

WIP: A Data-Driven Alumni Dashboard for Measuring Program Educational Objectives in a Civil Engineering Program

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Abstract

While ABET accreditation emphasizes the systematic assessment of Student Outcomes (SOs), demonstrating attainment of Program Educational Objectives (PEOs), such as professional advancement, leadership, and lifelong learning, remains a persistent challenge across Civil Engineering programs. Many institutions rely on anecdotal or self-reported evidence, limiting their ability to document longitudinal, quantifiable measures for continuous quality improvement (CQI). The primary objective of this Work-in-Progress (WIP) study is to develop and examine the feasibility of a scalable, data-driven framework for organizing and interpreting PEO-related evidence using an alumni outcomes dashboard within a Civil Engineering program at a public Historically Black College and University (HBCU).

Grounded in Kirkpatrick's Evaluation Model and Social Capital Theory, the study synthesizes existing institutional records, licensure-related information, employment data, and documented indicators of alumni professional engagement drawn from ABET self-study materials and publicly available professional sources. Civil-engineering-specific indicators include career progression in infrastructure-related roles, attainment or pursuit of professional licensure (FE/PE), involvement in professional societies such as ASCE and ACI, participation in public infrastructure or sustainable design projects, and engagement in leadership and community service activities.

The conceptual dashboard framework is illustrated using representative alumni-related data patterns derived from existing program documentation and is designed for future implementation using accessible data visualization tools. Stakeholder input used to refine indicator selection and dashboard structure is informed by documented faculty review processes and industry advisory board engagement.

Preliminary analysis indicates the feasibility of linking quantitative indicators such as licensure progression, certifications, and employment sectors with qualitative evidence related to leadership development and professional engagement to support CQI and ABET documentation. Ongoing work focuses on integrating the dashboard framework into routine accreditation review processes and exploring its adaptability to additional Civil Engineering programs. By operationalizing PEO assessment beyond narrative reporting, this WIP study contributes a practical and scalable approach to data-informed program evaluation aligned with the Civil Engineering Division's standing committees on Effective Teaching, Professional Practice, and Instructional Technology.

Keywords: Program Educational Objectives; ABET Accreditation; Alumni Dashboard; Continuous Improvement; Data Visualization; Civil Engineering Education; HBCU

1. Introduction

Accreditation by the Accreditation Board for Engineering and Technology (ABET) requires engineering programs to demonstrate not only the achievement of Student Outcomes (SOs) at the time of graduation, but also the attainment of Program Educational Objectives (PEOs) several years after graduation [1]. PEOs are intended to capture graduates' early professional accomplishments, including career advancement, leadership, ethical responsibility, and engagement in lifelong learning. While systematic approaches for assessing SOs are well established across engineering programs, the evaluation of PEOs remains a persistent challenge, particularly within Civil Engineering programs where alumni pursue diverse career

trajectories across public infrastructure agencies, consulting firms, construction management organizations, and regulatory bodies.

In practice, many engineering programs rely on periodic alumni surveys, anecdotal testimonials, or informal discussions with industry advisory boards to infer PEO attainment [2], [3]. These approaches often suffer from low response rates, limited longitudinal consistency, and insufficient quantitative rigor, making it difficult to support continuous quality improvement (CQI) in a data-driven manner. For Civil Engineering programs, this challenge is further compounded by the need to document discipline-specific professional milestones such as progression toward licensure, involvement in professional societies, participation in infrastructure or sustainability-focused projects, and leadership within multidisciplinary teams [4].

The challenge of meaningful PEO assessment is especially salient for Historically Black Colleges and Universities (HBCUs) and other minority-serving institutions, which often operate under constrained resources while fulfilling a mission to broaden participation in the engineering workforce [5]. These institutions must balance accreditation expectations with limited access to costly assessment platforms, dedicated alumni-tracking systems, or specialized assessment personnel. As a result, there is a pressing need for scalable, low-cost, and transparent mechanisms that allow Civil Engineering programs to systematically monitor alumni outcomes and link them directly to PEOs.

