The “Chip Voting System”: Bridging the Gap Between Industry and Faculty During a Curriculum Revision

Darren A. Olsen, J.D. and Richard A. Burt, Ph.D.
Auburn University
Auburn Alabama

A construction faculty used a simple, yet effective method of gathering input regarding the subject matter and topical content taught in the undergraduate curriculum. The method sought to ensure that relevant feedback was gathered from faculty members and industry leaders. This paper will discuss the mechanical and logistical issues of soliciting opinions from faculty and construction industry professionals and explain the “chip voting method” used to gather data concerning the future direction of the program’s curriculum. The “chip voting system” works by providing participants with a the list of ACCE subject matter and topical content to which they can assign votes in the form of “chips” based on the value they give to the teaching of the subject matter and topical content.

Key words: curriculum, curriculum review, industry, accreditation

Introduction

The primary reason for adopting a curricular change is the need to update, revise or modernize a curriculum (Thacker, 2000). When undertaking a curriculum review, the accrediting body’s and university’s curriculum requirements first and foremost must be taken into account. The first step in a curriculum revision is gathering input from primary stakeholders including students, faculty and industry professionals (Ferguson, 2004). An analysis of the industry’s critical needs is essential to discovering the skills and characteristics program graduates should possess upon graduating from a construction program and entering the workforce (Meyer and Laurence, 2004). If an academic program is to produce high caliber graduates who excel in an increasingly complex industry, those guiding the curriculum need to know what kind of skills and experience industry leaders are looking for in new hires. They must stay abreast of the latest industry trends and keep future industry personnel needs in mind (Ferguson, 2004).

Following an accreditation visit by the American Council for Construction Education (ACCE) at Auburn University, the subsequent accreditation report identified the lack of a recent curriculum revision as a weakness of the program. The response to reviewing the curriculum began the next semester. Early on, it was decided that a key component in the curriculum review would be the involvement of industry professionals. It was deemed that these stakeholders were important for a number of reasons including: 1) They would bring legitimacy and relevancy to the curriculum revisions; 2) Their opinions would help alleviate resistance to change which would inevitably occur among members of the faculty; and 3) Their opinions could provide an eye toward the future of what skills students need to possess to excel in the workforce upon graduation.

The ACCE backs up the need for giving construction professionals a seat at the table. Because the profession is “practice oriented,” the ACCE encourages direct industry involvement in construction education, and recommends the establishment of a committee of industry representatives to be actively involved in an advisory capacity (ACCE, 2006). The inclusion of industry professionals adds legitimacy to the process and provides faculty members with persuasive evidence to support the need for change (Thacker, 2000). Garnering industry support up-front can counteract the resistance toward change later in the process. The most influential voice for change can come via the feedback of non-academics who are professionals in the field.

Critical to the success of any curriculum revision is stakeholders’ willingness to start with a clean slate and throw out everything that’s been done in the past. Thought processes guided by the idea that “we’ve never done things this way,” undermine the process and ultimately destroy efforts to revise the curriculum (Thacker, 2000). Rather than simply conduct a traditional curriculum review that surveyed faculty members and students in the program along with industry professionals for their thoughts on the current state of curriculum content and delivery methods, the group sought innovation. Bearing in mind the need for both faculty and industry input, it was decided that after first soliciting the views of the faculty, the curriculum review would then be taken on the road to the front lines of the construction industry. First, a pool of companies including residential, commercial, industrial and specialty contractors was gathered via contacts in our alumni base and other program supporters. The vast majority of the participants would be considered commercial contractors. From this group, a number of industry leaders were consulted in an effort to gain their perspectives on what a cutting edge construction curriculum should include.

