Design-Build Education at Associated Schools of Construction Undergraduate Programs

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This study discusses the results of a survey conducted in 2001-2002 designed to determine the extent to which design-build project delivery is taught at four year construction programs within the membership schools of the Associated Schools of Construction (ASC) and to identify existing limitations and barriers to design-build education at these programs. A questionnaire was sent to all 4-year ASC construction programs. Forty four schools or fifty percent of the member schools responded. The study focused on three primary questions (1) Do you offer design-build education in your program and if you do, do you offer it as a stand alone course or as part of another course, (2) what elements of design-build are addressed in the course(s), and (3) what are the major barriers to delivering design-build education at the undergraduate level? A majority of ASC programs responding teach components of design-build project delivery at some level. Only 17% of the programs responding indicated that they taught design-build project delivery as a stand-alone course and 17% of the responding programs indicated that they do not teach design-build project delivery at all. Programs offering design-build project delivery as a stand-alone course address significantly more topic areas than do programs that teach design-build as part of another course. The top three topic areas addressed within those programs indicating that they teach design-build are (1) advantages and disadvantages of design-build, (2) owner's objectives and needs, and (3) conceptual estimating. The number one barrier or limitation to delivering design-build education at the undergraduate level is curricular restraints primarily associated with accreditation and general education requirements.

Key Words: Design-Build, Project Delivery, Curriculum, Conceptual Estimating, Integrated Project Delivery

Introduction

Design-Build is a method of project delivery in which one entity, the design-builder, forges a single contract with the owner to provide for architectural or engineering design and construction services. Independent research on project performance has shown that design-build, when compared with traditional design and low-bid contracting, is 33% faster, 6% less in unit cost, superior in product quality, and generates less than half the claims and litigation (Beard, Loulakis, & Wundram, 2001).

In the United States, the private sector's use of design-build has been increasing during the past thirty years, and is found in a wide array of commercial, institutional, and industrial applications. In the U.S. public sector, the federal government, as well as many states and local governments, employ Design-Build contracting for a significant percentage of their building programs. According to the Design Build Institute of America, overall, the use of design-build has grown from 5% of U.S. construction in 1985 to 33% in 1999, and is projected to surpass low-bid construction in 2005.

Although the actual use of Design-Build project delivery has increased dramatically since 1985, traditional low-bid project delivery remains the educational focus of undergraduate construction programs across the country. If construction education is to address future market expectations as expressed by the increased use of design-build, than an educational emphasis on design-build must occur at some level. The primary purpose of this study was to try to determine the extent to which design-build project delivery is currently being taught in construction management programs at ASC member schools.

Methodology

Participants

The membership list published on the Associated Schools of Construction website was used as the sample source for this study. The study's focus was colleges and universities that offer a four year construction program. It was determined that there were 88 four-year schools listed as members of the ASC at the time of the survey. The programs are identified as either Construction Management, Construction Engineering, Engineering Technology, Building Science, or Construction Science programs. Each of the programs is affiliated with a college or school of Engineering, Architecture, Technology, or other.

The methodology adopted for this study was the questionnaire survey. A questionnaire was sent via regular mail to each of the member schools. The questionnaire was addressed to the department head of each program asking that the questionnaire be forwarded to an individual faculty member that could best respond to the survey. A second mailing via email and fax was conducted approximately 3 months after the first collection attempt.

Instrument

The questionnaire utilized in this study initially contained 3 parts. Part 1 contained demographic questions regarding school name, program name, and college/school affiliation. Part 1 also contained qualitative questions such as those listed below:

1. In your opinion, is the design-build education being offered at the undergraduate level adequate?
2. What do you perceive to be the main barriers to providing design-build education at the undergraduate level?
3. Do you think the use of design-build project delivery will increase, decrease, or stay approximately the same over the next 10 years?

Part 2 of the questionnaire dealt with design-build curriculum offerings within the program. The fundamental questions for Part 2 were:

1. Do you teach specific "stand alone" courses in design-build project delivery in your undergraduate program? Yes___ No ___

2. Do you teach design-build project delivery as part of another course or courses in your undergraduate program? Yes___ No ___

For the purposes of this study a "stand alone" course meant that there was a specific design-build course being offered in the curriculum.

