Construction Engineering Management Educators: History and Deteriorating Community

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Abstract: The history of construction engineering and management education closely follows the emergence of the construction industry as an economic force in the United States. The initial introduction of programs in the post-World War II era was followed by specialization and the introduction of graduate construction specialties in the early 1960s. However, the lack of qualified individuals was recognized as a factor in successfully developing the construction engineering management (CEM) focus as an academic discipline. Today, that concern continues as CEM programs in the United States find themselves under attack by academic colleagues for issues such as lack of qualified faculty candidates and lack of funding opportunities. This paper addresses the status of the construction academic community by examining the common history of the CEM faculty through a genealogical approach, the historical research record through an examination of the publication record, and the questions that face a community that has appeared to slip from its intellectual peak.

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Introduction

The history of construction education in the United States is a mirror to the growth of the country. Prior to the industrialization of the United States, construction was viewed as a craft that was handed down from father to son from generation to generation. However, as the country moved into the modern age during the first part of the 1900s, the realization began to grow in all fields that formalization was required to promote standardization of skills and the expansion of knowledge. Construction was no exception to this trend, with engineering schools slowly adding construction courses to the civil engineering curriculum as specialty topics. This approach to construction as a skill within the overall civil engineering knowledge base remained consistent for several decades. In contrast to the traditional branches of civil engineering such as structural engineering, the thought that construction could define a foundation for university research was isolated to a few engineering faculty. This perspective remained until after World War II when construction was formalized as an engineering discipline at Texas A&M University in 1946 with the hiring of Robert Peurifoy. Combined with the efforts of individuals including F. H. Kellogg of the University of Mississippi, Eugene Grant at Stanford, and Walter Voss at MIT the beginning of a construction engineering community was established with two common goals: (1) recognition as a discipline and (2) survival as a formal engineering field of academic study (Ledbetter 1985).

Although the beginning of the construction academic community was forming, the evolution from a beginning to a stable mass was a hurdle that construction needed to overcome. Over the next decade, this struggle manifested itself in divisions between the Associated General Contractors and the universities, the American Society of Civil Engineers and the universities, and within the professional and academic communities (Oglesby and Fondahl 1959; Oglesby 1982; Jortberg and Haggard 1993). At the core of these divisions remained the common thread of whether or not construction engineering and management was a true academic pursuit and whether or not the field could develop research activities worthy of an academic degree or that could support professors embarking on a research and teaching career. The answer to this division did not emerge until several visionary construction educators including Clarkson Oglesby at Stanford, E. I. Brown at North Carolina State, and Glen Alt at Michigan convinced both the academic and the professional communities that construction not only deserved to be a specialty within civil engineering, but the body of knowledge was advanced enough to warrant the establishment of graduate degrees in the construction discipline (Ledbetter 1985). As such, the early 1960s witnessed the initiation of graduate construction engineering and management programs at universities including Michigan, Iowa State, and North Carolina State (Harris 1992).

Although only a few niche programs initially existed, the 1960s and 1970s witnessed a steady increase in engineering-based programs until over 40 programs existed by the start of the 1980s (Oglesby 1990). Concurrent with this increase in programs was an increase in the number of academics receiving doctorate degrees in construction within civil engineering departments and subsequently, joining civil engineering faculties as full-time construction educators. Today, this landscape has grown to include

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120 full-time faculty in civil engineering-based construction programs distributed among 52 universities in the United States. However, construction is again being challenged by funding agencies, universities, and professionals as to its relevance and ability to compete in a rigorous academic engineering environment. This challenge is addressed in this paper in three components; an examination of the heritage of the construction community, a study of the research history generated by the construction community, and a focus on the questions facing the construction community.

Construction Heritage Tree

One source of community within any family is its common heritage or family tree. The common background of individuals within a community provides a sense of similar experiences, vocabulary, and perspectives. The common background in the context of an academic community can also establish a foundation for education and research issues, which further reinforces the ability to communicate and exchange intellectual advances. This benefit of community served as the impetus for the current study of the heritage of the U.S. construction faculty in civil engineering-based programs. Specifically, the question of whether a common heritage existed from which a sense of construction community could be fostered served as the focal point of this endeavor.

