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Designing Engineering Contents for a Construction Management Program

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The engineering contents for the Construction Management program at a West Central University had shortcomings in their instructional objectives and delivery, and students frequently required more than the intended number semesters to complete them. Furthermore, administrative mandates compelled a reduction in their total number of credit hours. This article presents the strategies followed to develop a new engineering course sequence, with improved contents, in a very short time span. It also discusses the instructional design philosophy observed for these new courses, and the concerns raised by the participants in their development process.

Keywords: Construction Management, Instructional Design, Curriculum Development, Engineering Contents, Structural Design.

Introduction

There is a general consensus among Construction Management (CM) academicians and industry advisory boards that CM professionals need to have an understanding of the forces acting on construction structures, how these forces are supported by construction structures, and how these structures are dimensioned depending on their materials. Furthermore, CM professionals need to know and understand codes and regulations that reflect these engineering aspects. Laboratory tests, realistic final projects, and similar practical experiences enhance the learning experiences for most CM students. These topics will be called "engineering contents" in this article. But the devil is in the details. Should CM students be capable of designing structural members? Should soils engineering be included as a separate course? How many credits should engineering courses have apportioned? Who should teach these courses?

This article discusses how the engineering contents in the Construction Management program at a West Central University, were revised as part of a general curriculum overhaul planned for months, and made imperative by new university guidelines. These changes will take effect on the fall semester of 2000, and the changes discussed here were developed between September and November of 1999. The objective of this paper is presenting the strategies, pedagogical issues, administrative concerns, and lessons learned during this revision of the engineering contents. Some of the circumstances presented here are unique, and the curriculum decisions taken reflect the character of its CM program. However, many issues could be applicable to other CM programs.

The CM Program at a West Central University in Context

The CM program has been operating for over fifty years. It is one of three programs offered in the department of Manufacturing Technology and Construction Management (MTCM), the other two being Industrial Technology Management and Technology Education and Training. Furthermore, MTCM is in the College of Applied Human Sciences, which comprises nine relatively dissimilar departments, such as Occupational Therapy, the School of Education, Design and Merchandising, Health and Exercise Science, and Social Work. This broad scope has worked well for MTCM, since it has enjoyed more autonomy and appreciation for its mission than some other CM programs housed in Engineering, Architecture, or other traditional colleges.

The program experienced important changes in 1997. A Pre-MTCM program, common to the three department majors, replaced its freshman and sophomore years. The CM program became a controlled major, whose admission requires the completion of the Pre-MTCM curriculum and a minimum GPA of 2.3. Furthermore, a mandatory six-month, six-credit internship was implemented, which can be completed over one semester or two summers. No additional courses can be taken while carrying out the internship.

New university mandates have resulted in further program revisions. The program must be reduced from its current 128 credits to 120 credits by the fall of 2000. A new All-University Core Curriculum, also starting in fall of 2000, has new requirements and course offerings. The program has also strived to accommodate the new (but unofficial in 1999) AACE standards in these revisions.

Current Engineering Contents

The Construction Management program currently provides much emphasis in engineering contents. The current engineering curriculum structure is shown in Figure 1. It consists of six courses with a total of eighteen credits. Statics and Mechanics of Materials are offered in separate courses, followed by courses in Soils Engineering, Structural Design of Steel and Concrete Structures, Wood Structures, and a Construction Materials lab. The Civil Engineering (CE) department offers all these courses, except for Wood Structures, which, for historical reasons, has been offered by the Forest Sciences department.

Shortcomings of Current Engineering Courses

The current offerings have shortcomings in several areas. Many of them had been evident in the past, and the significance of others was made more evident in the research and development process for this revision.

Service courses

Some of the most important drawbacks in the current engineering courses derive from having them offered outside the MTCM department. Their contents frequently tend to reflect a civil

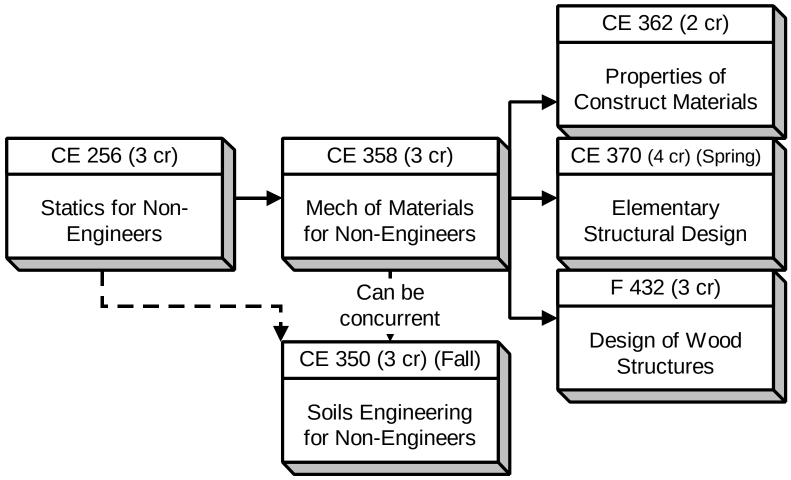

Figure 1. Current Engineering Sequence

engineering perspective instead of providing CM insights. For example, the Structural Design course emphasizes design details, while the rationale behind applicable codes and specifications (e.g., UBC, ACI) is much less stressed. Morris and Laboube (1995) discuss in more detail what constitutes a CE teaching perspective. A more pervasive but equally important problem is the lack of faculty ownership for some of these courses, which can lead to multiple pedagogical problems (Senior et al., 1993). Many CE instructors have taught Statics (a particularly extreme case) over the years. One instructor recently admitted to the class that, at least once, the loser of a straw draw among junior CE faculty determined who taught Statics. In fairness, it must be noted that permanent instructors have enthusiastically offered some of the engineering courses for years.

Transfers and prerequisites

Reviewing the prerequisites of the Statics course provided a particularly insightful case of why long-lived requirements need to be regularly challenged. Statics has currently two prerequisites, M126, Analytic Trigonometry, and M141, Calculus in Management Sciences. For years, students could take M126 concurrently with Statics, provided that they had finished M125, Numerical Trigonometry. An uncomfortable situation arose in fall 1999 when the CE department decided to enforce the M126 prerequisite. An articulation agreement with the local community college allows transferring its Statics course. However, this course only requires their equivalent of M125 as prerequisite. Students caught without the M126 prerequisite defected in mass to take Statics at the community college (CE did offer these students the chance to complete M126, a one-credit math module, in the first weeks of the semester. Many chose not to take advantage of this offer). Several questions ensued. Were these students getting an inferior education at the community college? If so, why did MTCM allow this transfer? If not, why was M126 a prerequisite for Statics? An analysis of these course syllabi showed that, in fact, Statics did not require it! The new curriculum will not list M126 as a prerequisite for any course. Less dramatic reviews were also conducted for all the other courses.

Internship and course sequencing

Many CM students transfer from other programs or colleges. They frequently can complete the Pre-MTCM program in one year and then move on to the CM major. As Figure 1 shows, the current engineering course sequence begins with Statics. Mechanics of Materials, and then the two Engineering Design courses and the Construction Materials lab, follow it. Soils Engineering can be taken concurrently with Mechanics of Materials, but it is offered in the fall only. Structural Design is also only offered yearly, in the spring semester. This sequence has a length of three semesters when a student takes Mechanics of Materials in the fall semester and enrolls concurrently for Soils Engineering. However, this assumes that the student can fit nine hours of engineering courses into the last year, and frequently, the last semester. Moreover, if a student takes Mechanics of Materials in the spring semester, the engineering course sequence requires four semesters. If the student takes Mechanics of Materials in the fall, but fails to enroll concurrently for Soils Engineering, the sequence also becomes four semesters long.

CM requires six months of full-time internship for all students. This internship can be taken in one semester worth six credits, or in two summer sessions of three credits each. Many intern sponsors prefer the six-month option, but only students finishing their engineering sequence in three semesters can take this option without prolonging their four-semester plan of study. Accommodating the internship into the inflexible engineering course sequence has been a major task for many students and their faculty advisors. More information about the internship program is available at the MTCM internship director’s office.

Engineering Materials Lab

The Construction Materials lab tends not to be taken concurrently with the engineering design courses. In some cases, this “Smash Lab,” as commonly called among students, is taken before the engineering design courses, thus nullifying the intended didactical effect of having a tangible experience along with the design concepts.

Accreditation issues

Although AACE has not finalized its new accreditation guidelines, a preliminary version was used as a point of comparison with the current engineering contents. These guidelines suggest between 20 and 30 credit hours of construction science contents. They should include a minimum of three credits of design theory, six of analysis and design of systems, six of methods and materials, one of construction graphics, and one of surveying. The current CM program has 46 credits covering these topics, substantially more than required. Factoring the university mandate to trim eight credits from the current program, the current engineering contents were prime candidates for an overhaul.

Strategy for the New Contents Development

The engineering contents revision had to be completed in a very short time span. The requirements for the new University Core Curriculum had not been established by the administration at the beginning of the fall semester. Modifying the engineering courses had been discussed for months, but no concrete steps had been taken at the beginning of the semester. The situation with the Statics course discussed before in this article brought a sense of urgency to the engineering contents overhaul, but with a deadline to submit curriculum changes by early November, it was clear that a design-by-committee approach would not be adequate. One of this article's authors has taught engineering content courses, is the undergraduate CM program coordinator, the head of the MTCM curriculum committee, and the MTCM representative to the college curriculum committee. The other author is a structural civil engineer, and has also taught engineering courses in civil engineering programs. The CM faculty decided to entrust the authors with reviewing the existing engineering contents, and recommending their new contents and delivery. The CM curriculum subcommittee met every week during the semester, and at least monthly with the CM faculty at large.

The Civil Engineering department fully concurred with the goal of overhauling the CM engineering contents. They had very little input up to the point where the first course drafts were prepared, since the CM faculty wanted to have maximum flexibility in their research and brainstorming. However, and considering that all but one engineering content course is offered in the CE department as a service to the CM program, it was always kept in mind that the final course structure should be acceptable to both departments. The first curriculum draft proposal was presented to CE representatives and the Woods Structures instructor. Several meetings with all the stakeholders followed. Attendees to these meetings included the two authors and the MTCM department head; several of the CE instructors and the CE assistant department head; and the Woods Structures course instructor.

Instructional Design Philosophy

Professional engineers need a deep understanding of design theory so that they can develop construction codes and specifications. Professional constructors need a deep understanding of construction codes and specifications so that they can develop construction projects. Engineers should have a good grasp of construction project issues to develop sound codes and specifications. Constructors should have a good grasp of design theory to understand codes and specifications.

The above design philosophy was established early on in the contents development process, and formally accepted by the CM faculty at large. Other curriculum design principles included that labs and other practical components should be provided as concurrently as possible with the corresponding theory; that there would be "no stones unturned" and no "sacred cows," that is, the design would cover every possible issue; and that no implementation constraints would be initially considered.

Preliminary Proposal

Several sources were researched to develop the initial contents proposal. While literature on individual engineering course development is available (e.g., Opfer & Gambatese, 1999), there is only scant information on the current engineering contents at CM programs. The summary presented by A. Chini (1995) proved invaluable as a starting reference. Several CM programs sent copies of their engineering syllabi. Contacts with instructors at other programs proved to be helpful.

The Internet was used extensively as a research tool. Most publishers have available on their websites the table of contents of virtually every recent book (e.g., McGraw-Hill at http://www.pbg.mcgraw-hill.com, Delmar Publishers at http://www.delmar.com, Prentice Hall at http://www.phptr.com. Sites such as Amazon.com provide powerful search engines, which can be used to pinpoint textbooks with any target keyword.

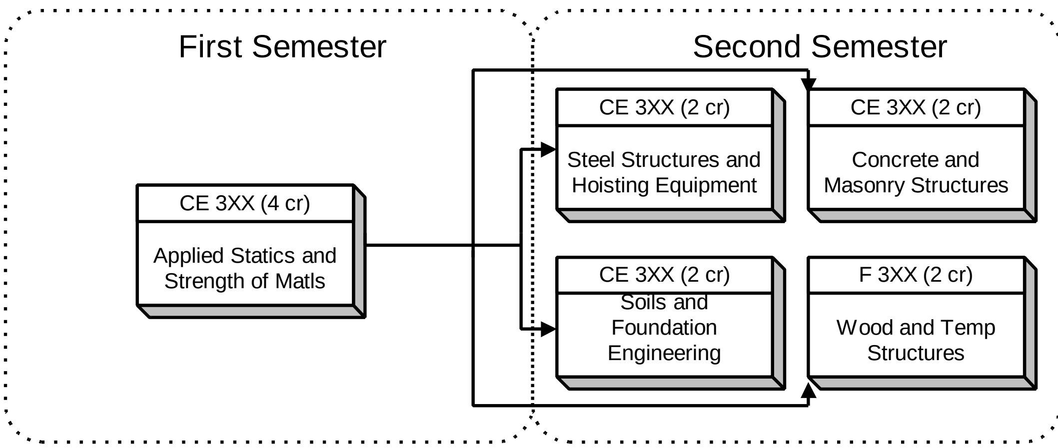

Figure 2. Initial Sequence Proposed

The first proposed course sequence is shown in Figure 2. This arrangement combined Statics and Mechanics of Materials into a four-credit course. Four design modules followed: steel structures, concrete and masonry structures, wood and temporary structures, and soils and foundations. Each of these two-credit modules was to be offered in eight-week sessions, every semester. This implied doubling the meeting frequency compared to a full-semester two-credit course, that is, six hours per week. Although Figure 2 shows the minimum sequence duration of two semesters, it was expected that many students would choose to complete the courses in three semesters, to better balance their total academic load.