Participants who responded in the affirmative to either question listed above were then asked to identify what elements of design-build project delivery they addressed in their courses. A list of design-build educational elements was taken from the Educational Needs Assessment for Design-Build Project Delivery research project conducted by the University of Colorado and the Design-Build Institute of America in 2001(Molenaar, 2001). This research was initiated to determine the most critical needs of design-build continuing education as viewed by industry professionals. The study resulted in a Design-Build Lifecycle model that divides the process into six main phases or categories—Project Initiation, Risk Allocation, Performance Specifications, Project Planning, Construction Administration, and Project Closeout (See Figure 1)

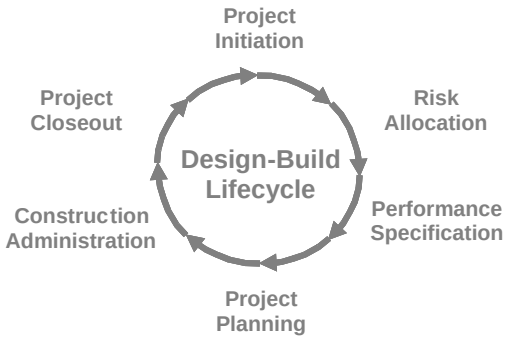

Figure 1: Design-Build Life Cycle Model

Under each phase or category, several educational elements were identified. The list of categories and elements can be seen in Figure 2. According to the study, these categories identify the most critical areas of the process. Participants were asked to mark all that applied.

PROJECT INITIATION
___ Owner's Objectives & Project Needs
___ Advantages and Disadvantages
___ Project Program and Feasibility
___ Fast Tracking (Project Timeline)
___ Early Budgeting and Contingency
___ Project Financing

PERFORMANCE SPECIFICATION
___ RFQ and RFP Definitions
___ RFQ and RFP Preparation
___ Performance Specifications
___ Preparing the Proposal Response
___ Proposal Preparation Costs
___ Design-Builder Selection and Evaluation

PROJECT ADMINISTRATION
___ Design-Build Contract Award Process
___ Progress payment Techniques
___ QA and QC for Design-Build
___ Design-Build Cost & Schedule Control
___ Change Order Management and Trending

RISK ALLOCATION
___ Laws and Licensing
___ D/B Contract Fundamentals
___ Teaming Agreements
___ Design-Build Insurance Considerations
___ Bonding for Design-Build

PROJECT PLANNING
___ Conceptual Design
___ Conceptual Estimating
___ Design and Build Scheduling
___ Life Cycle Costing
___ Value Engineering

PROJECT CLOSEOUT
___ Warranties in Design-Build
___ Facilities Commissioning Process
___ Facilities Maintenance
___ Facilities Management
___ Operations Planning

Figure 2:– Elements of Design-Build Education

Part 3 of the original questionnaire attempted to identify elements of design-build education that may not actually be recognized as such within an undergraduate construction program. The data from this part of the questionnaire was determined to be inconsistent and unreliable and therefore not utilized in the study.

Data Analysis

Data collected was analyzed using the Statistical Package for Social Sciences (SPSS). The data were analyzed using descriptive statistics only. No comparative or inferential statistics were required. Frequency and means provided sufficient measurement to fulfill the purpose of the study.

Results

Response Rate and Sample Profile

Questionnaires were returned from each of the seven regions of the ASC. Of the 88 questionnaires sent out, a total of 44 or 50 percent were returned. Of the 44 programs that responded, 53 percent were affiliated with an Engineering college or school equaling 55 percent of all Engineering affiliated construction programs, 20 percent were affiliated with an Architecture college or school equaling 73 percent of all Architecture affiliated construction programs, 20 percent were affiliated with a college or school of Technology equaling 55 percent of all Technology affiliated construction programs, and 7 percent were affiliated with a college

or school noted as other, equaling 18 percent of all "other" college affiliated construction programs.

Design-Build Curriculum

A majority of the schools that responded offer design-build education at some level. Seventeen percent indicated that they teach design-build as a stand alone course. Sixty-six percent of the respondents stated that design-build is taught as part of another course, and 17 percent indicated that they do not teach design-build at all.

