

Establishing New Graduate Competencies: Ensuring that Construction Management Curriculums are Delivering “Job-Ready” Employees

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Since the establishment of Construction Management (CM) programs at the undergraduate level, curriculum has adapted to faculty visions of appropriate course content, construction industry expectations, accreditation requirements, as well as ever changing resources and constraints imposed by university administrations. Even CM programs that have had years of building solid foundations for successful careers in construction benefit from a periodic review of their curriculum. The CM program in the Department of Building Construction Management at Purdue University began such a curriculum review in 2010. The culmination of many influences over the last year necessitated the need for a formal review including aging faculty, economic pressure to increase delivery efficiencies, accreditation requirements, and a newly introduced university core curriculum. With this extensive list of influences to be incorporated while maintaining the same high level of success for the students and the employers who hire them, the faculty decided to reach out to the construction industry for guidance in how best to invest the limited resources available for preparing undergraduates to meet the challenges they will face in their careers. This paper discusses the process used to obtain industry input in establishing new undergraduate educational competencies for use in a major review of the CM curriculum.

Key words: educational competencies, curriculum, accreditation, industry, curriculum review

Introduction

The construction industry is in a constant state of change because of economics, market forces, labor resources, new technologies, and government regulations. Similar to the industry, CM programs have to mirror these changes to ensure their students are “job-ready” upon graduation. In addition to the changing landscape of industry, universities are increasing pressure to increase graduation rates, staff efficiencies, and research funding, all while reducing the budget. Simply put, programs have to become more nimble.

Fortunately for all involved, the current curriculum has been built on a solid foundation and has been successful at delivering the fundamental skills required for the market. Many of the founding fathers of the program are close to retirement and are anxious to ensure this program remains solid and is not haphazardly altered because of short-sighted reactions. More so, the program needs to evolve with thought, deliberation, and research as the basis for change rather than mere economic pressures or simple opinions. Unfortunately, the retirement of these scholars will leave open teaching positions that will not be replaced in today’s economy. This CM program will have to deliver the same curriculum with less staff.

In addition, Purdue University has been challenged with building a fundamental core curriculum that applies to all students within the college. This involves the use of three courses totaling 9 credit hours. Members of the CM faculty are on the task forces responsible for developing these courses. This direction is not only shared by the university administration, but the state task force for higher education of Indiana. This task force is responsible for funding allocations to land grant institutions. Simply put, there is no alternative; the CM program must introduce these core courses.

For the reasons previously mentioned, and the constant need to be conscious of accreditation, the program has started the process of analyzing the curriculum. It was determined at the start that the architecture of this process should be easily repeated in the future. Pressures to adapt and update the curriculum are going to continue and the ability to systematically review the curriculum will be crucial to be a nimble program.

Literature Review

Contemporary literature covering undergraduate construction education reflects an ongoing concern with curriculum review and maintenance. It covers a range of concerns including the outside influences impacting Purdue University. Allan Hauck noted curriculum review needs to be driven by a desire to align CM curriculum with core course requirements within a college of technology (Hauck, 1997) and Shima Clarke described the influences of accreditation on curriculum development (Clarke, 2003). Even without outside influences, annual curriculum review is advocated (Thacker, 2000) and regular implementation of curriculum updates are expected as part of the ACCE required Quality Plan (ACCE, 2010). A tool for curriculum evaluation referred to as the Learning Outcome Template (LOT) is described by Auchey et al. in 1997. The LOT is used to perform detailed curriculum-wide course assessment. The LOT is a matrix of outcomes by course that displays both course outcome content and degree of emphasis. By having faculty complete the LOT, a dynamic, graphic depiction of the curriculum is available for communication about the curriculum as well as for continuous improvement.

