



Updating the Civil Engineering Body of Knowledge: A Proposed Methodology

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Background

In 2011, the American Society of Civil Engineers (ASCE) Committee on Academic Prerequisites for Professional Practice approved a long-term plan for management of updates to the published Civil Engineering Body of Knowledge (CE BOK) and the associated ABET accreditation criteria.¹ This plan calls for ASCE to develop a formal revision to the CE BOK and associated criteria on a regular eight-year cycle. This regular change-cycle reflects three broadly accepted conclusions drawn from ASCE's experience in developing the first two editions of the CE BOK, from 2002 to the present:

- A professional body of knowledge is a dynamic entity that reflects the ever-changing nature of professional jurisdictions. A given profession (or professional group) can be strengthened by formally articulating and publishing its body of knowledge, but only if the profession is willing to update its published BOK regularly, to reflect changes in the professional environment.²
- A published outcomes-based BOK may need to be updated if, during the implementation process, specific outcomes are found to be problematic from the perspective of assessment.³
- Changes to the CE BOK—and, especially, to the associated accreditation criteria—will be more acceptable to the accreditation community (especially ABET program evaluators, commissioners, accreditation committee members, department chairs, and faculty) if they occur on a predictable schedule that is longer than the current six-year accreditation cycle for engineering programs.

Consistent with the approved eight-year plan, a task committee to develop *The Civil Engineering Body of Knowledge, Third Edition* (BOK3) should be constituted by October 2016, should finalize its work by September 2018, and should publish its final product by March 2019. As with the previous two editions of the CE BOK, the Third Edition will be published in both hard-copy and electronic form, and then disseminated to the entire professional community via the ASCE website.

Purpose

The purpose of this paper is to propose a methodology by which the Civil Engineering Body of Knowledge Third Edition Task Committee (BOK3TC) can develop an updated BOK publication that objectively reflects the *profession's current consensus* on the knowledge, skills, and attitudes required for entry into the professional practice of civil engineering.

The Challenge

The most fundamental challenge in developing a CE BOK update that represents a legitimate consensus of the professional community is that each update will be developed by a committee composed of individuals, most of whom will have had no involvement in the development of

previous BOK editions. This deliberate inclusion of fresh perspectives is absolutely essential to the integrity of the BOK development process. Yet it is also problematic, for three reasons. First, no single individual can legitimately represent the needs of the profession as a whole. Second, every individual inevitably brings personal biases and agendas (sometimes consciously, sometimes not) to the committee's deliberations. And third, the thoughtful deliberations and painstakingly-wrought compromises of previous BOK committees will not be known or fully understood by the members of the new committee.

In the authors' view, these fundamental shortcomings of committee-based BOK formulation must be purposefully addressed in formal, well-conceived specifications for committee composition, recruiting and selection of committee members, decision-making protocols, and broad-based review of the work products and drafts. In the absence of such specifications, the committee's product is likely to be little more than a synthesis of current committee members' opinions—reflecting an arbitrary character that cannot legitimately reflect the profession's needs and is quite likely to result in excessively large, weakly justified (and perhaps contradictory) changes from update to update. This would be in sharp contrast with the two previously published CE BOK documents, which reflect a rigorous, scholarly problem-solving approach, enriched by broad input from across the profession.

Proposal

Based on these observations, the authors proposes the following guidelines for establishment of the BOK3TC:

- The committee will be designed and overseen by the ASCE Raise the Bar Committee (RTBC), with positions (not people) specified to represent all relevant constituencies of the civil engineering profession. If the leaders of ASCE believe that oversight of the BOK3TC is beyond the purview and resources of the RTBC, the ASCE Committee on Education (COE) or Committee on Advancing the Profession (CAP) could logically fulfill the BOK3TC oversight role.
- The committee membership will be determined through a formal application process. As part of this process, potential committee members must affirm their support for the established decision-making protocols (described below). Applications will be reviewed and members will be selected by the oversight committee; i.e., RTBC, COE, or CAP.
- The committee chair will be recruited and selected based on his or her experience serving on at least one previous BOK committee.
- The committee chair and senior staff leader will be identified and appointed by October 2015. From October 2015 through September 2016, this member-staff leadership team will oversee the execution of the application and selection process, and prepare a draft plan and schedule for the BOK3TC.

The committee's decision-making process will adhere to the following guidelines:

- ASCE's fundamental definition of a professional body of knowledge—consisting of the knowledge, skills, and attitudes necessary to enter professional practice—will be retained.