Generating the heritage tree required the establishment of bounding rules to retain a manageable scope for the project. Therefore, to establish the initial construction heritage tree, the following scope rules were established:

1. The starting point for retracing the community heritage would be current full-time, tenure-track faculty in civil engineering-based construction programs in the United States.
2. Advisors would be listed in the tree if they were in the construction field. If the advisor was in another field such as structural engineering, then the faculty member would be considered to be starting a new heritage line from that university.
3. Graduates of an advisor going to a foreign university would not be listed.
4. PhD recipients from a foreign university would be listed only from their degree country of origin without a heritage trace on their degree granting faculty advisor.

Results

In contrast to a traditional family tree where the roots of the tree are focused on a single entity such as a matriarch or couple, the construction heritage tree evolves from several roots. Specifically, the roots of civil engineering-based construction are anchored in five locations: Michigan, Stanford, North Carolina State, Purdue, and Texas A&M. In each of these cases, a commitment was made by the department to initiate a focus on construction research as a discipline within civil engineering.

Although the number of faculty emerging during the 1960s and early 1970s slowly gained momentum, construction remained a niche specialty in academic circles. However, two branches of the tree, Stanford and Purdue, formed their positions as primary influences in the construction community during this period. With nine of the 24 current faculty members who graduated during this time originating from these two universities, the two universities formed the first primary branches of the construction heritage tree. These branches remain a strong influence on construction academics, with 39% of the active faculty being able to trace a link to one of these two universities. The remaining primary branches of the tree also witnessed their growth periods begin to emerge during this period. Although MIT and Texas witnessed their greatest branch development in the 1980s, the core elements of the programs as heritage universities were established during the formative period of the late 1970s. Specifically, the recruiting of PhD students provided the impetus for six of the 17 current faculty members who graduated during the first part of the 1980s to emerge from these two universities.

Table 1. PhD Graduating Schools for Current Construction Faculty Members.

Active faculty graduate schools		(%)
Stanford	15	13
Purdue	12	10
Massachusetts Institute of Technology	11	9
Texas	10	8
Berkeley	7	6
Georgia Tech	5	4
North Carolina State	5	4
Penn State	5	4
Michigan	4	3
Illinois	4	3
Colorado	4	3
Carnegie-Mellon	3	3
Texas A&M	3	3
Clemson	3	3
Oklahoma State	2	2
Northwestern	2	2
Washington	2	2
Vanderbilt	2	2
Iowa State	2	2
Florida	2	2
Texas-Arlington	1	1
Maryland	1	1
Auburn	1	1
Wayne State	1	1
SUNY Buffalo	1	1
Cincinnati	1	1
Missouri	1	1
Princeton	1	1
International	9	8
	120	100

Note: SUNY=State University of New York.

The establishment of Stanford, Purdue, MIT, and Texas as the four primary branches in the construction heritage tree provided the foundation for the construction community today. Once established, these branches were strengthened and reinforced as primary suppliers for the construction academic community. As documented in Table 1, the primary four are responsible for supplying 40% of the current construction faculty in the United States through direct PhD graduations and are the only universities to have contributed double-digit numbers of current faculty members. If this statistic is carried one step further to document heritage links which are defined as tracing advisors back to the

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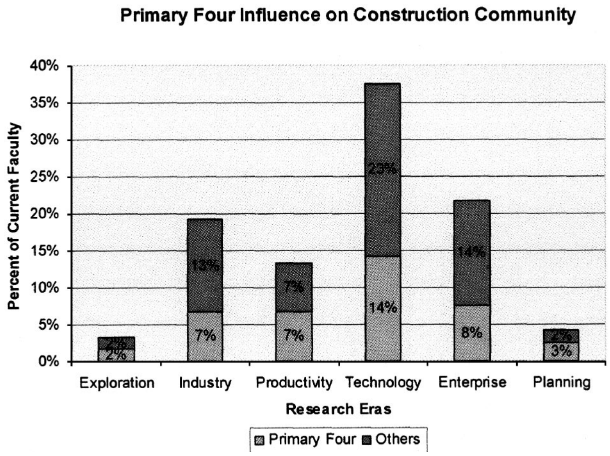