Learning outcomes are cited as a starting point for curriculum reform for both ACCE and ABET accredited programs (Hauck, 1998; Meyer & Jacobs, 2000). In 1998 Hauck also advocates that comprehensive reform should begin with outcomes obtained from external sources that drive curriculum revision as a whole avoiding piecemeal changes. Some advocate a wide base for input from any stakeholder with an interest in the department (Ferguson, 2004). The input should provide sufficient depth and breadth for meaningful input (Meyer & Jacobs, 2000), but many questions arise when trying to obtain input from industry framed within the constraints of accreditation and university guidelines. A task force of industry and faculty representatives may be employed as long as all involved are willing to discard past practices (Thacker, 2000). General discussions are frequently employed, but leave too much room for interpretation (Olsen & Burt, 2010).

Ultimately faculty must utilize performance outcomes driven by industry needs for program evaluation (Andersen and Andersen, (1995). In 1992 Jerald Rounds made the following prediction: *“The next major change, just starting to be felt in university construction education, but by no means new to the academic and professional arenas, is establishment of competency based standards ... focus(ing) upon the competencies desired in our graduates, rather than educational packages we create to produce those competencies.”* A competency is something that a person can do well and that meets and even exceeds his or her job requirements (Badger, Bonanno, Sullivan, Wiezel and Bopp, 2009). The most used definitions include:

- A written description of measurable work habits and personal skills used to achieve objectives at work (Green, 1999).
- A knowledge, skill, ability, or characteristic associated with high performance on a job (Mirabile, 1997).
- A combination of motives, traits, self-concepts, attitudes, values, content knowledge, cognitive skills, or other characteristic that can be measured and differentiate superior to average performance (Spencer, McClelland, & Spencer, 1994).

Once a list of competencies is ascertained, priorities must be established. No educational program is capable of covering every area of knowledge and skill equally. Methods for establishing priorities include numerical ranking of skills (Mead & Gehrig, 1995; Souder & Gier, 2006) or attempting to quantify the credit hours of study devoted to topic areas (ACCE, 2010; Olsen & Burt, 2010). The results from these prioritization efforts revealed a differential between the time devoted to areas of competency as desired by industry and faculty and the current curriculum emphasis (Olsen & Burt, 2010) or areas of competency with inadequate coverage (Souder & Gier, 2006).

The Review Process

The use of educational competencies to describe desired learning outcomes has proven successful in industry and academia. Competencies allow for the key tasks and processes within construction to be recognized, identified, and often measured. It was for these reasons the team chose to start with the end in mind. What do we want our graduates to be when they are done? What competencies do they require? Some would say the best judges of these competencies are those who hire new graduates. For this reason, the team set out to identify a process in which

industry professionals could help build the competencies required for the “perfect” graduate. It was determined that a comprehensive panel would be the best solution. This paper outlines the process employed with industry to determine these competencies, the results, and the future steps required to build the curriculum of the future.

Planning

Mapping out a plan and schedule were crucial to the project’s success and acceptance. The committee determined that the process needed to be transparent and allow for faculty to share insight and recommendations. Curriculum review can often be controversial and needs to be openly understood. The committee determined that the process needed to progress through three phases of planning as shown in Figure 1 below: development, communication, and consensus. As the process was mapped out, three chapters of the project were defined: process design, panel selection, and retreat findings. Figure 1 represents the process and required flow of information. In retrospect, the buy-in phase was instrumental in the overall project success for the faculty. Upon completion of the program, the entire faculty was aware of how the results were determined. More importantly, they each played a role in the architecture of the process.