The total of credits for the engineering sequence was abridged from 18 to 12 credits. This reduction was made possible in part by the elimination of the Properties of Construction Materials lab. An existing Pre-MTCM course, MC 251, Materials Testing and Processing, included some contents of secondary importance, from a CM perspective (as a Pre-MTCM offering, it also had to cover manufacturing materials). This course was revamped to include more construction-specific contents. The rest of the removed lab course was included in the proposed course modules.

The Schedule of Topics for Applied Structural Timber Materials and Design is shown in Table 1, as an example of the practical and code-oriented contents intended for these modules.

Table 1

Initial Schedule of Topics Example

CE 3XX APPLIED STRUCTURAL TIMBER MATERIALS AND DESIGN **Tentative Schedule of Topics**
1. Introduction. Relevance and objectives. Liability and ethics of professional wood structures engineers and constructors. Codes and standards for timber and engineered wood design, construction, and testing.
2. Design of Simple Timber Beams. Code design rationale and main provisions. Loads. Working stress computations. Reactions and load bearing. Gang-laminated beam sections.
3. Design of Simple Wood Joists and Rafters. Code design rationale and main provisions. Published tables. Lateral stability.
4. Design of Simple Timber Columns. Code design rationale and main provisions. Design procedure.
5. Wood Connections. Types of connections. Design principles. Commercial alternatives.
6. Design of Simple Concrete Formwork. Code design rationale and main provisions. Loads. Published tables. Commercial alternatives.
7. Wood and Wood materials. Wood structure and properties. Commercial timber and engineered wood products.
8. Plastics and Composite Materials Structure and properties of plastics. Properties of composite materials. Structural applications.
9. Laboratory tests. Bending and compression of wood specimens. Tensile properties of plastics.
10. Discussion of Notable Historical Failures in Timber Construction.

Administrative Concerns

The first proposed sequence brought concerns from several stakeholders, especially the CE department. A main concern was the eight-week, two-credit course sequences proposed. CE instructors are expected to teach 12 credits per year. Most CE courses have three credits. An instructor teaching one of the proposed two-credit courses every semester would most likely end up teaching an additional load of three three-credit courses. In other words, the instructor would exceed the CE standard of 12 credits, and would add a course to the usual load of four courses per year. It would also complicate teaching assistant assignments, and the labs would be overloaded during one half of the semester, and unused in the other half. Administrators also pointed out that two-credit courses are time-consuming and not very relevant in non-tenured faculty dossiers.

The proposed Statics and Mechanics of Materials course was readily accepted. As previously pointed out, this area has not had a permanent instructor. However, other areas with identifiable champions required much more discussion. Permanent instructors protested that their course contents were already lean, and any further reduction in contents was impossible. On the other hand, adding new contents was equally, if not more, unrealistic. CE instructors are expected to teach 12 credits per year. Most CE courses have three credits. An instructor teaching one of the proposed two-credit courses every semester would most likely end up teaching an additional load of three three-credit courses. In other words, the instructor would exceed the CE standard of 12 credits, and would add a course to the usual load of four courses per year. However, much tact and willingness to compromise was necessary to keep moving forward the new course definition discussions.

Final Version of the Contents and Courses

The final arrangement is shown in Figure 3. The eight-week courses were eliminated, and in their place, three full-semester courses of three credits each will be offered. Statics and Mechanics of Materials were kept in one course, as proposed, but some of the originally proposed contents will be covered in Wood Structures. This course will now include temporary structures, and will be a prerequisite for Elementary Design of Structures. This latter course will include steel and concrete structures, similarly to the current approach, but its contents will now reflect the objectives proposed by CM. This program is one of few programs offering Soils and Foundation Engineering. The current course has a dedicated CE instructor, and has excellent (if detailed) contents. It was decided that this area provides part of its character to the CM program, and was kept at its current three credits instead of the two proposed.

This final contents arrangement fulfills the instructional objectives of CM, while responding to the concerns of the CE department. It is administratively simple to implement, since of the four courses, three only require syllabus changes, and one is being reduced from four to three credits. This is especially evident compared to the initial proposal, which required creating five new courses, four of which would follow eight-week schedules. Turfs were protected, too. Wood Structures and Soils Engineering, the current courses with strongest champions, remain at three credits.

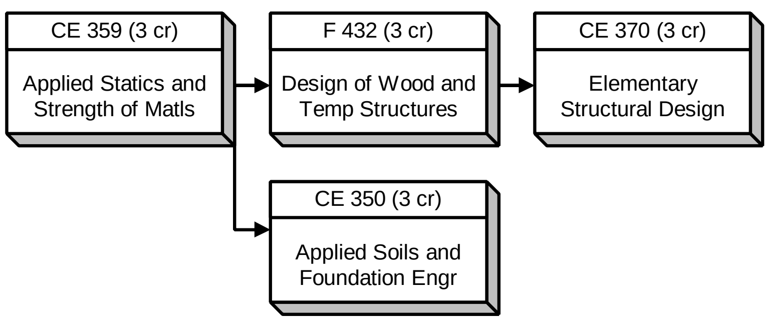

Figure 3. Final Adopted Sequence

Conclusion

There were many lessons learned for the CM program from this curriculum design experience. It clarified the intended role and relative importance of engineering contents in the program. The advantages and limitations of eight-week course modules were examined. The contents of existing courses were revisited, and showed how there can be misalignments between what is being covered in class and what other faculty assumes is being covered. MTCM improved its relations with the CE department and their faculty. The whole research, design and adjustment process took only three months, and showed a viable approach for compressing such curriculum projects. This approach can be summarized as an early, clear definition of objectives, which were entrusted to a small number of faculty members. These faculty members were given much latitude to develop the initial course proposal, and were key participants in the ensuing discussions.

Even with the full agreement in the new contents, there are implementation issues to be resolved. For example, although the new sequence is very likely to be approved by the Engineering and the University curriculum committees, it is not an official change yet. Should students refrain from registering for the last offering of the current Statics next semester? Since only the combined course will be offering in the fall, they would be retaking the Statics contents. One alternative being considered is offering the current Mechanics of Materials in the summer session, so that these students could be ready to start the engineering design courses by fall.

An unresolved issue is whether most or all of the engineering sequence could and should be taught in-house at MTCM. There are good reasons to seek this objective, such as having engineering instructors with a better understanding of CM education needs, and a more agile revision process for any contents area. On the other hand, one reason for offering engineering courses in the CE department has been creating a positive synergy between CE and CM students. Since CE students cannot take the CM service courses for credit, this reason has become less important over the years. A limiting factor for the in-house offerings is that CE would have to give up the faculty lines now devoted for these courses, which could be a long and delicate process.

The present curriculum development process will not be complete until the finer issues of course contents and delivery are completed. As mentioned in the introduction, the devil is in the details, and some fire and brimstones will probably materialize during the spring 2000 semester, when these points will be discussed.

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Evaluation of an Interdisciplinary Studio Experience to Teach Architecture and Construction Science Students the Design-Build Project Delivery Method

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This paper describes the authors' joint class project of design-build that was conducted in an interdisciplinary studio in the College of Architecture at a large Southern University during the spring semester, 1999. Students in ARCH 306, Architectural Design III, and COSC 455, Alternative Construction Delivery Systems, were joined in a studio to perform the design-build project, which was to design an ambassador's residence for a selected country on a pre-selected site in Washington, DC. The design-build studio project provides a perfect framework in which to initiate an interdisciplinary architectural studio that responds to the recommendations of the Boyer Report – the Special Report by the Carnegie Foundation for the Advancement of Teaching – on the future of architecture education and practice. The Boyer Report lists among its seven goals the need for a "full exploitation of the interdisciplinary potential for architectural education and practice," and "interdisciplinary connections to better serve society's needs." Evaluation of the integrated studio experience found it to be extremely rewarding for the students in that it gave them an accurate picture of professional practice.

Key Words: Project Management, Materials and Methods of Construction, Mechanical Systems, Alternative Project Delivery Methods, Value Engineering

Introduction

The design-build project delivery method is a system of construction project delivery in which one entity forges a single contract with the owner to provide for architecture/engineering design and construction services (Dorsey, 1997). Hence, a design-build project provides a perfect framework to initiate an interdisciplinary architectural studio that responds to the recommendations made by the Boyer Report (1996) -- the Special Report by the Carnegie Foundation for the Advancement of Teaching -- on the future of architecture education and practice. The Boyer Report lists among its seven goals the need for a "full exploitation of the interdisciplinary potential for architectural education and practice," and "interdisciplinary connections to better serve society's needs."

In response to the above recommendations and as a reflection of the authors' search for a teaching environment that better represents the realities of contemporary construction project delivery methods, a joint design-build project was initiated in which architecture and construction science students were teamed up in a studio experience to be taught how to prepare a single source contract package for an owner. The contract package included a design proposal, a conceptual project cost estimate, a conceptual project construction schedule, a cost-revenue curve, and value engineering analyses. It should be noted that the outcomes as well as the processes of this studio differ from other educational endeavors that are labeled as *design-build* which focus on actual construction of the projects in the course (Deamer, 1999).

In contemporary terms, a design-build studio simulates the professional practice where design-build becomes an important and viable construction project delivery option. The demand for a single source of responsibility that provides a seamless work environment between the design and construction teams, and the need for faster schedule delivery of the project contribute to the increased usage of design-build today. A number of authors on the topic of design-build have noted that as owners become increasingly familiar and comfortable with design-build services, and as firms continue to merge the design and construction teams, "…the prospects for firms offering design-build services will continue to be bright" (e.g. see Dorsey, 1997; and Tulacz, 1999a&b). These prospects demonstrate that design-build is becoming one of the significant trends in design and construction.

Furthermore, the link between today's design-build firms and the Master Builders of the Middle Ages, and of periods even before, demonstrates the importance of this system through historical precedent (Dorsey, 1997, p. 88). The Master Builder - part architect, part engineer, and part constructor - supervised the design and construction of important public/religion buildings throughout history. This one source of responsibility dominated building construction until the Industrial Revolution, when specialization of different professions such as architects, engineers, and constructors changed construction project delivery practices. In recent years, design-builders once again integrated design, engineering, and construction as a system of project delivery in which one entity is contracted to provide both design (architectural and engineering) and construction services. In contemporary practice of design-build, the Master Builder is replaced by a team of specialists who provide professional services to the owner under one "master" contract. Teaching an interdisciplinary studio of design-build, then, enhances the students' understanding of today's realization of design-build values in the light of history.

The Interdisciplinary Studio Project

This paper describes the authors' joint project of design-build that was conducted in an interdisciplinary studio in the College of Architecture at a large Southern University during the spring semester, 1999. Students in ARCH 306, Architectural Design III, and COSC 455, Alternative Construction Delivery Systems, were joined in the studio to perform the design-build project. "Interdisciplinary" in this instance means the combination of architectural design and building construction science students in one educational laboratory [studio] setting. The collaborative effort of an upper-level, six credit hour *Architectural Design Studio* (third year in the Architecture Program), and an upper-level, three credit hour *Alternative Construction Delivery Systems* class (fourth year in the Construction Science Program) in an interdisciplinary studio addressed the following preliminary objectives:

- Understand the process of design, construction and design-build by both disciplines;
- Create a realistic environment for design-build projects (simulating the professional practice); and,

- Develop the students' skills in working in interdisciplinary teams.

The Disciplinary Contributions

Architectural Design Studio (Architecture)

The main theme of the third year architectural design studio – architecture in an international context – was expressed by assigning the architecture students to design a residence for a foreign ambassador from France, Japan, South Africa, or Venezuela in Washington, DC. The project's specific location was at the corner of Massachusetts Avenue and Belmont Street NW, near a number of existing consulates. The residence was to serve as a residence, as a diplomatic government facility, as a place for receptions, and as a social hub for the embassy of the specific country. The total area of the facility was to be between 6,500 and 7,500 square feet.