Recent advances in data visualization, institutional analytics, and publicly available professional data sources present an opportunity to reimagine PEO assessment. Dashboards have been increasingly adopted in higher education to support evidence-based decision-making by integrating multiple data streams into interactive visual environments [6]. Within engineering education and related higher-education contexts, dashboard applications have largely focused on monitoring student performance, course-level outcomes, retention, and enrollment trends, with limited emphasis on post-graduation or alumni-based assessment [7], [8]. As a result, relatively few studies have examined how dashboard-based systems can be used to systematically measure alumni outcomes aligned with PEOs.

Moreover, many existing dashboard-based assessment efforts lack grounding in established evaluation or social theories, limiting their interpretability and transferability across institutions. Kirkpatrick's Evaluation Model provides a structured framework for evaluating outcomes beyond immediate learning by emphasizing behavioral change and long-term results [9]. In parallel, Social Capital Theory highlights the role of professional networks, institutional affiliation, and community engagement in shaping career advancement and leadership development [10], [11]. Together, these frameworks offer a theoretically robust lens for interpreting alumni outcomes as indicators of PEO attainment within Civil Engineering education.

To address these gaps, this Work-in-Progress (WIP) study presents the development and conceptual application of a data-driven alumni outcomes dashboard designed to support PEO assessment in a Civil Engineering program at a public HBCU. The primary objective of this study is to develop and validate a scalable framework for organizing and interpreting PEO-related evidence using integrated alumni data and interactive visualization concepts. The proposed dashboard leverages existing institutional records, licensure-related indicators, employment information, and documented professional engagement to support CQI and ABET documentation.

This work aligns with the Civil Engineering Division's standing committees on Effective Teaching, Professional Practice, and Instructional Technology by offering a practical assessment mechanism that

enhances transparency, accountability, and data-informed program evaluation. As a WIP contribution, the emphasis of this paper is on the design, structure, and preliminary application of the alumni dashboard framework rather than on summative evaluation outcomes. The long-term goal is to provide a transferable model that can be adapted by other Civil Engineering programs, particularly those at minority-serving institutions, seeking to operationalize PEO assessment in a sustainable and meaningful way.

2. Theoretical Framework

This study is grounded in two complementary theoretical perspectives: Kirkpatrick's Evaluation Model and Social Capital Theory. Together, these frameworks provide a structured lens for interpreting alumni-related evidence and support the systematic evaluation of Program Educational Objectives beyond graduation. Their combined use enables alignment between measurable indicators, professional behaviors, and long-term program outcomes within an ABET continuous quality improvement context.

2.1 Kirkpatrick's Evaluation Model

Kirkpatrick's Evaluation Model is a widely used framework for assessing the effectiveness of training and educational programs across four evaluative levels: Reaction, Learning, Behavior, and Results [9]. Originally developed for corporate and professional training contexts, the model provides a structured approach for examining how educational experiences translate into applied behavior and longer-term outcomes beyond initial instruction.

Within engineering education, Levels 3 (Behavior) and 4 (Results) are particularly relevant for evaluating Program Educational Objectives. Level 3 focuses on the extent to which individuals apply acquired knowledge and skills in real-world professional settings, while Level 4 examines the broader outcomes or impacts that result from those behaviors, including organizational and societal effects [9]. These outcome-oriented levels align closely with ABET's definition of Program Educational Objectives, which emphasize graduates' professional practice, leadership, ethical responsibility, and societal contributions several years after graduation [1].

In this study, Kirkpatrick's model provides a theoretical foundation for interpreting alumni-related indicators captured through the proposed dashboard framework. Indicators such as engagement in professional practice, progression toward licensure, leadership roles, and participation in infrastructure- or sustainability-focused projects are interpreted as evidence of behavioral change consistent with Level 3. Similarly, outcomes related to career advancement, professional recognition, and contributions to public infrastructure are interpreted as Level 4 results. Anchoring dashboard indicators to these evaluative levels supports a systematic and theory-informed approach to interpreting alumni evidence as indicators of Program Educational Objective attainment.