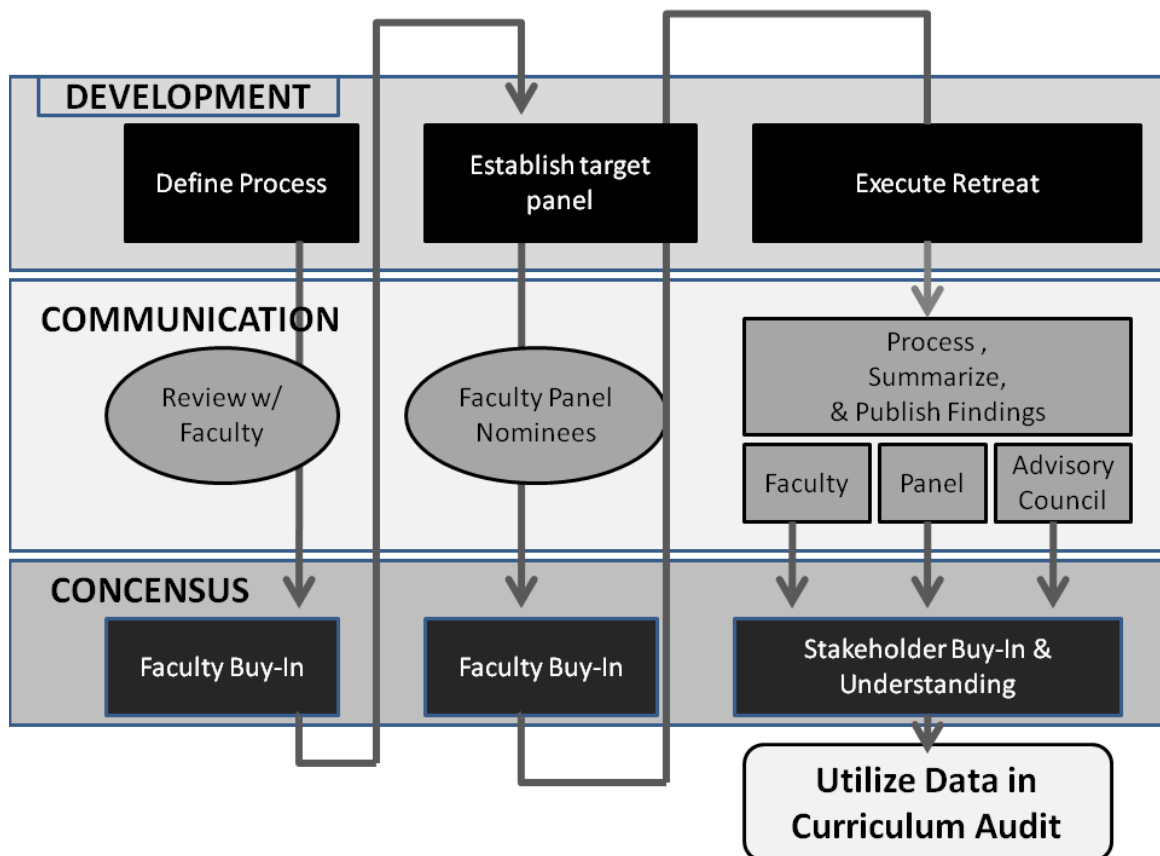


Figure 1

Panel Selection

In selecting panelists, it was important to mirror the typical mix of companies that regularly hire the program’s students. The committee reviewed the following characteristics:

- Type of company – GC, CM, subcontractor, program manager, specialty, other
- Size of company
- Years in business

- Type of ownership – public, private, employee
- Labor market – union, non-union
- Locale
- Type of management – conservative, moderate, or progressive

After the team selected target organizations, panelist characteristics were determined. They included:

- Operations based personnel rather than human resource managers
- Direct day- to-day exposure to new graduates
- Open-minded

Upon completion, the committee's process, selection criteria, and potential names were circulated to the entire faculty. Other faculty members were allowed to offer suggestions and potential names. This process proved valuable in providing transparency to the process and allowing buy-in from the entire staff. The final panel consisted of ten contractors. They represented Local, Regional & National organizations. General Contractors as well as organizations that self-perform a substantial proportion of their labor were represented in all of the following building segments:

- Building (more than half of the participants)
- Power
- Industrial Construction & Equipment Installation
- Industrial Piping
- Trade Contractor
- Civil & Public Works
- Heavy, Highway, Site Development

Pre-retreat – New Graduate Interviews

Upon graduation all seniors have a debriefing and exit interview about the program. Surveys are submitted and compiled each semester. In addition to this information, the selection committee determined that it would be beneficial to meet with several new graduates who have been in the work force for approximately 1-2 years. This group of 3 recent graduates went through each of the courses in the curriculum to discuss how each course has benefited them. The team did not deem it beneficial to have these graduates compile an extensive list of competencies. It was recognized that they had not been exposed to all aspects of a new hire.