The project was conducted in three main phases. First, the architecture class was divided into four teams of four students each. Teams were required to research and analyze the cultural and environmental background of the country of the ambassador, as well as the environmental conditions of the project site in Washington, DC. The results of this first stage were presented as conclusions and design guidelines that included the project concept (policy statement) and its operational objectives.

In the second phase, the architecture students worked in teams of two to develop their preliminary designs. The factors that influenced their building designs were their conclusions and design guidelines from the first stage, the programmatic requirements, and preliminary discussions of constructability with the construction science students.

In the third phase, the students finalized their designs based upon comments and criticism of their preliminary composition and the joint work with the construction science students. The final delivery of the design-build project of the residence for a foreign ambassador in Washington, DC included a summary of the research, the design proposal, and the analyses prepared by the construction science students. The project was submitted to the authors in a hard copy booklet and presented to a panel of reviewers as a digital presentation using PowerPoint™ software.

Alternative Construction Project Delivery Systems (Construction Science)

The construction science students of the *Alternative Construction Delivery Systems* class were assigned to work with the architecture students to prepare a conceptual cost estimate; a preliminary schedule analysis; a value engineering analyses of the foundation, structure, building cladding, roof system and selected equipment; a set of bid packages; and, a cost-revenue curve analysis for each building design. The results of these assignments completed by the construction science students were delivered together with the architecture students' designs as part of the final presentation of the project proposal.

Teams that included one or two construction science students prepared conceptual cost estimates for the preliminary architectural designs using a "square foot cost" multiplier to give the architecture students an idea how much their proposed facilities would cost. The students were required to use R.S. Means Systems Costs (1999) or some other similar source to prepare their estimates. In addition to the conceptual cost estimate the students prepared a preliminary schedule analysis of each proposed facility. Most teams proposed a bar chart diagram showing anticipated construction progress on a month-by-month basis.

The second assignment required the construction science students to analyze the architectural designs and to make suggestions about the proposed building materials and systems to satisfy the objective of value engineering. Thus, the students evaluated all parts of their team's project arriving at the best value commensurate with lowest life cycle cost. The students were reminded that "best value cost" implies that life cycle costs should be considered in making the value engineering recommendations.

Following refinement of the architectural design, each team of construction science students prepared a listing of the trades and activities required to build the design. Activities were grouped into bid packages according to a logical sequence of work. The subcontractors and suppliers required to complete each stage in the work were included in each package. The bid packages were based on the outline found in Dorsey (1997, p. 200) and in Construction Specifications Institute (CSI) divisions. In addition, the construction science students analyzed the cash flow from start to completion of their project. This analysis resulted in a chart showing the cost and revenue cash flows for each project over its construction life cycle. The purpose of the cost-revenue analyses was to determine the breakeven point where revenue equals cost. To develop the cost-revenue chart, a schedule of values was used to help predict the expected monthly cash flows. The cost and revenue curves were plotted from this information. The revenue curve on each chart reflected the expected payment, less retainage, that would be paid by the owner each month. The cost curve included all costs of the work including materials, equipment, labor, general conditions, and profit.

Joint Project Procedure

The joint project was conducted during the last 10 weeks of the 1999 spring semester. Students in both classes worked in teams that consisted of the random assignment of two design students with one or two construction science students. Team members from architecture and construction science were introduced to each other in a joint meeting of the two classes that was held at the beginning of the design-build project. This joint meeting occurred at about the mid-point in the semester. Additional joint meetings of the two classes were scheduled when the architecture students presented their research about their ambassador's country, when the architecture students presented their preliminary designs, and when the final presentations were made to a jury.

Figure 1 illustrates the various stages of the joint project and the deliverables of each stage. During the first phase, the architecture students researched the project's background, including the climate of Washington, DC, local building design practices; availability of materials, typical needs of this type of client, and related architectural programming matters. The architecture students also had to conduct research of similar facilities in the ambassadors' home countries to learn about traditions, history, climate, design and construction practices there. The construction science students did not take part in this stage of the project. Upon reflection, this procedure raised the important educational question of when interaction between the team members should begin.

In the second stage, the architecture students developed their preliminary conceptual designs for a critique by the architecture and construction science faculty members (see previous description of second phase of the project). With information provided by the architecture students, the construction science students were required to prepare a conceptual cost estimate, a list of the preliminary bid packages, and a preliminary project schedule for the first phase of the architecture students' designs, typically referred to as "schematic designs." Providing this information to the design student (the architect) and to the instructors (the client) at an early stage of the project helped in decision-making when the direction of the project was being established.

While the building program was not constrained by a fixed budget, the bid packages prepared by the construction science students translated the conceptual design of the architectural students into a sequence of construction, and cost. Introduction of the 16 CSI divisions and costs made the architecture students aware of the implications of using certain construction and finish materials, structural and mechanical systems, and construction methods. For some of these students this translation of drawings into cost served as a "reality shock," as design studio projects in classes up to this point had not paid much attention to cost. The construction science students developed their communications skills of being able to interpret the architectural conceptual designs visually and descriptively, and also to understand the process of architectural design.

The third stage of the project followed review of the preliminary architectural designs and the construction cost estimates. In this stage, the architecture students had to refine their designs and the construction science students had to refine their bid packages for the project. The construction science students consulted with their design colleagues and assisted them with value engineering of selected building materials and systems, and cost-revenue curve analyses. The value engineering analyses were submitted to the architecture students as a written statement of performance guidelines which included different construction alternatives (materials, systems, and methods), drawings of details, and their cost. The architecture students studied the analyses very carefully through discussions with the construction science students. Once a consensus was reached between the team members, some of the construction recommendations were incorporated into the final architectural designs and helped to refine the projects' estimated cost.

This process of interaction between the students in the two disciplines triggered important discussions in the architecture studio. The discussions focused on important practical questions such as: What is the appropriate level of incorporation of construction professionals' input in the architectural design process, and how much should the architectural image be modified due to costs of materials or structural systems? Furthermore, this process made the students of both disciplines aware of the importance of building technology, in addition to the understanding of how collaborative teamwork during the early stages of building design can assist the designer and the client in decision-making. It became obvious that this stage required more meetings of the team members to jointly discuss different recommendations and to subject some of them to more of a structured timetable.

The final stage of the joint project was delivery of the completed report. The architecture and construction science students prepared a 15-20 minute PowerPoint[Tm] presentation for a panel of reviewers that consisted of professors from the College of Architecture (Departments of Architecture and Construction Science), and from the College of Liberal Arts (Department of Political Science), representing the client. The slides in the presentation contained information about the process of decision-making (mostly designer's information), influences on the alternatives (mostly builder's information), and justifications for decisions made regarding the overall package going to the owner (joint designer and builder information). Specifically, the presentation included the background information on the project, the design proposal, a refined list of bid packages based on value engineering analyses and the Construction Specifications Institute divisions, an estimated schedule for constructing the project, and a cost-revenue curve. All student team members had to participate in the final presentation. In addition to this joint presentation the students submitted to both instructors – architecture and construction science - a booklet that included all the final design and construction information for this design-build joint project.

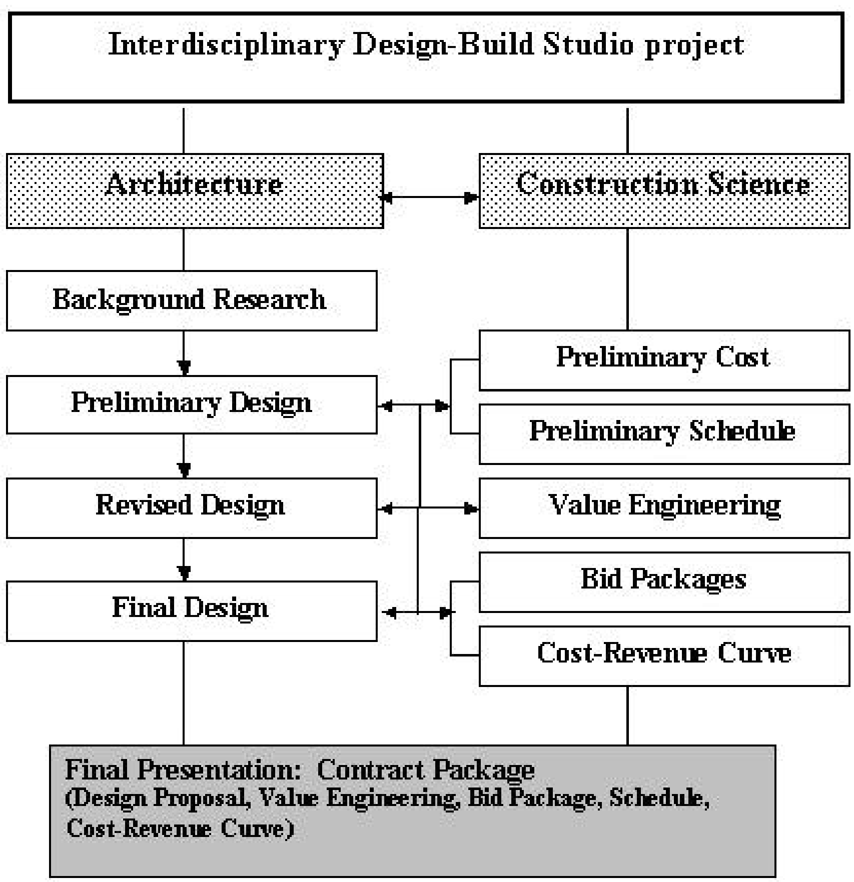

Figure 1. The procedure of the joint project

Examples of Student Projects

The examples demonstrate two typical teams' work and the factors that influenced the design and construction decision-making processes. The first project demonstrates the effectiveness of collaborations between the architecture and the construction science students early in the decision-making process. The second example shows a compromise design solution, which was the result of best value and cost analysis, owed in part to fewer joint meetings in the early stages of the project. As observed by the faculty, the students on this team waited until later stages of the project to seriously engage in collaborative exchanges of information.

The first project describes the design of a Japanese Ambassador's residence in Washington, DC. The joint team consisted of Travis Lucy and Luke Carnevale from architecture, and Justin Milam from construction science. The policy statement (architectural concept) of their design was: "This Ambassador's residence should be an accurate reflection of Japanese culture and direction, by incorporating aspects of both the traditional and modern Japanese architecture throughout." The team members prepared this policy statement through joint discussions and agreement at the outset of the project.

Figure 2 shows the influence of Japanese traditional site elements on the site development of the project and how each element of the house was tied together through the use of materials, color, and landscaping. Preliminary site development was analyzed by the construction science student, who followed the images of the designers and suggested some alternatives to finish materials (such as pavement), security details, and landscaping.

Figure 3 illustrates the floor plan and elevations of the project. The public areas of the Japanese Ambassador's house are located in the front as much as possible and represent a contemporary design, while the private areas, which express elements from Japanese traditional design, are in the back of the house, out of the public eye.

The differences in the images of the building's components called for different finish materials. The construction science student analyzed various options and helped the designers with the decision-making process. Eventually, the total area of the house was 6,678 sq. ft. and its estimated cost was calculated as $826,015, including security, overhead, and profit. The construction duration of the project was estimated as six to eight months. It should be added that this is an estimated duration of construction work. Pre- and post-construction activities would lengthen the overall project duration. Also, these estimates were prepared from schematic design drawings. More detailed construction drawings might suggest that a different overall project duration would be required.

These "impressive" estimated figures ($123.70/sq. ft.) were the result of the collaborative studio. Following analyses, evaluations, and discussions the designers incorporated the construction science student's value engineering analyses and recommendations early in the design process. This helped the team to produce a cost-effective design. In addition, the estimated preliminary cost calculated by the construction science student became the 'reality' framework for the designers who modified their work accordingly. For example, the position of the house on the site for this team's design solution required a minimum amount of soil removal and preserved almost all of the pre-existing trees. This was a very cost-effective decision on the overall cost of the site development. Making the building more compact and energy conscious was another example of cost-effective decision-making. For example, the building's circulation areas were cut to only about 11% of the total square footage; the bathrooms were grouped together; the mechanical system was split to fit the different functional zones of the house; and for energy conservation the glass was kept to a minimum on the west, east and south elevations. The selection of construction and finish materials was influenced by the architectural image as well as by best value (see Figures 4, 5, 6). The final presentation of the project also included analyses of the cash flows from start to completion of the designers' final proposal (see Figure 7).