A construction program's curriculum is primarily constrained by the requirements of the accreditation body (ACCE) as well as the university's curriculum requirements. Both of these institutions have placed constraints on the curriculum in regards to minimum number of credit hours in the curriculum and the subject matter and topical content covered. Within the limitations placed on a curriculum by these two institutions, a significant amount of choice and discretion is left up to the faculty and administrators to steer the direction of their programs. Herein lies the problem, how do you communicate accreditation constraints to non-academics and allow them to advise on curriculum issueswithin the guidelines of the University and ACCE? The challenge with such an endeavor lies in successfully bringing industry leaders into the academic arena and helping them participate meaningfully in a complex and unfamiliar process. A unique review methodology was needed to level the playing field and get the most useful information and opinions from all the participants. To address the issue, an innovative "chip voting system" was developed that works by providing participants with a list of the subject matter and topical content. The list was generated using American Council for Construction Education Document 103: *Standards and criteria for accreditation of post-secondary construction education degree programs.* Respondents were then asked to assign votes based on the importance they feel it is to teach that subject matter and topical content. To communicate credit hours requirements to the industry professionals, the credit hours were converted into voting "chips." Two voting chips equal one academic credit hour. For example, a three-credit-hour class equals six votes. The more important a survey participant deems the subject matter, the more "chips" they may assign to it. The less important subject matter is given fewer "chips."

Scheduling a series of meetings in five cities, faculty utilized the "chip voting system" to solicit the input and advice of construction executives and managers. The goal was to identify the subject matter and topical content the faculty and industry felt it was important to cover based on the restrictions imposed by the American Council for Construction Education Document 103: *Standards and criteria for accreditation of post-secondary construction education degree programs*. In addition it was hoped that "new" topical content would also be identified. This paper will discuss the mechanical and logistical issues of soliciting opinions of construction industry professionals, explain the chip voting method, and provide support for its effectiveness.

Methodology

Due to the number of people and opinions sought for inclusion in the curriculum review, it was decided faculty would travel to meet the industry professionals, rather than requiring them to travel to the university. The committee strategically selected metropolitan hubs spread throughout the reach of the program's main alumni and industry support groups. Eventually five metropolitan areas Atlanta, Birmingham, Fort Worth, Montgomery and Mobile were selected to hold curriculum review meetings. The visits were coordinated through construction organizations and the schools industry advisory council. Participants included many graduates of the university's program, but they also included industry professionals who simply had an interest in the curriculum. The majority of the participants were seasoned professionals with many years of industry experience. Before meeting with industry representatives the faculty members were surveyed first to identify their views.

The curriculum itself is made up not only of construction-related courses but also includes general education, math, science, business and management courses. These courses are primarily taken during a student's freshmen and sophomore years and for the most part are tightly constrained by the university core curriculum and ACCE requirements. These basic courses largely represent "knowns" and were selectively discussed in all the curriculum review meetings where discretion existed. However, they were excluded from the chip voting exercise so as not to further confuse an already complex procedure.

Once the basic requirements were taken into account, only the construction-related coursework remained. The ACCE makes an initial division of the topical content between Construction and Construction Science. Construction includes amongst other things estimating, scheduling and project management, while the subject matter in construction science relates to design theory, design analysis and materials and methods. Within these grand divisions lies a further two-tiered breakdown of the separate topical areas. For instance, the first subject matter category in Construction Science is Design Theory. The Design Theory category is further broken down into topical content areas of Structural Mechanics; Electricity; Thermodynamics; and Soil Mechanics. The ACCE requires in its *Standards and criteria for postsecondary construction education degree programs* that a minimum of 20 hours of academic credit in the curriculum are assigned to the curriculum categories of Construction Science and Construction respectively. There is an additional requirement of a minimum of 50 combined hours of academic credit in both the Construction Science and Construction categories (ACCE, 2006). The aim of the meetings with faculty and industry was to get respondents to apportion those 50 credit hours across the specific topical content areas listed in the standards. For the purposes of the study two votes equaled one academic credit hour so a three credit hour class would equal six votes. Therefore respondents were able to cast a total of 100 votes.