Retreat Program

Prior to arriving, attendees were given three categories that would be utilized and the definition of a competency. They were also instructed that this would not be a curriculum review. The team would not be discussing specific courses. The categories of competencies included: field and site supervision, project management, and general.

The process to collect suggested competencies from the retreat participants was a form of group needs assessment specifically designed to identify the educational outcomes necessary for students who would be hired in entry level construction management positions. The group members' knowledge and experience enabled them to identify and rank educational needs. To avoid an unstructured collection of data that could be dominated by high ranking, outspoken, strong willed or better prepared individuals, the nominal group technique was used to promote active participation by all group members (Bickman, & Rog, 1998). The nominal group technique (Delbecq, Van de Ven, & Gustafson, 1975) asks participants to generate ideas independently, ideas are then stated and recorded one at a time in a round-robin format, and finally after a full list of ideas is produced each item is discussed separately to allow for clarification without association with the originator of the idea. This process was utilized during the six hour retreat in a conference room located away from department teaching and administrative activities to avoid interruption.

Following breakfast, attendees were seated around a large conference table. Faculty acted as facilitators and scribes. In addition to numerous flip charts and easels, the process was video taped. The team went through the following steps for all three categories:

1. Each attendee would share a competency with a brief definition
2. Step #1 continued around the table until all suggested competencies were heard and recorded
3. As a group, led by the faculty members, each competency was discussed and clarified in a roundtable approach
4. Similar competencies were combined and the list was reduced to a comprehensive list

During this process it was important to the committee that the panel had ownership of each competency rather than a just list of panelists' individual suggestions. The two-step roundtable approach proved successful. The initial ideas were laid out for the group and listed on the flip charts. By the time the second round table occurred, attention was not paid to the original author. Conversation would then ensue about each competency with each panelist sharing their interpretation and meaning of the competency. The definition of each competency then evolved from the group discussion.

Upon completion of all three categories, the faculty explained that it would be impossible to deliver all of these competencies in a typical four year program. There would have to be priorities. Each team member was then asked to force rank each category. The final task was for each attendee to force rank the entire list. Each respondent turned in their sheets which were compiled into one singular list.

Results

The industry group was not provided any information about the current curriculum. Consequently, their input was a reflection of their perception of what the department currently teaches along with their idea of how an ideal entry-level employee would be educated. Although the development of the competency list during the one-day industry representative retreat was done in a manner that promoted equal participation from each member of the group and minimized dominance by any of the individual participants, the authors realize that the sample size was small and potentially influenced by the nature of the participants' normal business practices.

The highest quartile of ranked competencies and the lowest quartile of ranked competencies provide the strongest indication of industry preference. These competencies are shown in Table 1. By examining the most highly ranked competencies and those that the group deemed to be the least important along with carefully consideration of the full discussion that took place, the authors noted several significant results discussed below. General educational requirements for a well-rounded learning experience were not fully recognized by the industry representatives; consequently accreditation requirements from ACCE in these areas of study will be utilized in the final detailed curriculum review.