Figure 2. Japanese ambassador residence in Washington, DC: site plan

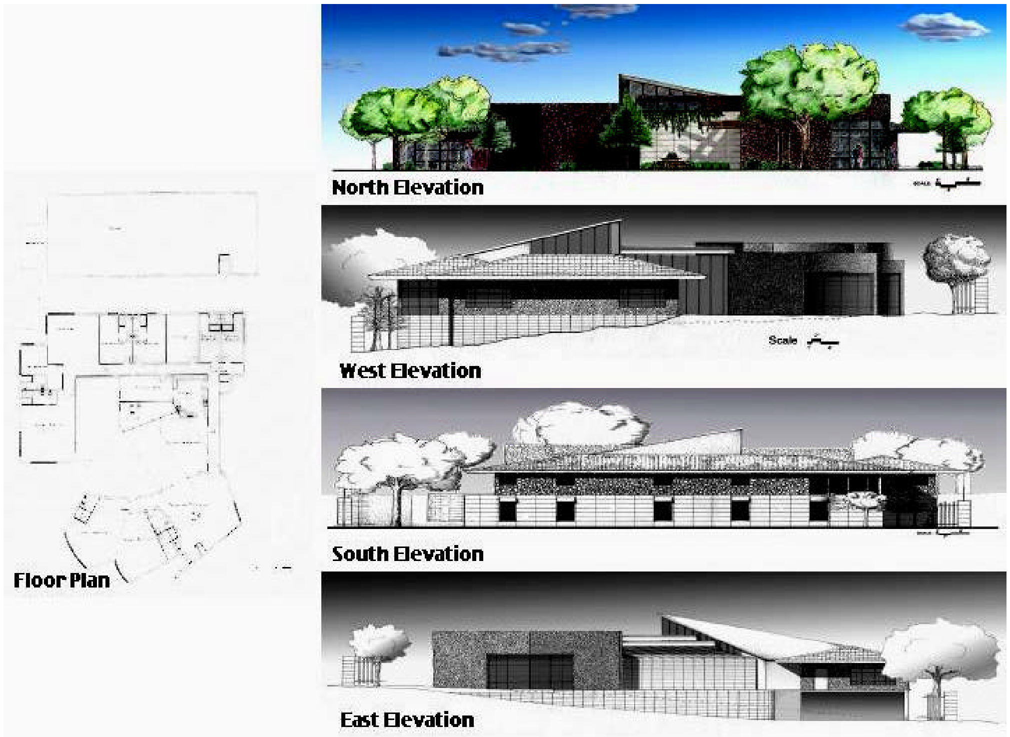

Figure 3. Japanese ambassador residence in Washington, DC: floor plan and elevations

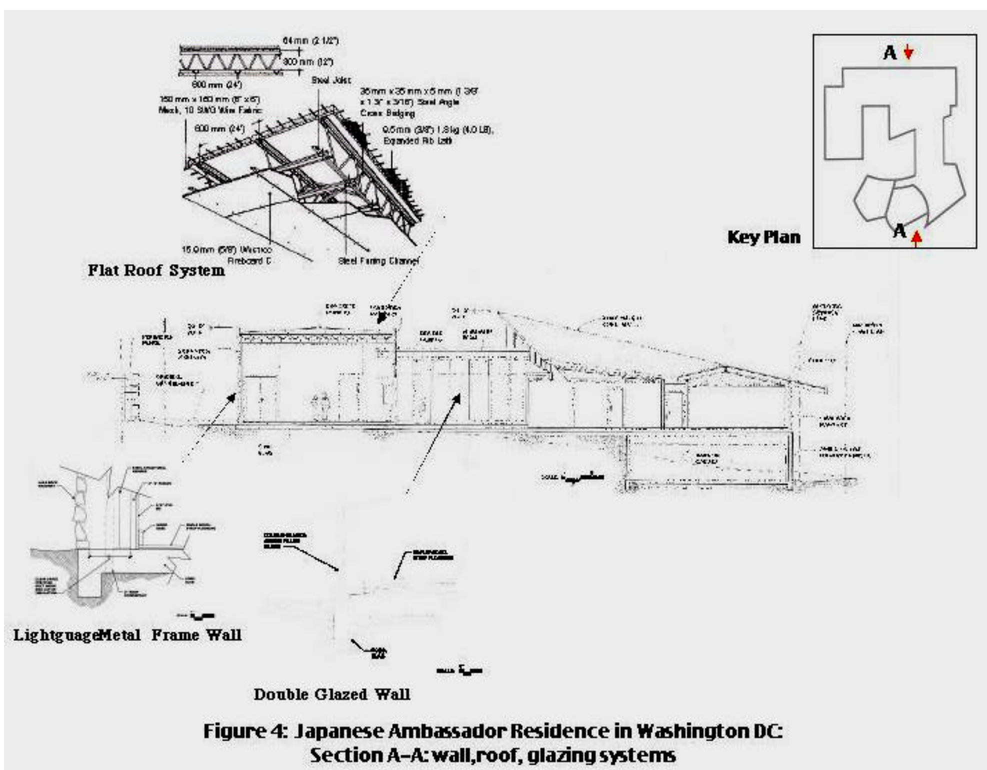

Figure 4. Japanese ambassador residence in Washington, DC: section A-A: wall, roof, glazing systems

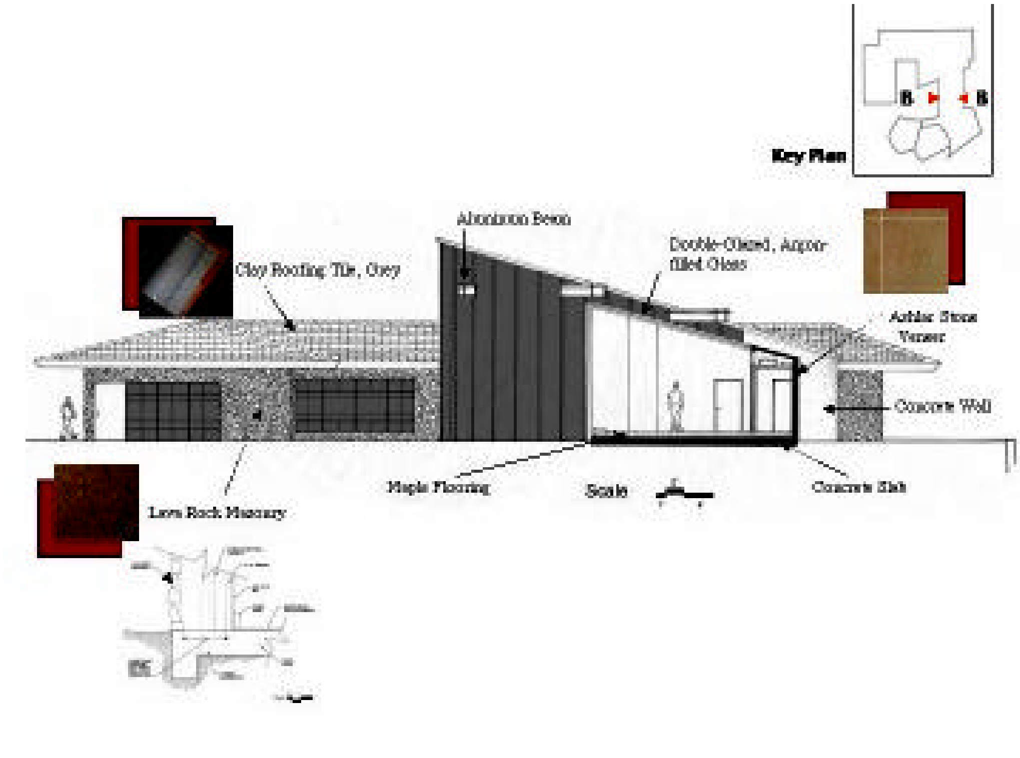

Figure 5. Japanese ambassador residence in Washington, DC: section B-B: finish materials

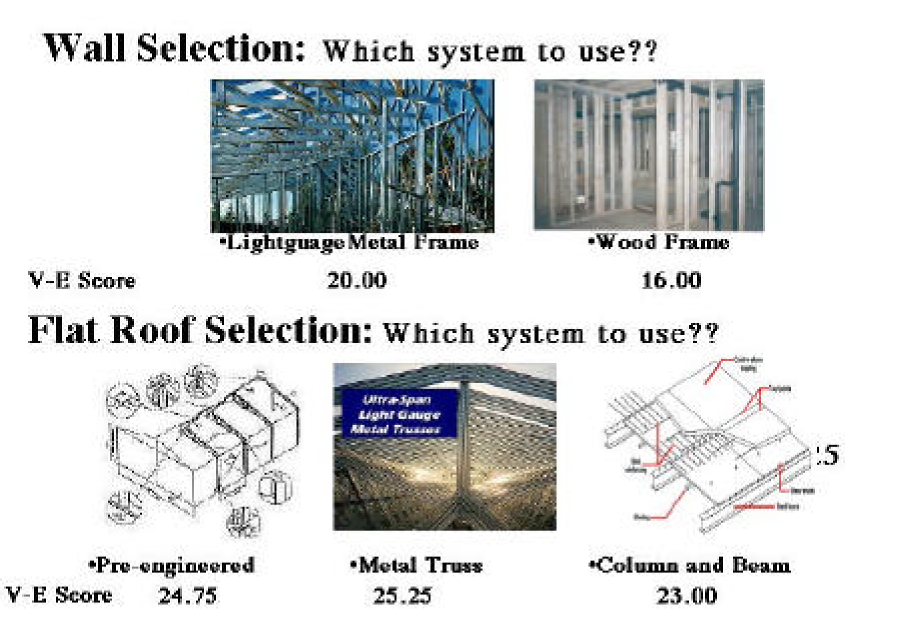

Figure 6. Japanese ambassador residence in Washington, DC: example of value engineering analysis

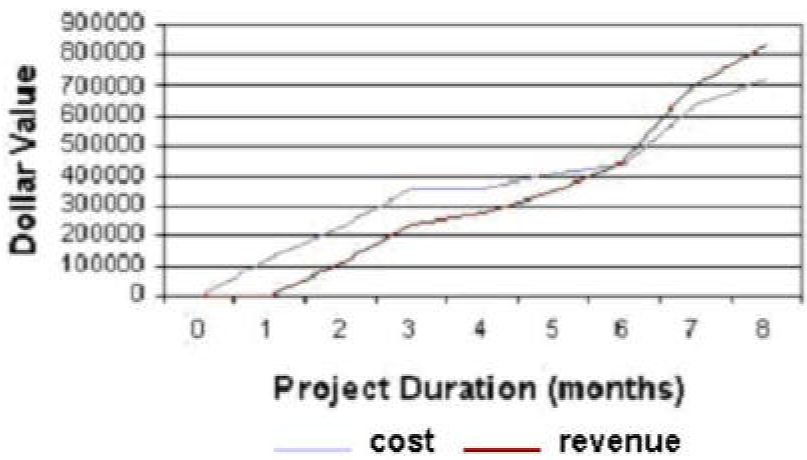

Figure 7. Japanese ambassador residence in Washington, DC: cost vs. revenue

The second example of the design-build studio describes the design of a South African Ambassador's residence in Washington, DC. The joint team consisted of Ben Callison and Lee Johnson from architecture, and Justin Lischka from construction science. This team's architectural concept was: "…to reflect the cultural heritage of South Africans in the context of the era of technology and in regard to Washington, DC's environment."

Figure 8 shows how this team's design expressed this statement and incorporated the shapes of traditional houses in South Africa, while using contemporary materials such as steel, concrete, and glass. The use of these materials was analyzed by the construction science student only toward the end of the design process (see Figures 9 and 10).

Figures 9 and 10 demonstrate the relationship of the design and the construction science analyses. The architectural sections in these figures show a split-level floor plan that divides the public, semi-public and private areas of the house. These spaces were connected by a glass/steel corridor that serves also as the focal point of the design. This kind of arrangement was not discussed with the construction science student beforehand and therefore the first conceptual cost was much higher than expected.

The materials chosen by the designers to express a certain architectural image dictated certain structural systems and construction methods. The construction science student prepared value engineering analyses that evaluated the suggested construction/finish materials, systems, and methods. These analyses considered design characteristics (e.g., fitness to neighborhood, accessibility, functions), construction issues (such as safety, speed, cost), and operation factors (e.g., energy efficiency, maintenance, durability). Since the joint effort started later in the design process, the results of the value engineering analyses showed that the suggested materials were not rated as best value for the owner. This result provoked an important and constructive discussion about the process of finding the balance between the project's image and its cost. It also triggered discussion of when the best time to involve the builder would be during the project's life cycle.

The final design of this residence consisted of 7,450 sq. ft. with a calculated total cost of $1,087,001, including security, overhead, and profit ($145.90/sq. ft.). The project's construction duration was estimated as eight to nine months and is illustrated in Figure 11.