Design-Build Elements Taught

The Molenaar study (2001) identified the specific aspects of design-build that are the most crucial for the continuing education of professional practitioners within the industry. The study integrated the experiences of professionals from all sides of a construction project. In determining these crucial aspects, information was gathered from seven different sectors of industry, including builders, designers, integrated design-builders, public and private owners, lawyers and sureties. For the purposes of this study, this same model was used to evaluate the extent to which design-build education is being addressed at undergraduate construction management programs. Note that the number in parentheses next to each element represents its Educational Needs Ranking identified in the Molenaar Educational Needs Assessment study (2003). Each category is considered separately.

Project Initiation Elements

Table 1 indicates the percent of programs responding that teach project initiation elements of design-build. Project Initiation elements as a group received the highest percentages across all three categories of evaluation (All Programs, Part of Another Course, and Stand Alone Course). The elements Owner's Objectives & Needs and Design-Build Advantages & Disadvantages received high indicators across all three categories, ranging from 63 percent to 86 percent for Owner's Objectives & Needs and from 68 percent to 86 percent for Advantages & Disadvantages. Eighty-six percent of the programs that teach design-build as a stand alone course address Project Program & Feasibility—this is more than double the coverage percentage by programs that teach design-build as part of another course. This is important to note in that this particular element represents a service often required by Owner's seeking design-build services. On the other hand, it is also noteworthy to recognize that the element Project Financing, a service increasingly in demand by procurers of design-build, was addressed by fewer programs offering design-build as a stand alone course than by those that teach design-build as part of another course.

Table 1

Project Initiation

	All Programs	Part of Other Course	Stand Alone Course
Owner's Objectives & Needs (3)	63	73	86
Advantages & Disadvantages (1)	68	81	86
Project Program & Feasibility (16)	35	31	86
Fast Tracking – Project Timeline (5)	50	58	71
Early Budget/Contingency (2)	43	46	71
Project Financing (29)	35	46	29

*Number in parentheses represents the Educational Needs Ranking identified in the Molenaar Educational Needs Assessment study.

Performance Specifications

The Performance Specifications category includes the most distinctive educational elements of design-build versus traditional project delivery. These elements deal with how the design-builder gets their work—via the RFQ / RFP process, how RFP's are written and evaluated using performance criteria, how to prepare a response to an RFP, and how a design-builder is selected and evaluated in the marketplace. Table 2 indicates the percent of programs responding that teach Performance Specifications elements of design-build. The data clearly indicates that these critical and distinctive elements of design-build are best served by programs providing design-build education as a stand alone course. For almost all of the elements listed under the category Performance Specifications, stand alone courses provide coverage two or three times more often than did design-build education offered as part of another course.

Table 2

Performance Specifications

	All Programs	Part of Other Course	Stand Alone Course
RFQ/RFP Definitions (17)	33	27	86
RFQ/RFP Preparation (22)	23	12	86
Performance Specifications (8)	50	54	86
Proposal Response Preparation (12)	35	27	100
Proposal Preparation Costs (19)	20	15	67
DB Selection & Evaluation (10)	48	50	86

*Number in parentheses represents the Educational Needs Ranking identified in the Molenaar Educational Needs Assessment study.

Project Administration

Table 3 reveals the percentage of programs responding that teach design-build Project Administration elements in their undergraduate construction programs. For three of the elements, DB Contract Award, DB Progress Payments, and DB Cost & Schedule Control, those programs teaching this content in stand alone courses address these elements by a ratio greater than two to one. There appears to be little difference between the emphasis on QA / QC for Design-Build, and DB Change Order Management between the two methods of providing design-build curriculum.

Table 3

Project Administration

	All Programs	Part of Other Course	Stand Alone Course
DB Contract Award (21)	33	31	71
Progress Payments in DB (31)	30	27	71
QA and QC for Design/Build (15)	25	31	29
DB Cost & Schedule Control (6)	33	31	71
DB Change Order Management (11)	38	42	57

*Number in parentheses represents the Educational Needs Ranking identified in the Molenaar Educational Needs Assessment study.

