lab is that the strategy is beneficial but organizational and evaluation kinks need to be worked out to maintain a high level of student motivation. Sophomores are not formally interviewed.

Analysis

The strength of the integrated lab is that it structurally alters the typical capstone model away from task management and into people management. It initiates a different level of performance objectives that have removing ambiguity and uncertainty as their leading elements. This ambiguity and uncertainty highlights the fundamental aspects of risk so inherent in the construction arena. By allowing the students graduated access to self-managed and self-discovered leadership attributes the faculty is able to contribute successful problem solvers who can work "outside the box." These students are poised to take the reins of leadership and achieve success using people management to mitigate risk.

The challenge that must be overcome is the fear of failure by not following a formula that has been taught all one's life. This is true from both the faculty and the student standpoint. The formula of objective task management, and thoughtful risk shedding has long been touted as a formula for project management success. By taking a different path with potholes of ambiguity the participant have difficulty predicting the outcomes. Readiness preparation and understanding by the home and lead integration faculty are crucial to being able to present a course that tackles uncertainty head-on.

True project management success is derived from the decisions that are made by all the participants, down to the individual trades worker on a daily basis. By focusing on the people and encouraging self-management the attribute of success is identified as the reduction of uncertainty and the removal of ambiguity. It is the leader of the team that makes and reinforces this as the predicator of success.

Toward A Successful Capstone Integration

Successful integration requires a commitment to a long-term vision for what is internalized within the student. The goal of producing leaders in lieu of managers is primary. This vision guides the development of incorporating lower division students into the process as support personnel, followers and future leaders.

A consistent presentation of the learning goals and objectives across the curriculum creates support among the students. As the culture of the integrated lab grows so do the support and the anticipation of graduated levels of responsibility and authority. The ability to see the bigger picture of learning and differentiate it from the vehicle used to get there is a test of the successful management of the course. To improve the success and consistency of the course several components require implementation. Among the policies to internalize are:

- Establishment of clear performance activities.
- Establish what learning is to take place.
- Establish what knowledge is to be applied.
- Firmly establish the expectation on attendance and promptness.
- Consistent presentation of performance criteria that is consistent with the goals and distinct from the problem set solutions.
- A motivational strategy that reaches students with different skills and understandings.
- Student readiness preparation, across the curriculum.
- An on-time policy reinforced throughout the integration.
- Integrated faculty feedback and interaction.
- Formal peer evaluation across the internal teams.

References

Andersen, K. W. & Andersen, N. J. (1992). Managing change in the construction arenas with the concerns based adoption model. *Proceedings of the 28th Annual Conference of the Associated Schools of Construction,* 73-78.

Andersen, N. J. & Andersen, K. W. (1993). Integrating the concerns based adoption model with situational leadership. *Proceedings of the 29th Annual Conference of the Associated Schools of Construction,* 89-94.

Auchey, F. L., Mills, T. H., Beliveau, Y. B., & Auchey, G. J. (1997). Using the learning outcomes template (LOT) as an effective tool for evaluation of the undergraduate building construction program. *Proceedings of the 33rd Annual Conference of the Associated Schools of Construction,* 81-94.

Dingle, J. (1997). *Project management, orientation for decision-makers*. New York: John Wiley & Sons.

Forsberg, K., Mooz, H., & Cotterman, H. (1996). *Visualizing project management.* New York: John Wiley & Sons.

Hersey, P., & Blanchard, K. (1993). *Management of organizational behavior: Utilizing human resources.* New Jersey: Prentice-Hall.

Holland, N. & Feigenbaum L. (1998). Using peer evaluations to assign grades on group projects. *Journal Of Construction Education, 2*(3), 227-233.

Lonsdale, E. M., Mylrea, K. C., & Ostheimer, M. W. (1995). Professional preparation: A course that successfully teaches needed skills using different pedagogical techniques. *Journal of Engineering Education*, *84*(2), 187-191.

Mead, S.P. & Gehrig, G. (1995). Skills For the 21ST century: What constructors need to know. *Proceedings of the 31st Annual Conference of the Associated Schools of Construction*, 145-150.

Mills, T.H., Auchey, F. L., Beliveau, Y. B. (1997). The development of a vertically and horizontally integrated undergraduate building construction curriculum for the twenty-first century. *Journal Of Construction Education*, *1*(1), 25-34.

Rounds, J. (1992). Construction education: On the brink. *Proceedings of the 28th Annual Conference of the Associated Schools of Construction,* 145-150.

Journal of Construction Education
Fall 1999, Vol. 4, No. 3, pp. 289-299

1522-8150/99/$3.00/Educational Practice Manuscript

Creating a Student Resume for a Construction Department's Web Site

Kenneth C. Williamson III
Texas A&M University
College Station, Texas

This paper presents uses for the Open Database Connectivity (ODBC) interface and the application of Internet Database Connector or Active Server Pages. Software is suggested that provide for seamless integration between the Web server, database connector, and database application. The described processes and examples provide, at best, the basic information and structure necessary for the creation of an ASP student resume page. It is intended to assist Web-site developers in achieving a minimal no frill Web site for a construction program's students to be able to post their resumes on the Internet.

Key Words: World Wide Web, Internet, IDC, HTX, ODBC, Student Resumes

Introduction

Building a useful Active Server Page (ASP) for an institution's Internet web site is well within the reach of most web-site developers. It should be noted that this paper is written on a level where the reader should have some prior experience with writing Web pages and a cursory understanding network servers. With Web browsers appearing on most all user (Web client) desktops and Web servers providing standard Structured Query Language (SQL) gateways, many valuable program, faculty, and student databases are just waiting to provide manageable and user friendly information over the Internet.

Users with Local Area Network (LAN) access can quickly connect to a Microsoft Access® database using Web client software in the form of a Web browser, such as Netscape Navigator® or Microsoft Internet Explorer®. All one needs to develop such an ASP is a Web server, a database connector, and a database. Using service software such as Microsoft NT®, Microsoft Internet Information Server® (IIS) and Microsoft Office Suite Professional® makes the ASP process even easier because of the built-in Open Database Connectivity (ODBC) interface and seamless integration between application software. Additionally, the Microsoft FrontPage® software package will easily and effectively integrate the Web site's administration, page authoring, and photo/graphic editing tasks (see Appendix A for suggested software).

For a typical Web page, the Universal Resource Locator (URL) fetches a static Hypertext Markup Language (HTML) file within the directory structure of the Web site and returns this file back to the Web client as pre-formatted HTML page. For an ASP, the URL points instead to an Internet Database Connector (IDC) file that executes a program or script that executes a query fetching the contents of Fields within a database. The Web server then dynamically formats the results in HTML and sends this HTML page back to the Web client. Because this process is based on the Internet, the Web client platform can be any machine that runs a Web browser, and the Web server platform can be any machine that runs a Web server.

The Associated Schools of Construction's Web site running on Windows NT® uses the ODBC abilities of IIS to serve and implement many different ASPs using a Microsoft Access® database. Examples of these ASP can be viewed on the ASC's Web site; http://ascweb.org, i.e., the membership directory, its related update pages and the reviewer listing within the Journal of Construction Education.

The design of this paper is to familiarize a web-site developer with the database connectivity capabilities of a Web server. This paper first provides the web-site developer with the procedural algorithms required for ASP design and then demonstrates how to publish student resumes on their Web site. Also provided are sample Web-site directory folders, HTML (HTM), executable HTML (HTX), and IDC, files for the developer's unrestricted use, including their being imported into an institution's Web-site. This WinZip file (Resume Page Download.zip) is accessible at ftp://ascweb.org/resume and is available for downloading as an attachment to this paper.

Active Server Pages

The function of any Web server is to serve HTML files. Using ASPs, pages with new dynamic content can be created in response to Web client requests. The Web server itself becomes active in the process of creating the Web page. It is important to understand how this process is carried out (Figure 1).

1. The Web client enters the URL address of a Web server with an HTM extension into the address bar of a Web browser and presses Enter. The Web client is then served a static HTML Page from Web server.
2. The Web client picks a hyperlinked button or text on the page, which is linked to a URL address of an ASP file with an IDC extension.
3. The Web browser sends a request for the ASP's IDC to IIS.
4. IIS receives the request and recognizes the IDC extension as a program and retrieves the IDC file from the directory structure of the Web site.
5. IIS processes the IDC's SQL string from top to bottom. The SQL string identifies the Access database MDB file where data is maintained, retrieves the information requested from the database Fields, and executes an HTX template file.
6. The HTX template file writes the HTM file and sends the results of this process back to IIS.
7. IIS sends the HTM file back to the Web browser.
8. The Web browser interprets the HTM file and displays the results as a static HTML page for the Web client.

Building any ASP application requires five basic steps:

1. Create a database for the ODBC and IDC to access in a Web site's directory that is hidden (i.e., _private directory, see Figure 2).
2. Configure the IIS for ODBC and establish the database interface.
3. Create HTM pages to start the query by put a URL address pointing to the IDC in an HTM file somewhere accessible for reading by a Web browser (almost anywhere under the Web site's directory, see Figure 2).
4. Create IDC file to translate SQL string into HTML, and putting the IDC file into a Web server directory that is enabled for execution (i.e., _exec or _cgi-bin directory, see Figure 2).
5. Create HTX template files that the IDC will use to translate the SQL string results into HTML, and putting the HTX files in the place indicated in the IDC files (same directory as the IDC files).

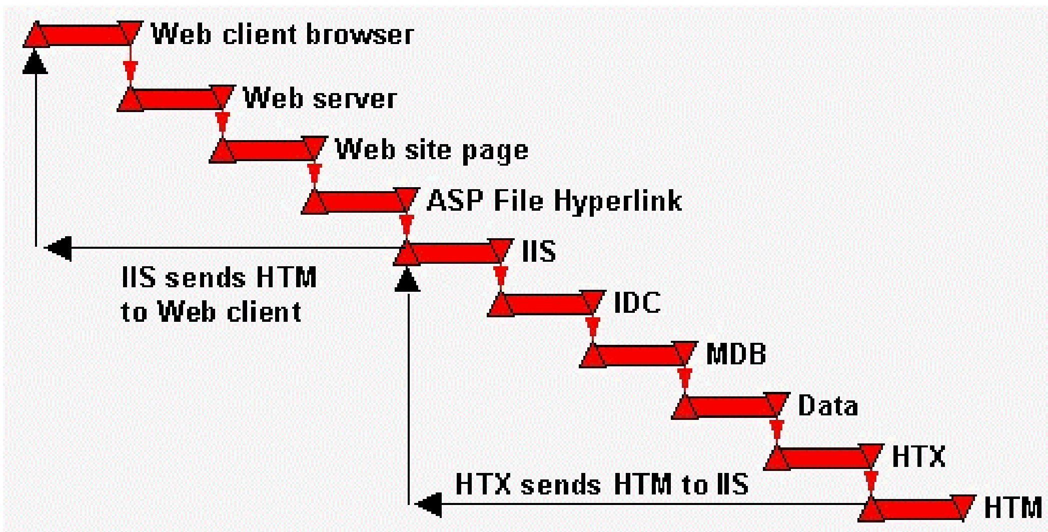

Figure 1. ASP process.

Figure 2. Web site directory structure.

The Student Resume ASP

The remainder of this paper references the Student Resume Web-site pages accessible at ftp://ascweb.org/resume. Download the WinZip file and unzip it to the desktop. Open

FrontPage Explorer® and import the directories and files into the root web directories of the Web server. Appendix B contains a complete listing of file setup procedures and Appendix C contains a complete listing of directories and files.

Setting Up Your Database

The Microsoft® Access database (stures.mdb) used in this example is stored in the "_private" directory of the downloaded Web site. To make the data accessible, it must be stored in a table. The table included within the “stures.mdb” is named “students.” After importing the database onto the Web server, it can fill it with information. In this example, the database can be populated with information attained from the student enrollment information supplied by university admissions office. Only juniors and seniors should be included, thus making the life span of student resumes limited to two years. The single asterisk Fields in Appendix D may be inserted and the double asterisk Field should be set up as a "Default Value" of "No". The developer may create these Field columns in Excel and paste them into the database versus individual entry. Do not forget to save the database in the _exec folder of the Web site when finished.

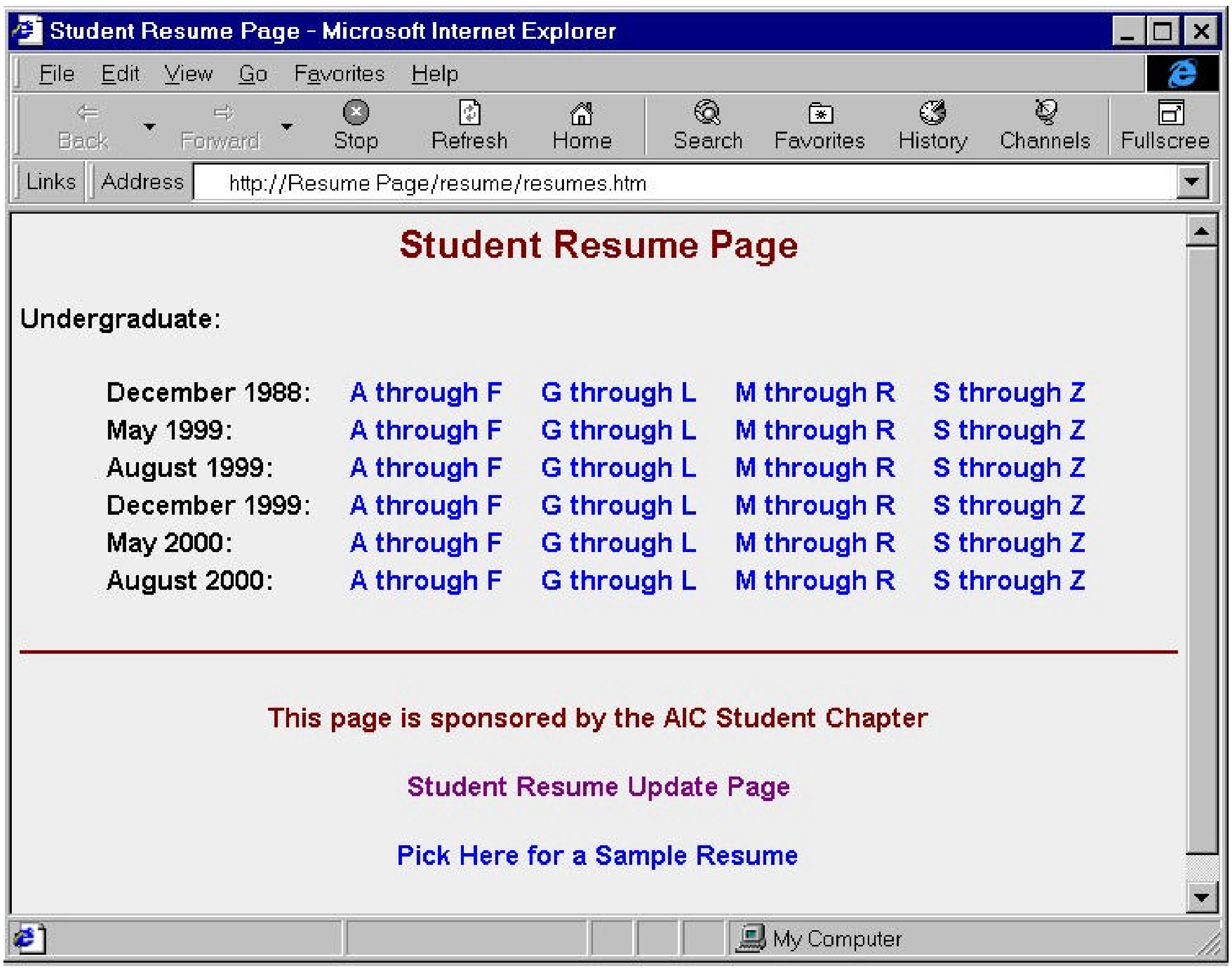

Figure 3. Resumes.htm

Christopher S. Ahrens

Scheduled Date of Graduation:
December 1998

UNIVERSITY ADDRESS
811 Harvey Rd #2
College Station , TX 77840
409.680.8977
shane_ahrens@hotmail.com

PERMANENT ADDRESS
PO Box 2602
Wimberley , TX 78676
512.847.5059

EDUCATION

Institution	*City, State*	*Degree*	*Date*
Texas A&M University	College Station, TX	B.S. in Construction Science	December 1998

WORK EXPERIENCE

Heldenfels, Inc., San Marcos, TX — May - June 1998

INTERNSHIP - Worked in Quality Control at the pre-stressed concrete plant for five-week duration. Inspected forms, reinforcing steel, and concrete, before and after pour for correct quantities and specifications. Also, made molds and tested concrete samples for Texas Department of Transportation for conformance with specifications. Observed the entire process for the pouring of both state beams and panels for the private sector.