- The general formulation of the CE BOK—based on an articulation of clear, discrete, measurable outcomes and associated levels of achievement—will be retained.
- The outcomes and levels of achievement articulated in the most recent edition of the CE BOK will be retained unless there is a compelling, objective justification for adding, deleting, modifying, or reorganizing outcomes. That justification can *only* be one of the following:
 - A formal vision, policy statement, or similar publication promulgated by an organization that can legitimately claim to represent the engineering profession or a portion of the engineering profession.
 - A documented change in licensure policies or examination content that directly affects the knowledge, skills, or attitudes expected for professional practice.
 - A documented change in accreditation policies, procedures, or criteria that directly affects the knowledge, skills, or attitudes expected for graduation from an accredited engineering program.
 - Clear, convincing evidence that a specific aspect of the previous edition of the CE BOK is erroneous, incomplete, or unclear.
 - Clear, convincing evidence that one or more outcomes articulated in the previous edition of the CE BOK are problematic from the perspective of implementation (e.g., an outcome is not measurable, or its measurability could be improved).
- Given that BOK outcomes will not necessarily be translated into corresponding accreditation criteria, the committee will refrain from considering the potential impact of changes to the CE BOK on future accreditation criteria. Consistent with well-established practice, the accreditation implications of each newly published BOK edition will be considered by a subsequently-constituted Civil Engineering Program Criteria Task Committee.⁵
- The committee will aggressively seek feedback on its draft work products from the entire civil engineering professional community.

With these guidelines serving as statements of principle, the BOK3TC will fulfill its charge through a methodology that incorporates:

- Purposeful effort to understand and respect the work of previous BOK committees, through careful study of the following foundational documents:
 - *The Civil Engineering Body of Knowledge, Second Edition*, with particular emphasis on Appendices J through O—the detailed explanation of outcomes and their rationale⁶
 - The ABET Engineering Accreditation Commission (EAC) Criteria for Accrediting Engineering Programs⁷
 - The National Academy of Engineering (NAE) *Engineer of 2020* report⁸
 - The NAE *Educating the Engineer of 2020* report⁹
 - The ASCE *Vision for Civil Engineering in 2025* report¹⁰
- Broad-based scholarly research to identify all potential justifications for change;
- Rigorous analysis to derive BOK changes that derive logically from these justifications;
- Development of a draft report that clearly articulates the rationale for each proposed change; and
- Appropriate input from across the profession.

In considering potential justifications for changes to the BOK outcomes, the BOK3TC will consider the following, as a minimum:

- The *Environmental Engineering Body of Knowledge*, published in 2009 by the American Academy of Environmental Engineers and Scientists (AAEES).¹¹
- The *Engineering Body of Knowledge for Professional Engineers*, published in 2013 by the National Society of Professional Engineers (NSPE).¹²
- The *Graduate Attributes and Professional Competencies*, published by the International Engineering Alliance (IEA) in June 2013.¹³
- Substantial changes to the content of the Fundamentals of Engineering (FE) Exam, implemented by the National Council of Examiners for Engineering and Surveying in conjunction with its transition to a computer-based examination format in 2013.¹⁴
- Possible changes to Criterion 3 (Student Outcomes) of the ABET Criteria for Accrediting Engineering Programs, which are currently being proposed by the ABET Engineering Accreditation Commission (EAC).¹⁵

Inclusion of these latter two items might seem inconsistent with the principle that examinations and accreditation criteria are assessment tools—and thus should derive from the CE BOK rather than influencing it. However, the FE Exam and the ABET General Criteria are not *merely* assessment tools. They are statements of the competencies required of entry-level engineers, formulated by professional communities other than ASCE—and *not* derived from the CE BOK. Indeed, the new civil engineering FE Exam actually contradicts the CE BOK, in that it drops coverage of differential equations and linear algebra. Similarly, the proposed update to ABET EAC Criterion 3 drops the requirements for students to understand the impact of engineering solutions in a global, economic, environmental, and societal context; to recognize the need for life-long learning; and to understand professional responsibilities—all in contradiction to the CE BOK. The BOK3TC must consider these deletions to determine if they reflect bona fide changes in the engineering professional environment, which might therefore influence the new CE BOK.

Conclusion

A formally published BOK can be highly valuable in strengthening the associated professional jurisdiction, but only if the publication reflects the dynamic, ever-changing nature of a professional body of knowledge. The planned *Civil Engineering Body of Knowledge, Third Edition* will achieve this goal, provided that the committee charged with its development employs a methodology characterized by rigorous research, careful analysis, broad input from the professional community, and respect for the contributions of previous BOK committees.

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