2.2 Social Capital Theory

Social Capital Theory offers a complementary lens for understanding how professional networks, institutional affiliation, and community engagement influence career development and leadership trajectories. Coleman defines social capital as the resources embedded within social relationships that facilitate individual and collective action [10]. Putnam further emphasizes the role of civic engagement, trust, and professional participation in generating social and economic benefits at both individual and societal levels [11].

Within Civil Engineering, social capital is widely recognized as influential in shaping professional advancement through mechanisms such as mentorship, professional society involvement, collaborative

project work, and engagement with industry and public-sector stakeholders. Alumni participation in professional societies, advisory boards, or community infrastructure initiatives reflects not only technical competence but also the development of professional identity, leadership capacity, and ethical responsibility, which are key dimensions commonly embedded in Civil Engineering Program Educational Objectives.

In this study, Social Capital Theory informs the selection and interpretation of dashboard indicators related to alumni engagement and professional connectivity. Indicators such as professional society involvement, leadership roles, mentoring activities, and community-based infrastructure participation are used as proxies for social capital accumulation. These indicators provide insight into how graduates leverage professional networks and institutional affiliations to advance their careers and contribute to the civil engineering profession.

2.3 Integrated Framework for PEO Measurement

By integrating Kirkpatrick's Evaluation Model and Social Capital Theory, this study establishes a multidimensional framework for interpreting alumni outcomes captured through the proposed dashboard. Kirkpatrick's model provides a temporal and outcome-oriented structure for assessing post-graduation behaviors and results, while Social Capital Theory contextualizes these outcomes within broader professional networks and societal engagement.

This integrated framework supports the design of dashboard indicators that move beyond static or anecdotal evidence toward more systematic, theory-informed representations aligned with ABET expectations. In particular, it enables Civil Engineering programs to link alumni behaviors, professional engagement, and career outcomes to PEO categories in a structured manner that supports continuous quality improvement. As a Work-in-Progress effort, the emphasis is on demonstrating the conceptual validity and practical applicability of this integrated framework as a foundation for dashboard-based PEO assessment.

3. Methodology and Dashboard Framework Development

This section describes the document-based methodology used to develop and pilot an alumni dashboard framework for measuring Program Educational Objectives (PEOs) in a Civil Engineering program. As a Work-in-Progress (WIP) study, the methodology emphasizes systematic extraction, organization, and reinterpretation of existing ABET assessment evidence rather than the generation of new primary data. The approach is designed to demonstrate feasibility and alignment with established continuous quality improvement (CQI) practices.

3.1 Document Corpus and Context

The primary data sources for this study consist of official ABET accreditation materials prepared for the Civil Engineering program, including the ABET Self-Study Report, Criterion 2 documentation on Program Educational Objectives, Criterion 4 documentation on Continuous Improvement, Appendix G detailing Program Outcomes and Performance Criteria, and Criterion 8 documentation on Institutional Support. Together, these documents represent a comprehensive and authoritative record of the program's assessment practices, governance structures, and evidence streams used for accreditation.

These materials document established processes for defining, reviewing, and evaluating PEOs, as well as the mechanisms through which assessment evidence informs program-level decision-making. Because the

documents are produced as part of routine accreditation activities, they provide a reliable foundation for examining how existing evidence can be reorganized to support longitudinal PEO evaluation.

3.2 PEO Decomposition and Indicator Identification

The first methodological step involved systematic review of the Criterion 2 documentation to identify the program's stated PEOs and their intended dimensions, such as professional practice, leadership, ethical responsibility, and lifelong learning. Each PEO was then decomposed into observable and potentially measurable elements that could be inferred from existing assessment evidence.

To ensure consistency with established assessment practices, the decomposition process was informed by the outcome-to-performance mapping approach documented in Appendix G. This appendix explicitly links student outcomes to performance criteria, assessment measures, and evidence sources. A similar logic was applied at the PEO level by identifying indicators that reflect post-graduation behaviors and achievements aligned with each objective.