Camp Olympia, Trinity, TX — June - August 1998, June - August 1997

COUNSELOR/DIVISION HEAD - As counselor, responsible for every camper's well being, presenting lessons for sports classes, and being a good role model and positive influence in campers lives. As division head, and in addition to counselor's duties, handled discipline problems between campers and problems between counselors in my cluster. In charge of the everyday operations within the cluster and held responsible for the cluster's behavior and actions.

RBS Excavation, Albers, IL — June - August 1995

INTERNSHIP - Tested sewers and storm lines for imperfections and code compliance, shot grades and installed drainage culverts, assisted with installation of circulation devices in sewer pond, maintained adequate supplies on job site. Also observed the estimating and bidding process, and the installation of force mains, gravity storm drains, sanitary sewer lines, lift stations, and manholes.

ORGANIZATIONS/HONORS

Student Organizations

Associated General Contractors (present), Associated Builders and Contractors (1997), Crew Chief - Texas Aggie Bonfire (1996), H.O.S.T.s tutor (Spring1996), Walton Hall Executive Council (1994 - 1995), Resident Hall Association committee-person (1995), Walton Hall Ramp Representative of the Year (1994).

Honors

SPECIAL SKILLS

OSHA 10 and 30 hour Construction Safety Certification; CPR and First Aid Certification; Computer Skills include Microsoft Word and Excel, internet/e-mail applications, and limited experience with Microsoft Power Point and Access, and AutoCAD r.13; Financed 25% of college education.

Back to Resume Page

Figure 4. Resume.htx

Resume Page Web-site Pages

Upon opening the Web site to the "resumes.htm" page containing the hyperlinked ASP selections for student resumes two sets of options are offered (Figure 3). The first set is arranged by graduating term and resume selection by alphabetized student name categories. When a service selection is made and, for example, the "December 1998: A through F" hyperlinked text is clicked, an SQL string runs from the "dec98_1.idc." This SQL string captures the appropriate information from the data Fields within the “stures.mbd’ database, and by using the "resume.htx" template file the December 1998 undergraduate resumes, A through F, are posted within the Web pages target frame (Figure 4).

The second service selection set is for students to enter, edit and review their personal resume data. When a student selects the “Student Resume Update Page” hyperlink, the “sturesupd.htm” page containing the hypertext service selections by alphabetized student name categories are offered. When a service selection is made and, for example, the student’s last name begins with the letter “M” therefore, the “M through R" hyperlinked text is clicked, an SQL query runs from the "M_R_studentlist.idc." This SQL query captures all the student names whose last name begins with the letters “M through R” from the data Fields within the “stures.mbd’ database, and by using the "M_R_students.htx" template file, builds and posts a listing within the Web page’s target frame. If the student’s name is within that list, they proceed by entering their last name and the last five digits of their student ID number into the provided text boxes and selecting the "Update Resume" button. If their name does not appear in the name list, they have not been populated within the student resume database and will have to be entered before they may continue. This button executes the “M_R_student.idc” file, which runs the SQL query that captures that specific student’s resume information within the “stures.mbd’ database, and by using the "M_R_studentupd.htx" template file builds and posts the appropriate resume information for editing. After editing and reviewing, the student picks the “submit Information” button that runs the SQL query within the “M_R_studentupd.idc” file. This SQL query populates the student resume database Fields with the data and submits a hidden Field value which allows the resume to be built upon request from the first set of service selections as described above. Additionally, this IDC file offers the “return.htm” page within the Web’s target frame, which confirms data entry and provides a hyperlink back to the “resume.htm” page (Figure 5).

Conclusion

This paper and example provides, at best, the basic information and structure necessary for the creation of an ASP student resume page. It is intended to assist Web-site developers in achieving a minimal no frill site for a construction program’s students to be able to post their resumes on the Internet. There are additional uses for this type of Web-site programming. Others could include student job postings, industry information pages, links pages, student surveys, and test administration. You are welcome to browse the TAMU Construction Science Department’s, Dr. Williamson’s or the ASC’s Web site at: http://taz.tamu.edu/cosc, http://165.91.199.100/kcwilli, and http://ascweb.org. Each of these sites provides active server page examples demonstrating the potential applications that can be developed within an institution's Web site.

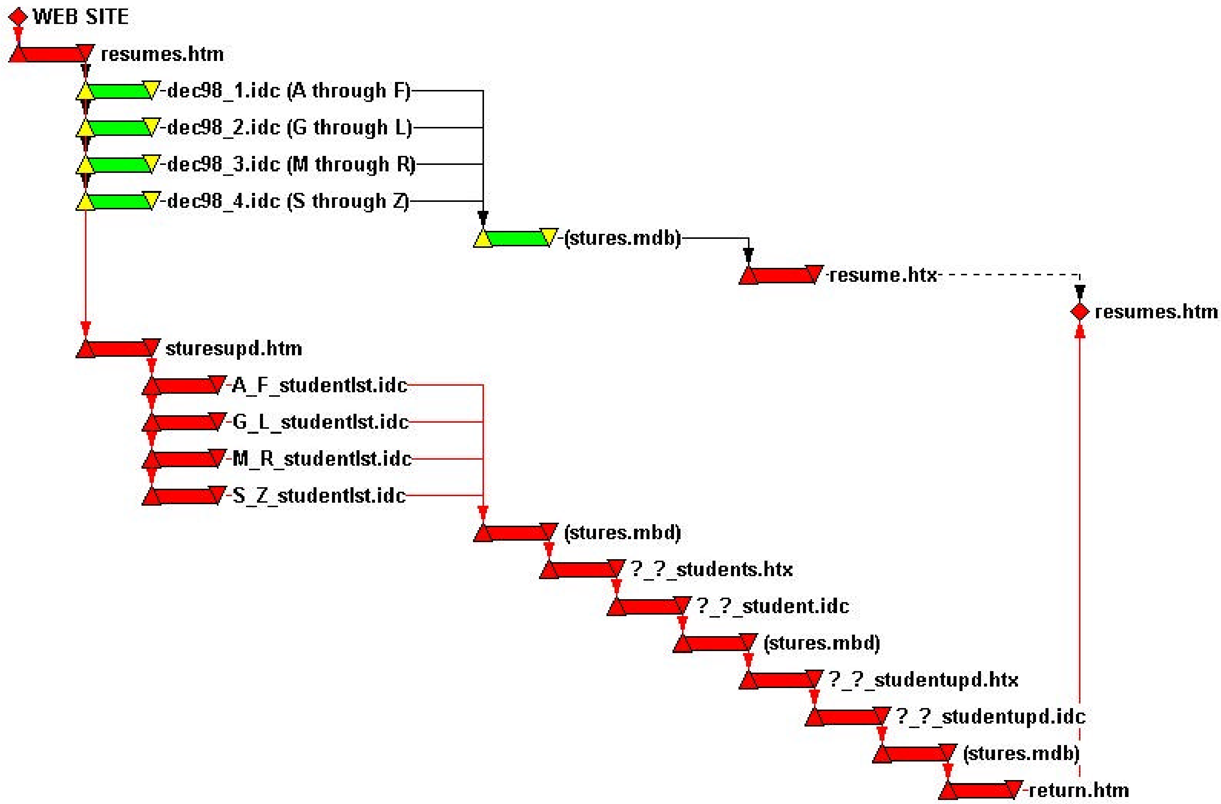

Figure 5. Student Resume Web Site Logic Diagram

Appendix A
Suggested Software

- Microsoft NT®
- Microsoft Internet Information Server®
- Microsoft Office Suite Professional®
- Microsoft FrontPage®

Appendix B
File Setup Procedures

Setting Up an ODBC System Data Source Name (DSN)

To set up the ODBC DSN:

1. Click the **Start** menu, point to **Settings,** and click **Control Panel**.
2. In the **Control Panel** window, double-click the **32-Bit ODBC** icon.
3. In the **Data Sources** dialog box, click **System DSN**.
4. In the **System Data Sources** dialog box, click **Add**.
5. Select the **Microsoft Access Driver** and click **OK**.
6. In the **ODBC Microsoft Access 7.0 Setup** dialog box, under **Database,** click **Select**.
7. Locate the **stures.mdb** file in the **_private** directory on your hard disk, select it, and then click **OK**.
8. In the **ODBC Microsoft Access Setup** dialog box, in the **Data Source Name** box, type **Student Resume Database**, and click **OK**.
9. Click **Close**, and then click **OK**.

Creating an HTML Extension (IDC) File

Creating the IDC File:

1. In the FrontPage Editor, on the **File** menu**,** click **New,** and select **Database Connector Wizard**.
2. In the **ODBC data source** box, type **stures**, and then click **Browse**.
3. Locate the **resume.htx** file, select it, and then click **OK**.
4. Click **Next**.
5. In the **SQL** box, type the following SQL statement:
   SELECT EntryID, StudentID, (Appendix E)
6. Click **Finish.**
7. Double-click the **_exec** folder. In the Save As box, type **dec98_1.idc** and click **OK.**

Creating an HTML Extension (HTX) File

To create the HTX file:

In the FrontPage Editor, create a **New** page, and enter the necessary text and column values to create the Resume page (see the resume.htx file provided). Below is a simplified example of how to create a portion of this page.

1. Create a table with two columns labeled **First Name** and **Last Name**.
2. Select the second row in the table.

3. On the **Edit menu,** point to **Database,** and click **Detail Section.** The detail section will be shown with brackets surrounding it, as in the following example:
    a. On the **Edit** menu**,** point to **Database,** and click **Database Column Value**.
    b. In the **Database column name** box, type **FirstName**, and click **OK.** The database field name will appear in the table cell.
    c. Repeat step 6 for the Last Name column (this time type **LastName** in the **Database column name** box).
4. Save the file and name it **resume.htx.**

Note: The .htx and .idc files must be saved in the in the same _exec directory.

Appendix C
Contents of Resume Page Download.zip

- resume
  - _exec
    - stures
      - A_F_student.idc
      - A_F_studentlist.idc
      - A_F_students.htx
      - A_F_studentupd.htx
      - A_F_studentupd.idc
      - aug20_1.idc
      - aug20_2.idc
      - aug20_3.idc
      - aug20_4.idc
      - aug99_1.idc
      - aug99_2.idc
      - aug99_3.idc
      - aug99_4.idc
      - dec98_1.idc
      - dec98_2.idc
      - dec98_3.idc
      - dec98_4.idc
      - dec99_1.idc
      - dec99_2.idc
      - dec99_3.idc
      - dec99_4.idc
      - G_L_student.idc
      - G_L_studentlist.idc
      - G_L_students.htx
      - G_L_studentupd.htx
      - G_L_studentupd.idc
      - M_R_student.idc
      - M_R_studentlist.idc
      - M_R_students.htx
      - M_R_studentupd.htx
      - M_R_studentupd.idc
      - may20_1.idc
      - may20_2.idc
      - may20_3.idc
      - may20_4.idc
      - may99_1.idc
      - may99_2.idc
      - may99_3.idc
      - may99_4.idc
      - S_Z_student.idc
      - S_Z_studentlist.idc
      - S_Z_students.htx
      - S_Z_studentupd.htx
      - S_Z_studentupd.idc
  - _private
    - stures.mdb
  - resumes.htm
  - sturesupd.htm

Appendix D
Microsoft Access Database Fields

Field Name	Data Type	Input Mask	Required	Allow Zero Length	Indexed
StudentID*	Text	000\-00\-0000;0;_	No	No	Yes (Duplicates OK)
Password*	Text		No	No	No
FirstName*	Text		No	No	No
MiddleInitial*	Text	?.;0;_	No	Yes	No
LastName*	Text		No	No	No
Suffix*	Text		No	Yes	No
NameSortID*	Text		No	No	Yes (Duplicates OK)
Approval**	Text		No	No	No
Zip1	Text	00000\-9999	No	No	No
Phone1	Text	000.000.0000;0;_	No	Yes	No
Zip2	Text	00000\-9999	No	Yes	No
Phone2	Text	000.000.0000;0;_	No	Yes	No

Appendix E
Sample SQL Statement

mySQL= "SELECT EntryID, StudentID, Password, Approval, NameSortID, FirstName, MiddleInitial, LastName, Suffix, Classification, GradDate, Address1, City1, State1, Zip1, Phone1, Address2, City2, State2, Zip2, Phone2, Email, URL, Institution1, CityState1, Degree1, Date1, Institution2, CityState2, Degree2, Date2, Institution3, CityState3, Degree3, Date3, Employer1, EmploymentDates1, JobDescription1, Employer2, EmploymentDates2, JobDescription2, Employer3, EmploymentDates3, JobDescription3, StudentOrganizations, Honors, SpecialSkills "
mySQL=mySQL &"FROM students "
mySQL=mySQL &" WHERE (GradDate='December 1998') AND (Approval='Yes') AND (NameSortID='1') "
mySQL=mySQL &" ORDER BY students.LastName"

Journal of Construction Education
Fall 1999, Vol. 4, No. 3, pp. 300-312

1522-8150/99/$3.00/Educational Research Manuscript

Decision Support System Impact on Conceptual Cost Estimating and Risk Analysis

Michael D. Nobe
University of Nebraska – Kearney
Kearney, NE

M. Atef Sharkawy
Texas A&M University
College Station, TX

MaryEllen C. Nobe
University of Nebraska – Kearney
Kearney, NE

This paper summarizes the findings of a previous research project, which examined the area of decision support as it relates to the generation of real estate conceptual cost estimates (Nobe, 1996). The purpose of this research was to evaluate a prototype development cost estimating decision support system for use in the pre-development planning stage of real estate development. The system evaluated was the Real Estate Development Decision Support System (*REDDS*?), which is currently in the prototype stage of development. The system was tested on a group of real estate development and construction management students at Texas A&M University. It was hypothesized that an interdisciplinary methodology, which utilizes a decision support framework, would facilitate generation of consistent and timely analysis of real estate development cost and associated risk, and elevate the confidence of the user in the estimating decision making process. Test results indicate that the *REDDS*? system does significantly reduce conceptual cost estimating preparation time. However, it was also determined that the *REDDS*? system does not significantly change the confidence of the user in the decision making process. Finally, this research shows that the use of the *REDDS*? system provides a consistent and sophisticated framework for evaluating development cost and risk, which leads to less variation and more accurate estimates.

Key Words: Decision Support System, Conceptual Estimating, Cost Estimating, Risk Analysis, Real Estate Development

Introduction

General Problem

This study deals with decision-making in real estate development with a particular focus on conceptual cost estimating. It is the current investment decision for an uncertain future return, the reconciliation of a project's projected cost with its projected income and corresponding value, which forms the general basis of this research problem. Specifically, the cost side of the development decision equation is the focus of this study. In order to properly frame the problem, it is useful to understand the basics of the real estate development process, the characteristics, which complicate real estate investment decisions, and the market in which these decisions are made.

The real estate development process varies tremendously in the number and exact sequence of steps depending on the scope and nature of the project, but in general the process follows the four stages of pre-development, document development, product development and post development (Sharkawy, 1994). As with the process, the key participants vary, and on occasion take on multiple roles, but typically would include a developer, equity partner(s), and lenders (Sharkawy, 1994). This research will focus on the pre-development stage of the development planning process, and primarily with the developer's investment decision as it relates to the projected cost of the proposed development project. It should be noted, however, that this focus does not preclude the interests of other key participants in the development process, who are equally concerned with making wise investment decisions.