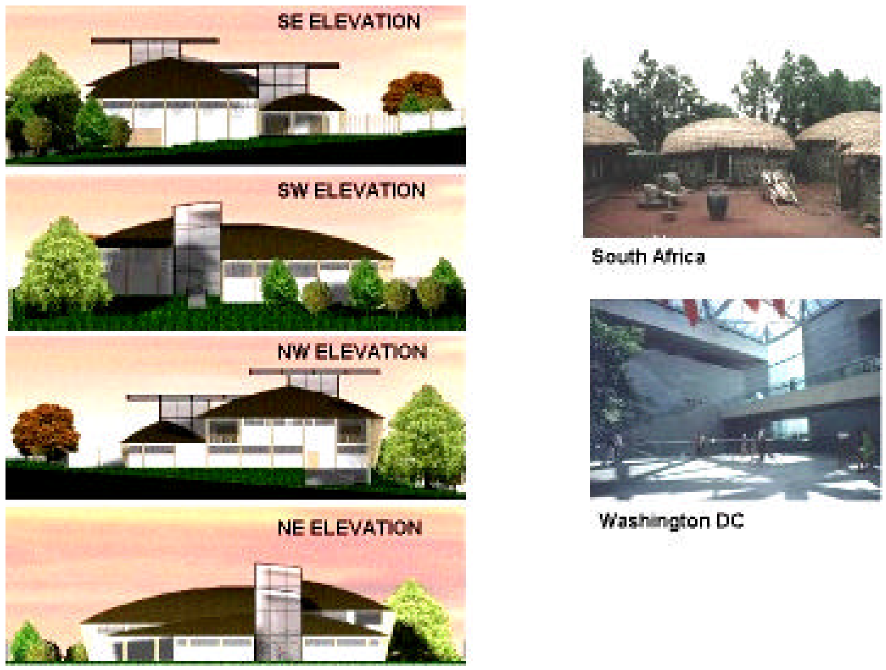

Figure 8. South African ambassador residence in Washington, DC: elevations

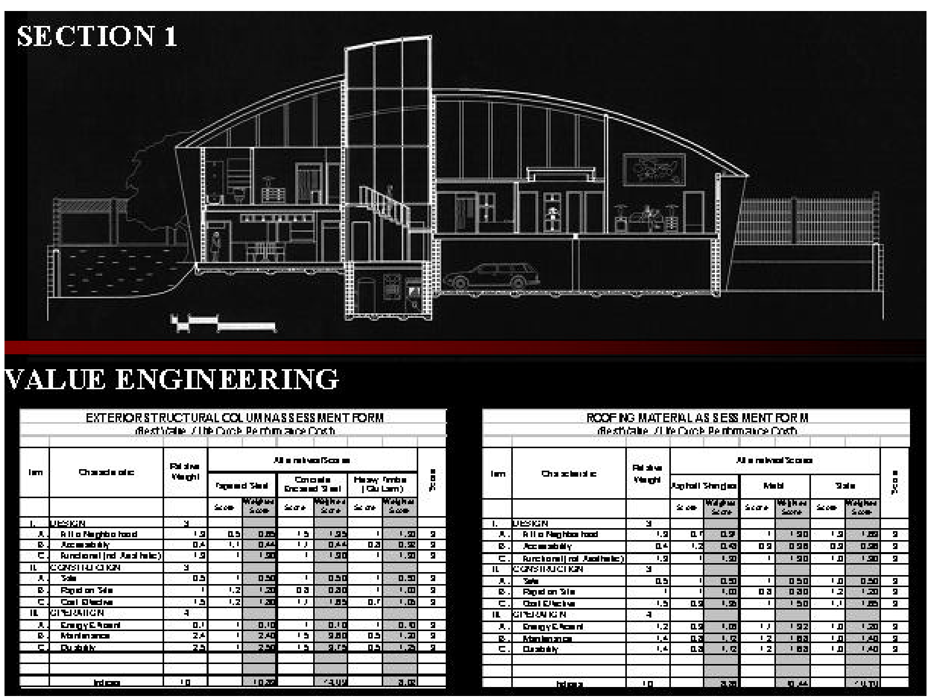

Figure 9. South African ambassador residence in Washington, DC: section 1 and examples of value engineering

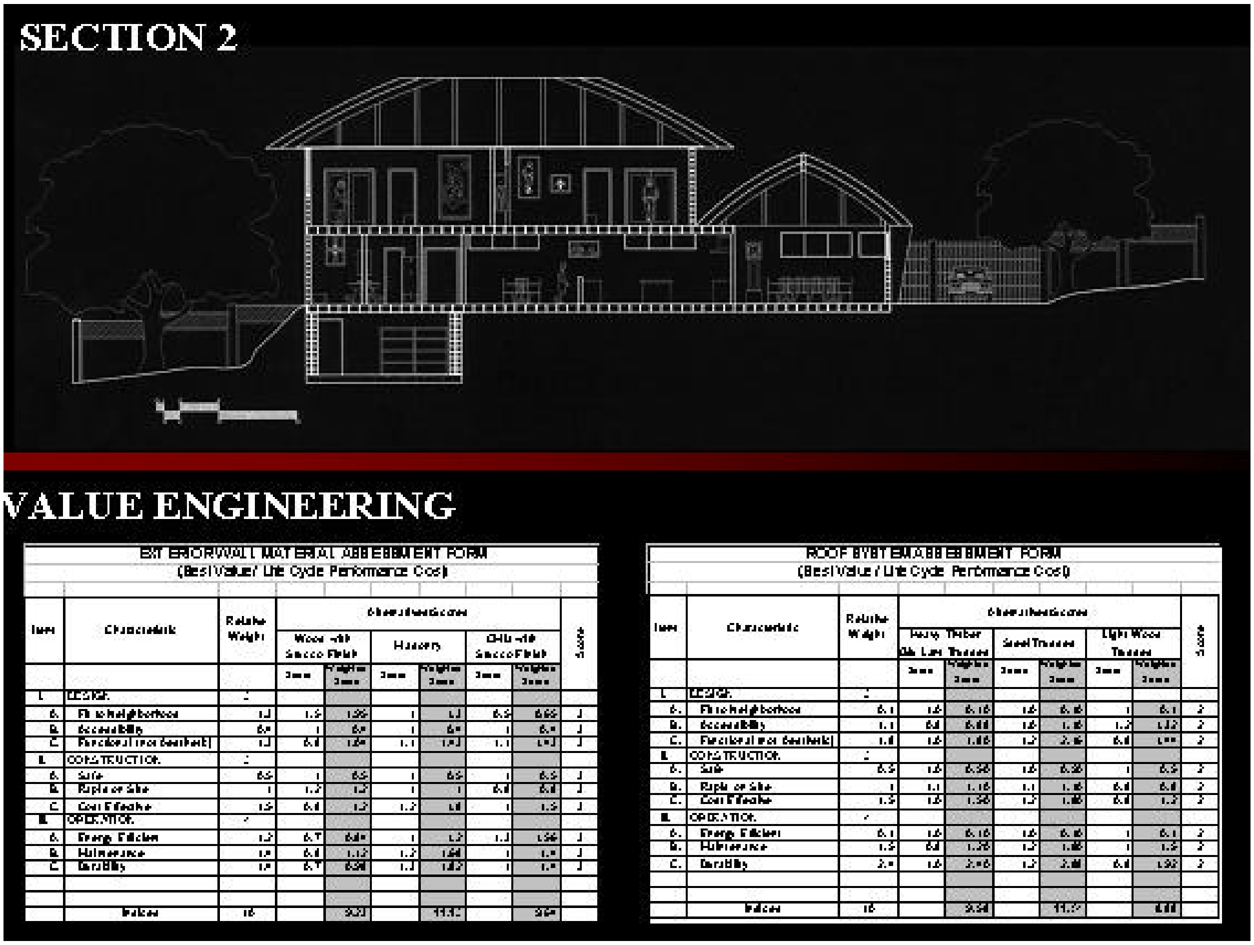

Figure 10. South African ambassador residence in Washington, DC: section 2 and examples of value engineering

Conclusion

Toward the end of the semester the students of both disciplines responded to an evaluation questionnaire on the joint design-build project. Their responses indicated that they were excited about this type of joint studio project. They identified the utility of exploiting the potential of interdisciplinary education, both in the discussions and in the final presentation that represented the joint effort of the design-build project.

The students' major conclusions supported the authors' ideas that led to this attempt to bring together architecture and construction science students to work on a joint studio experience incorporating the design-build project delivery method. In the project evaluations the students suggested some modes of improvement, primarily focusing on the logistics, and timing and amount of joint meetings. The students indicated that more time should be allocated for joint meetings, which should be coordinated by the instructors as part of the requirements/program of the project.

In addition to these suggestions, the instructors thought that one of the activities that should be undertaken in future joint projects would be a two or three hour session in which the students from the two classes were led through a team building exercise. An outside facilitator besides the instructors should lead this meeting because it is important to demonstrate the partnering workshop process to the students (see Ronco & Ronco, 1996, for a good overview of partnering workshops). In construction practice, an outside facilitator typically leads these exercises during a two-day workshop or retreat setting. Since one of the main objectives of the educational studio is to attempt to simulate the practice of design-build project delivery, the authors suggest conducting this exercise in one evening, at an off-campus location, and around a meal. Dedicating two days to a retreat to work through the partnering process, typical for industry, would not be possible in the academic setting, but the format could be presented in an abbreviated fashion and the students should still be able to develop a mission statement and partnering goals, which are common in these exercises.

Table 1 lists the scheduled activities that should be undertaken in an interdisciplinary studio where architecture and construction science students are given a joint design-build project. The activities in Table 1 are the result of input from the students in their course evaluation forms, and practical experiences noted by the authors. The construction science students asked for an opportunity to take the site planning process undertaken by the architecture students a step further and to let them (the construction science students) prepare a site logistics plan where the layout of materials, equipment, travel, and other activities during the construction period were planned and indicated on a site plan. In Table 1, therefore, preparation of a site logistics plan is scheduled near the end of the class project when the architecture students have made their decisions about facility design and location.

In summary, this design-build project demonstrated that "reality bites" in the studio were extremely important to the students and made them aware of the design and construction decision-making processes. The architecture students were made more aware of building materials, construction technology, and cost, while the construction science students were provided with an opportunity to better understood the process of design and the importance of architectural forms and images.

It is recommended that the collaboration between the two disciplines should continue in this mode of joint projects. Institutionalization of such efforts in formal syllabi will enable more effective and better-coordinated schedules of the classes involved. Such coordination will help to improve the educational experience for the students and prepare them better for the new realities of practice.

Table 1

Interdisciplinary Studio Deliverables for Design-Build Projects

Activity	Assignment	Description	Needs
1	Project Definition	Project program or scope of work	User group with a need; written description of the need
2	Team-Building Exercise	Two hour exercise led by a third party facilitator to get students acquainted, form teams etc.; accompanied by a meal	Experienced facilitator in team building; food; location; personal information such as telephone numbers and e-mail addresses
3	Conceptual Cost and Schedule Analysis	Preliminary analysis of overall project cost by CSI division; bar chart for project completion by billing period	Spreadsheet; cost guides; understanding of construction process; preliminary design drawings
4	Value Engineering	Analyses of least first cost and life cycle costs of the foundation, structural system, envelope, and selected equipment or finishes	Materials and methods references; equipment and furnishings specifications; knowledge of local construction conditions; climate etc.
5	Bid Packages	Grouping of activities and subcontractors activities into logical bid packages	Refined design drawings; CSI Divisions
6	Refined Cost and Schedule Projections	Revise and fine tune the conceptual cost and schedule projections in response to refined design drawings	Refined design drawings
7	Site Logistics Plan	Plan showing site access, contractor lay down, storage, trailer park, material deliveries, temporary traffic, temporary signage, contractor parking, crane and hoist locations etc.	Site plan with proposed construction, existing traffic circulation plan (around property), site access points, signalization and signage around site
8	Cost-Revenue Curve	Preliminary analysis of cost-revenue curves over the duration of the project	Cost breakdowns per month and applications for payment less retainage
9	Final Presentation	Computerized presentation (PowerPoint or other) of design-build proposal, 10 minutes maximum	Computerized slides with supporting graphics; jurors; computer projection equipment; presentation with question and answer period
10	Project Evaluation	Evaluation of the overall project by the faculty and the students	Project evaluation form; analysis of feedback; redesign of next iteration as required

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Strategic Planning for an Academic Department of Construction Science: Fostering Change

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For the past several decades, the corporate world has used the strategic planning process to set goals and objectives and frame the activities of the company. However, the use of strategic planning is a relatively new concept for academic institutions. Because of the complex array of stakeholders, the few post-secondary institutions using strategic planning have had limited success in using strategic planning. Strategic planning used by an academic department within a university is not common practice. This paper reviews the strategic planning process initiated by a new Department Head of an academic department of Construction Science. The emphasis is on the process used to involve faculty and to produce a strategic plan.