Examples of such indicators include licensure preparation and participation, employment in civil engineering–related sectors, progression in professional roles, engagement in professional organizations, and participation in continuing education or graduate studies. Importantly, indicators were limited to those that could reasonably be supported by existing institutional records and documented assessment evidence.

To synthesize the relationship between program-defined PEOs and the multiple sources of assessment evidence identified in this study, a conceptual framework was developed to guide subsequent indicator mapping and dashboard design. The framework illustrates how existing ABET assessment documentation can be reorganized into a structured, PEO-centered alumni dashboard that supports continuous quality improvement processes. Figure 1 illustrates the conceptual framework through which existing ABET assessment evidence is reorganized into a PEO-centered alumni dashboard to support continuous quality improvement in a Civil Engineering program.

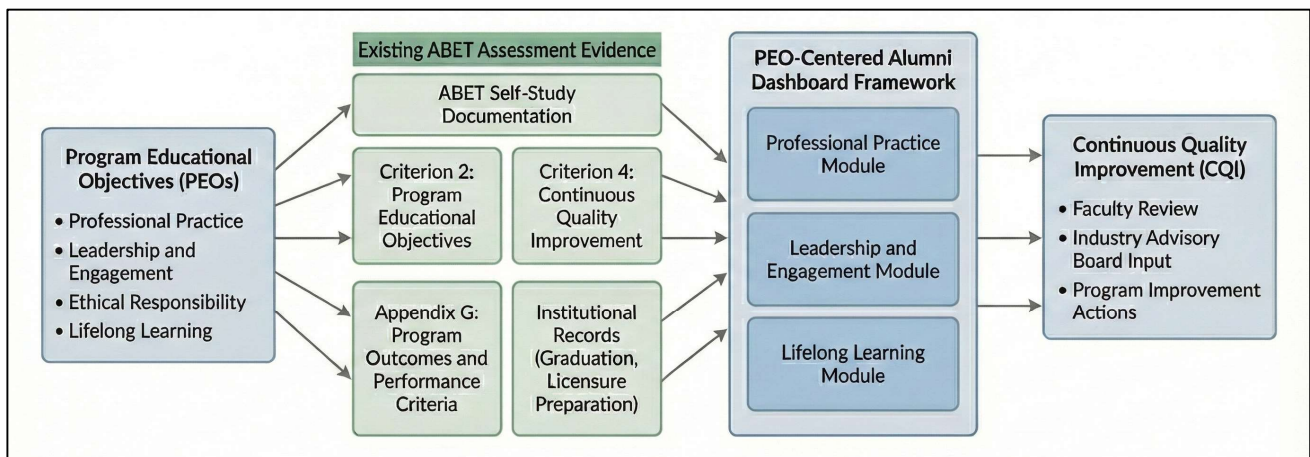


Figure 1. Conceptual framework for a PEO-centered alumni dashboard supporting continuous quality improvement.

3.3 Evidence Mapping and CQI Alignment

Following indicator identification, existing assessment evidence documented in the ABET Self-Study and Criterion 4 materials was mapped to the proposed PEO indicators. Criterion 4 provides detailed descriptions of how assessment data are reviewed by faculty, discussed with advisory boards, and used to

inform program improvements. This documentation demonstrates that multiple data streams are already collected and interpreted within a CQI framework.

The mapping process examined how enrollment trends, graduation data, licensure-related information, stakeholder feedback summaries, and documented improvement actions could be reorganized to provide a longitudinal view of PEO attainment. Rather than introducing new metrics, the dashboard framework is designed to consolidate and visualize evidence that is already collected but distributed across multiple sections of the self-study documentation.

This alignment ensures that the dashboard framework complements existing CQI practices while supporting ABET expectations for evidence-based program evaluation. Figure 2 illustrates the process by which existing ABET assessment documentation is systematically extracted and mapped to PEO-aligned indicators within the proposed dashboard framework.