The value of all investments by definition involves the assessment of the present value of the future cash flows (Etter, Summer 1994). Real estate investment, however, has several characteristics, which complicate investment decisions. Three are of particular importance (Etter, 1989) and will be referred to as *inherent* characteristics:

- ***Physical immobility.*** Real estate cannot be easily relocated at some future date; therefore, its value is directly related to the market area in which it is constructed.
- ***Long economic life.*** It takes many years, often decades, to recover the cost of the asset through its ability to generate income.
- ***Large economic outlay.*** Cost of acquisition and/or construction is large, often requiring the use of long-term financing in addition to investor equity.

In addition to these inherent characteristics, investment in real estate is further complicated by the inefficiency of the market in which it operates (Etter, Fall 1994). An investment market is generally classified as inefficient if it possesses one or more of the following:

- ***High transaction cost.*** Investors are charged substantial fees for each individual transaction.
- ***Limited or costly information.*** Information is either difficult to obtain or cannot be obtained without undue cost.
- ***Disagreement on information.*** There is general lack of agreement on what impact this information has on prices.

The inherent characteristics of real estate outlined above are by their very definition unlikely to change. In other words, that's what makes it uniquely *real estate*. The market characteristics, and especially the *information* components, on the other hand, vary considerably, and therefore present an opportunity for research and development.

Importance of the Problem

Framed by real estate's inherent temporal and spatial restraints, initial studies must nevertheless be performed in an inefficient market. It is these studies, which form the basis for investment decisions in the short-run, that become critical to success of the development project in the long run. Despite the long-term ramifications, decisions must be made *now*, with limited, sometimes questionable information. Further complicating the situation is the fact that such decisions are generally based on limited developer resources, including time, capital and manpower. In addition, because of a narrow "window of opportunity", time is of the essence, and the stakes are generally high.

Given this, why do individuals continue to enter this complicated and risky investment environment - and more importantly, why do they do it with limited or no information? The answer, in simple economic terms, is that high risk implies a high market expectation of financial returns (Etter, Summer 1994). Therefore, any methodology, which facilitates information flow and the associated decision analysis, will reduce risk (Etter, 1988) and provide that individual investor a competitive advantage over less informed investors in the same market.

Definitions and Abbreviations

Definitions are provided as a basis of the system language employed in the built environment and decision support-system disciplines. Please note that they are in alphabetical order with no implication of relative importance.

- ***built environment:*** a comprehensive term used to encompass land and real estate development including design, construction, and/or management of existing and/or proposed projects.
- ***decision analysis:*** a rational framework which provides a structure for making multiple-objective decisions under conditions of uncertainty by breaking the problem into manageable parts (Finlay, 1994).
- ***decision support system (DSS):*** "interactive computer-based systems that help decision makers utilize data and models to solve unstructured problems" (Nagel (quoting Gorry and Scott Morton 1971), 1993, p. 145). Figure 1 graphically depicts a generic decision support system.
- ***model:*** a representation of reality or some part of the real world. Models are created to "simplify reality to some level that permits us to think rationally about our problems" (Lifson and Shaifer, Jr., 1982, p. 6).
- ***prototype:*** the first functional pattern of a future product.
- ***system:*** in computer context, refers to the joining of logic and data models (Finlay, 1994).
- ***total development cost:*** The sum of a project's hard cost, soft cost and land cost (Sharkawy, 1992, 1994). Also referred to as development cost.

Problem Statement

The purpose of this study is evaluation of a prototype development cost estimating decision support system named ***REDDS***? for use in the pre-development planning stage of real estate development.

Research Objective

The purpose of a decision support system is to ***facilitate*** cognitively complex tasks (Olson and Courtney, 1992). In this case, the *task* is projecting the total development cost of a real estate project during the pre-development planning stages of property development. As discussed earlier, investment decisions in real estate are *complicated* by the inherent characteristics of real estate as well as the inefficiency of the market in which the decisions are made. *Cognitive* refers to the process of reduction of empirical knowledge and includes both awareness and judgment. In this case, the knowledge being reduced relates to the derivation of project cost as it pertains to land, design, construction, etc. Finally, consistent with the defined purpose of decision support systems, the primary objective of this research project is *facilitation,* which among other things, means assisting the decision maker in generation of consistent and timely analysis of a project's total development cost and associated risk.

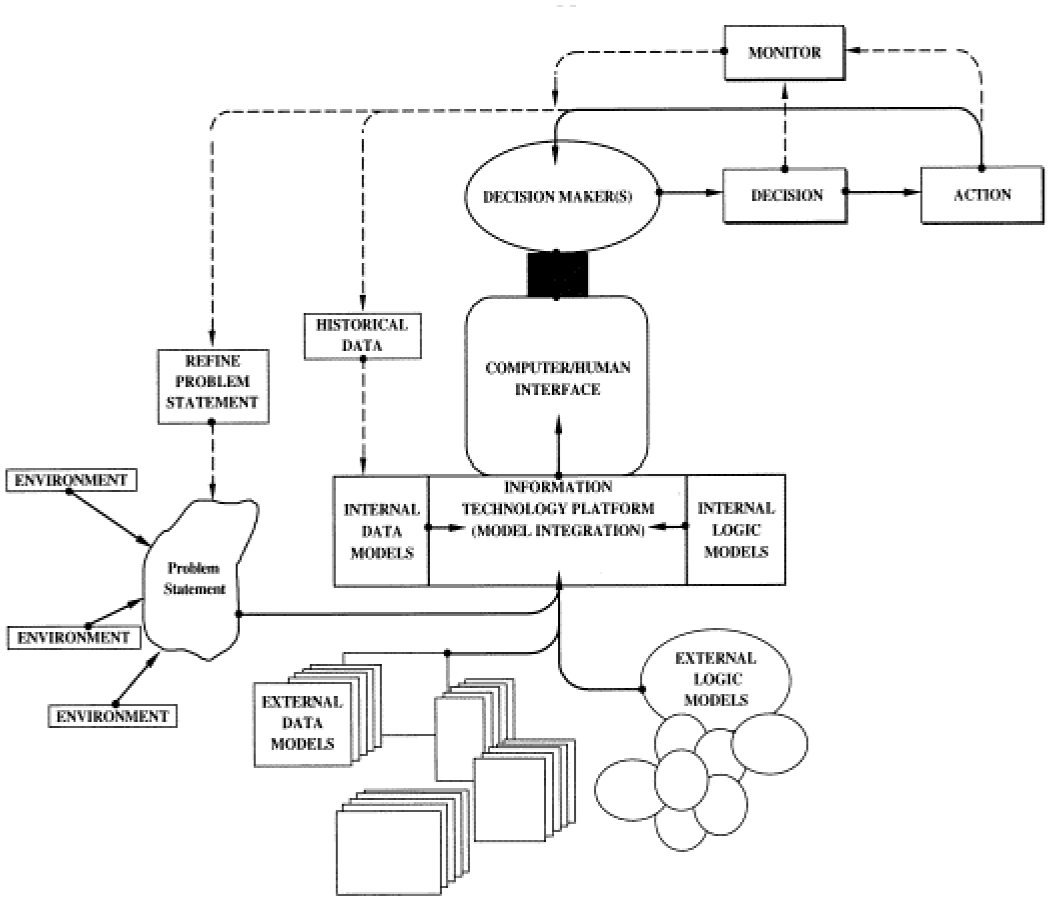

Figure 1. Generic decision support system.

Research Hypotheses

This research tests the *facilitation* objective. To this end, the following hypothesis and sub-hypotheses where tested:

General Hypothesis. Using a decision support system for derivation of total development cost in the pre-development planning stage of real estate development will facilitate the decision-making process.

Hypothesis 1. Cost analysis facilitated by the subject decision support system will take significantly less time to produce.

Hypothesis 2. Cost analysis facilitated by the subject decision support system will elevate the confidence of the user in the decision-making process.
Hypothesis 3. Cost analysis facilitated by the subject decision support system will provide a consistent framework for investigating alternatives, evaluating risk and determining critically sensitive variables.

Anticipated Benefits

The multidisciplinary theoretical base underpinning the built environment is in most cases well established. Likewise, analytical procedures in support of these theories are not only established, but often quite advanced. The data, which is necessary as inputs to these procedures, is abundant and generally readily available. And finally, the recent advances in decision support theory and computer technology are, in most cases, beyond the capabilities of the users. Despite this favorable environment, investment analysis of real estate development remains a segregated, time-consuming and expensive proposition. As Miles and Wurtzebach (1977, p. 338) note: "The complexity of the real property development process … implies the need to develop a computer simulation model designed to aid development period decision makers…" - a specialized framework unique to the development process. This research test just such a model - the ***REDDS***? decision support system prototype which facilitates answering the question; "How much will this project cost and what is the probability that it will cost that much?"

In addition, there is a benefit related to availability as a function of cost. In other words, "good" analysis is not necessarily limited by technological or theoretical restraints - given enough capital and/or time to hire a multitude of experts. Since the process of real estate analysis, and in this case the determination of project cost, is basically the same regardless of the scope of the proposed project (Sharkawy, 1994, and Sharkawy and Nobe, 1995), there are by definition economies of scale realized by those involved in larger projects. In many respects, a thorough analysis represents a fixed cost to the proposed project, and in many instances, one that cannot be overcome by smaller scale projects. "Affordable" analysis will therefore benefit many developers of small/medium-sized projects who until now may not have been able to afford it. In this case, a purely qualitative or intuitive approach would be properly supported by a quantitative decision support system.

The result: time can be spent on analysis, not data gathering and number crunching. Other resources, such as capital, can be spent to investigate the most sensitive variables (components) of the estimate instead of all of them. And finally, more projects can be evaluated, increasing the opportunity of finding a "winner". All this reduces the risk of real estate investment. In addition to the potential benefits for investors (both the developer and the equity investors), the other key participants in the development process will similarly benefit; namely, the short-term and long-term lenders who provide capital, based at least partially on the projected development cost.

Method

The purpose of this section is to provide a detailed description of the methods employed in testing of the Real Estate Decision Support (*REDDS*?) system. This study involved two separate tests. The purpose of the first test was to determine if the decision support system was capable of constantly representing the environment it was intended to model and designed to specifically address *Hypothesis 3*. This portion of the test roughly followed Finlay's (1994) recommended procedure of separately validating the logic and data models. Validation of the logic model included checks on definitions, consistency of variables and consistency of dimensions. As Finlay (1994, p. 210) notes, "validation is a process that should take place throughout the building process". Therefore, while these checks are separately addressed for purposes of this discussion, they where actually conducted simultaneously during the analysis, design and programming stages. As far as the data models are concerned, established models (i.e. historical cost, interest rates and job conditions/compression) were used and accordingly are assumed to be valid. Likewise, logic models included typical processing of data (i.e. linear regression, averaging, and simple algebraic computations). In addition to logic and data models, which were integrated to generate cost estimates, the *REDDS*? system also employed sophisticated economic and statistical models (i.e. probability and breakeven analysis) in the risk assessment portion of the analysis.

The second test was designed to address *Hypotheses 1 and 2*. Because these two hypotheses deal directly with how the DSS interacts with human subjects, evaluation research (Nagel, 1993) utilizing a survey instrument was chosen and incorporated into an untreated control group with a pretest and posttest design (Cook and Campbell, 1979). The target population was future professionals of the built environment. The initial study population was graduate-level students in the Real Estate and Land Development program at Texas A&M University, and it is assumed to have moderate external validity (generalizability). Additional testing for accuracy as discussed in the Hypothesis Three Results section also used undergraduate Construction Science majors from Texas A&M University. Although the students from these two majors don't represent the entire population of future professionals, they are nevertheless expected to enter the built environment on a professional level in the near future. The research construct (Kerlinger, p.27) of *facilitation* is operationalized with the dependent variables of time (*Hypothesis 1*) and confidence (*Hypothesis 2*). Although admittedly underrepresented, which lowers the construct validity (Kerlinger, 1986), the construct is nevertheless considered adequately represented because it is aligned with two universal management objectives (*time* and *quality*).

The second test consisted of two case studies and utilized two randomly selected student groups, one as a control and one as a test group. Random selection consisted of picking every other person seated in a row until the class was approximately evenly divided. An attempt was also made to have roughly the same number of males and females in both groups to eliminate this as a confounding variable. The groups were then directionally tested based on applying and/or removing the treatment of the ***REDDS***? system. Each group was given an identical case study (Case Study I - Mountain Lodge), which required the individual to derive total project development cost and make several assessments of the associated risk. This included a break-even analysis, sensitivity report, confidence probability assessment, and a graphical cost breakdown. Prior to distributing Case I, the entire class was given a short lecture on the fundamentals of conceptual estimating.

Based on dissemination of this information, it was assumed that both groups had knowledge and access to the same logic and data models. Prior to segregating the groups, everyone was informed that upon completion of the assignment, they would be asked to conduct a survey, and that one of the questions would specifically request the exact amount of time spent on the analysis. To increase the probability of receiving accurate information, they were further informed that all responses would be anonymous and separate from any grade they may receive from their regular instructor for completion of the assignment. Following the lecture and division of the class into the two groups, one group was taken to a computer lab and introduced to the ***REDDS***? system and asked to use the system to aid them in completing Test Case I. To assist them in organizing variable input, the ***REDDS***? input sheets were also distributed to this group. The control group conducted a manual estimate and risk analysis.

The following day, after everyone from both groups had turned in their case analysis, the class was surveyed regarding the students' individual decision-making process experience. The survey was conducted in accordance with the Belmont Report and followed Texas A&M protocol for human subjects in research.

A second case (Case II - Housing Development) was then given, and both groups were given access and asked to utilize the ***REDDS***? system; no one preformed a manual analysis. A second survey was then administered and the results statistically analyzed for direction of responses. Due to the small sample size (approximately 5 students per group), the test was pre-determined to have weak statistical conclusion validity, increasing the chance of concluding there is *no-difference* between groups (Type II error) when a difference does exist.

The survey instrument was considered a reliable test device since many of the questions were easily quantifiable (i.e., how many hours did you spend preparing the cost estimate...; how may hours did you spend researching ..., etc.) In addition, for questions which are based on the test-takers' perception (i.e., how confident are you...) a scale similar to that used for instructor evaluations was used since most students are already familiar with this type of rating scale.

Results

As described earlier in the Methodology section, the research construct *facilitation* was tested as proposed using three operational hypotheses.

Hypothesis One - Time

The study results indicate that it does take less time to produce conceptual cost and risk analysis using the ***REDDS***? system as compared to manual preparation. For the pre-test, the mean manual preparation time was 300 minutes compared to a 173 minute ***REDDS***? preparation time. Based on a sample of seven students, the post-test mean preparation times, which were entirely supported by the ***REDDS***? system, were 100 and 105 minutes respectively. This represents a 61% decrease in time going from manual to ***REDDS***? and a 33% decrease in time utilizing ***REDDS***? in both the pre-test and post-test. To determine if this decrease is statistically significant, a pooled t-test was run resulting in a t-statistic of 2.67, which is greater than the t-critical value of 2.57 for a 95% confidence interval. This indicates that the null hypothesis can be rejected meaning there is most likely a significant difference in time.

Several reasons for the decrease in time for the ***REDDS***? control group between the pre-test and post-test are plausible. First, the two cases, while intended to be comparable in the amount of work, may have been different simply because they were different projects. Second, there is an expected maturation effect due to efficiency that would produce a decrease in the control group mean preparation time. This would explain the 33% time decrease for the control group. This leaves 28% (61% - 33%) unaccounted for and potentially to the credit of the ***REDDS***? system. It is also important to note, for each case test, each participant was requested to produce a break-even analysis, sensitivity report, probability assessment, references for data and models employed and assumptions. In general, all ***REDDS***? participants produced the requested documents in the times reported above. The manual group, however, produced varying levels of the requested risk assessments, with none of them producing all of it. The time test results are graphically shown in Figure 2. The times reported for the manual estimates (control group), therefore are understated in the sense that not everything was completed; adding more creditability to the DSS time decrease findings.