Fig. 1. Impact of primary four universities on construction research from 1962 to 2002

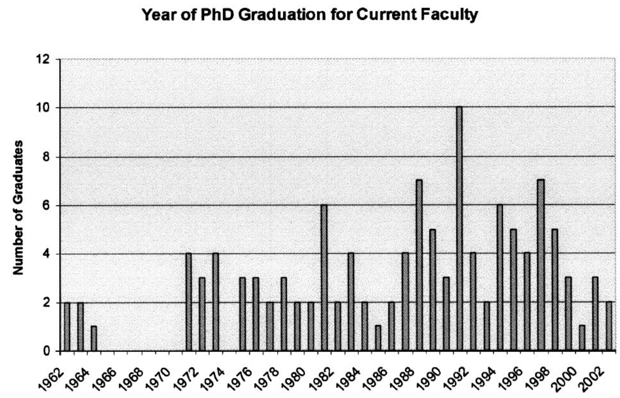

Fig. 2. Distribution of graduation years for the currently active construction faculty

point where a heritage line begins, this number increases to 51%. Additionally, if the Primary Four are examined through time, the resulting percentages remain consistent throughout the forty years of construction graduates with the primary four responsible for 35–60% of the new faculty members over any given era as defined in the research section below (Fig. 1).

The overall effect of this focus on a core group of four universities is a heritage tree that contains a strong group of anchor points, but branches quickly, to distribute faculty members to numerous locations. Additionally, the tree has secondary branches that serve to support the primary four. Specifically, seven universities including Berkeley, Georgia Tech, North Carolina State, Michigan, Penn State, Colorado, and Illinois have each established a record of continuous faculty output throughout the heritage tree. These secondary branches, or secondary seven, continuously intertwine with the core branches through faculty hiring practices to form an interrelated chain throughout the tree.

With the primary and secondary universities forming the central focus of the construction community, a common point of reference begins to emerge within the construction community for issues including curriculum and research. However, external influences have also merged within the heritage tree. Specifically, outside of the primary four and secondary seven, 17 domestic universities have graduated 28 current construction faculty members. These domestic university inputs are referred to as the tertiaries. Although a common focus among construction faculty is a U.S.-based education for PhD studies, some external influence has penetrated the community. Currently, nine active faculty members received their doctorate degrees from outside the United States. This translates to 8% of the community population. The combination of this international influence with the tertiary branches provides diversity in the construction community by supplying approximately one out of every five active faculty members.

Placing all of these statistics in context, the complete construction heritage tree currently in place can be summarized as follows:

1. One hundred twenty full-time, tenure-track faculty members are currently in civil engineering programs that offer construction as a specialty area or offer construction courses.
2. Forty percent of the faculty members have graduated from four universities—Stanford, Purdue, MIT, and Texas, 67% have graduated from the top 11 universities.
3. Eight percent of the faculty members originate from international universities.
4. The average time since graduating with a PhD is 15 years with 14 (12%) of the faculty members graduating within the last 5 years and 12 (10%) of the faculty members graduating 30 or more years ago (Fig. 2).

Current Tree Position

When examining the heritage of a community, the past is limited to providing an explanation component for the present and a potential precursor of the future. To completely understand a given community, its current state must also be examined to determine the health of the community and its potential for future growth and expansion of its heritage.

The first statistic that characterizes the current construction community is the number of programs that currently have full-time, tenure-track faculty members in the construction area. Although construction started as a niche specialty in only a few programs in the early 1960s, within a decade this number had grown to over 20 programs. This trend continued during the 1970s with the number of construction programs increasing to over 30 and similarly increasing to over 40 programs during the 1980s. Today, the number of programs has grown to 52, with representation in every part of the country and in civil engineering departments of every size. This statistic illustrates that there is demand for construction both from students or local industry.

The second statistic characterizing the construction community is the distribution of faculty members. Similar to the primary four universities graduating faculty members, the distribution of faculty members in construction programs is concentrated in a relatively few departments. Specifically, four universities, Texas, Stanford, Purdue, and Florida account for 22 current faculty. When combined with the next five universities who each have four faculty members, these nine universities account for 42 current faculty members or 35% of the construction faculty. The remaining programs have an average of less than two faculty members in the majority of universities offering this specialty. This statistic leads to a conclusion that the construction community is too diffused around the country and lacking a critical mass in the majority of universities.