Risk Allocation

The Risk Allocation elements also represent distinctive components of design-build project delivery. Table 4 indicates the percentage of programs responding that teach design-build Risk Allocation elements in their undergraduate construction programs. In this case the data reveals that many of these elements are similarly addressed regardless of the mode of delivery. However, it is interesting to note that when it comes to design-build insurance and bonding that programs teaching design-build as part of another course address these elements at a ratio of slightly more than two to one over stand alone courses. It should also be noted that neither methodology offers a high likelihood of inclusion. One would also think that design-build contract fundamentals would be addressed by 100 percent of the programs providing design-build education. But the data reveals that this is not the case.

Table 4

Risk Allocation

	All Programs	Part of Other Course	Stand Alone Course
DB Laws & Licensing (26)	28	35	29
DB Contract Fundamentals (9)	53	62	71
Teaming Arrangements (18)	35	42	43
DB Insurance Considerations (24)	23	31	14
Bonding for Design-Build (28)	25	35	14

*Number in parentheses represents the Educational Needs Ranking identified in the Molenaar Educational Needs Assessment study.

Project Planning

The elements listed under Project Planning once again represent distinctive components of design-build project delivery. Table 4 indicates the percentage of programs responding that teach design-build Project Planning elements in their undergraduate construction programs. Conceptual estimating, conceptual design, life cycle costing, and value engineering are all fundamental requirements in design-build project delivery. However, they are also recognized tools that can be applied to any project. This may explain why the variance between the percentages for Part of Another Course and Stand Alone Course is relatively unremarkable for all elements within the category. It should also be noted that conceptual estimating received the highest single percentage of offering by all programs at 69 percent.

Table 5

Project Planning

	All Programs	Part of Other Course	Stand Alone Course
Conceptual Design (13)	55	50	86
Conceptual Estimating (4)	69	72	100
Design & Build Scheduling (7)	40	42	71
Life Cycle Costing (20)	40	42	57
Value Engineering	60	62	86

*Number in parentheses represents the Educational Needs Ranking identified in the Molenaar Educational Needs Assessment study.

Project Closeout

Table 4 indicates the percentage of programs responding that teach design-build Project Closeout elements in their undergraduate construction programs. It is clear from the information included in this table that these elements receive the least attention regardless of how the curriculum is offered. Given the trend toward broader services being offered to facility owners by design-builders such as design-build-operate-maintain and design-build-operate-transfer, this data suggests a possible gap in design-build education.

Content Coverage per Category

Table 7 shows the mean number and percentage of elements addressed within a topic category. These are broken down for all programs responding, programs that teach design-build as part of another course, and for stand alone courses. Among all programs and programs where design-build is being taught as part of another course, Project Initiation elements received the most attention. Among programs that teach design-build as a stand alone course, Performance Specification elements were taught more often with Project Initiation elements a close second.

Overall, the top three single elements of design-build project delivery being addressed at all programs that reported teaching design-build, regardless of whether design-build was being taught as part of another course or as a stand alone course, is the advantages and disadvantages of design-build (68 percent), owner objectives and project needs (63 percent), and conceptual estimating (69 percent).

Table 6

Project Closeout

PROJECT CLOSEOUT	All Programs	Part of Other Course	Stand Alone Course
Warranties in Design-Build (25)	23	31	14
Facilities Commissioning (27)	18	19	29
Facilities Maintenance (30)	0	0	0
Facilities Management	0	0	0
Operations Planning (30)	3	0	14

*Number in parentheses represents the Educational Needs Ranking identified in the Molenaar Educational Needs Assessment study.

Table 7

Content Coverage per Category

	All Programs	Part of Another Course	Stand Alone Course
Project Initiation	3.08 / 44%	3.54 / 51%	4.43 / 63%
Performance Specification	2.10 / 30%	1.88 / 27%	5.00 / 71%
Project Administration	1.58 / 32%	1.62 / 32%	3.00 / 60%
Risk Allocation	1.65 / 28%	2.04 / 34%	1.86 / 31%
Project Planning	2.58 / 43%	2.65 / 44%	3.71 / 62%
Project Closeout	0.43 / 9%	0.50 / 10%	0.57 / 11%

Adequacy of Undergraduate Design-Build Education and Projected Use of Design-Build Project Delivery

As can be seen in Figure 3 more than half of the participants responding indicated that the current level of design build education is inadequate or barely adequate. This information taken together with the information depicted in Figure 4 indicating that 79 percent of the participants of this study believe that the use of design-build project delivery in the marketplace will increase over the next 10 years are strong indicators for further consideration of design-build curriculum at the undergraduate level.