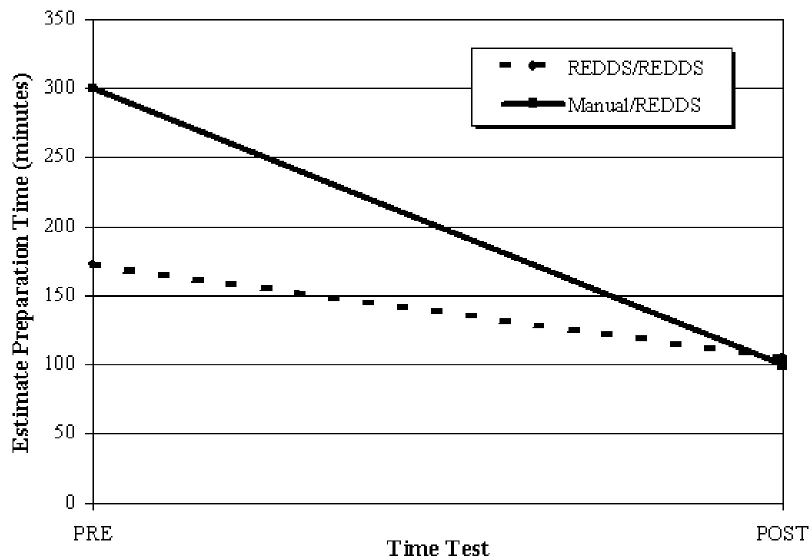

Figure 2. Time Comparison.

Hypothesis Two - Confidence

The study results indicate that use of the ***REDDS***? system compared to manual preparation does not significantly elevate the confidence of the users. For the same pre-test, post-test described above for the time hypothesis, the confidence level of the users was solicited using a rating scale of 1-5. While the ***REDDS***? users mean was higher in the pre-test (4.0 vs. 2.7); the post-test results showed similar increases in both groups (4.5 vs. 3.0). This represents a 29% increase in confidence going from manual to ***REDDS***? and a 7% increase in confidence utilizing ***REDDS***? in both the pre-test and post-test. To determine if this increase is statistically significant, a pooled t-test was run resulting in a t-statistic of 1.02, which is less than the t-critical value of 2.57 for a 95% confidence level. This indicated that the null hypothesis cannot be rejected meaning there is probably not a significant difference in confidence.

Part of the mutual increase can be explained by the same reasons outlined above in Hypothesis One. It is also plausible that because confidence was measured prior to release of the estimate results, they had no basis of comparison. In other words, had the ***REDDS***? group known that they had on average produced much closer estimates of the true cost of the project in the pre-test case (as described in hypothesis three below), they may have had higher levels of confidence in the method they utilized to achieve the estimate results, in this case ***REDDS***? **.** The confidence test is graphically shown in Figure 3.

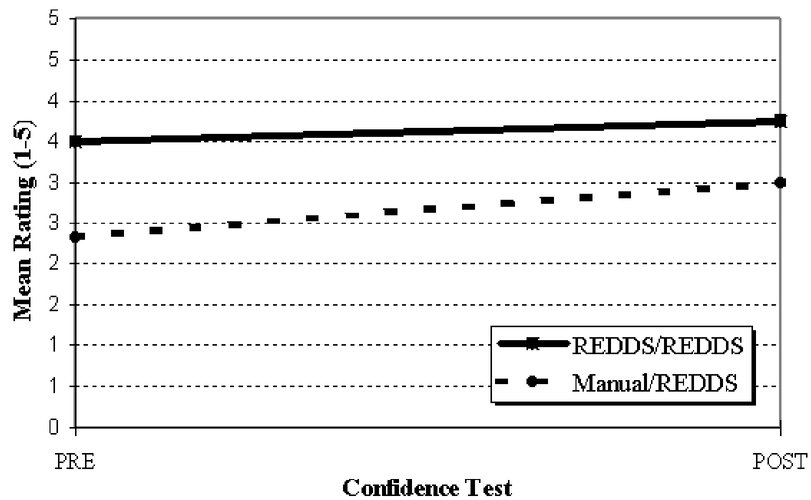

Figure 3. Confidence Comparison

Hypothesis Three - Consistency

Several tests were conducted to support the finding that cost analysis facilitated by the ***REDDS***? system does provide a consistent framework for investigating alternatives, evaluating risk and determining critically sensitive variables. This has been supported by three separate evaluations as discussed below.

As discussed, the consistency dimension of ***REDDS***? was continually tested during the design and development. This included checking for consistency in model definitions and units of analysis. This has resulted in consistent output. In addition, a set of secondary consistency tests was conducted.

Because the first case study was based on the combination of several actual projects, the actual cost could be derived. Therefore, it was decided to test project cost as a consistency dimension. For additional data, the cost estimates of 12 student projects produced from 2-3 person teams, and within a 160 minute period, where also used for comparison purposes. The test results indicate that the ***REDDS***? system users are much more consistent, and accurate in determining conceptual cost. First, variation in estimate cost was compared utilizing the coefficient of variation (standard deviation divided by the mean estimated cost). The first graduate group has a variation of estimates of 17% compared to the manual group, which had nearly a 40% variation. Both groups combined using ***REDDS***? for the second case produced estimates that varied by 27% - still considerably below the manual number. The undergraduate group effort produced 12 estimates that varied by only 15%. This is shown graphically in Figure 4.

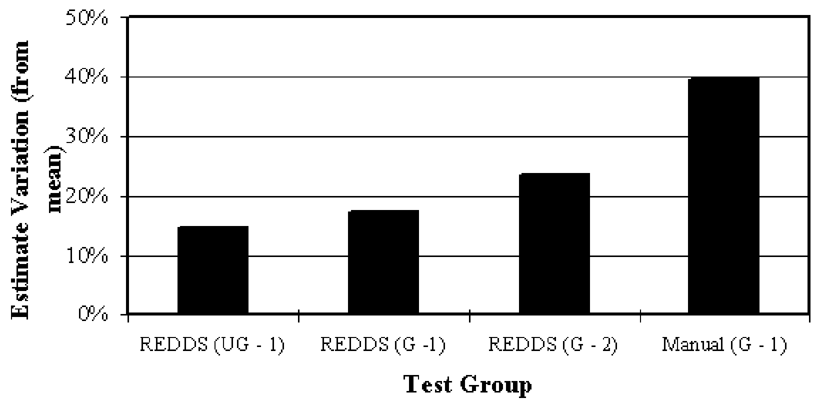

Figure 4. Estimate Variability Comparison.

Next, the mean estimated cost of each group was compared to the actual cost. Again, on average, the ***REDDS***? users produced more accurate estimates. The actual derived cost of the project was $13M. The pre-test graduates using ***REDDS***? had a mean estimate of $15.75M (121% of actual), the undergraduate ***REDDS***? users has a remarkable mean estimate of $12.30M (95% of actual), and the pre-test manual users had a mean estimate of $21.00M (162% of actual). These results are shown graphically in Figure 5.

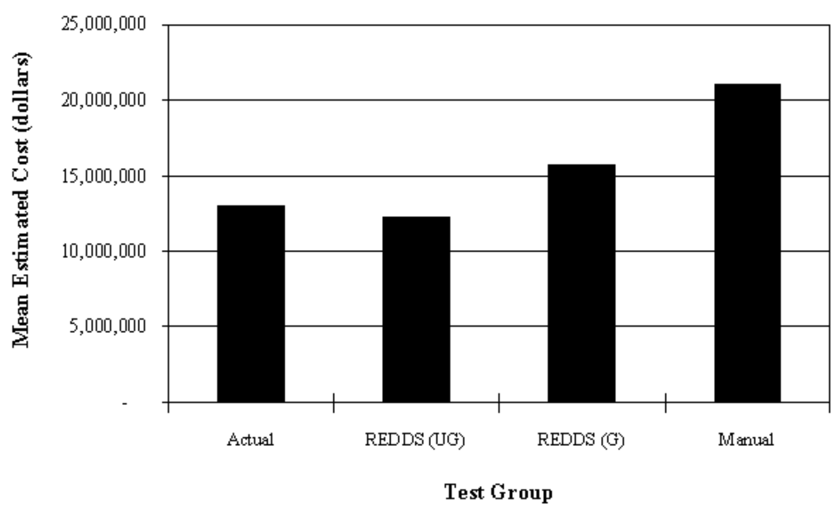

Figure 5. Estimated Cost Comparison.

Finally, visual inspection of the results of ***REDDS***? users compared to manual preparation did of course result in a more consistent format. This, does not however, indicate that the consistency necessarily means increased quality.

Discussion

Overview

The ***REDDS***? system was tested to determine if it facilitated the cost estimating decision process. The construct was tested by three operation variables of time, confidence and consistency. The results indicate that while the system does reduce estimate time, it does not necessarily contribute to the overall confidence of the user. Further, it was shown that estimates using ***REDDS***? were more consistently prepared and on average more accurate than those prepared manually.

At this early stage of development, the system is not adequate to meet the needs of most professional developers. It is anticipated, however, that with additional programming, and continued linkages, ***REDDS***? could potentially benefit real estate developers during the early stages of project development and cost estimating. A quick, reliable and consistent tool to "take a look" at potential projects may help developers better identify feasible projects. This is especially true for small developers with limited resources and/or new developers with limited experience.

A fully developed ***REDDS***? system could potentially benefit many professional in the built environment. This includes anyone who is concerned with the cost side of the development equation (i.e. lenders, appraisers, design professionals, and equity partners). In addition, the testing of ***REDDS***? inadvertently revealed another group which may also benefit, namely students of the built environment. This of course includes all those who eventually fill the professional positions listed above and includes such disciplines as construction science, architecture, land and real estate development, economics, and finance.

Strengths and Weaknesses of the Study

During the course of design and development, notes were continually recorded to assure that weaknesses would be documented. In addition, as discussed earlier, several pre-tests were conducted to begin identification of overall as well as specific strengths and weaknesses of this study.

- ***Flexibility.*** As developed, ***REDDS***? lacks flexibility in both input and output. The input is limited somewhat in the sense that there is often more than one model, which could potentially be used to evaluate a certain variable. Since the model only accesses one database and provides one decision support aid per variable, flexibility is limited. In addition, the format of the reports is fixed. In today's world of word processing, and the general accepted built in flexibility of most programs to adjust the output to the users preference, this limitation is considered serious and essential to overcome in a commercial grade edition.
- ***Linkages.*** Overall the case has been made that existing data and logic models can be linked. Automation of some of these linkages is needed, with direct access to the Internet being considered the linkage of most importance. With its expanding database, especially regarding economic and demographic data, automation of this link will

become extremely important as the analysis scope of the program is accomplished as discussed below.

- ***Scope.*** The scope of ***REDDS***? is limited both categorically and analytically. Categorically, the system is currently only capable of estimating in the conceptual stage of development planning. Although this is consistent with the delimitations set forth, given access to a building cost database, and with limited programming, the system is designed for an upgrade in this area. From an analysis standpoint, although the product of this research is consistent with the proposed scope, it nevertheless falls short of the ultimate goal of total linkage to financial feasibility analysis in the planning stage of property development. It should be noted, however, that one of the major strengths of the system is that expansion into these areas of financial analysis has been anticipated. In some cases, such as the Gross Income Multiplier Front Door Analysis, expansion has already begun.
- ***Data Sources.*** Although this study has demonstrated the potential to link multiple data bases from using a variety of medium, the primary weakness is considered to be lack of a good conceptual building square foot cost data base. Although some sources have the making of this database in the form of assemblies cost, and available in electronic medium, they have not compiled the assemblies to represent entire building costs.
- ***Speed.*** The program as developed, is slow by modern standards. Although this was overcome in the testing phase by using the latest in hardware configuration, specifically, Pentium coprocessors at 133 MHz speed, it is recognized that the average developer or other professional who may find this system of value may not have hardware with capable of this speed.

Recommendations for Further Study

Based on the conclusions, implications, strengths and weaknesses discussed above, the authors of this study make the following recommendations to others who are interested in the area of real estate decision support:

- Continued development of modules under construction
- Continued identification of data
- Continued development of decision logic models to increase analysis flexibility
- Continued development of output flexibility
- Continued development of automation of linkages
- Commercial Programming.
- Commercial Endorsement
- Commercial Documentation and Support
- Data Procurement Agreement
- Test for Accuracy/Precision

References

Cook, T.D. and D.T. Campbell (1979). *Quasi-Experimentation: Design and Analysis Issues for Field Settings*, Boston, MA: Houghton Mifflin Co.

Etter, W. E. (1994, Fall). *Real Estate Research Developments* working paper, College Station, Texas: Texas A&M University, Real Estate Center.

Etter, W. E. (1994, Summer). Why Investors Invest, *Tierra Grande*, 1:4, 14-15.

Etter, W. E. (1989, February). Complexities of Real Estate Investment, *Real Estate Center Journal*, 3:2, 17-19.

Etter, W. E. (1988, October). Investment by Design, *Real Estate Center Journal*, 3:1, 16-19.

Finlay, P.(1994). *Introducing Decision Support Systems*, Oxford, UK: NCC Blackwell Ltd.

Kerlinger, F. N. (1986). *Foundation of Behavioral Research*, Orlando, Florida: Harcourt Brace Jovanovich College Publishers, third edition.

Lifson, M. W., and Shaifer, E. F., Jr. (1982). *Decision and Risk Analysis for Construction Management*, New York, New York: John Wiley & Sons.

Miles, M. and Wurtzebach, C. H. (1977, December). Risk Analysis in the Real Property Development Process: A Conceptual Framework and a Computer Simulation Model, *Journal of Business Research*, 5, 325-57.

Nagel, S. S., ed. (1993). *Computer-Aided Decision Analysis: Theory and Applications*, Westport, CT: Quorum Books.

National Estimator (1995). *1996 CD Estimator*, Craftsman.

Nobe, Michael D (1996, December 6). *Decision Support for Real Estate Development Cost Estimating*. UMI Company, Ann Arbor, Michigan.

Olson, D. L. and Courtney, J. F., Jr. (1992) *Decision Support Models and Expert Systems*, New York, NY: Macmillan Publishing Company.

Sharkawy, M. A. (1994) PHYS-FI: A Physical-Financial Model for Design Economy Trade-Offs, Appraisal, *Market Analysis, and Public Policy in Real Estate: Essays in Honor of James Graaskamp*, Eds. J. DeLisle and J. Sa-Aadu, Kluwer Academic Publishing, 203-35.

Sharkawy, M. A. and Nobe, M. D. (1995, April 27-29). A Decision Support System for Planning Property Development, *Proceedings of the Pacific Asia Research Conference,* Singapore.

Journal of Construction Education
Fall 1999, Vol. 4, No. 3, pp. 313-320

1522-8150/99/$3.00/General Manuscript

Comparison of Construction Firms Based on Fuzzy Sets

Amaury A. Caballero and Jack Dye
Florida International University
Miami, Florida

The paper builds upon and extends a previous work of the authors. It presents a methodology allowing individuals or organizations to compare the capacity of construction firms using a fuzzy logic expert system model. The paper briefly discusses the concept of fuzzy logic and the task of choosing an appropriate family of parametric membership functions by which to define capacity. The extended methodology is an alternative to a previously developed multiple attribute analytical hierarchical procedure that was developed to enable general contractors to rate the capacity of minority and small/disadvantaged business subcontractors. The model provides a means by which general contractors, private owners, or public agencies can rank competing construction organizations on matters other than the bid price for the work.

Key Words: Construction, Business Capacity, Fuzzy Logic

Introduction

General Contractors, private owners, and public agencies are often faced with a problem; how to evaluate the bids of competing construction organizations with respect to variables other than the lowest price. It is axiomatic that the each of these constituencies wants to choose from amongst the competing firms the one that best suits their needs. However, all too often the evaluation is made on the basis of cost alone with subsequent regret when the chosen firm proves incapable, for a variety of reasons, of performing the work (Barnes & Mitrani, 1991,1992).