A final statistic that is relevant to the current state of the con-

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Table 2. Construction Research Areas and Topics

Research area	Research topic	Percent of total research in this area (%)
Project development		8
	Risk analysis	
	Contracts/claims/legal	
	Contractor selection/delivery	
Project planning/design		20
	Constructability	
	Project organization	
	Planning and workflow	
	Estimating and scheduling	
Project execution		22
	Project controls	
	Labor and personnel	
	Productivity	
	Methods/equipment	
	Construction engineering	
	Safety	
Technology		30
	Robotics and automation	
	Information technology	
	Artificial intelligence	
	Distributed computing	
	Computer aided design/ Multimedia/Geographic information system	
	Quantitative methods/simulation	
Enterprise forces		11
	Public/private enterprises	
	International	
	Environmental	
Education/research		7
	Education	
	Research plans/interactions	
Materials		2

struction tree is the number of branches that have been eliminated from the tree. While the number of construction programs has grown to the current level of 52, 11 programs have eliminated construction as civil engineering specialties. When viewed as a potential population of 63 programs, the community has declined by 17.5% in terms of the total number of programs. Additionally, the minimal number of programs with a critical mass is a direct relation to department investment in construction. Specifically, construction programs are being faced with losing positions due to monetary considerations; notably, construction does not typically bring in equivalent research dollars to competing engineering-based disciplines.

Construction Research Heritage

The opportunity for collaboration and common focus activities within the construction community can be put forth based on both the relatively limited number of members within the construction heritage tree as well as the small number of universities comprising the primary branches. Whether this opportunity will be realized in the future can only be a matter of speculation. However, one way of understanding the potential for collaboration is to examine the research heritage of the community. Specifically, if a broad spectrum of research topics exists at a given time, then that is one indicator that a greater number of individual research pursuits existed at that given time. Conversely, if a number of faculty members are focused on a common topic, then the distribution of research topics will be reduced. Similarly, the length of time that a topic remains as a primary focus is a relevant statistic. Specifically, if the community moves from research topic to research topic with consistent regularity, then the question must be raised as to the ability of the researchers to develop a deep understanding of a topic and consequently to develop associated new theories and knowledge.

As a first step in examining the construction research heritage, a detailed research publication history of the members in the construction heritage tree was compiled. In this effort, the publications of each member were obtained through a number of methods including self-reporting, personal publication lists, journal reference services, and library searches through original ASCE journals. The result of this effort was a collection of papers, abstracts, and titles that exceeded 3,000 in number and ranged from 1962 to 2002. Given this collection of papers, the papers were catalogued based on keyword focus topics. The result of this sort-

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Table 3. Definition of Construction Research Eras

Era	Years	Focus	Percent of total research in this era (%)
Exploration	1962–1969	Focus on developing construction research concepts by first construction faculty members	1
Industry	1970–1979	Focus on industry experience as a basis for initiating research thrusts.	10
Productivity	1980–1985	Intense focus of project controls in general and construction productivity specifically.	14
Technology	1986–1994	Focus on the introduction of computing and automation into the construction process.	42
Enterprise	1995–1999	Focus on external influences on the construction enterprises as a viable operating entity.	25
Planning	2000–	Renewed focus on issues related to project planning, initiation, and life-cycle.	8

ing process was the establishment of 25 research topics sorted within seven general research areas (Table 2).

Given the catalogue of papers, the next step was to reduce the papers to individual research efforts. This step was critical to equalize those individuals who publish extensively on a single research effort to those who may publish only a single paper on a research effort. From this perspective, one research effort was assigned to a published topic for a researcher in an individual year. Therefore, if a faculty member published one paper on a topic in a given year, or ten papers on one topic in a given year, each option was assigned as one research effort in the single year in a single topic. This consolidation resulted in a final total of 1,553 papers that were used to develop the construction research heritage.