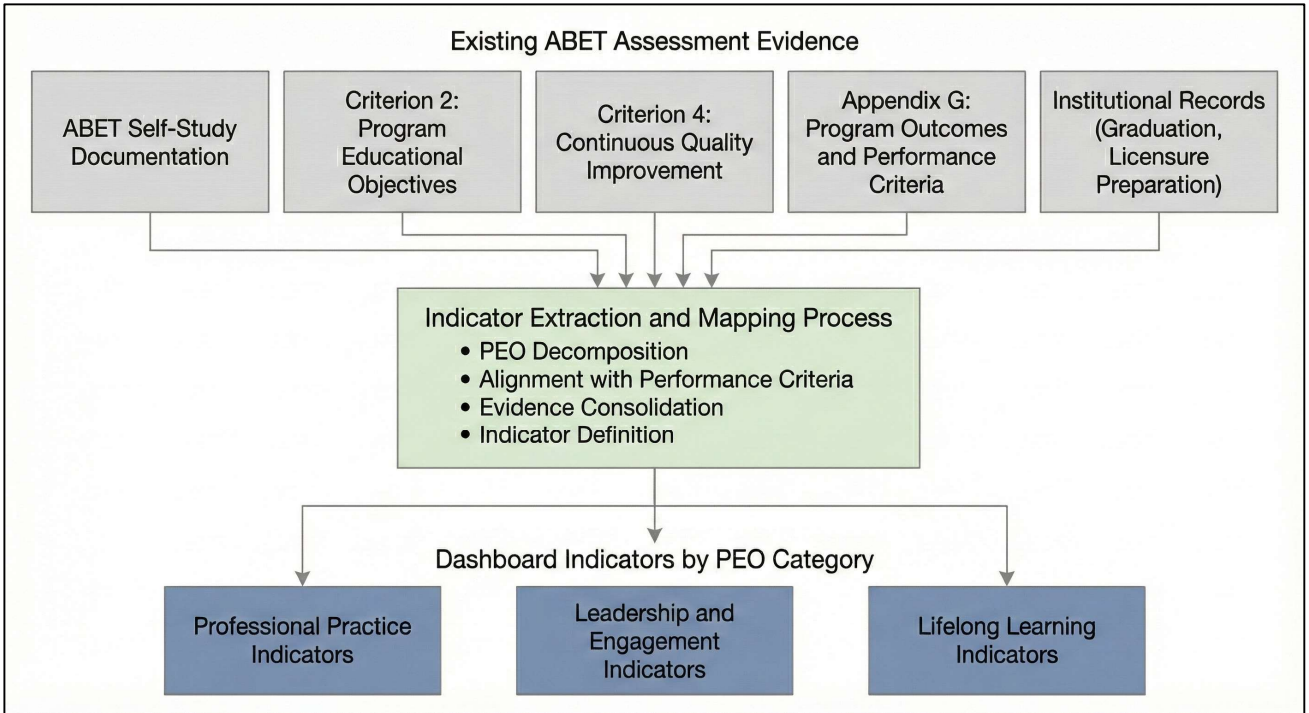


Figure 2. Evidence-to-indicator mapping process for PEO-aligned dashboard development.

3.4 Dashboard Framework Design

Based on the indicator identification and evidence mapping processes, a conceptual dashboard framework was developed to organize PEO-related information into thematic modules. Each module corresponds to a PEO category and aggregates relevant indicators and supporting evidence. The framework emphasizes clarity, transparency, and interpretability rather than technical complexity or real-time performance monitoring.

The dashboard design is intended to support cohort-based and longitudinal interpretation of PEO-related evidence through summary tables, placeholder trend visualizations, and indicator coverage matrices. These elements are designed to facilitate faculty and advisory board discussions during routine review cycles while remaining consistent with the program’s existing assessment infrastructure.

3.5 Feasibility and Stakeholder Integration

Feasibility of the proposed dashboard framework is supported by evidence documented under Criterion 8 on Institutional Support, including the availability of data infrastructure, faculty engagement, and administrative resources necessary to sustain assessment activities, indicating that the framework can be integrated into existing program operations without significant additional burden. Stakeholder integration is reflected in governance and review structures documented in the ABET Self-Study and Criterion 4 materials, where faculty committees and industry advisory boards already participate in assessment review cycles and provide established venues for interpreting dashboard outputs and informing continuous quality improvement (CQI) decisions. Stakeholder input, as reflected in documented faculty reviews and advisory board feedback, informed the selection and organization of PEO-aligned indicators within the framework, positioning the dashboard as an organizing and decision-support tool that strengthens existing practices rather than introducing parallel assessment processes.