Using the chip voting method, each grand division must receive a minimum of 20 credit hours. This leaves ten credit hours as wild card "chips," which can be used to cast a vote that shifts the focus of the program toward Construction Science or Construction. Within each grand division the ACCE mandates a certain number of credit hours in each of the subject matter areas. For example within the Design Theory subject matter area survey participants had three prescribed credit hours to vote with. The three prescribed credit hours could be spread amongst any one or any combination of the topical content including the ACCE designated topical content of Structural Mechanics, Electricity, Thermodynamics and Soil Mechanics, and the "new" content identified by faculty or industry of Temporary Structures Sustainable Design and Building Envelope.

Participants' votes were taken in a three-part process which correlated with the requirements of ACCE. The first and second step involved allocating the 20 credit hours worth of mandatory votes amongst the grand divisions of Construction Science and Construction. The first step was to allocate the prescribed credit hours in each first tier category (Figure 1). Construction Science included 17 prescribed credit hours (34 votes) and Construction had 12 prescribed credit hours (24 votes). The second step was to assign the leftover "chips" of the mandatory 20 credit hours to each grand division. These leftovers could be assigned to any first-tier category. The final and possibly the most important step in the voting process involved assigning the remaining 10 credit hours to any chosen category in either grand division. Respondents were allowed to vote in quantities of less than one vote if they so wished as long as they did not vote in quantities of less than 0.01 votes. To parallel the process to political elections, the first two steps were like a primary which is restricted to a certain party, in this case either construction or construction science. The last step was akin to a general election in which respondents could vote for any candidate in any party and really change the emphasis of the program.

Before respondents were able to vote, they were first asked to identify the topical content they thought was missing from the list provided by ACCE and secondly to identify the subject matter category it should be located in. The "new" topical content that gained significant support from faculty and industry respondents is set out in Appendix A in italics. The voting then followed the following procedure:

- Respondents were asked to assign their prescribed votes for Construction Science topical content under column 1 (see Figure 1). The number of prescribed votes for each subject matter area is set out in Table 1. For example, ACCE prescribes a minimum of six credit hours of Analysis and Design of Construction Systems subject matter. Respondents could assign their 12 votes (12 votes = 6 credit hours) whichever way they wished across the four ACCE topical content areas and the three "new" topical content areas identified by either faculty or industry respondents. In total, this would account for 34 votes or 17 credit hours of instruction in Construction Science.
- Respondents were next asked to assign "free" Construction Science topical content votes under column 2. Respondents had 6 votes or 3 credit hours to cast whichever way they wished among the construction science topical content. At the end of this task a total of 40 votes or 20 credit hours had been assigned to Construction Science topical content thus meeting the minimum requirements of the ACCE standards.
- Respondents were asked to assign their prescribed votes for Construction topical content under column 4. The number of prescribed votes for each subject matter area is set out in table 1. For example ACCE prescribes a minimum of three credit hours of Estimating subject matter. Respondents could assign their 6

votes (12 votes = 6 credit hours) whichever way they wished across the seven ACCE topical content areas and the five "new" topical content areas identified by either faculty or industry respondents. In total this would account for 24 votes or 12 credit hours of instruction in Construction.

- Respondents were next asked to assign "free" Construction topical content votes under column 5. As the ACCE standard is less prescriptive in this subject matter respondents had 16 votes or 8 credit hours to cast whichever way they wished among the Construction topical content. At the end of this task a total of 40 votes or 20 credit hours had been assigned to Construction topical content thus meeting the minimum requirements of the ACCE standards.
- The final task was to assign the remaining free votes in either column 3 or 6. The preceding tasks had accounted for 80 votes or 40 credit hours. The remaining 20 votes or 10 credit hours could be assigned to any topical content. This would bring the total number of votes cast to 100 or 50 credit hours.
- Finally respondents were asked to check all the numbers for any errors or omissions.