Although consolidation provided a normalization of publishing efforts, the large number of papers over an extended period of time required a further filtering to enable specific characterizations to be made of the research efforts. In response to this need, it was decided to divide the papers into chronological eras based on research focus points. Given this decision, the research team analyzed the focus points for research trends over specific time periods. This analysis resulted in the development of six distinct research clusters where specific research areas either originated or formed primary focal points for a large group of research efforts. These research clusters mapped on the 40 year history of the construction research community provide the basis for establishing six distinct research eras for the construction research community (Table 3). These eras are described in detail in the following section.

Construction Research Eras

Era of Exploration

The first research era established for the construction research community is the Era of Exploration. This first era was given the exploration name as a reflection of the distributed topics explored from 1962 to 1969. Reflecting the limited number of construction researchers and the relative infancy of the concept in construction academics, the group of researchers in this era including John Fondahl and Richard Clough were balancing traditional civil engineering focus points with emerging construction research topics. The result of this balance was an era characterized by diversity in its research focus. However, this diversity should not be interpreted as a lack of focused research interest. Rather, researchers at this time were faced with the difficulty of establishing a research foundation as well as establishing a respected education curriculum within the context of traditional civil engineering curricula. Therefore, operating as pioneers in a new field, the researchers made initial inroads into several research topics including project development, project execution, and construction education.

Era of Industry

The end of the initial research era and the beginning of the Era of Industry is marked by two changes in the construction research timeline. First, the Era of Industry represents the first major increase in the number of researchers entering the field resulting in a concurrent increase in the number of papers produced and topics addressed in the research domain. Second, the time from 1970 to 1979 represents the emergence of the first significant clusters of papers within specific research areas, thus creating a distinct research profile for the Era of Industry. In respect to the former issue, the Era of Industry witnessed the entry of today's senior construction faculty into the construction community with 23 of the faculty graduating during this period.

The profile of research during the Era of Research is characterized by a strong link to practical experience and industry issues. The entry of researchers with strong industry backgrounds such as Dan Halpin and Boyd Paulson into the construction research community was reflected in research efforts that were grounded in the solution of long-term industry issues such as scheduling, estimating, and project controls. Specifically, the Era of Industry witnessed a significant focus on the two elements of construction anchored in industry focus, planning and execution. The combination of these two areas represented 58% of the research efforts during the Era of Industry (25% in planning and 33% in execution), a strong reflection of the industry input and influence during the 1970s within the construction research community.

Era of Productivity

The third construction research era is once again notable for two unique items; first, it is the shortest era, lasting from only 1980 to 1985, and second, it represents the first concentrated move of a

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number of researchers into one research topic. Based on a confluence of influences including the strong role of the Construction Industry Institute, the introduction of computing and quantitative simulation methods, and a focus on field operations, the topic of productivity took center stage during a distinct period in the construction research timeline. To illustrate the influence of the productivity topic on the research community, no research efforts on the topic were recorded in 1977, only 3 years before the beginning of the era. From this lack of focus, productivity grew to 20% of the recorded research efforts at the height of its focus in 1983. However, by 1988, 3 years after the end of the productivity era, this number had been reduced to 2.7% of the research efforts. This rapid rise and fall of research focus is unique in the construction research timeline and thus stands alone as a distinct point of reference in the development of the construction research community.

Era of Technology

If there is an example of researchers moving en masse from one topic to another it is the change from the Era of Productivity to the Era of Technology. In a similar manner to the rapid increase in focus on productivity, the beginning of the Era of Technology in 1986 witnessed a rapid move into the use of computers as a central element in construction research. Although this focus deserves attention, this era is also notable for the greatest influx of construction research community members. With 45 of today's construction faculty graduating between 1986 and 1994, the Era of Technology ranks as the single greatest growth period in the development of the construction research community.

The influx of new researchers into the community during this period coincided with the personal computer moving from an isolated business tool to a ubiquitous piece of office equipment. This coinciding of events was not lost on construction researchers. Rather, the Era of Technology focused heavily on answering the question of how computer technology could transform the construction industry. With 39% of research efforts devoted to this topic during the overall era and 47% of research focused on this topic at its height, computer technology was transformed during this era from boutique research to a permanent fixture in the construction research community. However, in contrast to the focused topic efforts witnessed in the previous eras, the Era of Technology witnessed a research move into multiple components of computer and information technology. Distinct efforts in artificial intelligence, database systems, robotics, and simulation each influenced the overall direction of the computer technology revolution.