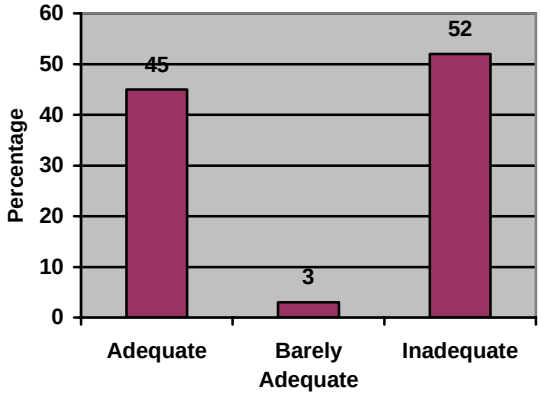

Figure 3: Adequacy of Undergraduate Design-Build Education

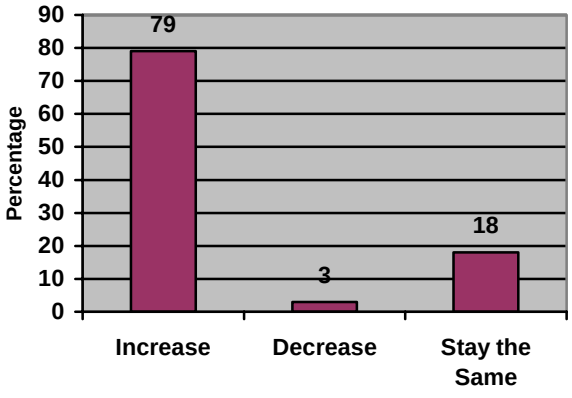

Figure 4: Projected Use Of Design-Build Education

Barriers and Limitations to Design-Build Education

Survey participants were asked to list perceived barriers and constraints to delivering design-build education at the undergraduate level. Participants were allowed to list as many barriers or constraints as they wished. Figure 5 indicates their responses. Curricular restraints are by far the barrier most often reported. Some of the specific curricular restraints mentioned were: (1) Limited number of credit hours in the curriculum, (2) Accreditation requirements dictate, (3) No room in curriculum after meeting general education and accreditation requirements, and (4) Programs have few or no electives.

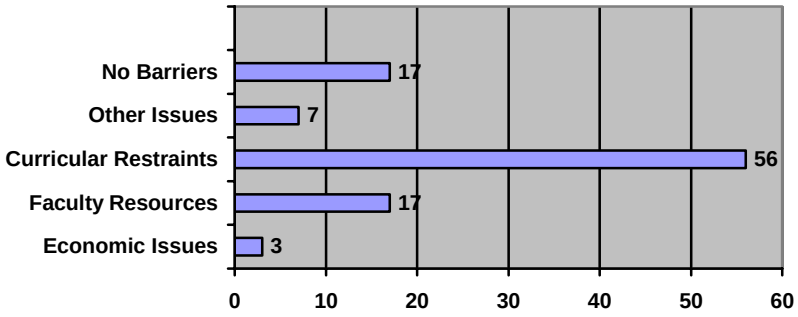

Figure 5 – Barriers and Limitations to Offering Design-Build Curriculum

Other responses that were listed were grouped under the categories of faculty resources, economic issues, and other issues. Some of the specific responses under these categories are listed below. It is also worth noting that several participants indicated that there were no barriers to delivering design-build education.

Faculty Resources-

Faculty resistance to change.

Lack of qualified/knowledgeable faculty.
Refusal to integrate across disciplines.
No time to develop new courses.
No resources to develop new courses.