Table 1: ACCE Standards and Criteria Prescribed voting

Subject Matter Area	**No. of Votes**	**No. of Credit Hours**
Design Theory	6	3
Analysis and Design of Construction Systems	12	6
Construction Methods & Materials	12	6
Construction Graphics	2	1
Construction Surveying	2	1
Construction Science Subject Matter	6	3
Estimating	6	3
Planning and Scheduling	6	3
Construction Accounting and Finance	2	1
Construction Law	2	1
Safety	2	1
Project Management	6	3
Construction Subject Matter	16	8
Construction Science/Construction Subject Matter	20	10
Total	**100**	**50**

Curriculum Chip Vote

#	Topical Content	# of Votes			#	Topical Content	# of Votes		
4.00	**Construction Science**	**Prescribed**	**Free Con Sci.**	**Free**	**5.00**	**Construction**	**Prescribed**	**Free Con.**	**Free**
		1	**2**	**3**			**4**	**5**	**6**
4.10	**Design Theory**	*6*			**5.10**	**Estimating**	*6*		
4.11	Structural Mechanics				5.11	Types of estimates and uses			
4.12	Electricity;				5.12	Quantity takeoff			
4.13	Thermodynamics.				5.13	Labor and equipment productivity factors			
4.14	Soil Mechanics.				5.14	Pricing and price data bases			
	Architecture				5.15	Job direct and indirect costs			
					5.16	Bid preparations and bid submission			
					5.17	Computer applications (not BIM)			
4.20	**Analysis and Design of Construction Systems**	*12*				*Building Information Modeling*			
4.21	Civil					*Sustainability*			
4.22	Electrical					*Conceptual Estimating*			
4.23	Mechanical					*Value Engineering*			
4.24	Structural					*Life Cycle Costing*			
	Temporary Structures								
	Sustainable Design								
	Building Envelope Design				**5.20**	**Planning and Scheduling**	*6*		
					5.21	Parameters affecting project planning			
					5.22	Schedule information presentation			
4.30	**Construction Methods and Materials**	*12*			5.23	Network diagramming and calculations with CPM			

Figure 1: Layout of curriculum chip vote sheet

Results

After meeting with Auburn University faculty, industry meetings were held in Atlanta, Birmingham, Forth Worth, Montgomery, Mobile and a return to Birmingham. The number of respondents at each meeting was:

Table 2. Number of Respondents

Venue	No. of Attendees
Auburn University (BSCI Faculty)	16
Atlanta, GA	23
Birmingham, AL	13
Fort Worth, TX	5
Montgomery, AL	8
Mobile, AL	15
Birmingham, AL	12
Total	**92**

The ACCE standards and criteria allow individual construction units to decide how they distribute their teaching hours between the Construction Science and Construction subject matter areas. Table 3 below shows the results of the analysis of the current BSCI curriculum, the BSCI faculty vote, and individual and combined industry votes.

Table 3. Results of votes Construction Science and Construction subject matter

	Subject Matter Area (Credit Hours)	
	Construction Science	Construction
Current BSCI Curriculum*	28.53	20.17
BSCI Faculty	24.38	25.62
Atlanta Industry Group	22.21	27.79
BirminghamIndustry Group	23.76	26.24
Fort WorthIndustry Group	25.28	24.72
MontgomeryIndustry Group	22.94	27.06
MobileIndustry Group	22.99	27.01
BirminghamIndustry Group 2	22.60	27.40
Combined Industry	22.97	27.03

*1.3 Hours of **** curriculum was judged as being in the "Other" subject matter area

A clear difference exists between the number of credit hours being taught in the Construction Science and Construction subject matter areas in the current curriculum and what the faculty and industry respondents voted for. The results suggest a need to reduce the amount of instruction in the Construction Science subject matter area and a corresponding increase in the Construction area of between 4 and 5.5 credit hours. Appendix A gives a summary of the results, which show how the 50 credit hours are currently appropriated across the Construction Science/Construction subject matter and how the faculty and the combined industry group would apportion their time. The appendix also identifies the topical content where a reduction or increase in the number of hours is suggested. The "new" topical content suggested by the faculty or industry is also identified.

Conclusions

Determining how best to get industry professionals and faculty meaningfully engaged in the curriculum review process presented a difficult challenge. Gathering the stakeholders together to talk in generalities about the direction of the program and to discuss which areas of study should receive additional emphasis would have been easier, but it was felt that this would not provide the type of detailed information around which to overhaul a program's curriculum. We felt that the results obtained by such general discussions would have been too non-specific and leave too much room for interpretation. When significant change is necessary and the occasions for resistance to change are many, gray areas must be minimized so that the path toward change is backed up by persuasive evidence. To accomplish this end, the industry professionals who participated in the curriculum review did so at the same level of detail and involvement as the faculty members. The method used to survey and gather feedback leveled the playing field for all participants, both academics and non-academics.