Table 1

<i>Highest and Lowest Quartile of Ranked Competencies</i>	
Highest Quartile of Ranked Competencies	Rank
Construction cost accounting (not financial accounting)	1
Basic understanding of materials, systems, structures & processes	2
Ability to communicate respect, work with craft trades & develop operations plans	3
Presentation / public speaking / phone skills	4
Basic understanding of plan reading	5
Basic understanding of documentation in the field – Daily Construction Reports, photos, logs	6
Prioritization / time management	7
Ethics and professionalism	8
Computer skills – excel, MS Office, Adobe, scheduling, estimating, Internet based, etc.	9
Basic understanding of logistics planning, work flow sequences, and coordination trades	10
Basic understanding of labor productivity – measuring, reporting, & forecasting	11
Project delivery methods	12
Change order review & management	13
Ability to set up an expediting log and procurement, submittal log	14
Understanding of when to use different types of communication, effectively communication in writing	15
Meeting management and minutes	16
Basic understanding of engineering structures Div 2,3,5 (pre-2004 CSI notation used)	17
Basic Understanding of engineering systems for Div 15,16 (pre-2004 CSI notation used)	18
Basic understanding of long range and look ahead's schedules	19
Knowledge and understanding of project specifications	20
Forecasting of overall project cost	21
Lowest Quartile of Ranked Competencies	Rank
Basic understanding of diversity in the field	66
Basic understanding of the preconstruction process	67
Basic understanding of lifting, hoisting, and rigging planning	68
Basic understanding of bonds	69
Lump sum bidding	70
Basic understanding of roles of players and etiquette associated w/working with team	71
Basic understanding of MEP coordination	72
Ability to read & understand P&L (Profit and Loss) statements for any company	73
Basic understanding of managing unknown risks through contingencies & allowances	74
Basic understanding of Design / Build	75
Marketing and business development	76
Basic understanding of commissioning	77
Managing joint ventures & working w/ competitors	78
Story boarding – who owns tasks and accountability	79
How to plan for your subs to succeed	80
Resource allocation (labor, material, equipment)	81
Time value of money	82
Resume writing	83
Understanding of lean construction	84
Basic understanding of GPS layout and control	85
Building codes and standards (JHA's)	86

A universal topic of discussion during the industry retreat was the need for improvement in the “soft skills” of graduating students. The competency rankings also made this apparent. The fourth and fifth most important (out of 86) competencies to the industry group were the “ability to communicate respect, work with craft trades & develop operations plans” and “presentation / public speaking / phone skills”. The discussion made it clear that these skills were important in making use of competencies that did not mention this type of skill specifically. For example #7 “basic understanding of documentation in the field – Daily Construction Reports, photos, logs” requires soft skills to adequately complete the tasks described. Souder and Gier also found a strong industry desire for more emphasis on project administration skills in their 2006 survey.

The industry group expressed a seemingly unanimous agreement that graduates fully understand the logistics of all types of project delivery. They also indicated that graduates did not need concentrated education in the design-build delivery method. In the rankings “project delivery methods” was ranked number 12 and “design-build” was ranked 75th out of 86. This result is also similar to the findings of Souder and Gier in 2006.

The industry group discussions concerning need for accounting knowledge was specific to “project cost” accounting. The general feeling of this group was that “company accounting and financial analysis” was beyond their expectations for entry level employees. Nevertheless, there was some recognition that company accounting basics are difficult to learn outside the classroom. Because basic company accounting knowledge is a general educational requirement for a well-rounded learning experience, ACCE accreditation requirements for this area of study will be used as a minimum expectation in the final detailed curriculum review.

The second highest ranking of competencies was for “basic understanding of materials, systems, structures & processes”. Discussion on this topic was about the need for an understanding of a complete range of materials, methods, and structures. A possible guide for review of this area of study would be to check for coverage of knowledge in all of the CSI divisions.

It is interesting to note that both building codes and advanced surveying or jobsite layout were ranked near the bottom or as a lower priority in credit hour expectation by this competency ranking as well as two of the papers reviewed in the literature (Olsen & Burt, 2010; Souder & Gier, 2006).

Conclusions & Next Steps

As part of a full curriculum review to examine coverage of the list of competencies generated at the industry retreat, the highest quartile of ranked competencies and the lowest quartile of ranked competencies will provide input relating to construction industry preferences for use of the limited time and resources available in the undergraduate construction management curriculum. The full list of competencies generated will help determine the degree to which current course content aligns with the industry's expected entry-level student competencies. Over the course of the next six to nine months the list will be used to guide the curriculum committee in a full review of the curriculum. Certain educational areas required for a well-rounded learning experience (for example the English, social science, math, and science requirements) may not be fully reflected in the industry representatives feedback from the retreat. In general, accreditation requirements from ACCE identify these areas. The faculty will provide the guidance required to assure that these general education competency areas are reflected in the updated curriculum with further guidance from the ACCE accreditation requirements. At the conclusion of the process and in regular future course content reviews, the faculty will consider the degree to which course content aligns with the industry group's competencies and rankings.

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