Keywords: Strategic Planning, Higher Education, Outcome Assessment, Faculty Involvement, Mission Statement

Introduction

Current literature is replete with references to terms like "strategic planning", "mission statements", "vision", "values", "statements of purpose", " long term goals", and "areas of emphasis". “Strategic Plans” are touted as the essential underpinning of many types of organizations. Private corporations have become so absorbed with strategic planning that at many firms “strategic planners” are permanent employees, and corporate strategic planning exercises are underway on a continuous basis. An entire industry of strategic planning experts and consultants has been spawned over the last decade. Most of the large accounting firms have created business areas that sell management consulting and organizational and strategic planning services. There seems to be a consensus among senior executives that the strategic planning process and a comprehensive Corporate Strategic Plan are essential to provide focus on where a company is going and how they are going to get there (Minzberg, 1994).

Unlike the corporate world, strategic planning in higher education has not been the norm (Cutright, 1999). In the early 1980’s, Keller (1983) estimated that no more than a dozen of 3400 colleges and universities nationwide were engaged in strategic planning. By the mid-1990’s, approximately 25% of those original universities/colleges were using strategic planning (Keller, 1993). To evaluate the effectiveness of strategic plans in higher education, a study published by the American Council on Education (Schuster, et. al., 1994), based on Keller’s original work, found that, although the number of universities/colleges who used strategic planning had grown, there were mixed results on the successes of the plans generated. Perhaps unlike their private corporate counterparts, whose motivations are driven by “shareholder value” and the "bottom line" of the next income statement, and the profit motive, university administrators serve many stakeholders that require accountability, i.e., state agencies and taxpayers (public institutions), governors and boards of trustees, alumni, corporations who hire the graduates, faculty, and research funding agencies (Lucas, 2000). The diversity of the stakeholders in the higher education arena could be a contributing factor to the lack of success of the strategic planning process.

In recent literature, the positive outcomes of strategic planning in the university environment appear well worth the effort. Universities, colleges, and academic departments need to engage in "the process of making decisions in the present concerning which strategies and actions are to be taken in the future in order that certain goals or outcomes may be realized by a specified date" (Tucker, 1992, p. 311). Several researchers (Cutright, 1999; Wolverton & Gmelch, 1998; Taylor & Karr, 1999; Konsky, 1999; Lucas, 1994; and Lenington, 1996) in the area of strategic planning in higher education have suggested processes to promote success in conducting strategic planning and implementation. Some of these suggested processes are:

- Evaluate the external and internal environment(s) that may affect the planning process, outcomes, and implementation.
- Develop a vision, goals, and strategies that are aligned with the board of trustees, university, and college.
- Involve faculty in all phases.
- Develop aggressive, realistic measurable goals
- Develop timelines for goal attainment.
- Assign subcommittees or an "owner" for specific plan items to maximize goal achievement.
- Schedule periodic updates with the faculty to monitor progress and communicate milestones and achievements to all stakeholders.
- View the strategic plan as a living document and change the plan when necessary (as events warrant).

This paper provides a strategic planning process model of an academic department within a large, land grant university. The champion of the process was the new Department Head who had recently come from the corporate world.

Background

In late 1996, the University launched a university-wide strategic planning exercise for the period 1998-2000. In a kickoff memo, the Provost wrote:

> *" Although strategic planning poses a challenge for any organization, it can be particularly vexing for universities with the tradition of shared governance. Where should the process start? If the president and vice presidents, or even the deans, attempt to draw up a plan, the faculty, staff, and students will almost certainly object. How can we tell them what direction "their university" will be taking without first consulting with them? On the other hand, a bottoms-up approach can result in attempts to ride off in all*

directions often ignoring critical issues and resulting in a multiplicity of plans, which resists integration into one plan for the whole university.

Moreover, based on what one observes as the result of planning at most universities around the country, one is tempted to forget the whole thing. Either the plan adopted represents all things to all people, and choices are harder to make, not easier, or there is a plan calling for action, which leads to sharp arguments and resignations. Still we need a common vision for the University and one sufficiently grounded to inform the decision-making process at all levels."

Six months before the University initiated its strategic planning exercise, a new professor and Department Head of Construction Science (COSC) joined the faculty at the University. The new Department Head had 35 years experience in both the public and private sectors in the construction business. He had extensive involvement with strategic planning with two large construction companies from 1985-1996. The first major task upon the new Department Head's arrival was to put together a Strategic Plan for the Department. This paper chronicles that effort; and hopefully, other programs can benefit from the process and the product and avoid the pitfalls of the planning process that plague many strategic planning efforts. The process, which is detailed in this paper, is not necessarily the "right" process or the "best" process--it is "a process" that was used to produce a Strategic Plan that has strongly influenced the day-to-day activities and direction of the Department.

The Process

The Starting Point

The Department of Construction Science is one of three departments (Architecture and Landscape Architecture and Urban Planning) in the College of Architecture. There were 15 full-time faculty with several courses being taught by Ph.D. and Master's students. Faculty numbers were down from 24 in 1988 and only one new faculty hire had been made since 1991. The Department had 640 undergraduate students, and 30 Master's students, and graduated about 150 students per year. The undergraduate degree in Construction Science required 137 hours of coursework and a 12-week summer internship with industry.

The Department Head approached the departmental strategic planning process with certain paradigms resulting from industry experience:

- *The process is as important as the product.* The process needs to be a "bottom up" process with participation by as many players as possible. Without broad-based "buy in" of the Strategic Plan produced, the Plan has little chance to succeed. One of the best ways to create "buy-in" is to let everyone possible participate in the process, and conduct a process where all participants are heard and their opinions considered. While the final Strategic Plan will necessarily represent a compromise to many individual opinions and suggestions, active participants are more likely to embrace the compromises.

- *The product must contain discrete, measurable goals.* Far too many strategic plans suffer the "answer to all ills" syndrome, consisting of glowing generalities which management can hide behind and claim to adhere to, while in fact providing little in the way of guidance or direction. Setting discrete, measurable goals is anathema to management--you might fail to meet these goals; in fact, you should fail to meet some goals if you set challenging goals which are necessary to stress an organization.

- *Many strategic plans fail from poor implementation and undisciplined follow up.* The need for disciplined implementation should permeate the planning process.

The Department had a Strategic Plan, written by the previous Department Head with limited faculty participation that had been in place for three years. This existing Plan was not used in the planning process described below.

Creating an artificial time schedule because of an urgent need to hire new faculty, the new Department Head wanted a coherent plan in place by the end of 1996 so the recruiting process could begin as soon as possible in 1997. He was concerned that it would be late for recruiting faculty to come on board during the summer of 1997 if the timeline was extended any longer. The Department Head wanted at least the essence of a Strategic Plan in place before the desired credentials for the new faculty were decided.

The Initial Phase

Using a strategic planning model similar to Minzberg's (1994), the Department Head used the following six-step model was used:

- ASSESS. Define the status quo. Do a critical examination of existing strengths and weaknesses. Document what is known.
- DEVELOP ALTERNATIVES. Take off all the boundary conditions possible and lay out alternatives. Provide sufficient detail to analyze each alternative.
- EVALUATE ALTERNATIVES**.** In the private sector this is the most demanding step because alternatives are usually costed, requiring some rather elaborate costing models.
- DECIDE**.** Pick an alternative.
- PLAN**.** Determine action items and short-term objectives to implement the decision.
- IMPLEMENT**.** Require a disciplined, structured implementation process.

The Department Head introduced the above model at his initial faculty meeting on August 30, 1996, which served to kick off the strategic planning process. At that meeting, the Department Head divided the faculty into five teams and assigned a topic to each team. The team topics were:

- Undergraduate programs (including curriculum)
- Graduate programs (including curriculum)
- Facilities and Equipment
- Research
- Development (Fundraising)

Every faculty member was assigned to one of the teams and each team was assigned a graduate student to help document committee work. The following schedule was given to the teams:

August 30	Kickoff
September 9	Team Charters Due
October 4	Draft Team Findings Due
October 7	Shuffle Teams
October 11	Revised Charters Due
November 1	Revised Findings Due
November 16-17	Faculty Retreat

The Department Head required each team to do a "charter" for their team's effort. This charter was to define the efforts of the team. The Team Charter included:

- SCOPE (Define what the team will look at)
- PURPOSE (The "why" of the team's effort)
- BOUNDARIES (As few as possible)
- ASSUMPTIONS (As required to meet the schedule)

The purpose of the charter was to insure that the teams got off to a quick start and that they had appropriately framed their issues. The first "deliverable" from each team (post charter) was a set of findings that would carry them through the first four steps of the strategic planning model. The Department Head did not participate with any of the teams, but kibitzed with each team constantly to insure that activity was underway. The teams responded quite well and seemed to take the process seriously. All five teams submitted their findings by the due date, and for the most part, they presented some excellent concepts with specific decisions and solid goals.

At this point, the Department Dead shuffled the topics, retaining the same teams, but giving each team a new topic but one of the same five original topics. An effort was made throughout the initial phase of the process to structure the teams and assign topics to take advantage of the institutional memory and background of each faculty member. For the second iteration, teams received the work product--findings--produced by the initial team. For this second iteration the teams ran the first four steps of the model and produced their own "findings". The Department Head, also, introduced a set of questions, which were given to each team with the requirement that the team seek to answer the questions and include their responses in their "findings". The questions were designed to begin to have the faculty teams come to grips with significant issues for the final Strategic Plan. The questions were:

1. What are the most important issues that will be facing the construction industry in the year 2000? (List no more than 5)
2. Which of those issues could provide an area of emphasis for the COSC Department, given current capabilities, or capabilities that could be developed by the year 2000?
3. What factors are the most important in determining the size of the COSC Department? ("Size" refers to student population and faculty numbers.)

4. What student population would you recommend as optimum for the COSC Department? (Break your response down to undergraduate and graduate categories and provide the logic for your response.)
5. How many faculty members would you recommend are required to support the student population recommended in question 4? (Provide the logic for your response.)
6. Assuming that the Department will be hiring additional faculty in the near future, list the credentials that you would recommend for the top three priority recruits. (Example: Priority one recruit; Ph.D.; expertise in Arctic construction; 5 years industry experience, etc.)

On November 1, the Department Head had two sets of findings on each topic--every faculty member received a copy of all findings.

The Compromise Phase

With ten sets of findings on five different topics, it was time to move toward a single, integrated Strategic Plan. The Department Head structured a retreat agenda designed to promote consensus and produce the essential elements of a Strategic Plan. The Department Head considered bringing in an outside facilitator, but ultimately filled that role himself. The retreat was held on a Saturday and faculty participation was excellent. After a long day of "structured adversarialism", the faculty spoke well of the process.

The retreat was broken into multiple activities. In the morning, using standard "brainstorming" techniques to generate ideas and "chip voting" techniques to determine priorities, the faculty sought to answer the following questions:

1. What are your primary concerns related to the Construction Science Department? (This question served as an "ice-breaker" and demonstrated the use of brainstorming and chip voting procedures.)
2. What are the primary issues facing the construction industry today and in the next five years?
3. Given the resources and capabilities of the Construction Science Department, which construction industry issues could the Department take a leadership role in addressing?

In the afternoon, the faculty was broken into four teams and each team worked independently to address a series of tasks. The teams spent about an hour on each task and presented their findings to the reassembled faculty group. The tasks were:

1. What are the most important departmental issues in the area of teaching?
2. What are the most important departmental issues in the area of research?
3. Draft a department mission statement.
4. Over the next five years what should be the size of the Department--undergraduate students, graduate students, faculty, and teaching graduate students and what assumptions did you make in arriving at these numbers?

After each of the independent teamwork periods there was spirited give and take concerning the teams' findings. A graduate student captured the essence of the discussions on a laptop computer, and the work product of each teams' activities was documented on poster boards.

The Drafting Phase

Taking into account the work products from the previous two phases, the Department Head produced a first draft of the Departmental Strategic Plan. This first draft was provided to all faculty and feedback was solicited. Feedback was fairly extensive, and the Department Head spent time on every comment with the faculty member concerned to insure there was complete understanding. A second draft was produced. This second draft was again sent to all faculty for comment and it was also sent to the industry Executive Committee members of the Department's Professional Advisory and Development Board. Copies were also provided to the Dean and other Department Heads in the College. Feedback on the second draft was comparatively sparse; however, the Department Head responded to every comment. A final work product was then produced and is attached as Appendix A (excluding extensive budget details).

The Product

Appendix A contains six sections. It is intended to be readable yet quite definitive with measurable goals.