The "chip voting system" was implemented to collect curriculum revision feedback from industry professionals and faculty members alike. The method proved to be extremely effective in gathering data. Critical to the success of the systems was its simple approach which made the curriculum easy to communicate and easy to understand for those not privy to academic requirements. The industry professionals who participated in the process were pleased with the process. Moreover, they appreciated that the construction faculty sought their opinions. At the end of the process the industry participants were also more aware of the constraints imposed by ACCE accreditation and had a better understanding why certain subject matter and topical content had to be taught.

The data gathered from the curriculum review surveys has been compiled and in general seems to suggest the focus of the program needs to shift toward Construction-related topics and away from Construction Science. This data has been turned over to the faculty to implement in their curriculum revision. Ultimately it will be up to the faculty to decide whether or not to incorporate the recommendations of the industry reviewers. The data itself is very pointed and specific. Oddly enough, the results of the chip votes provided by the faculty and industry were by in large similar in a number of subjects, suggesting that there is general consensus concerning the focus areas that need to be changed in the curriculum. The curriculum revision is an ongoing exercise at Auburn, the opinions of the industry professionals have been critical to the progress of the review to date.

References

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Appendix A

Summary of Results

	Subject Matter	Curr.	Faculty	Industry	Topical Content		
					Reduce	**Increase**	**Add***
4.1	Design Theory	1.43	4	3.43			*Architecture*
4.2	Analysis and Design of Construction Systems	9.6	7.86	7.54	Structural Design Analysis	Civil	*Temporary Structures*
						Electrical	*Sustainable Design*
						Mechanical	*Building Envelope*
4.3	Construction Methods and Materials	9.09	8.54	8.59	Composition and properties, Products, systems and interface issues, Equipment applications and utilization, Assembly techniques and equipment selection	Comparative cost analysis	*Sustainable Materials and Methods, Mechanical Equipment, Electrical Equipment and Innovation in Methods and Materials*
4.4	Construction Graphics	6.29	2.67	2.01	Basic sketching and drawing techniques, Graphic vocabulary, Detail hierarchies, scale, content,		*Building Information Modeling*
					Notes and specifications, reference conventions		
					Computer applications (not BIM)		
4.5	Construction Surveying	2.11	1.32	1.41	Survey, layout, & alignment control	Site organization and development	
	Total Construction Science	**28.52**	**24.39**	**22.98**			
5.1	Estimating	7.16	6.36	6.74	Quantity take off, Pricing and price data bases and Computer applications (not BIM)		*Building Information Modeling (BIM), Sustainability, Conceptual Estimating and Value Engineering*
5.2	Planning and Scheduling	2.83	5.43	5.07		Parameters affecting project planning, Schedule information presentation, Network diagramming and calculations with CPM, Resource allocation and management, Impact of changes, Computer applications (not BIM)	*Building Information Modeling*
5.3	Construction Accounting and Finance	2.37	2.13	3.12		Fixed and variable costs: insurance, bonding, marketing, general and administrative expenses, Forecasting costs, cash flow requirements	
5.4	Construction Law	2.08	2.07	2.46		Construction contracts, roles & responsibilities of parties	*Dispute Resolution*
5.5	Safety	2.51	1.39	1.58	Safe practices		
5.6	Project Management	3.23	8.24	8.06	Labor relations	Cost control data and procedures	*Sustainability, Building Information Modeling, Decision Making and Risk Management, Submittals co-ord/drawings, RFPs/proposals, Meetings, Presentations*
	Total Construction	**20.18**	**25.62**	**27.03**			
6	Other	1.3					
Total Construction Science/Construction		**50**	**50**	**50**			

*Only new Topical Content that received significant industry support is included