Other Barriers-

1. Why develop a course around a single delivery method?
2. Students unable to understand.
3. Lack of student interest.
4. Complexity of design-build.
5. No reference materials/textbooks.
6. Design-Build is still unproven in the marketplace.

Conclusions

At first glance it may appear that Design-Build being addressed at 83% of all programs responding is a positive result. However, with further analysis and in consideration of the numerous educational elements of design-build, the picture is less encouraging. For example, when the three most important educational needs identified by industry practitioners in the Molenaar Study (2001) are considered, the analysis is as follows:

Element #1 – Advantages & Disadvantages

6 programs or 14% of all programs address this element in a stand alone course.
24 programs or 55% of all programs address this element as part of another course.
14 programs or 32% of all programs responding did not offer this element at all.

Element #2 – Budget & Contingencies

5 programs or 11% of all programs address this element in a stand alone course.
44 programs or 32% of all programs address this element as part of another course.
25 programs or 57% of all programs responding did not offer this element at all.

Element #3 – Owner's Objectives & Needs

6 programs or 14% of all programs address this element in a stand alone course.
22 programs or 50% of all programs address this element as part of another course.
16 programs or 37% of all programs responding did not offer this element at all.

Quantity versus Quality

Although an effort was made to quantify the educational elements of design-build being addressed at ASC programs in this study, it is important to recognize that the findings don't reveal anything about the quality of the design-build curriculum being offered. Even though the industry has surged forward in its use of design-build and the marketplace is a clear demand for it, there is probably limited knowledge and experience of the design-build process among construction academics. Therefore, it is likely that the quality and consistency of design-build education is suspect at best. Professional educational offerings in design-build presented by DBIA, ASCE, AGC, AIA, and others might be considered appropriate professional development avenues for those programs and individual faculty that are interested in improving design-build educational opportunities at the undergraduate level.

Discussion

One of the questions that need to be addressed by construction educators is whether the coverage of these topics is warranted in an undergraduate construction management program today—in other words, is there a need to provide specific design-build curriculum to CM students. To help answer this question the author suggests consideration of the following 4 factors:

- During the past decade, the use of and interest in design-build in the United States and Canada has greatly accelerated, making the growth of this delivery method one of the most significant trends in the design and construction industry (DBIA, 1996).

- Design-build requires a team and a new mentality—an integrated mentality. In colleges and universities around the country, the architecture, engineering, and construction disciplines are taught in programs with an inherent bias towards separation of design and construction professionals. These biases can be more deeply entrenched in a workplace where design-bid-build delivery environments exist. As the delivery process has changed in the US market, so have the educational needs of the professionals (Molenaar, 2001).

- For at least the past six years the design and construction industry itself has responded to this trend by developing specific design-build educational courses to serve practitioners who find themselves ill equipped to provide the unique design-build services that the public is a demand for.

- According to Doug Gransberg, , an instructor for the American Society of Civil Engineers (ASCE) and professor at the University of Oklahoma, the ASCE has offered an intensive 2-day course entitled "Design-Build Contracting" approximately 6 times per year since 1996. These courses have been attended by engineers, contractors, architects,

and several owners. They have also provided coast to coast design-build training to the Federal Transportation Administration, the National Park Service, the United States Navy, and several other public and private entities.

- Michael Sallas, Vice President for Education and Research at the Design-Build Institute of America reports that over 100 design-build courses, serving over 5000 practitioners and owners have been delivered across the United States in the past 6 years. Approximately 40 percent of the course attendees have been contractors, 30 percent architects and engineers, and 30 percent have been owners.

- There are many factors that clearly distinguish design-build as a unique, complex process. Design-Build project delivery is distinctly different in at least 5 significant areas.

- Traditional project delivery award is based upon low price. Design-build project award is typically based upon "best value"—a consideration of both quantitative and qualitative factors. The competitive RFQ/RFP process is very different from the competitive low bid process. Design-build teams and proposals are selected based upon any number of unique evaluation processes—weighted criteria, fixed price/best design, adjusted low bid, etc.
- Traditional project delivery depends upon 100 percent complete plans and specifications in order to provide detailed estimates and competitive bids. Design-build depends upon performance criteria spelled out in an RFP (which may or may not include drawings) to develop conceptual estimates in order to provide conceptual estimates leading to a guaranteed maximum or even lump sum price very early on in the process.