Although computer technology dominated the Era of Technology research, it was not the sole focus of the construction research community. Rather, researchers continued to explore traditional topics in project planning and execution as well as introducing new focus areas such as project delivery and constructability. As discussed in the conclusions, this diversity introduced the first questions of individualism versus community advancement and the issue of contribution and recognition in a traditional academic system.

Era of Enterprise

In contrast to the previous eras that were characterized by large movements toward a single research topic, the Era of Enterprise (1995–1999) is characterized by a change in the scope of research topics. Specifically, previous eras followed established research methodologies that emphasize examining detailed areas to establish findings based on extensive data analysis and/or experimentation. In contrast, the Era of Enterprise introduced a broader focus on research topics including environmental issues, management issues, and public infrastructure issues in addition to the traditional research areas. In these topics, measuring direct results was not always possible as the results of a new theory such as sustainability might not be evident for years or generations. Therefore, research findings were no longer limited to defined observations, but now included findings that espoused conclusions on the role of construction on long-term events and the role of outside influences on construction operations. These enterprise-wide concerns brought a new perspective on the role, scope, and boundaries of construction research.

Era of Planning

The final era in the construction research timeline brings the historical perspective to the present. In this final era, research appears to once again be shifting in emphasis. However, rather than shifting to a new area, the research emphasis is returning full circle back to the topic of planning that was prevalent in the initial research eras. This emphasis lends its name to the current era as the Era of Planning. Although 2 years is premature to make any definitive retrospective conclusions, the pattern appears to be reinforcing this research path. The difference in this era is that the approach to planning is broader than that witnessed in earlier eras. Specifically, the concept of planning now includes the enterprise issues introduced in the Era of Enterprise, technology issues introduced over the past 20 years, and a broader concept of construction constituents. In this context, perhaps we are witnessing the emergence of the Era of Collaboration rather than a focus on planning. The exact direction and extent to which this change will define the current era or set the foundation for the next era will require a retrospective analysis at a future date.

Research Heritage Summary

In summarizing the research heritage of the construction community, several key conclusions support the title of this article that the construction community is diminishing. First, the intellectual output from research has noticeably diminished since its peak in the early 1990s. Specifically, research output over the 2 year period of 2001–2002 was down 35% from the peak of 1993–1994. If intellectual output is the ultimate output of an academic community, then the numbers indicate a distinct drop in construction community intellectual output.

Second, the construction research output indicates a lack of stability in research focus among community members. Predominantly, it is appropriate to characterize the majority of construction research as following a circuitous trail from research topic to research topic. During its entire history, construction research and the research community has moved into and out of topic areas. The productivity topic and its associated pattern described earlier is not unique. Similar patterns can be found throughout the research history including topics such as robotics from 1988 to 1994, artificial intelligence from 1986 to 1995, and estimating and scheduling from 1973 to 1978. In each of these cases, noticeable reductions in other topics occurred as the focus turned to new research areas on a regular basis.

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Third, the diffusion of research topics indicates a lack of collaboration within the construction community. Although individual collaboration exists, collaboration as a means to overcome program diffusion is not a prevalent theme within the community. Rather, the number of individual research topics indicates either a need imposed by the academic system or a desire by community researchers to engage in individual research efforts focusing on narrow topics rather than pursue collaborative research efforts that address broader research themes.

In summary, the construction research heritage does not reveal the community focus that was predicted based on the attributes of the construction heritage tree. Rather, the research heritage emphasizes individual efforts on a spectrum of research topics. However, at any given time, the community is significantly influenced to move individual research efforts in a particular direction.