4. Dashboard Framework Illustration and Preliminary Observations

This section presents an illustration of the proposed alumni dashboard framework and summarizes preliminary observations derived from applying the framework to existing ABET assessment documentation. The dashboard is designed to organize PEO-related indicators into thematic modules that support longitudinal interpretation, faculty review, and advisory board engagement without introducing new assessment requirements. The conceptual illustration reflects representative patterns derived from existing program documentation rather than outputs from a fully implemented dashboard system. Figure 3 presents a conceptual layout of the proposed PEO-centered alumni dashboard, illustrating how indicators are organized by PEO category and interpreted to support continuous quality improvement activities.

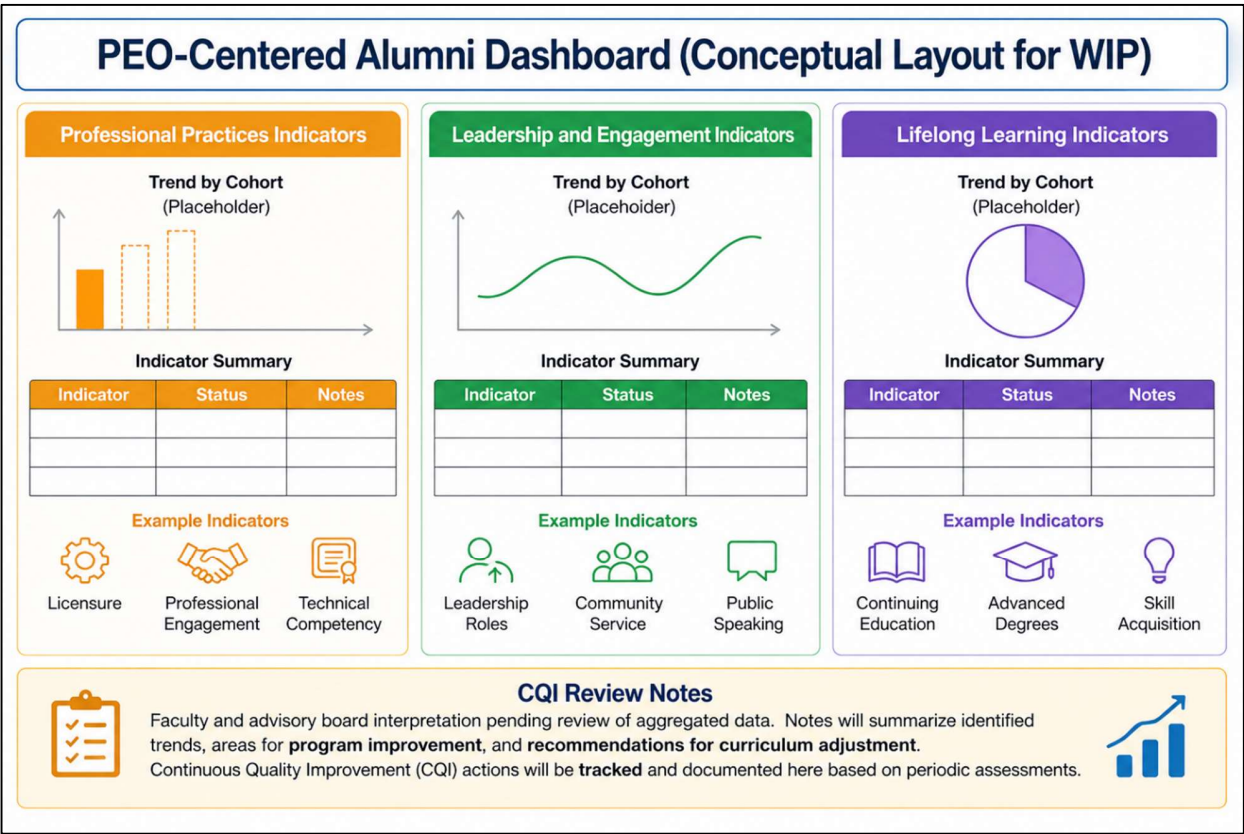


Figure 3. Conceptual PEO-centered alumni dashboard layout supporting continuous quality improvement