The problem has been addressed in a previous work that led to the design of a multiple attribute analytical hierarchical expert system model (Ahmad & Dye). In order to use the model a list of attributes had to be developed and data accumulated for each firm that was under consideration. The list of attributes needed to be exhaustive but not so long as to be unwieldy. Additionally, the attributes should be independent of each other. A total of 18 attributes were used to demonstrate the model. Pair-wise comparisons were required in the definition of weighting functions, a step that requires the cooperation of the decision maker on the first round and in making any subsequent revisions.

Subsequently, the current authors proposed a modification to this expert system model through the incorporation of fuzzy logic (Caballero & Dye, 1998). Instead of pairwise comparisons that resulted in a specific point value, the fuzzy operators allowed a range of possibilities.

General Background

Borrowing directly from the authors' previous work, fuzzy logic can be explained by the relative simple statements "I am hot" or "I am cold." In the first case, individuals generally do not say, "I am 100 degrees," although if one did and if the listener carefully analyzed the statement, the meaning might be clear. More generally, the statement "I am hot," means that the individual is uncomfortable due to the ambient temperature, which might be somewhere between 80 and 100 degrees Fahrenheit. Similarly the statement, "I am cold," means that the ambient temperature is somewhere below, say, fifty degrees and that the individual is not dressed appropriately. This is the way that we speak and reason, and the use of such ranges with many different variables allows one to design an expert system based on these ranges rather than on discreet points.

In a fuzzy system, each of the variables we need to describe a particular situation or expert model can be described by a membership function. A membership function can be a linear relationship or a function that resembles a triangle, a normal distribution, or any other distribution that is reasonable for the attribute being described. As an example, going back to the "I am hot" statement, we can describe the membership function as follows:

- At any time an individual is experiencing an ambient temperature less than 70? F, the individual is not considered to be hot;
- Any individual experiencing an ambient temperature range between 70? F 100? F is considered to be some degree of hot;
- Any individual experiencing an ambient temperature over 100? F is considered to be hot.

This membership function derived is depicted in Figure 1, where the X-axis represents the temperature (T), and the Y-axis represents the degree of membership [?(T)].
Similar to utility values in utility theory, the membership function, ?, varies between 0 and 1, and every one experiencing an ambient temperature of less than 70? F has a membership value of 0. Simply, those in cooler air are not hot and are not members of the hot group. Individuals experiencing an ambient temperature between 70? F and 100? F have a membership value varying linearly from 0 to 1, and those above 100? F have a membership value of 1.

Discussion

Extrapolation of fuzzy logic to an expert system requires that one follow the usual general outline:

1. Determination of the objective function,
2. Determination of the attributes that describe the essential features of the objective function,
3. Determination of a means to rank these attributes with respect to each other,
4. Collection of data, and
5. Analysis, results, and validation.

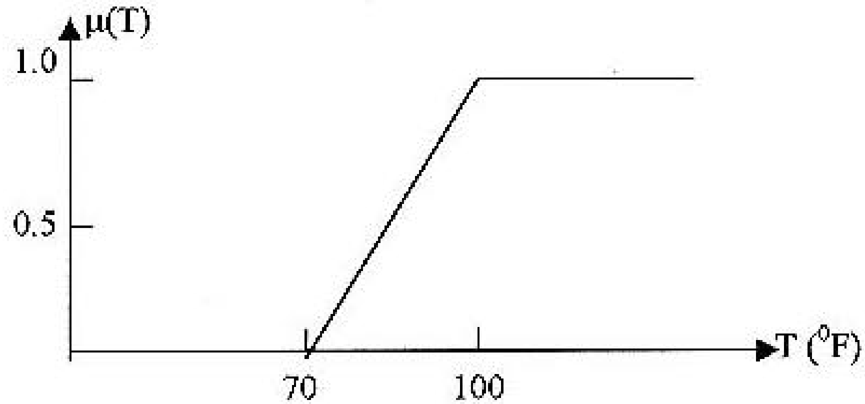

Figure 1. Example of a fuzzy set for the hot condition.

The latter two items are not discussed in this paper. In the present case, the desired outcome is an expert system that allows individuals, agencies, or general contractors to rank the capability of competing construction organizations to perform a certain project.

The second point of the general outline has been addressed by an extensive body of literature representing the opinions of various scholars on the common essential attributes of business organizations (Dye & Einstein, 1997). There is no intent by the authors to engage in that debate at this point. Instead, the attributes suggested in the earlier work by Ahmad and Dye (1994), reproduced here as Table 1, are stipulated as a sufficient starting point.

Table 1

Primary and Secondary Performance Criteria

Business Experience	Personnel	Financial
Number of years in business	Number of full time employees	Annual Revenues
Number of Contracts completed, previous 3 years	Average length of time employed	Liquid Quick Assets
Largest contract completed, last 3 years	Ratio of supervisors to tradesmen	Dollar value of lines of credit
References	Level of training of supervisors	Dunn and Bradstreet rating
Type of License	Workers Compensation Modification factor	Aging of receivables
	Established full-time office	

For the purposes of this and the original discussion, a single variable was chosen from each of the major groupings: number of full time personnel; number of years in business; and annual revenues. Figure 2 depicts nominal domains for these variables. The individual distributions were generated by software (Fuzzy Query 1.0) and no representation is made at this time that these are the actual distributions.

The descriptors of the particular attributes are as indicated on the individual figures. The actual descriptors need not be the same for different organizations using the model. All that is required is that the definition be understood and agreed to. Given that one of the essential features of fuzzy logic is that there are ranges of possibilities, the descriptors generally will have overlapping ranges.

It is instructive and central to the use of the fuzzy sets to consider how the sets can be used. If, for whatever reason, the preference is for a medium sized construction organization and the firm being evaluated has 22 full time employees, one would enter the horizontal scale at 22, move vertically until intersecting the "medium" distribution, and horizontally to the membership function. In the data depicted, the membership value, ?, would be 0.8. If the number of full time personnel were less than 10 or more than thirty, then ? would be 0. Similarly if the standard were anything other than medium, the membership function would also have been 0.

It is easy to see that organizations may fall within two (or more) distributions. The assumed fuzzy sets shown in Figure 2 can be used to demonstrate this fact. If one has an organization that has 9 full time employees it falls within both the small (? = 0.2) and moderate (? = 0.55) distributions. If the standard being evaluated is, say, moderate, then only the membership function for the moderate range is of interest.

If the variables are evenly weighted and none is more important than any of the others, a ranking may be established by computing the **Compatibility Index (CI).** The calculations will provide a rank ordering of the competitors and indicate how closely they are attuned to the specified standards. In this instance the CI is defined as the aggregate of all of the membership function values, ?, divided by the total number of descriptors used. Logically, one has to ensure that the same descriptors and variables are used for all organizations and that the number of descriptors, N, is constant throughout the computations.

$$CI = [\; \overset{\mathbf{N}}{\underset{i=1}{?}}\; ?_{i}\,(x)]/N \qquad (1)$$

If it is considered that the different attributes are not of equal importance, then relative weights must be calculated. One simple method for determining such weights is the technique of successive comparisons. As an example, if a particular user of the model outlined above feels that P (personnel factors) should be 1.5 times as important as B (business experience factors), then the weights assigned would be 1.0 for B and 1.5 for P. Putting this aside, but considering that P is the most important factor thus far, the user would next rank P and F (financial). If the relative weight obtained as a result of this pair wise comparison is 2.0, then the relative weights for all three criteria will be:

B	1.0
P	1.5
F	1.5 x 2.0 = 3.0
Total	5.5

If these are normalized the resulting weights are as follow:

BUSINESS EXPERIENCE:	1.0/(1.0 +1.5+3.0) = 0.182
PERSONNEL:	1.5/(1.0 +1.5+3.0) = 0.273
FINANCIAL:	3.0/(1.0 +1.5+3.0) = 0.545

Having the relative weights, the modified formula for the compatibility index calculation becomes:

$$CI = \overset{N}{\underset{I=1}{?}}\ ?_{I}\ ?_{I}(x) \qquad (2)$$

Where $?_{I}$ is the weight of attribute and the other terms are as defined in equation (1).
The weighting of attributes may change the rank ordering of the CI for construction organizations when compared to the calculations where no weighting is utilized. To the extent that this is true, then the model more clearly reflects the concerns of the ranking organization. If an examination of the CIs, computed using weighted and non-weighted attributes indicates that there is no change in the ranking, or that the differences in the relative differential between the CIs computed by either method is small, then the weighting refinement may be unwarranted. The trivial case is, obviously, when all of the weights are approximately equal.

As a demonstration of the utility of the use of fuzzy logic in the selection of construction organizations using other than cost factors, the authors designed 6 hypothetical firms as indicated in Table 2. Only the three attributes shown in Figure 2 were utilized.
The standards against which the firms are being evaluated are:

- Number of Personnel: **Medium**
- Business Experience: **Young**
- Financial Situation: **Medium**

For each firm and each characteristic, using the represented in figure 2 membership functions, it is possible to replace the obtained results in formula 1, in order to find the compatibility index. As an example, let's analyze firm B: It has 23 employees. In figure 2b), starting from number 23 on the horizontal axis and moving up until the membership **Medium** is encountered, the corresponding value on the vertical axis (degree of membership) is 0.80. The same firm has a business experience of 14 years. Applying the same procedure, but using now figure 2a), and moving up until the membership function **Young** is encountered, the degree of membership in this case will be 0.20. For the financial situation, in figure 2c) it is found that for $1 700 000 annual revenues, the membership function **Medium** gives a degree of membership of 0.60. The same process is repeated for each firm and each characteristic.

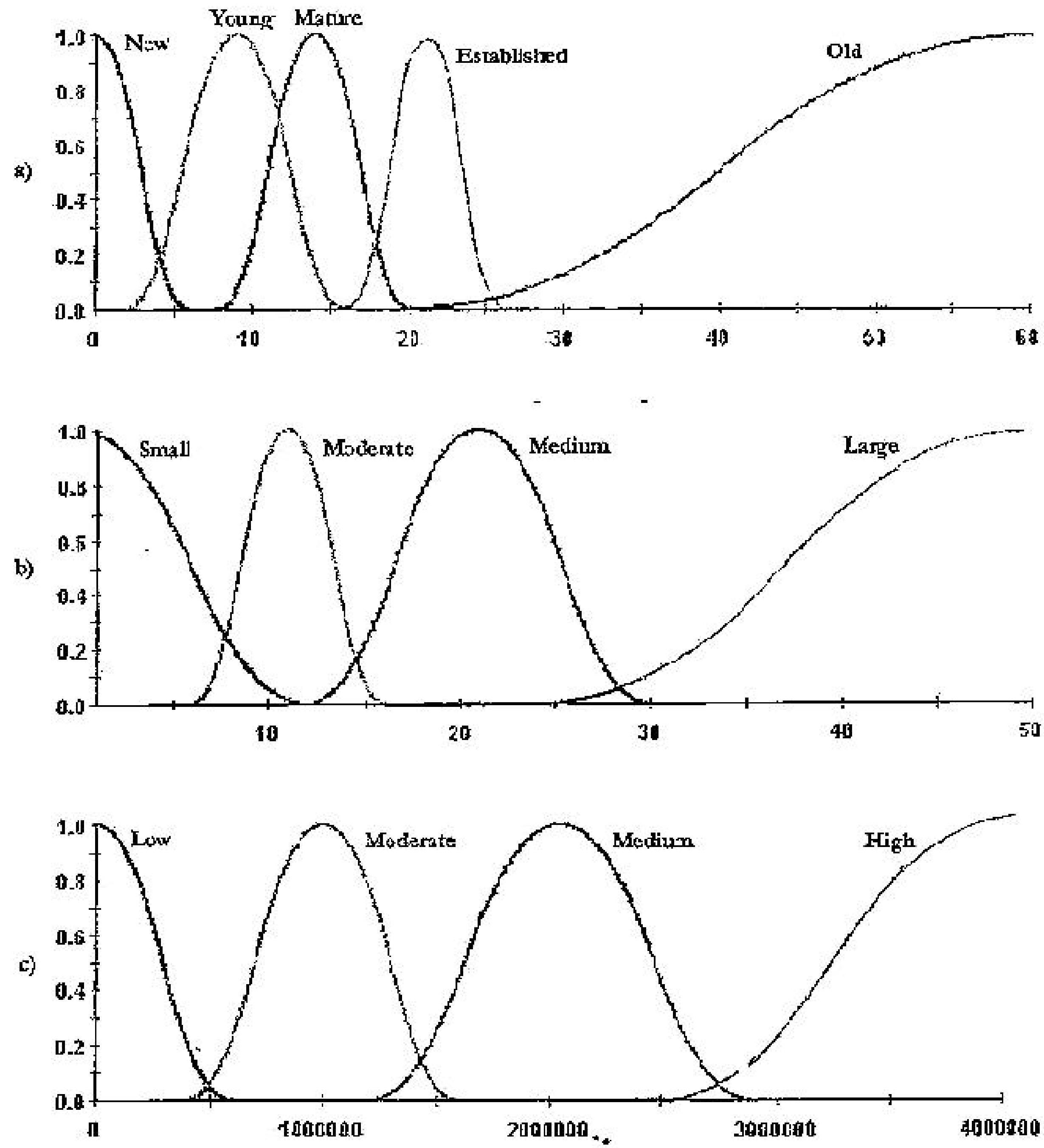

Figure2. Fuzzy Sets: a) Business Experience, b) Number of Employees, c) Annual Revenue.

The unweighted calculations for the Compatibility Index were performed utilizing the same software that generated the fuzzy sets. The weighted calculations were done manually. The results of both are displayed in Table 3.

Table 2

Firms and Attributes

Firm	Full time employees	Annual revenues (millions of $)	Business experience (years)
A	10	0.5	5
B	23	1.7	14
C	30	2.5	10
D	37	3.1	16
E	16	2.7	8
F	25	1.8	6

Table 3

Fuzzy Set Calculations

Firm	*Equation (1)*	*Equation (1) rank*	*Equation (2)*	*Equation (2) rank*
A	0.018	4	0.054	4
B	0.563	1	0.763	1
C	0		0	
D	0		0	
E	0.128	3	0.055	3
F	0.206	2	0.327	2

Two things are immediately apparent: for the sample calculations, there was no change in the ranking between the weighted and unweighted data despite the fact that one variable was considered three times as important as another; and firms A and E declined markedly as a competitors when compared to the two leading firms. Additionally, Firm B is more compatible with the assumed requirements under the weighted system, showing that it closely conforms to the stated conditions.

Conclusions

The extension of the model previously presented provides a refinement that allows the user of the basic model to more completely reflect their concerns in the ranking of competing firms. Quoting from the original work, "The power of the fuzzy logic model is that it uses imprecise terms to arrive at 'crisp' values." Modifying these 'crisp' values by establishing weights, reflecting the importance of various attributes, is a logical next step.

The use of software to both generate the fuzzy sets and perform calculations provides the necessary link between theory and practice. The number of manual calculations that would be required to examine several competitors and more than a small number of attributes is excessive, time consuming, and would surely discourage any practical application of the work.

An additional effort is required to demonstrate the usefulness of the model. In particular, it is necessary to move to the practitioners to:

- Develop the attributes that are of concern;
- Develop the distributions for the descriptors

- Develop the weights and see if these can be generalized throughout the construction industry.

References

Ahmad, I., & Dye, J. M. (1994). *Development of a Database of MBE/DBE Firms and Decision Model to Determine Their Capacity for the Florida Construction Industry*. Miami, FL: Technical Report 120, Department of Construction Management, Florida International University.

Barnes, W. C. & Mitrani, J. D. (1991) *Develop and Teach a Course on Practices and Pitfalls in the Construction Industry that are Subject to Law Suits*. Miami, FL: Technical Report 102, Department of Construction Management, Florida International University.

Barnes, W. C., & Mitrani, J. D. (editors) (1992). *Practices in the Construction Industry Which are Subject to Law Suits*. Miami, FL: Technical Report 108, Department of Construction Management, Florida International University.