- PREAMBLE. The Preamble sets the tenor for the Plan and emphasizes the changing nature of the industry, driving the need for regular updates.
- STATEMENT OF PURPOSE. The Mission of the Department is detailed in descriptive narrative designed to set the stage for more detailed and objective goals.
- VALUES. Values seek to influence the culture of the Department, setting forth "what is important".
- AREAS OF EMPHASIS. The Department can't "be all things" to the industry so definition is provided for those specific areas that are both important to the industry and "a fit" for the Department's resources.
- VISION. These are the goals of the Department--both near term by the year 2000, and longer term by the year 2003. The goals are challenging, but achievable.
- RESOURCES. (Omitted from Appendix A). This is a somewhat lengthy discussion of resources available versus resources needed to implement the Plan. The discussion includes budget, faculty, staff and facility resources.

Conclusions

Several findings can be postulated with a significant degree of certainty:

1. The process produced a Strategic Plan, which has influenced the day-to-day decisions and activities of the department. For example, seven new tenure-track faculty were hired and the Strategic Plan influenced the credentials sought and the screening process.

2. The faculty appear to endorse the Strategic Plan. Certainly every faculty member is familiar with the Plan and often comment about whether or not a proposed action supports the Plan or is driven by the Plan.

3. The Strategic Plan is causing the Department to pursue actions, which will have a significant impact on the overall program. Three examples- (1) a substantial curriculum overhaul was completed in 1997 (2) plans have been drawn-up for a new facility to house the Department and a major fund-raising effort is planned, and (3) a major restructuring of the industry outreach program has been accomplished by the creation of a strong Construction Industry Advisory Council (CIAC).

4. In retrospect, there are some things that might have been done differently:

    A. The planning time frame of essentially three months was very compressed. This limited time was driven by the need to recruit new faculty and the necessity to have a Strategic Plan in place to define faculty needs.
    B. The process could have sought more active, continuing industry involvement. The review by industry of the second draft produced some limited comments, but the final Plan could have included more extensive industry input.
    C. The Department Head should not have moderated the faculty retreat. His role as moderator may have stifled full and open discussion.

In summary, this paper details a process used to produce a Strategic Plan for an academic Construction Science Department. Was it worth the effort? -ABSOLUTELY!

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Appendix A

The Strategic Plan for the Department of Construction Science
College of Architecture
1997-2003

PREAMBLE

Construction Science is an emerging field. Today, construction accounts for eight to nine percent of the nation's GDP and employs 4.5 million workers. Historically, construction managers were trained "on-the-job." Good engineers and architects became good project managers, good businessmen, and good leaders through trial and error. In the past, formal management training was available almost as an afterthought in engineering and architectural schools. Construction Science programs that he sprung up in other universities around the nation in the last five years are an acknowledgment that formal education is essential to product excellent construction managers and future leaders in the construction industry, one of the largest industries in the nation.

The Department of Construction Science at the University, which celebrated its 50^{th} anniversary last year, has long been known as one of the best programs of its kind in the world. It is THE LARGEST in terms of student population and the number of graduates produced. It can become, without question, THE BEST Construction Science program in the world if this Strategic Plan is implemented successfully.

The Department's Strategic Plan is to provide purpose and direction for all actions of the Department. It sets priorities and provides a common vision, which every member of the Department should consider in day-to-day activities.

This Strategic Plan was created over a period of months with every faculty member participating. It represents a consensus, in some cases a compromise, that the Department collectively endorses. Without this consensus, the Strategic Plan is worthless.

The Plan is just a plan—not an inviolate set a rules and procedures. It will be re-examined from time to time. Current thinking is that a formal, all-inclusive re-evaluation will occur every two years.

Many Strategic Plans fail because of poor implementation. The Department has launched aggressive, disciplined implementation plans, realizing that future success cannot just happen.

STATEMENT OF PURPOSE

The Construction Science Department's primary mission is to prepare students for successful careers in construction and construction-related industries.

To accomplish this mission the Department must create an environment conducive to academic excellence that is responsive to the needs of industry. Not only must faculty be excellent teachers, they must also be in search of new knowledge that defines construction science and advances the state-of-the-art in the industry.

A complete environment requires a faculty-team eager to perform those service tasks essential to the smooth functioning of the Department and to promoting the image of the College, the University and the global construction industry.

The Department intends to become THE BEST Construction Science program in the world—the BEST in teaching, the BEST in research, and the BEST in service.

VALUES

The Department places great value on:

- **Producing well-rounded students** whose broad-based educational experience will produce graduates who will **elevate the level of professionalism** of the construction industry commensurate to other recognized professions.
- **Generating new knowledge to advance the profession of construction management.**
- **Working** together in a team approach so staff and faculty experience a collegial atmosphere, where **open and frequent communication** is the norm.
- Maintaining the Department's reputation for fostering **a "student-friendly" environment** where students are encouraged to interface with staff and faculty, and where staff and faculty go out of their way to be responsive to students' needs and concerns.
- Improving **its relationship with industry** on a continuing basis.
- **Strengthening its student chapters** of professional organizations – AGC, ABC, AIC, and NAHB. These student chapters offer leadership opportunities, foster team activities, and provide an invaluable supplement to traditional academic programs.
- **Promoting the concept of certification** as proposed by the American Institute of Constructors. Certification can provide validation of construction management as a profession and improve the image of the industry.
- **Offering honors courses** which challenge both the students and faculty.
- **Supporting and encouraging interdisciplinary activities** by students and faculty, because the success of interdisciplinary teams is increasingly important to the construction industry.
- Recognizing the benefit to the program and to the graduates derived from curriculum emphasis on:
  1. **The ability of students to function in a team setting**. The construction industry relies on teams—sales teams, project teams, quality improvement teams—to function effectively.
  2. **The ability of students to communicate effectively**—both orally and in writing—in deliberate presentations or impromptu settings.
  3. **The ability of student to use computers and related systems** as tools in their academic work which will be a critical requirement in their construction careers.
  4. **The ability of students to function effectively in a global setting**.

AREAS OF EMPHASIS

While the Department will be required to maintain a broad knowledge of construction industry issues in order to keep its academic programs current, there is recognition that the Department cannot acquire and maintain academic leadership in all issue areas. Therefore, the Department has elected to become the leading academic authority in the following issue areas:

- **Image.** As viewed by the general public and particularly high school work force candidates, the image of the construction industry is not good. Research is required to identify root causes and to develop programs to address those causes.
- **Labor.** The industry predicts a severe shortage in construction labor for the foreseeable future. The shortage is caused by a combination of factor – increasing demand, marginally competitive salaries, frequent dislocation, and image. Working with the professional societies and the **industry, the Department will emphasize research and service to address this issue.**
- **Construction Delivery Strategies.** Strategies for delivering construction projects are changing from traditional "design-bid-build" scenarios to more complex design-build and design-build-finance-operate delivery strategies. These evolving strategies transfer risk to the contractor. The Department will track these evolving strategies and develop "expert knowledge" in the area.
- **Accommodating the global trends of the industry.** The construction industry is becoming a global industry. Many large international firms are acquiring U.S. construction firms or are otherwise creating a presence in the U.S. Conversely, some large U.S. construction firms are multinational and are seeking to expand their business outside the U.S. The Department needs to exploit this trend and to prepare its students for service in tomorrow's global industry.

VISION

By the year 2000 –

- The Department will be THE BEST academic program of Construction Science in the world.
- The Department will be recognized both nationally and internationally for its excellence in its chosen Areas of Emphasis.
- The Department will have identified funding sources for foundation endowment (for whom the Construction Science School may be named) and for a new facility to house the Construction Science Department (for whom the facility may be named).
- The Department will have established, or be an integral part of, Centers for Construction Education and for Construction Research. Continuing education programs will be an integral part of the Construction Science program with widespread faculty participation. Outside funding for research will total $250,000 annually, and the Department will have an active role in a refereed journal.
- The Department will have 60 graduate students, and will have admitted its first candidate for a Ph.D. degree in Construction Science.
- The Department will have 600 undergraduate students with honors courses available in at least half of the Construction Science courses.
- The Department will have international faculty, courses in the global construction issues, and international student and faculty exchange programs.

By the year 2003—

- The Department will have enhances its reputation as THE BEST academic program of Construction Science in the world.
- The Department will have enhanced its national and international reputation in its selected Areas of Emphasis.
- The Department will reside in its own facility, will enjoy a significant endowment, and may be known as the School of Construction Science, named for a significant donor.
- Centers for Construction Education and Research will be well established. Annual research funding will have reached $1 million.
- The Department will have 100 graduate students, including 10 Ph.D. candidates. The Department will have graduated its first Ph.D. student.
- The Department will have 600 undergraduate students with honors classes available in all Construction Science courses.
- The Department will have enhanced its reputation for excellence in global issues.

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Industry Advisory Councils of Undergraduate Construction Programs: A Comparative Study of Common Practices

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This paper presents the findings from a survey of 13 American Council of Construction Education (ACCE) accredited university programs of higher education. The survey focused on the common practices used by these programs in responding to the ACCE requirements that programs have a strong relationship with the construction industry. This relationship, typically, centers on an industry advisory council (IAC). The survey results revealed the range of practices being followed by ACCE-accredited programs. The survey evaluated the IAC structure, by-laws, leadership, and other activities. IAC roles in student placement, student enrichment, curriculum review, strategic planning, fundraising, and internships were also documented.

Key Words: Industry Advisory Council, Undergraduate Construction Programs, Industry/University Collaboration.

Introduction

Relationships with industry are crucial to programs of post-secondary education in construction. Accrediting bodies for post-secondary education construction programs, the American Board of Engineering Technology (ABET) and the American Council on Construction Education (ACCE), require a formal linkage between industry and programs preparing students to enter the construction or construction-related industries. This linkage is most often in the form of an industry advisory council (IAC).

The purpose of this study was twofold: (a) to determine how various ACCE-accredited use IACs in relationship to structure (use of by-laws), leadership of the council, council membership, meetings, and activities (placement, internships/co-op, and curriculum); and, (b) to summarize the thoughts of construction program leaders regarding the current ACCE IAC standard (Appendix A).

Background

Collaboration between universities and industry has been receiving increased attention because of the potential benefits for all parties (Nasr and AbdulNour, 1997). Powers, et. al., (1988) conducted a survey to evaluate why universities and companies collaborate. The authors state that universities collaborate for the opportunity to provide student exposure to the real world of work through research and student and/or faculty internships, to have access to possible funding sources, to work on tangible industry-related research, and to have industry practitioners provide input on academic curricula. Companies collaborate in order to obtain access to program graduates, obtain a window on science and technology, and gain access to university facilities.

Tener (1996) states an important way of cementing industry/university collaborative efforts is for a construction program to have an industry advisory committee that provides input on significant issues that affect the construction program and the quality of the undergraduate education.

Advisory boards/committees/councils bridge the gap between the academic world and the workplace (Dorazio, 1996). Benefits are threefold: to students, to program, and to advisory board members. Benefits for the students are a curriculum that has input from industry professionals, field and job placement opportunities, internships and work practicums, and field trips. Benefits for the programs are in the form of free advice on programs and curricula, donations of material, equipment, human resources (guest lecturers/speakers), and consulting and research opportunities for faculty. The board members benefit from being able to feel useful by making valuable contributions and suggestions. The members have the knowledge that they are impacting future professionals in the industry. It allows for professionals to “give back” for the betterment of the construction programs (in some situations, their alma mater).

Badger (1999) further expands on the benefits of an industry advisory council by outlining the role of the IAC for the undergraduate construction program where he serves as director. This paper identified key areas of involvement of Badger’s IAC specific to: (a) strategic planning; (b) increasing enrollment, marketing of the program; (c) increasing research (benefit to the faculty and the industry); (d) expanding physical and monetary resources; (e) being an advocate to the state and university administration; (f) developing curriculum to meet the changing needs of the construction industry; (g) developing an internship program; and, (h) development of continuing education for construction professionals. Badger states, “the IAC has given advice and support, knowledge of needs of the modern, highly technical industry, and funds to ensure that the program has the resources it needs (p. 128)."

The ACCE feels that there are benefits for having construction industry professionals serving on advisory councils for undergraduate programs, and has developed, via their Standards Committee, an IAC requirement for ACCE accreditation (Appendix A). There has been no research on undergraduate construction program IACs to determine common practices of various undergraduate construction programs in implementing the IAC standard for accreditation or re-accreditation.

Methodology

This was a qualitative research project utilizing a structured interview and a non-random sample. A call for participation was sent to all Associated Schools of Construction (ASC) members who had a four-year ACCE-accredited program. (Of the 48 ACCE accredited four-year construction programs, only two had joint ABET accreditation. Therefore, this study focused only on four-year ACCE-accredited programs.) Construction program leaders who responded to the call for participation were included in this research. There were 13 programs participating in the study

(Appendix B) with a representative mix of program sizes, geographic locations, and program age.