- In traditional project delivery, what constitutes the "contract" are the plans, the specifications, and the agreement form itself. In design-build what constitutes the "contract" is the RFP performance requirements, the technical proposal (design, schedule, management plan, etc.), and the price proposal. There are <u>no</u> completed plans and specs at the time of the signing of an agreement.

- In traditional project delivery, the owner warrants the sufficiency of the plans and specs to the contractor. The owner is responsible for any gaps between the plans and specs and the owner's requirements for performance. Under deign-build the design-builder warrants the sufficiency of the plans and spec to the owner. The design-builder is liable for any gaps between the plans and specs and the owner's expectations for performance.

- Traditional project delivery is linear in approach and restricts early contractor involvement. Design-build is an integrated, interdisciplinary team approach and permits/requires early contractor involvement.

Some construction faculty have suggested that design-build education would best be provided by graduate programs and indeed there are now 4 universities that offer a Masters degree in design-build—Georgia Tech, University of Oklahoma, Washington State, and Stanford. However, given the apparent urgent need for design-build education by practicing construction

professionals, and the unlikelihood that graduate education will fill that urgent need, one might conclude the following:

- Design-build requires unique skills and knowledge and is obviously needed to perform and compete in today's market.

- Our undergraduate construction programs are not adequately providing it, but could possibly do so, and thereby better serve the industry

Future Opportunities

There is significant evidence that design-build is not just a fringe delivery system. Design-build is here to stay. In many ways, the "best value approach" as signified by design-build could be said to be the emerging new standard for project delivery. For example, best value contracting is now being used for over 50% of federal construction projects and is applied to over 66% of federal construction dollars (Waites). Very recently the U.S. Federal Highway Administration has given the green light to widespread use of design-build project delivery for federally aided transportation jobs (ENR, 2002). According to the Mechanical Contractors Association of America Reporter (2001), after getting consistent, positive results with best value approaches, federal agencies increased their use of best value contracting by more than 500% in the 1990's, reversing a prior preference for low bid.

One could make the case that design-build could become the foundation upon which we build an entire new construction, engineering, and architecture curriculum, just as we built our current A/E/C curriculum around design-bid-build. According to experienced Design-Build practitioners, the term design-build is really inadequate to describe the level of services that are now being demanded by clients and offered by Design-Build professionals. Clients not only want a single source for design and construction but they also want the design-builder to finance the project, maintain the project, and operate the facility in some cases. And it doesn't stop there. What clients are really looking for are comprehensive facility solutions, fully integrated by the design-build team. Traditional project delivery methods and thinking can not provide that for a client. Just as practicing professionals have been forced to educate themselves in these new ways of thinking and doing business, construction educators must likewise educate themselves so that they may be responsive to the needs of their students and the futures that they will move into.

Does Design-Build Education Make a Difference?

For the past 4 years a stand alone design-build course has been required at the author's university. A recent 2001 construction management graduate employed by a major general contractor/design-builder who completed the stand alone course offered these comments when asked if a design-build education made a difference in his career:

> "Having a design-build educational background has blown open the doors of opportunity for me. I don't just see the project from the builder's perspective, I see the project from everyone's eyes—the owner, the architect, the end user. This allows me to anticipate in a

way that I couldn't do from a single discipline perspective. I can be one step ahead and contribute in a way that adds value and results in a win for everyone."

Further progress has been made with a new 30 unit undergraduate minor in Integrated Project Delivery with an emphasis on Design-Build has been approved by the department, college, and university curriculum committees. This program, offered by the Construction Management Department, will be available to various majors from across the campus including construction management, architecture, civil engineering, architectural engineering, mechanical and electrical engineering, landscape architecture, and city and regional planning starting in the fall of 2003, and will be taught in a multidiscipline environment. In addition to addressing all of the cognitive elements of a design-build education suggested in the Molenaar Report (2001) including facilities, project feasibility, and programming, the new program will also provide the critical affective components of successful design-build and the collaborative process— high performance teams, communication, and leadership.

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