4.1 Dashboard Framework Illustration

The proposed alumni dashboard framework organizes PEO-related indicators into thematic modules aligned with program-defined Program Educational Objectives. As illustrated in Figure 3, the conceptual layout groups indicators under professional practice, leadership and engagement, and lifelong learning categories, providing a structured view of post-graduation outcomes across graduating cohorts. Each module is designed to present summary indicators and placeholder trend visualizations that support interpretation rather than direct performance evaluation.

The framework emphasizes clarity and usability by consolidating distributed assessment evidence into a single, PEO-centered view. Indicator summaries and cohort-based placeholders are intended to support faculty and advisory board discussions by highlighting patterns and areas of emphasis without introducing new data collection requirements. A dedicated section for continuous quality improvement (CQI) review notes further reinforces the dashboard's role as a decision-support tool rather than an operational performance system.

4.2 Preliminary Indicator Coverage Analysis

Application of the framework to existing ABET assessment documentation reveals that a substantial portion of PEO-related evidence is already available within the program's current assessment ecosystem. Indicators associated with professional practice, including graduation trends and licensure preparation, are consistently documented and well supported across accreditation materials. These indicators provide a strong foundation for longitudinal evaluation of professional readiness and workforce alignment.

Indicators related to leadership and engagement are present but less systematically organized. Evidence of professional participation, service activities, and stakeholder engagement appears across multiple sections of the self-study documentation but is not consolidated in a manner that readily supports longitudinal interpretation. The dashboard framework highlights this fragmentation and demonstrates how such evidence can be reorganized to improve visibility and coherence.

Lifelong learning indicators show the greatest variability in coverage. While participation in continuing education, certification activities, and graduate studies is referenced, documentation is uneven across cohorts. The framework makes these gaps explicit, enabling programs to identify opportunities for targeted enhancement of evidence collection while remaining aligned with existing assessment practices.

4.3 Integration with Continuous Quality Improvement

The dashboard framework aligns closely with the program's established continuous quality improvement processes documented under ABET Criterion 4. Faculty review cycles, advisory board input, and documented improvement actions provide natural integration points for dashboard use. By presenting PEO-related indicators in a consolidated and longitudinal format, the framework supports more focused and efficient interpretation of assessment evidence during routine review meetings.

Rather than replacing existing CQI mechanisms, the dashboard functions as an organizing layer that enhances transparency and supports evidence-based discussion. The conceptual layout illustrates how faculty and advisory boards can use dashboard outputs to identify strengths, recognize emerging gaps, and prioritize program improvement actions. In this way, the framework strengthens the linkage between PEO assessment and continuous improvement without imposing additional reporting or resource burdens.

5. Discussion

This Work-in-Progress study demonstrates the feasibility of leveraging existing ABET accreditation evidence to support systematic and longitudinal assessment of Program Educational Objectives in a Civil Engineering program. By reorganizing distributed assessment documentation into a PEO-centered alumni dashboard framework, the study addresses a persistent challenge in ABET accreditation while remaining aligned with established continuous quality improvement practices.

5.1 Contribution to Civil Engineering Education

Assessment efforts in Civil Engineering programs have traditionally focused on student outcomes and course-level performance, with comparatively limited attention to post-graduation achievement of Program Educational Objectives. The framework presented in this study extends established assessment practices beyond graduation by translating existing accreditation evidence into a structured, alumni-focused perspective.

The use of a dashboard-based approach enables clearer visualization and interpretation of PEO-related indicators without requiring new assessment instruments or data collection processes. Grounding the framework in Kirkpatrick's Evaluation Model and Social Capital Theory further strengthens its conceptual foundation by linking alumni professional behavior, engagement, and lifelong learning to intended program objectives. As such, the framework contributes a practical and theoretically informed approach that can be adapted across Civil Engineering programs.