Caballero, A. A., & Dye, J. M. (1998). Application of a Fuzzy Logic Model to Compare the Capacity of Construction Firms. Proceedings of the Associated Schools of Construction Southeast Regional Meeting. Atlanta, GA.

Dye, J. M., & Einstein, W. A. (1997). A History of Efficiency & Effectiveness: With an Introduction to *n* Space. The Journal of Applied Management and Entrepreneurship Vol 3, No. 1, pp 99+.

Fuzzy Query 1.0. (1998). Sonalysts, Inc., 215 Parkway North, Waterford, CT. 06385

Goodwin, P., & Wright, G. (1998). *Decision Analysis for Management Judgement*, 2nd edition. John Wiley & Sons, West Sussex, England.

Journal of Construction Education
Fall 1999, Vol. 4, No. 3, pp. 321-331

1522-8150/99/$3.00/General Manuscript

An Evaluation of the *Good Cents*? Program in College Station, Texas

Lee A. Ellingson
Indiana State University
Terre Haute, Indiana

Paul K. Woods
Texas A&M University
College Station, Texas

This study is an evaluation of an energy-efficiency program sponsored by College Station, Texas, called the *Good Cents*? Program. The *Good Cents* Program is designed to encourage builders to build more energy-efficient homes. One difficulty with evaluating this type of program is that energy use not related to outdoor air temperature introduces a large amount of unexplained variability into total energy use. This study uses a statistical method that separates energy related to outdoor temperature from energy not related to outdoor temperature. Three-parameter models have proven to be very useful in modeling residential energy use. This study uses parameter estimates of three-parameter models to compare a treatment group of *Good Cents* houses to a control group of non-*Good Cents* houses. Parameters used are cooling slope, heating slope, and Normalized Annual Consumption (NAC).

Key Words: Energy, Good Cents? Program, Residential, and Statistics

Background

Utility companies are in the process of shifting emphasis from the production of energy to a more comprehensive strategy of managing energy resources. Utility companies are encouraging their customers to be more energy efficient. It may appear to be counterintuitive for a supplier to advocate efficient use of the product it sells (in this case, electricity). This is partly due to the monopoly status enjoyed by many utility companies. In return for this status, utility commissions require electricity providers to install and maintain the infrastructure to cope with extreme power demands. This means that under average conditions the utility's infrastructure is not operating at full capacity. This does not optimize the industry's potential for making profits. Moreover, the construction of new power plants has become exorbitantly expensive. Utility companies are interested in reducing the rate of demand—not total consumption. This is consistent with the original vision of Thomas Edison. As the inventor of both the generating plant and the light bulb, he understood the importance of efficient generation and conversion. Today, many utility companies are once again taking interest in the efficient conversion of energy to specific uses and are considering a more comprehensive approach to their business activities. This comprehensive strategy is called Integrated Resource Planning (IRP).

Integrated Resource Planning involves both the supply and demand of energy resources. The supply side of the energy business has reached a state of great efficiency. On the other hand, the demand side of the energy business remains relatively inefficient. It is ironic that the word utility implies the practical use of energy rather than the production of energy. But utilities are changing their concept of what services they can and should provide. Encouraged by increased demand

and the increasing cost of production, utility companies are beginning to address the second half of Edison's vision? the efficient and profitable use of energy.

Strategies that encourage more efficient utilization of energy are called Demand Side Management (DSM). The popularity of DSM is growing. Utilities are projecting expenditures of $23 billion on DSM programs by the year 2000 (Southerland, 1994). DSM programs may be classified into two types-energy-efficiency programs and market transformation programs. Residential energy efficiency programs offer a variety of services to individual customers, such as energy audits, weatherization, rebates, or low-interest loans. Market-transformation programs differ from energy-efficiency programs in that they attempt to influence an entire industry rather than individual customers. A good example is the EPA Energy Star program that allows participating companies to identify their computer equipment with the program logo. Another good example is the Good Cents Program, which offers rebates to homebuilders for each new house that meets program criteria.

The Good Cents Program was developed by the electric utility industry (Homebuyer's Guide). Although national in scope, it is adopted locally. Each local utility company has a good deal of autonomy in establishing program criteria and how the program is administered. The Good Cents Program of College Station, Texas has adopted both descriptive and performance criteria. Typical descriptive criteria are minimum insulation requirements, double-glazed windows, minimum equipment efficiency, and maximum equipment capacity; performance criteria consist of a blower-door test and estimated heat gain.

The federal government, many public utility commissions, and conservationists are supporting Integrated Resource Planning and Demand Side Management in an effort to make conservation programs competitive with energy supply alternatives. However, some people question the means that are currently being used to evaluate the true costs of energy-efficiency programs (Jaskow & Marron, 1993). Jaskow and Marron claim that savings estimates for many utility programs have not been subject to rigorous, empirical examination in real, representative settings.

The Problem

A direct and logical method to evaluate the effectiveness of the Good Cents Program would be to compare the total energy used by a treatment group of houses with the total energy used by a control group of houses. The treatment group would consist of houses approved by the Program; the control group would consist of houses not approved by the Program. If the total energy used by the treatment group is significantly less than the total energy used by the control group, this should indicate that the Program is indeed effective. There is only one problem with this method-miscellaneous energy use.

Miscellaneous energy use is energy that is not related to outdoor air temperature. This category of energy use is highly correlated to occupant behavior. The efficiency of the house, on the other hand, is highly correlated to the materials and workmanship of the structure and the efficiency of the heating and cooling equipment. The efficiency of the house is the target of the *Good Cents*

Program. Research has shown that miscellaneous energy use can constitute from 20 to 80 percent of the total electricity consumption for a typical modern house (Goldstein, Schneider & Clarke, 1985; Meier, Rainer & Greenburg, 1992; and Pettersen, 1994). Therefore, in order to effectively compare the energy efficiency of two experimental groups, it is necessary to separate out energy use that is related to outdoor air temperature from total energy use. Otherwise, miscellaneous energy use will mask or overwhelm any difference that is due to the energy efficiency of the houses.

The Study

This is an *Ex Post Facto* correlation study. The study was designed to take advantage of available data. Two types of data that are readily available are daily temperature readings and monthly billing statements. Daily temperature readings are available from the local weather station, and monthly billing statements are available from the local utility company. Houses included in the study were selected by a two-step process. In order to qualify for the study, houses had to be detached single-family and must have been built after 1989, the onset of the *Good Cents* Program. The population of the treatment group included every house approved by the Program. The population of the control group included every house issued a building permit from 1990 to 1993 with the houses approved by the Program removed. All houses in the study are cooled with electricity and heated with natural gas. A random sample of 100 houses was selected from the population of each group using a random number table. The final selection of houses was based on the following criteria: All houses must have had the same residents for the study period, and they must have had a minimum of twelve consecutive months of utility data. The final number of houses for each group is 71. Color photographs were taken of every house in the study. These were used to visually compare houses between the treatment group and the control group. Floor area, land value, value of improvements, and total value for each house were collected from the county tax appraiser. These statistics were used to compare the two experimental groups.

In order to separate energy use related to air temperature from energy use not related to outdoor air temperature, spline regression is used to construct three-parameter models for both cooling and heating. The three parameters are cooling or heating slope, base load, and change point. When using three-parameter models, the slope of the base load is assumed to be zero. The cooling and heating models are defined by the following equations:

$$\text{KWhday} = \text{alpha } 1 + \text{beta } 1 * \max(\text{Tavg} - \text{Tcool}, 0) \quad (1)$$
$$\text{Gasday} = \text{alpha } 2 + \text{beta } 2 * \min(\text{Tavg} - \text{Theat}, 0) \quad (2)$$

Where kWh = estimated electric energy used per day, gasday = estimated gas energy used per day, alpha 1 = cooling intercept, alpha 2 = heating intercept, beta 1 = cooling slope, beta 2 = heating slope, Tavg = average billing period temperature, Tcool = cooling change point, and Theat = heating change point.

The cooling or heating slope is a ratio of energy consumption per day to the average billing period temperature. This is sometimes called the cooling or heating efficiency. These two variables are used to compare the thermal efficiency of houses in the two experimental groups. A more sophisticated variable of efficiency is Normalized Annual Consumption (NAC). This is determined by multiplying the cooling or heating slope times an average or "normalized" monthly temperature for an extended period - in this case, thirty years. Normalized Annual Consumption is especially valuable in retrofit studies when it is necessary to adjust for the weather. Research has shown that NAC is a robust and reliable indicator of energy efficiency (Fels, 1986; Stram & Fels, 1986).

Estimating change points is the most difficult procedure in constructing three-parameter models. For this study, a suite of statistical applications called Statistical Analysis System (SAS) was used. Four separate procedures in SAS were used to construct the final models. The four procedures and their output are listed below:

1. Average
   - Calculates the number of days in each billing period
   - Calculates average billing period temperature
   - Plots temperature vs. energy consumption
   - Change points are estimated visually by the researcher
2. Initial Regression
   - Calculates parameter estimates
   - Plots residuals
   - Plots predicted values
3. Iteration
   - Estimates change points more precisely by minimizing the sum of the squared residuals
4. Second Regression
   - Adjusts parameter estimates for new change points
   - Plots residuals
   - Plots predicted values

Results

Figure 1 shows a typical three-parameter model for cooling; Figure 2 shows a typical three-parameter model for heating. The units of the heating model have been converted from cubic feet of gas to kWh so both models can be expressed in consistent units. The cooling or electricity models typically have twenty-three data points; the heating or gas models typically have thirteen data points. Of course, when using least squares regression, more data points provide a more accurate trend line. The R-square value (coefficient of determination) for the model in Figure 1 is 0.92; the R-square value for the model in Figure 2 is 0.51. The R-square values reinforce what is visually obvious: The electric model is a better estimator of energy consumption. The cooling change point is 66? F and the heating change point is 84? F. The cooling change point is the average billing period temperature at which cooling begins, and the heating change point is the average billing period temperature at which heating begins. The cooling change point appears to be reasonable; the heating change point appears to be too high. One reason why the heating change points are consistently too high is that the assumption that the slope of the base load be zero may be incorrect. The gas base load may be slightly related to outdoor air temperature. A comprehensive review of the plots indicated that this might indeed be the case. Water heating is a primary component of gas consumption. Two reasons why gas usage may be seasonally related are that people tend to take more hot showers in the winter, and colder ground temperatures lowers the temperature of water delivered to water heater. A four-parameter model may be more appropriate for the heating data. (See Figure 3.)

An examination of the photographs of the houses revealed no striking or consistent differences between the two groups. The predominate color of the roof shingles is a light gray; a few are light brown. All of the houses have continuous ridge vents. No turbine ventilators can be seen. All have a brick veneer. Trees and landscaping vary considerably between houses but not between groups. There were no significant differences between the mean floor areas or values of the two groups.

Table 1

SAS Parameter Estimates--Treatment Group

Parameter	units	mean	std dev	max	min	median
T-cool	degrees F	67.8	2.8	76.5	56.7	67.7
T-heat	degrees F	79.1	3.9	91.2	72.7	78.7
B1(cooling slope)	kWh/deg F	2.5	0.7	4.3	1.3	2.5
B2(heating slope)	kWh/deg F	-3.0	1.7	-0.5	-12.8	-2.8
Cooling base	kWh	27.6	12.5	63.2	6.4	24.4
Heating base	kWh	20.2	9.1	43.3	1.7	17.4

Table 2

SAS Parameter Estimates—Control Group

Parameter	units	mean	std dev	max	min	median
T-cool	degrees F	68.6	2.7	77.5	63.0	68.6
T-heat	degrees F	78.7	3.7	87.6	62.1	79.1
B1(cooling slope)	kWh/deg F	2.3	0.8	5.1	0.9	2.1
B2(heating slope)	kWh/deg F	-3.2	2.6	-0.2	-21.9	-2.8
Cooling base	kWh	27.7	18.6	152.2	9.2	23.2
Heating base	kWh	15.6	7.6	36.7	3.3	14.0

Table 3

Comparison Tests

Parameter	P-value	Test
T-cool	0.106	t-test
T-heat	0.611	t-test
B1	0.059	MWRST
B2	0.554	MWRST
Cooling base	0.524	MWRST
Heating base	0.002	MWRST

MWRST = Mann-Whitney Rank Sum Test

A simple t-test and the Mann-Whitney Rank Sum Test were used to compare data between the Good Cents houses and the non-Good Cents houses.

Table 4

SAS Normalized Annual Consumption--Treatment Group

Parameter	units	mean	std dev	max	min	median
E-cool	kWh	5,033	1,837	9,621	1,659	5,049
E-base	kWh	10,088	4,570	23,070	2,353	8,906
E-base%	%	66	8	82	44	65
G-heat	kWh	13,288	9,183	74,368	2,484	11,548
G-base	kWh	7,381	3,317	15,816	636	6,361
G-base%	%	37	12	73	14	37
Total	kWh	35,790	14,604	116,130	7,524	33,173

Table 5

SAS Normalized Annual Consumption—Control Group

Parameter	units	mean	std dev	max	min	median
E-cool	kWh	4,279	1,811	9,532	1,250	3,865
E-base	kWh	10,105	6,789	55,599	3,368	8,480
E-base%	%	69	9	89	41	69
G-heat	kWh	13,114	5,772	31,005	1,634	11,806
G-base	kWh	5,700	2,790	13,388	1,212	5,099
G-base%	%	31	12	76	7	30
Total	kWh	33,198	13,033	101,088	15,925	30,303

Table 6

Comparison Tests--Mann-Whitney Rank Sum Test

Parameter	P-value
E-cool	0.004
E-base	0.524
G-heat	0.636
G-base	0.002
Total	0.112

The following results are based on a significance level of 0.05:

- There is no significant difference between the mean cooling slopes (B1, Table 3).
- There is no significant difference between the mean heating slopes (B2, Table 3).
- There is a significant difference between the mean cooling NAC (E-cool, Table 6) However, please note that this statistic is *higher* for the treatment group than for the control group. Since the difference in total NAC is not significant, this may simply be an anomaly. (A non-parametric test is not nearly as sensitive as a parametric test based on normally distributed data.)
- There is no significant difference between the mean heating NAC (G-heat, Table 6). There is no significant difference between the total NAC (Table 6).

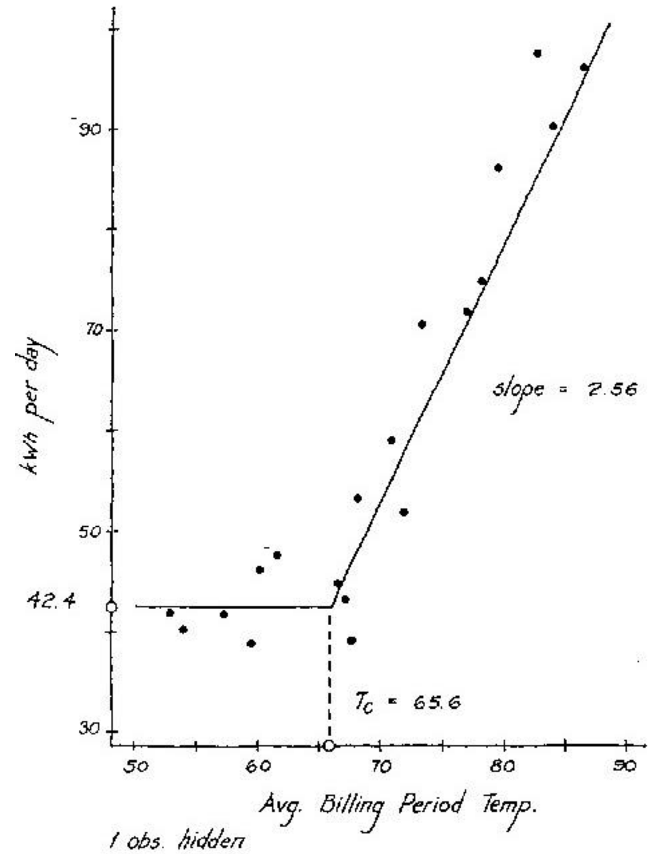

Figure 1: Typical cooling model.