Figure 1. Locations of Participating Construction Programs

A telephone conference was held with the researchers and each program leader using a structured questionnaire (electronically sent to the participants prior to the telephone interview). The questionnaire was comprised of six sections: IAC structure, leadership, membership, meetings, activities, and ACCE IAC standard discussion.

All programs represented were four-year, ACCE-accredited undergraduate construction programs. Because all programs were ACCE-accredited, size of the program was not viewed as an important variable.

Findings

The findings are presented from the information gathered from the questionnaire in the following categories: structure, membership, meetings, fundraising, placement, internships/co-ops, curriculum, and the ACCE IAC standard. The responses were wide and varied with very little consistency between the 13 programs.

Structure

Respondents were asked if the activities of their IACs were governed by written by-laws. While eight of the 13 respondents indicated that they did have written by-laws, several admitted that the written by-laws were outdated and were not followed in current practice. There was a majority consensus that written by-laws were either not needed, or were necessary only to satisfy a university or accreditation requirement. Some respondents said that industry members themselves were against written by-laws. Those few programs with current, written by-laws, that were serving to control IAC activity, were strong in their advocacy of the need for written by-laws that were updated regularly.

One survey question dealt with the leadership practices for IACs. Responses ranged from IACs without a Chair to a formal, structured nomination and election process to pick the Chair. In many situations the program leader acted as the defacto Chair. A few programs have a Chair with fixed terms, but in most cases Chair terms were flexible and some Chairs had served in that capacity for many years. In a few of the programs Chairs were selected by the Department Head and faculty. Chairs being elected by the IAC membership were the most predominant response. Overall, this survey question did not reveal any consensus regarding the selection and term of IAC Chairs.

Most respondents indicated that their IAC functioned as a monolith without any internal structure. However, several IACs, particularly the larger ones, functioned with a set of committees or subcommittees. One IAC had 12 committees to address a broad range of program issues. Other common internal groups included were curriculum, long range planning, alumni (actually a subgroup of the IAC where membership included those other than alumni), budget, and industry relations.

Membership

The IAC membership numbers ranged from a low of six to a high of 80. The average membership number was about 15 and most respondents had between 12 and 18 members on their IAC. Typically respondents indicated that the IAC membership was chosen to represent the industry sectors served by the program. The selection of new members was most often done either by the Department Head or based upon the recommendation of the other IAC members.

Membership terms varied widely. Five programs reported term limits of two to five years with renewals possible; others reported no term limits. One respondent stated: “You should never fire a volunteer" and that premise seemed to carryover to most IACs. Most respondents indicated that terms could be extended indefinitely and as long as a member was active and participating his/her tenure was assured. A common tenet was that productive members should be retained as long as they desired to participate. In two programs, continued membership was tied to a requirement to pay annual dues.

Meetings

Almost all schools in the study held IAC meetings on campus and met twice a year. Reported attendance was typically about 75% of total membership. Meeting length ranged from 1½ hours to 8 hours with an average of about three hours. In a few cases, meetings were timed to complement another campus event (a football game or the Department Awards Banquet), but most often the campus meetings were stand-alone events.

Meeting agendas were often prepared by the Department Head and almost always included time for the Department Head to give the IAC a report on the “State of the Program.” Most agendas incorporated a lunch or dinner. Faculty and student participation in the agenda was common for about half of the respondents, with the other half indicating that participation by faculty and students was not usually part of the agenda. A common agenda item from many respondents involved curriculum oversight by the IAC with the program seeking input on curriculum content. Other unique agenda items that were felt to be constructive included: (a) a closed one-hour session for only IAC members and student leaders to discuss program issues; (b) student presentations; (c) IAC exit interviews with graduating seniors; and, (d) a “value-added” presentation on a contemporary issue from an industry “expert”, e.g., use of the internet in project management. A common theme from respondents was the difficulty in developing an agenda that would keep the IAC members' interest and to insure active, continued involvement by the members.

Fundraising

The role of IACs in fundraising varied widely in this survey. Two programs had an IAC dues structure that generated substantial income. Many programs had a limited fundraising dimension that is largely ad hoc, designed to cover IAC expenses only, e.g., the cost of meeting lunch/dinner, or to address modest one-time needs, e.g., a new computer. Some programs had chosen not to involve the IAC in any form of fund raising, reacting to IAC member comments that they were giving time and did not feel it appropriate to have the program constantly soliciting money.

The two programs with IAC dues structures had common features that enabled the assessment of dues to be successful. Both programs have written by-laws, which clearly explain the dues structure, the purpose of the dues, and the use of the dues income (e.g., scholarships, student enrichment, faculty development, research seed funding, etc.). The IAC members seem willing to pay dues if there is a clear understanding of the use that will be made of dues income, and if that use was tied to improving the quality of the program.

Placement

All of the programs use university/college/school/department placement services without formal assistance from the IACs. However, three of the respondents cited one of the reasons individuals want to serve on the IAC is the networking opportunities between the department head, faculty, and students for hiring of graduates. One program has a bonus incentive for joining the IAC by allowing IAC companies/members early access to interviewing the graduating seniors during the career fairs.

Internships/Co-Ops

Six of the programs had structured internship/co-op programs. Five of the six programs gave academic credit for the internship. One program had an internship requirement, but offered no credit. All six of the respondents stated the IAC members were very supportive and provided internship/co-op opportunities. One respondent said that this support carried over to faculty internships, as well.

One program, not requiring an internship as part of the curriculum, has an IAC that wants internships to be a requirement, but the members will not guarantee internship positions for the students. Seven of the 13 programs do not have structured internship/co-op requirements.

Curriculum

The most commonly cited involvement in the programs was the review of and input for the curriculum by the IACs. Twelve of the 13 indicated curriculum review as an important part of the IAC activities. Input ranged from suggestions of new courses to modification of current courses. All respondents complimented their IAC on understanding its role as one of curriculum advisor/reviewer. The respondents felt that one of the best links to keeping the curriculum current was to formally solicit feedback from the IAC members. Several of the programs have made curriculum changes because of suggestions made by their IAC. Three of the 12 programs had an IAC curriculum subcommittee to formally review the curriculum with faculty representatives.

ACCE IAC Standard

The question of whether the current ACCE IAC standard needs to be changed generated dynamic discussion and no consensus. Six respondents said yes, four said no, two said the standard should be dropped, and one respondent was not sure.

The six respondents who felt the IAC standard needs to be changed recommended that more specific outcomes, in the form of metrics, be specified in the standard. These respondents cited the IAC standard as being “too loose and wide-open” and should include parameters that would allow for consistency when a program is being accredited or re-accredited. Examples of recommended metrics were: (a) to specify the minimum number of IAC meetings each year (two per year was recommended as the minimum); (b) to require written by-laws that outline roles and responsibilities of the members; (c) to outline how the IAC Chair is chosen; (d) to specify length of term for members; and, (e) to demonstrate other ways to show that the IAC is active in the program.

The five respondents who believed the standard should remain the same voiced concern about a standard that was so tight that individual programs were limited or given a heavy burden to implement in order to maintain or acquire accreditation. Flexibility was a keyword most often mentioned, and the respondents stated that the current standard allowed for this.

Two individuals recommended that the IAC standard be removed from the overall ACCE standards. They felt no formalized section in the standard was necessary and created “just another item” that had to be done.

Pros and Cons

Respondents were asked to identify the three most important advantages of IACs and the three most frustrating aspects of IACs. The following responses were given by the majority of respondents in each category.

Advantages:

- Curriculum support.
- Networking with industry.
- Influence with University.
- Strategic thinking and planning.

Frustrations:

- Finding IAC members who are activists.
- Keeping IAC members engaged.
- Lack of IAC member knowledge of academia.
- The "burden" of planning and holding IAC meetings.

IAC on the Web

Only two of the respondents indicated that they included any information on their IAC on their departmental web site. Consensus seemed to be that inclusion of IAC information on their web site was a "good idea," but they simply had not done so as a priority matter.

Conclusions

This study has provided significant insight into the use of IACs in ACCE-accredited programs. While all respondents had an IAC as required by ACCE standards, most considered the IAC to be a burden without commensurate benefit. Many programs appear to be "going through the motions" to satisfy an accreditation or university requirement with no effort to take full advantage of the value that IACs can bring. Those few programs that have aggressively sought IAC support of their programs have been very successful in leveraging the resources of industry to add significant value to the program. There seemed to be a reluctance to approach the construction industry for funding; this reluctance is unfortunate since all programs are producing a vital product for the industry—the next generation of construction industry leaders. The industry should be willing and eager to help with funding resources for these programs and programs should be aggressive and open in their efforts to acquire industry funding with the IACs as one vehicle.

The ACCE standard for IACs and other industry relations (Appendix A) is so broad that it can be satisfied with almost any response as evidenced by the wide disparity of responses to this survey. The standard is so imprecise that it should be eliminated completely or rewritten to include some specific metrics that enable measurement. There are good examples of IACs that have added tremendous value to programs, and metrics (outcomes) could be developed that would measure the benefits produced by IACs. For example, some of these metrics might be--funding provided (via dues, scholarships, fellowships, professorships, chairs, etc.), guest speakers provided, field trips sponsored, internships/co-op slots provided, etc.

There is a more fundamental issue evidenced by this survey. Most respondents implied that there was less than a sincere partnership between programs of construction higher education and the construction industry. There is strong industry demand for entry-level managers produced by programs of construction higher education. Recent research findings indicate that less than one-third of industry demand is being supplied by programs of construction higher education (Bilbo, et. al., 2000). Based upon this trend, the construction industry needs to be mobilized to seek "ownership" of programs of construction higher education and be prepared to devote significant resources to support and expand these programs. Programs of construction higher education must be receptive and responsive to aggressively seek out and take advantage of the resources available in industry. Leaders of both groups (ACCE and ASC for programs of construction higher education; and professional groups, such as; American Institute of Constructors [AIC], Construction Business Roundtable, Associated General Contractors [AGC], Associated Builders and Contractors [ABC], etc. for the construction industry) should meet to collectively plan an order of magnitude increase in industry support for programs of construction higher education.

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Appendix A

ACCE Advisory Council Standard Relations with Industry Support

Support from Industry

Construction is a practice-oriented profession. Therefore, it is imperative that an industrial advisory committee, consisting of representatives from the construction industry, be actively involved in an advisory role for the construction program. The committee should meet on a regular basis for the purpose of advising and assisting the development and enhancement of the program. Although the composition of the committee should change periodically, there should be provisions to ensure reasonable continuity. The composition of the committee should be representative of the potential employers of the graduates of the construction program.

Support for Industry

There should be an active program of continuing education and, in the case of baccalaureate programs, research directly applicable to and in support of the construction industry. The construction program should maintain continuous liaison with the various associations to determine needs of the construction community for the purpose of establishing educational and professional development activities for the construction industry.

Student-Industry Relations

There should be well-defined communications and participation between faculty, students, and the construction industry. There should be well-documented evidence of industry involvement such as field trips and speakers for student clubs. Students should attend membership meetings of the various associations and participate in summer work programs and other activities in the construction industry.

Appendix B

Construction Programs at Universities Participating in the IAC Survey

Del E. Webb School of Construction
Arizona State University
Tempe, Arizona

Department of Building Science
Auburn University
Auburn, Alabama

Department of Construction Management
California Polytechnic State University
San Luis Obispo, California

Department of Construction Science and Management
Clemson University
Clemson, South Carolina

Construction and Facilities Department
Ferris State University
Big Rapids, Michigan

Construction Management
Milwaukee School of Engineering
Milwaukee, Wisconsin

Department of Building Construction Management
Purdue University
West Lafayette, Indiana

Department of Construction Science
Texas A & M University
College Station, Texas

Department of Construction Management
University of Cincinnati
Cincinnati, Ohio

M.E. Rinker Sr. School of Building Construction
University of Florida
Gainesville, Florida

Department of Construction Management
University of Nebraska – Lincoln
Lincoln, Nebraska

Construction Engineering and Management
University of Nevada – Las Vegas
Las Vegas, Nevada

Division of Construction Science
University of Oklahoma
Norman, Oklahoma.

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Membership Applications

Inquiries should be send to: Associated Schools of Construction ? John Murphy, Jr., ASC President, 224-C Guggenheim Hall, Colorado State University, Tel: 970.491.6336, E-mail: jmurphy@cahs.colostate.edu

Organizations eligible for membership may fill out one of the following application forms: (http://ascweb.org/asc/internet/positions/industry/main.asp). 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.