5.2 Implications for HBCUs and Resource-Constrained Programs

The proposed framework is particularly relevant for Historically Black Colleges and Universities and other resource-constrained institutions. Because it relies on assessment evidence that programs already collect as part of routine accreditation activities, the approach minimizes additional workload and avoids dependence on specialized or costly assessment platforms.

In addition to improving assessment efficiency, the framework enables programs to more systematically document alumni outcomes related to workforce participation, leadership, and community engagement. These dimensions are closely aligned with the mission of many HBCUs, which emphasize broadening participation in engineering and advancing the success of underrepresented groups within the civil engineering profession. By organizing alumni evidence into structured, PEO-aligned indicators, the dashboard supports more transparent evaluation of how graduates contribute to infrastructure development, public service, and community impact.

By demonstrating feasibility using existing ABET self-study materials, this study provides a realistic model for programs seeking to enhance PEO assessment while maintaining alignment with existing governance and continuous improvement structures. The framework also supports greater transparency and consistency in how alumni-related evidence is documented and interpreted during accreditation review cycles.

5.3 Limitations and Future Work

As a Work-in-Progress effort, this study has several limitations. The proposed dashboard framework has not yet been implemented as a live system with automated data updates, and the present analysis does not evaluate the impact of dashboard use on program decision-making or continuous improvement outcomes.

In addition, some PEO dimensions, particularly those related to leadership and lifelong learning, would benefit from more systematic and consistent documentation across graduating cohorts.

Future work will focus on implementing the dashboard framework using commonly available visualization tools, refining indicators through stakeholder engagement, and examining how dashboard use influences faculty discussions, advisory board input, and program improvement actions over time. Longitudinal deployment will enable more robust evaluation of the framework's effectiveness in supporting sustained PEO assessment.

5.4 Positioning as a Work-in-Progress

The decision to present this study as a Work-in-Progress reflects a deliberate emphasis on framework development, feasibility, and alignment rather than on summative outcome evaluation. By documenting the design and conceptual application of a PEO-centered alumni dashboard framework, this paper establishes a foundation for future research that examines implementation, validation, and long-term impact.

6. Conclusion

Assessing Program Educational Objectives remains one of the most challenging aspects of ABET accreditation, particularly for Civil Engineering programs seeking to demonstrate longitudinal graduate outcomes using credible and sustainable evidence. This Work-in-Progress paper presents a data-informed alumni dashboard framework that leverages existing ABET self-study documentation to support systematic, transparent, and theory-grounded evaluation of PEO attainment.

By synthesizing evidence from ABET Criterion documentation, Appendix G outcome mappings, and established continuous quality improvement practices, the study demonstrates that substantial PEO-relevant data already exist within most accredited programs. The proposed framework reorganizes this distributed evidence into a coherent, PEO-centered structure that enables longitudinal interpretation without requiring new surveys, costly platforms, or additional reporting burdens. Grounding the framework in Kirkpatrick's Evaluation Model and Social Capital Theory further strengthens its interpretive value by linking alumni professional behavior, engagement, and lifelong learning to intended program objectives.

The primary contribution of this work lies in illustrating how Civil Engineering programs, particularly those at Historically Black Colleges and Universities and other resource-constrained institutions, can extend existing assessment cultures to address PEO evaluation more effectively. Rather than introducing parallel assessment systems, the framework enhances current continuous improvement processes by improving visibility, consistency, and usability of alumni-related evidence.

As a Work-in-Progress, this study emphasizes framework development, feasibility, and alignment rather than post-deployment impact. Future efforts will involve implementation of the dashboard using commonly available visualization tools, refinement of indicators through stakeholder engagement, and evaluation of how dashboard use informs faculty deliberations and continuous improvement actions over time. Collectively, this work provides a practical foundation for advancing PEO assessment practices and offers a scalable model that can be adapted across Civil Engineering programs and minority-serving institutions.

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