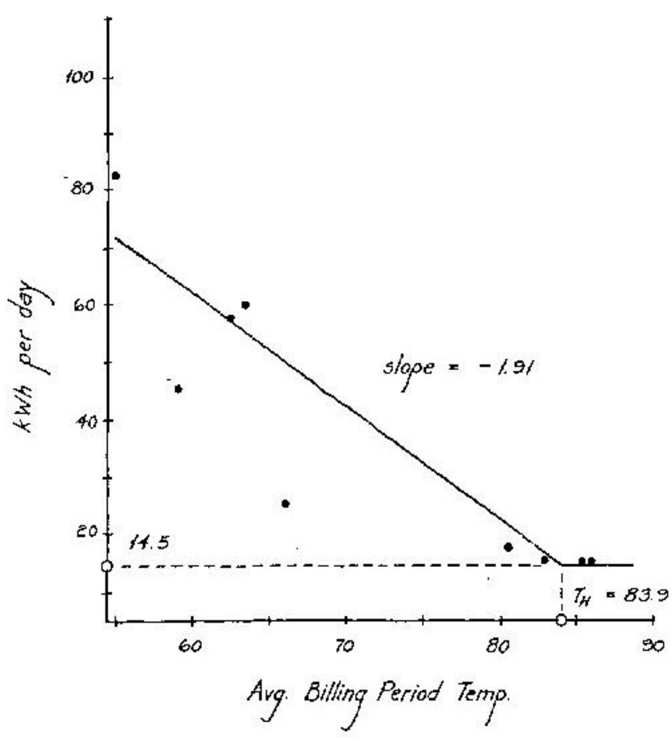

Figure 2: Typical heating model.

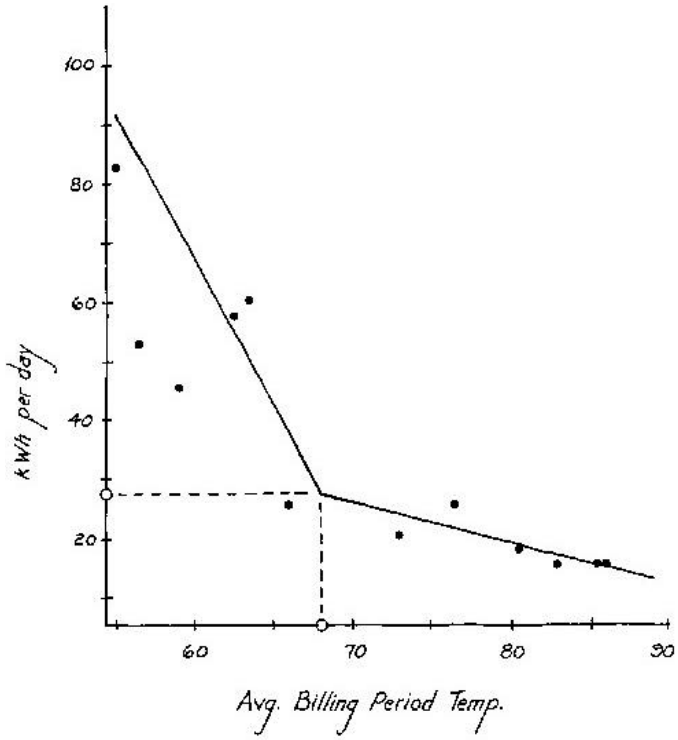

Figure 3: Four-parameter heating model.

Conclusions

Houses constructed between 1990-1993 and approved by the *Good Cents* Program in College Station, Texas, are not more energy efficient than comparable houses not approved by the Program. Houses not approved by the Program include houses that failed inspection and houses that were never submitted for approval. Literature distributed by the *Good Cents* Program nationally, claims that a *Good Cents* home can reduce electric consumption by 28? (Questions and Answers, 1996). Since the literature does not specify the criteria used to calculate the advertised savings, it is not possible to evaluate the stated claims.

Considering the results of this study, it is reasonable to conclude that contemporary builders in College Station are building energy-efficient houses with or without the endorsement of the *Good Cents* Program. In order for the Program to become effective, the qualifying criteria should be made more restrictive. (See Appendix.) Administrative personnel may be reluctant to do so because this may discourage builders from participating in the Program.

Speculative builders are very cost conscious. They probably will not incorporate expensive energy-saving features unless they are confident there is a market for them. It is quite likely that we have arrived at a point of diminishing returns for residential energy-saving features. We can build houses that are more energy-efficient, but will it pay to do so?

References

Fels, M. F. (1986). PRISM: An introduction. *Energy in Buildings*, 9, 5-18.

Goldstein, R. J., Schneider, M. E., & Clarke, M. I. (1985). Residential energy use: An analysis of factors affecting gas and electricity use in single-family houses. *ASHRAE Technical Bulletin, 1(3)*, 219-236.

Homebuyer's guide. (n.d.) College Station, TX: Energy Conservation Division, City of College Station.

Joskow, P. L., & Marron, D. B. (1993). What does utility-subsidized energy efficiency really cost? *Science, 260*, 281 & 370.

Meier, A., Rainer, L., & Greenberg, S. (1992). Miscellaneous electrical energy use in homes. *Energy, 17*, 509-518.

Questions & Answers. (1996). College Station, TX: Energy Conservation Division, City of College Station.

Stram, D. O. & Fels, M. F. (1986). The applicability of PRISM to electric heating and cooling. *Energy and Buildings, 9*, 101-110.

Sutherland, R. J. (1994). Income distribution effects of electric utility DSM programs. *The Energy Journal, 15*, 103-118.

Appendix
City of College Station
Good Cents Qualifying Criteria

Heat Gain

A heat gain equal to or less than 12 BTU per square foot is required.

Air Infiltration

An air infiltration test will be performed on each Good Cents House during final inspection. The minimum acceptable air change in the Good Cents program is .75 air changes per hour measured at .1 inch of water column using an INFILTEC blower door.

Air Conditioning

All Good Cents homes must have high-efficiency heating and cooling systems. Heat pumps are to have a minimum 10.0 SEER and 3.0 COP as their rating. Back-up electric strip heat shall be no more than 5 kW per ton. Homes with natural gas as a heating fuel are to have the air conditioning with a 10.0 SEER or better rating. The gas furnace will have an 80 AFUE rating or better. The capacity for any air conditioning unit shall not exceed 1 ton per 600 square feet of conditioned floor area.

Insulation

R-13 required in the walls. Insulation to be installed according to manufacturer's specifications including filling the entire stud cavity, cut tightly around junction boxes, and placed behind corners and tees on the exterior walls. All windows in a Good Cents home are to be double-glazed or better. R-30 required in the attic. All attic access doors inside the conditioned area are to be weather-stripped and insulated.

City of College Station
Recommended Energy Efficiency Features

The following features and recommendations are presented as a means to achieve the Good Cents performance standards; they are not requirements, but rather construction features typically found in energy-efficient homes.

Door Insulation

Urethane core doors are recommended. Glass doors should also be double-glazed with a thermal break.

Windows

Exterior shading such as porches or overhangs are recommended. Sun glass is suggested for exposed east and west windows.

Insulation

Experience shows that a house needs a minimum ceiling insulation level of R-30 or greater and R-13 with ½-inch poly sheathing as a minimum in the walls. Cathedral ceilings should be designed to provide proper amount of space for insulation to achieve the R-values specified, as they are generally a source of high BTU heat gain. Sheathing should be placed on entire exterior wall including over bracing when possible.

Attic Ventilation

Continuous ridge and soffit vents are strongly recommended. Ventilation should be calculated at one sq. ft. of net free area for each 100 sq.ft. of horizontal ceiling/attic area. Preferably, half of the ventilation area should be upper and half lower to provide efficient airflow.

Air Infiltration

Sole plates should be sealed. All exterior doors should be weatherstripped. All penetrations in the thermal envelope should be sealed. All sheathing joints should be taped with thermal tape. Windows are to be sealed with expandable foam and taped around the edges to the exterior sheathing.

Roofs

Dark roofs are discouraged as they absorb and transmit a large amount of heat. Lighter color roofs are strongly recommended.

Skylights

Skylights are not recommended due to the emissivity of the glass in relation to its long exposure to solar heat gain.

Water Heaters

Water heaters should be installed with a minimum insulation value of R-11. All exposed hot water pipes should be insulated and the water heater should be centrally located near the highest usage area in the house.

Air Conditioning

While the *Good Cents* requirement for air conditioning sizing is 1 ton per 600 conditioned sq. ft., it is recommended the unit be sized at 1 ton per 750 conditioned sq. ft. The heating and cooling system is suggested to be controlled by programmable thermostats.

Journal of Construction Education
Fall 1999, Vol. 4, No. 3, pp. 332-340

1522-8150/99/$3.00/General Manuscript

An Assessment Model for Quality Performance Control in Residential Construction

Zeljko M. Torbica
Florida International University
Miami, Florida

Robert C. Stroh
University of Florida
Gainesville, Florida

This paper is concerned with two important aspects of the home-building segment of construction: quality performance of homebuilders and homebuyer satisfaction. A model for assessing a homebuilder's quality performance is presented. It is argued that customer satisfaction can provide the strategic intelligence needed to direct the quality improvement effort.

Key Words: Quality Improvement, Customer Satisfaction, Homebuilding

Background

Observers close to the construction industry have expressed great concerns over the problems facing the industry. The industry has been criticized for common cost overruns, expensive delays, high-accident rates, ever-increasing litigation costs, and declining international competitiveness. There is a consensus among professionals and researchers that the solution to the problem lies in formal quality management at all levels of design, procurement and construction. As Tucker puts it: "The future advancement and accomplishments of our industry will depend upon our acceptance of the quest for quality much more than reaching any specific milestones" (Tucker 1990, p.152). Providing superior quality is rapidly becoming the way for companies to differentiate themselves from competitors and win more projects. To meet this quality challenge, many companies are adopting new management practices that focus on the continuous improvement of product and service quality.

Companies need assurance that their improvement efforts are organized and that their priorities are on the right track (Kelvin and Lynch 1992). Quality improvement is difficult to achieve unless quality is accurately and periodically measured. One reason for that difficulty is the lack of good overall measures of quality in its broadest sense. Companies say they have difficulty even making a baseline assessment of their quality (ENR 1995). Before one can define methods for improving and maintaining the quality of construction, two fundamental questions need to be answered: Who sets the quality standards and what is high quality in construction?

Objective

The objective of this paper is to define quality in the home building industry and to present a tool for measuring that quality.

Quality in Construction

There are, generally, two approaches to quality in construction, conformance to requirements approach and customer satisfaction approach.

Conformance to Requirements Definition of Quality

Traditionally, the construction industry has preferred the conformance-to-requirements definition of quality where the major concern has been how well the constructed facility conforms to design specifications. According to this approach, excellence is equated with meeting specifications and with "making it right the first time."

The conformance-to-requirements definition of quality demonstrates a number of very important attributes and strengths. Measuring quality by using this definition is relatively straightforward and easy (Reeves and Bednar 1994) for it is readily translatable into operational criteria (Seymour and Low 1990). This approach, however meaningful, also possesses some inherent limitations. A serious weakness is that its primary focus is internal; it assumes that providing a facility, which satisfies the design and specifications, as, developed by a designer and interpreted and implemented by a constructor, it is of high quality. In many cases this quality paradigm has been proven inadequate. There is ample evidence that construction is not immune of technically incomplete and unsound designs and specifications (see for example Burati et al. 1992). The issue becomes the quality of design and specifications, since they come to be viewed as a neutral touchstone against which quality in implementation is assessed.

Another limitation of the conformance-to-requirements definition of quality is that it assumes that we can get stable and complete requirements; it ignores the potential mismatch between what is specified and what the customer needs or wants. In fact, customers may not know or care about how well the constructed facility conforms to specifications; they want their needs and expectations to be met. The crucial task is how to establish design requirements and specifications that best reflect their needs and expectations. This is a particularly problematic 0step for non-technical requirements, such as aesthetics, comfort, and convenience, which usually are not completely addressed by specifications (Kenny 1988).

While the conformance-to-requirements definition is appropriate for the construction phase of a project, it is more problematic for the design phase, which, by its nature, requires much judgment, discretion and creativity (Davis et al. 1989). There is also questionable usability of the definition for evaluation of service quality for it fails to address the unique characteristics of service (Reeves and Bednar 1994). This is especially true when a high degree of human contact is involved.

Considering limitations in the development, interpretation and implementation of design requirements and specifications, it is obvious that the conformance-to-requirements approach should not be used as the exclusive criterion for defining quality. As Seymour and Low (1990) pointed out, the conformance-to-requirements definition is far too limiting and provides an incomplete vocabulary of quality. In summary, there is a need for a more robust view of quality.

Customer Satisfaction Definition of Quality

For a company to compete effectively on the quality of its products and services “a deeper understanding to the customer’s perspective is a necessary first step” (Garvin 1984, p.43). A more robust view of quality comes with the customer satisfaction approach, which places the emphasis upon the customer. It demands an entirely new perspective--one that calls for viewing quality externally, from the customer’s perspective, rather than internally, from a quality-assurance point of view. According to that approach, quality is the extent to which a product or service meets a customer’s expectations. The serious limitation of this definition is its complexity; it is the most complex definition of quality and the most difficult to measure for different customers place different weights on the various attributes of a product and service.

Apparently, both approaches to quality have strengths and limitations in relation to measurement, generalizability, and practical usefulness. They should not be seen as mutually exclusive; rather they should be viewed as complementary to each other. The main premise of this paper is that in the marketplace, quality must ultimately be evaluated from the customer’s perspective. Consequently, we define quality as customer satisfaction with a product and service received.

Customer Satisfaction as a Performance Criterion

Recently a number of companies have begun to create new performance measurement systems that supplement and extend the more traditional financial measures of company performance. In response to changing markets, and concerns about a “short-term orientation,” these firms have begun to use, so called, nonfinancial measures, such as quality and customer satisfaction (Eccles and Pyburn 1992).

The use of “soft” performance criteria, such as customer satisfaction, in construction is at an early evolutionary stage. Companies still track customer satisfaction less than they do individual project performance, overall company performance, or safety and estimating, for example (ENR 1995). In this paper we argue that customer satisfaction can be used for evaluation of quality and ultimately for assessment of success of a company’s quality improvement program.

A Model for Evaluation of Homebuilder Quality Improvement Effort

In this section we present a model in which customer satisfaction is utilized for evaluation of a homebuilder’s quality improvement effort. Before we can elaborate on the model, it is necessary to provide simple, conceptually sound definitions of a customer. The simplest available definition of a customer is “one who pays the bill” (Austin and Peters 1985)-- a “paying” customer. Within the construction context, it is the owner or client. Another type of customer, equally important, is one who uses a product or service-- a “user” customer. Most facilities have been designed and built for a client other than the user--the designer and contractor, paid by one client, design and build for another, the user. It is very important to make the distinction between the two types of customers for they use different sets of criteria against which they judge their satisfaction. The unique characteristic of the homebuyer population is that it represents both types of customers, paying and user customers.

Figure 1 shows a model depicting the relationships between a homebuilder's quality improvement program, product and service quality, and customer satisfaction. According to the model, a quality improvement effort, if observed and managed in an organized fashion, will lead to achieving higher product and service quality, which will eventually lead to improved customer satisfaction.