Community Issues and Conclusions

A community of 120 faculty members distributed among 52 programs is one that can be conservatively characterized as dispersed. However, dispersion does not necessarily have to translate to separated and disjointed. Rather, dispersion can be developed into a force for greater cohesion due to the lack of critical mass in many areas. The question for the construction community is what direction the future growth in the heritage tree and the research profile will develop. Of particular interest and potential concern are the following issues:

1. Expansion or contraction?—The legacy of the primary four and secondary seven universities in producing faculty members has been a continual output enabling the construction community to expand at a consistent pace throughout its 40 year history. However, the discipline is now mature enough to be faced with a large number of faculty retirements (10% with more than 30 years experience). The question is then whether the narrow number of producers has potentially led to a scenario where the output stream is no longer large enough to meet the demands of retirements, program growth, and other vacancies. The issue now becomes whether enough tertiary suppliers can supplement the output, or has the community reached its peak in terms of size. To do so requires that they each have a vigorous research and PhD program. To do so, of course, presupposes adequate research funding.
2. Individuals or collaboration—with 120 faculty members dispersed over 53 programs, the construction community is slightly larger than a medium engineering office. Although academia is inherently different than a professional office, the issues of focus and collaborative energy remain relevant. Why are most programs small? In large measure, it is because each program has a local constituency of architecture/engineering/construction firms that hire students and contribute to programs in other important and tangible ways. Universities (especially state universities) must address the real needs of this constituency. This suggests that multiple, small local programs are both a practical and political necessity. However, if a primary goal is to make a difference through research, then we must establish a different model for collaboration so the research programs seem larger than they really are. Like-minded programs could develop formal interuniversity collaboration and strategic alliances. These aligned research programs might be technology enabled or perhaps they are enabled through faculty or student exchanges. These collaborative programs will require increased resources, which of course presupposes adequate funding.
3. Theory or application—The move by the construction community on a regular basis to new research topics that emerge primarily from outside sources such as other academic disciplines including computer science and business, or industry input, places the community squarely in the research applications domain. Although the approach of translating or transferring outside theories to construction has served the community up to this point, the community must consider whether or not it wants to be a fundamental developer of theory or whether it wants to continue applying the theories of others. The ability to develop the deep knowledge needed to enable development of new theory presupposes, once again, the existence of sufficient funding to allow researchers to focus on one problem for an extended period of time.

Analysis

Answering the previous questions can take many paths based on the perspective and experience of the individual answering the question. In an attempt to tie together the many facts introduced in this research, the authors put forth an analysis of their own for consideration.

Certainly one of the motivations for construction researchers to frequently move from research area to research area is the relative paucity of construction research funding. There are no consistent sources of funding for construction research on the scale of that enjoyed by industrial engineering or transportation engineering. For the construction community, the Construction Industry Institute has served as the primary funding source over the last 2 decades with funding levels consistently around $1 million per year. Due to the lack of a broad funding base, many researchers have been compelled to go from research area to research area in an effort to keep programs, students, and faculty funded. Perhaps the scarcity of funding is due to our relative youth as a discipline, or the lack of research focus of our industry or even due to the relative lack of intellectual or practical impact of our research. Whatever the underlying reasons, the effects on the construction research infrastructure are profound. First, as demonstrated by the foregoing analysis, few researchers have had the ability (luxury) of defining a focused, directed research program. As a result, many construction researchers do not have an identifiable corpus of knowledge to claim as the foundation of their research contribution. This is different in the construction discipline from most other academic disciplines. Since we rarely have long-term directed research activities, we have rarely had the opportunity of developing our own theory and knowledge set. Mostly we are consumers not producers of theory. We adopt theory developed by other antecedent disciplines. We use theory, frameworks, and knowledge developed in Mathematics, Psychology, Computer Science, Economics, and even Business (who also are theory consumers) as the basis of our research activities. Yet, only rarely is our work looked at as providing fundamental contributions to these antecedent disciplines.

In conclusion, the construction community is facing several critical issues as follows:

1. the community is losing intellectual vitality as measured by intellectual output;
2. there is a loss of viability as programs become diffused across the country with little critical mass;
3. there is a need for a greater number of alliances to develop collaboration rather than isolationism;
4. the community needs a group of individuals who will focus

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on obtaining greater resources for the community as a whole; and

5. a greater focus needs to be placed on engaging the broader construction industry into the research process.

And, finally, the construction community needs to address the issue of home. Specifically, construction has spent 4 decades attempting to fit in to the civil engineering academic domain. This attempt to fit has been less than successful at many universities. However, the authors have failed to identify a preferred home for this discipline. Therefore, the question for the construction community is not where do we belong, but how do we change to better fit our civil engineering home and better build a strong foundation for the future.

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