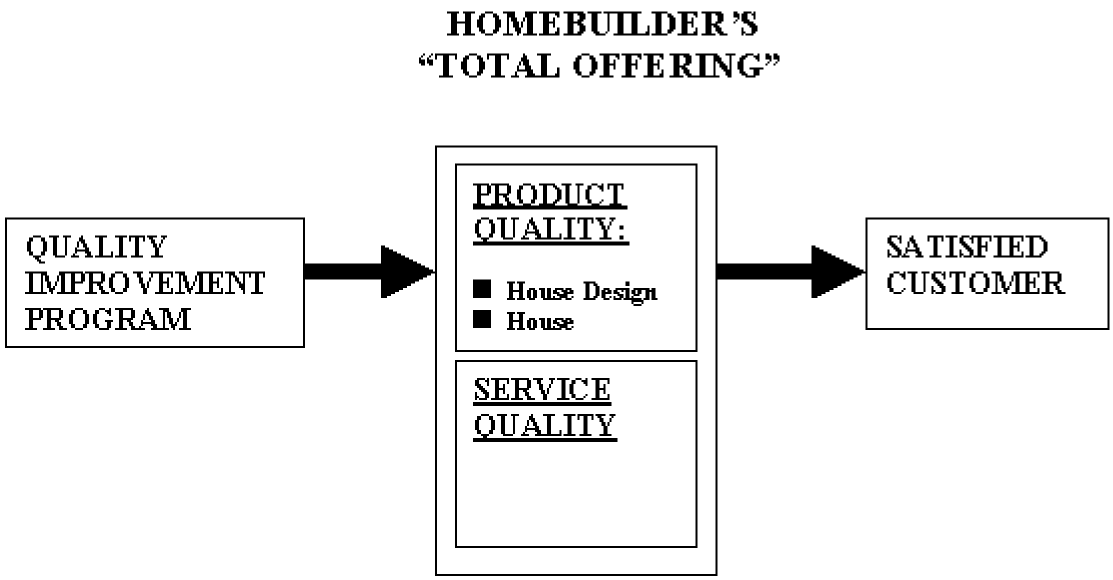

Figure 1. The relationship between quality improvement program, product and service quality and customer satisfaction.

Our model assumes that the relevant elements of a homebuilder's market offering extend beyond the core offering, namely, building the house itself. In fact, the quality of service may be the only factor that sets a homebuilder apart from other homebuilders who are offering similar homes for similar market segments (NAHB 1988). As Brown and Fern (1981) pointed out, rarely are market offerings all products or all services but most often they are a blend of the two. Consequently, every product and service must be designed, produced, and delivered in the context of a total package of products and services -- it is the "total offering" that generates the total degree of customer satisfaction.

HOMBSAT--An Instrument for Measuring Homebuyer Satisfaction

Although the construction industry has recognized quality and client satisfaction as decisive business factors, it is still unknown how well the industry is meeting client expectations. There are no commonly accepted methods of measuring customer satisfaction in the construction industry. One reason for this is the existence of a wide variety of customers that can be found across the spectrum of construction projects. Customers encountered in a typical highway construction project, for example, use a different set of criteria against which they judge their satisfaction, from, for example, that used by a purchaser of a single-family house. Consequently, measuring customer satisfaction in different segments of construction requires different "custom-designed" methods and instruments. The absence of a generally acceptable operational definition of customer satisfaction in construction appears to result in neglected implementation of this critical concept.

In order to measure the extent of homebuyer satisfaction we need an instrument to enable structured observation and measurement of the concept. Based on an exhaustive review of the literature, an instrument for measuring homebuyer satisfaction, called HOMBSAT (**HOM**e-**B**uyer **SAT**isfaction), was developed (Torbica 1997). To test HOMBSAT instrument data were collected from homebuyers regarding their level of satisfaction with design, house, and service. The measures proposed were tested and shown to be reliable and valid, and it was concluded that the HOMBSAT represents a credible instrument to measure homebuyer satisfaction. More detailed discussion on the development and testing of the HOMBSAT can be found in Torbica (1997). The instrument consists of 51 items-14 items representing the DESIGN dimension, 16 items representing the HOUSE dimension, and 21 items representing the SERVICE dimension of homebuilder's total offering. A complete list of 51 items is shown in Appendix. To measure homebuyer's perception about design/house/service quality, a seven point Likert-type scale, like one shown in Table 1, is used.

Table 1

A Typical Item from HOMBSAT: How satisfied are you with illumination level or quantity of light in your house?

Very Dissatisfied	**Dissatisfied**	**Somewhat Dissatisfied**	**Neither Dissatisfied Nor Satisfied**	**Somewhat Satisfied**	**Satisfied**	**Very Satisfied**
1 1	2	3	4	5	6	

Home Buyer Satisfaction Scores

Operationally, customer satisfaction is a complex and elusive phenomenon (Peterson and Wilson 1992) that is not directly measurable by any observable variable. It is, however, indirectly measurable via a multiple-indicators approach (Johnson and Fornell 1991). Typically, a concept is rated on several scales representing items, or statements associated with a single dimension, and the results are averaged to provide a single score for each dimension. The summed scale score serves as an index of attitudes towards the concept.

Homebuilder's quality performance can be indirectly inferred from scores on each of the three HOMBSAT dimensions. The scores for DESIGN, HOUSE, and SERVICE for a company are obtained by averaging the individual homebuyer scores. The individual homebuyer scores are the mean of the individual's responses for the items within each dimension. The scores can be used independently, or in combination. For example, if homebuilder itself does not provide the design, it can be excluded from consideration. On the other hand, a total company score for homebuyer satisfaction can be calculated by adding up the average score on each of the three dimensions and then dividing by three.

HOMBSAT instrument has been successfully used in a study of Total Quality Management (TQM) practice employed by 16 medium to large Florida homebuilders (see Torbica 1997). The study has confirmed that implementation of TQM is positively associated with homebuyer satisfaction.

Conclusion

Organizational efforts towards continuous improvement should be focused on creating performance measurement systems that provide relevant, factual information on core business processes and key activities (Miller 1992). We have shown that customer satisfaction, as an external measure, can provide the strategic intelligence needed to direct the quality improvement effort. We have also pointed out that in the home building industry the homebuyer represents both the "paying" customer and the "using" customer. This situation requires that the tool for measuring quality address the needs and wants of both customer types.

HOMBSAT, the measurement tool proposed, is most valuable when it is used periodically to track homebuyer satisfaction trends. It allows homebuilders to track their improvement in providing quality homes and services over the coming years. Also, HOMBSAT can be used by homebuilders to track and make comparisons among the company's quality performance provided by different divisions, projects, or in different geographic locations.

References

Austin, N. and Peters, T. (1985). *A Passion for Excellence.* Warner Books, New York.

Brown, J. R. and Fern, E. F. (1981). "Goods vs. Service Marketing: A Divergent Perspective". In Donnelly, J. H. and George, W. R., Eds., *Marketing of Services.* America Marketing Association, Chicago, 205-212.

Burati, J. L. Jr., Farrington, J. J., and Ledbetter, W. B. (1992). "Causes of Quality Deviations in Design and Construction". *Journal of Construction Engineering and Management.* ASCE, 118 (1), 34-49.

Davis, K., Ledbetter, W. B., and Burati, J. L. (1989). "Measuring Design and Construction Quality Costs". *Journal of Construction Engineering and Management.* ASCE, 115 (3), 385-400.

Eccles, R. G. and Pyburn, P. J. (1992, October). "Creating a Comprehensive System to Measure Performance". *Management Accounting.* 41-44.

ENR. (1995, February 1). "TQM is underutilized, according to poll". 14.

Garvin, D. A. (1984, May-June). "Product Quality: An Important Strategic Weapon". *Business Horizons.* 43-47.

Johnson, M. D. and Fornell, C. (1991). “A Framework for Comparing Customer Satisfaction Across Individuals and Product Categories”. *Journal of Economic Psychology*. 12, 267-286.

Kelvin, F. C. and Lynch, R. L. (1992, April). “For Good Measure”. *CMA Magazine.* 20-23.

Kenny, A. A. (1988, June). "A New Paradigm for Quality Assurance". *Quality Progress.* 30-32.

Miller, J. A. (1992, April). “The New Activity Performance Measures”. *CMA Magazine.* 34.

NAHB. (1988). *Customer Service For Home Builders.* Washington, D.C.

Peterson, R. A. and Wilson,W. R. (1992). “Measuring Customer Satisfaction: Fact and Artifact”. *Journal of the Academy of Marketing Science.* 20 (1), 61-71.

Reeves, C. A. and Bednar, D. A. (1994). “Defining Quality: Alternatives and Implications”. *Academy of Management Review.* 19 (3), 419-445.

Seymour, D. and Sui-Pheng, L. (1990). “The quality debate”. *Construction Management and Economics.* 8, 13-29.

Torbica, Z. (1997). “*Total Quality Management and Customer Satisfaction in Home Building*”. Ph.D. Dissertation. University of Florida, Gainesville, Florida.

Tucker, R. L. (1990, May). “The Biq “Q””. *The Construction Specifier.*151-152.

Appendix
HOMBSAT Questionnaire:

	DESIGN:
1	How satisfied are you with your house floor plan?
2	How satisfied are you with the scale and proportion of floor plan?
3	How satisfied are you with the number of rooms in your house?
4	How satisfied are you with the size of the rooms in your house?
5	How satisfied are you with the layout of the rooms, that is, the design in relation to your daily life?
6	How satisfied are you with the location of the different rooms?
7	How satisfied are you with individual space for each member of your household?
8	How satisfied are you with your kitchen design?
9	How satisfied are you with bathroom(s) design?
10	How satisfied are you with the number of bathrooms in your dwelling unit?
11	How satisfied are you with ceiling height?
12	How satisfied are you with the amount of privacy available in your house?
13	How satisfied are you with the number and placement of electrical outlets?
14	How satisfied are you with the brightness or light in your house during the daytime?

	HOUSE:
15	How satisfied are you with the energy-efficient features in your house?
16	How satisfied are you with utility cost?
17	How satisfied are you with low-cost maintenance features in your house?
18	How satisfied are you with easiness of maintenance of your house?
19	How satisfied are you with the cost and effort needed to keep the house up?
20	How satisfied are you with the operation of Heating/Air Conditioning?
21	How satisfied are you with the quality of building materials used in your house?
22	How satisfied are you with the quality of materials used in floors?
23	How satisfied are you with the quality of materials used in walls?
24	How satisfied are you with the operation of windows?
25	How satisfied are you with the operation of doors?
26	How satisfied are you with the operation of electrical features?
27	How satisfied were you with quality of finish workmanship?
28	How satisfied are you with the quality of workmanship of painting (free of nail pops, free of shrinkage cracks, etc)?
29	How satisfied are you with the roof performance?
30	How satisfied are you with the performance of foundation?

	SERVICE:
31	Extent to which home builder set your expectations early.
32	Extent to which home builder personnel were available during evening and weekend hours.
33	Extent to which you were welcomed enthusiastically.
34	Extent to which home builder presented the basic advantages of their home.
35	Extent to which home builder pointed out some hidden values of the home.
36	Extent to which you were treated like a person, not a number.
37	Extent to which home builder personnel showed interest in you as a customer.
38	Extent to which you were given a quiet place to make decisions.
39	Extent to which home builder explained every step of home buying and building process to you.
40	Extent to which it was made clear to you whom you should contact during construction.
41	Extent to which home builder explained to you warranty coverage.
42	Extent to which homebuilder explained to you your responsibilities for maintenance and upkeep.
43	Extent to which homebuilder explained to you the way the various items in your home operate.
44	How satisfied were you with professionalism of home builder personnel?
45	How satisfied were you with competence (skills and knowledge) of home builder personnel?
46	How satisfied were you with responsiveness (willingness to help and provide prompt service) of homebuilder personnel?
47	How satisfied were you with reliability (ability to perform the promised service dependably and accurately) of homebuilder personnel?
48	How satisfied were you with courteousness of homebuilder personnel?
49	How satisfied were you with communication with builder's construction personnel?
50	How satisfied were you with builder's responsiveness to questions/ concerns?
51	How would you rate your satisfaction with your builder's attitude about customer service (i.e. after move-in)?

Author Index to Volume 4

Contributing Reviewers

Dr. John W Adcox, *University of North Florida*
Dr. Burcu H Akinci, *Stanford University*
Mr. Joseph O Arumala, *University of Maryland* **-** *East Shore*
Dr. Flynn L Auchey, *Virginia Polytechnic Institute and State University*
Dr. David L Batie, *East Carolina University*
Dr. Charles W Berryman, *University of Nebraska* **-** *Lincoln*
Mr. Keith Bisharat, *California State University* **-** *Sacramento*
Dr. Richard A Boser, *Illinois State University*
Dr. Hollis G Bray, *Northeast Louisiana University*
Dr. Amaury A Caballero, *Florida International University* **-** *Timiami*
Dr. Abdol R Chini, *University of Florida*
Dr. William C. Epstein, *California Polytechnic State University* **-** *San Luis Obispo*
Dr. John A Gambatese, *University of Nevada* **-** *Las Vegas*
Dr. Mousa T Gargari, *University of Cincinnati*
Mr. David W Goodloe, *Clemson University*
Mr. David Hanna, *Ferris State University*
Mr. Paul E Harmon, *University of Nebraska* **-** *Lincoln*
Dr. Allan J Hauck, *Colorado State University*
Ms. Dianne H Kay, *Southern Illinois University* **-** *Edwardsville*
Dr. Mostafa M Khattab, *University of Nebraska* **-** *Lincoln*
Mr. Kraig Knutson, *Arizona State University*
Dr. Douglas W Kruger, *East Carolina University*
Mr. Jeffrey J Lew, *Purdue University* **-** *BCM*
Mr. Jon L Mason, *Boise State University*
Mr. Charles A Matrosic, *Ferris State University*
Mr. Bill W McManus, *University of Oklahoma*
Mr. Thomas H Mills, *Virginia Polytechnic Institute and State University*
Dr. John D Murphy, *Colorado State University*
Dr. Larry Muszynski, *University of Florida*
Ms. MaryEllen C Nobe, *University of Nebraska* **-** *Kearney*
Dr. Michael D Nobe, *University of Nebraska* **-** *Kearney*
Mr. Neil Opfer, *University of Nevada* **-** *Las Vegas*
Dr. Ray J Perreault, *Central Connecticut State University*
Mr. Randy R Rapp, *Southern Illinois University* **-** *Edwardsville*
Dr. John E Schaufelberger, *University of Washington*
Dr. Bolivar A Senior, *Colorado State University*
Ms. Linda Swoboda, *University of Nebraska* **-** *Lincoln*
Dr. Zeljko M Torbica, *Florida International University* **-** *Timiami*
Mr. James (Mike) M Tramel, *University of Arkansas* **-** *Little Rock*
Mr. Frederick J Trost, *Texas A&M University*
Dr. Philip D Udo-Inyang, *Temple University*
Mr. Tim Wentz, *University of Nebraska* **-** *Lincoln*
Dr. Avi Wiezel, *Arizona State University*
Dr. Paul K Woods, *Texas A&M University*
Mr. Eugene H Wright, *University of Nebraska* **-** *Lincoln*
Mr. Bruce Yoakum, *California State University* **-** *Chico*
Mr. William H Zabel, *Georgia Southern University*

Acknowledgement

Ms. Rashmi Menon a graduate student with Texas A&M University has joined the Journal as Administrative Assistant. The Editor truly looks forward to working with her for the next couple of years. The Editor continues to thank the Department of Construction Science and the College of Architecture of Texas A&M University for their support of the *Journal* creation and operations. Thanks are also due to the Editorial Advisory Board whose names appear on the second page; and to those serving on the Review Board listed above.

Membership Applications

Inquiries should be send to: Associated Schools of Construction, Hendrick D. Mol., Executive Director, Building Science Department, 119 Dudley Hall, Auburn University, Auburn, AL 36849-5315, Tel: 334.844.4518, E-mail: molhend@mail.auburn.edu

Organizations eligible for membership may fill out one of the application forms at: (http://ascweb.org). Please read the following membership grouping information, pick or enter the hyperlink into your web browser for the type of membership that fits your organization and submit the completed form.

- Institutional Members: shall be those institutions having at least one baccalaureate or higher degree construction program. Annual member dues are $400.00.
- Associate Members: shall be institutions of higher education, including junior and community colleges, not meeting institutional member requirements (two year programs). Annual member dues are $250.00.
- Industrial Members: shall be industrial organizations demonstrating a constructive interest in construction education. Annual member dues are $400.00 base membership or $650, which includes $250 for advertising industry, positions on the ASC web site. This service (http://ascweb.org/internet/positions/industry/main.asp) includes full-time, part-time, summer internship, and co-op program listings.