International Journal of Engineering Education Vol. 36, No. 1(A), pp. 130–141, 2020
Printed in Great Britain

0949-149X/91 $3.00+0.00

Understanding Leadership Through an Ecological Lens: A Rhetorical Cluster Analysis of the *Civil Engineering Body of Knowledge**

KATIE L. GARAHAN
Assistant Professor, College of Humanities and Behavioral Sciences, Department of English, Radford University, P.O. Box 6935 Radford, Virginia, 24142, USA. E-mail: klgarahan@radford.edu

NICHOLAS A. CLEGORNE
Associate Professor, Bagwell College of Education, Department of Educational Leadership, Kennesaw State University, MD 0114 Kennesaw Hall Room 3114, 585 Cobb Ave., Kennesaw, GA 30144-5591, USA. E-mail: nclegorn@kennesaw.edu

DENISE R. SIMMONS
Associate Professor, Department of Civil and Coastal Engineering, Herbert Wertheim College of Engineering, University of Florida, University of Florida, 460D Weil Hall, PO Box 116580, Gainesville FL 32611-6580, USA. E-mail: denise.r.simmons@essie.ufl.edu

As construction and civil engineering professionals continue to acknowledge the need for leadership development in college graduates, it becomes increasingly essential for professionals, educators, and administrators to develop a clear definition of leadership. To move toward this goal, the present study identifies civil engineering's existing definitions of leadership and examines the underlying assumptions of these definitions by focusing specifically on the American Society of Civil Engineers' *Civil Engineering Body of Knowledge for the 21st Century*. Through this analysis, this study seeks to identify *how* leadership is discussed in civil engineering to understand better the trajectory for the civil engineering field's engagement with leadership. Further, given the industry's expressed desires for a more cohesive workplace ecosystem, recommendations are provided for espousing an eco-leadership approach in civil engineering education and praxis.

Keywords: leadership; ecologies; Civil Engineering Body of Knowledge; rhetorical analysis

1. Introduction

Construction professionals and employers are increasingly interested in civil engineering and construction graduates with knowledge in both technical and professional competencies [1–3], particularly leadership and management skills [4]. As such, accrediting bodies such as the Accreditation Board for Engineering and Technology and the American Council for Construction Education now require postsecondary engineering programs to prepare students in both competency areas. Additionally, scholars have explored the positive outcomes associated with an increased focus on professional competencies, positing that explicit education in leadership skills increases students' confidence in both technical and professional competencies [5] and suggesting that portfolio practice in engineering leadership curriculum supports student learning [6]. However, research still shows that engineering and construction students lack necessary leadership skills to be successful on the job [7]. Indeed, according to a recent survey by the Bloomberg Next-Workday report, college graduates in general lack professional skills, including emotional intelligence, persuasion, and complex reasoning [8] – competencies that have been associated with leadership [9]. While construction programs have recently attempted to teach students a mix of technical and professional skills, outcomes still tend to favor technical competencies [10, 11]. These findings suggest a disconnect between the needs of industry professionals and the goals of academe.

Industry, university, and professional organizations must collaborate more genuinely in order to enhance new civil engineering and construction graduates' preparedness [12]. Upon conducting a critical review of 36 sources, Simmons and colleagues identified that the engineering and construction fields lack a clear definition of leadership that is consistent with the industry's values and culture [7]. To move closer towards a consistent definition of leadership, the present study first identifies civil engineering's existing definitions of leadership and examines the underlying assumptions of these definitions. To do so, authors rhetorically analyze the second and third versions of American Society of Civil Engineers' *Civil Engineering Body of Knowledge for the 21st century: Preparing the Civil Engineer for the Future* [13, 14] (hereafter, BOK Version Two and BOK Version Three). The authors focus on both versions two and three in order to examine how the concept of *leadership* has evolved in one of

* Accepted 3 October 2019.

the civil engineering field's most important documents. Using the method of rhetorical cluster analysis undergirded by leadership theory, the authors examine the assumptions, biases, and paradigms underlying the documents' conceptions of *leadership*. The present study seeks to illuminate the trajectory for the civil engineering field's understanding of leadership and make recommendations for espousing an eco-leadership approach in civil engineering education and praxis.

2. Methodological Framework

The present study focuses on the BOK, which is an appropriate text through which to understand the field's definition(s) of leadership, as it encompasses the knowledge, skills and attitudes required of industry practitioners, educators, professional organizations, and students. The BOK Version Three posits that *all* civil engineers from students to seasoned professionals should be interested in the document as it is "the roadmap for properly preparing our future civil engineers, not for practice as we know it today, but for the profession as we expect to be tomorrow" [14, p. vii]. As such, it delineates student outcomes and guidance for faculty, students, interns, and practitioners in accomplishing outcomes and upholding the BOK's vision for civil engineering. How the document is read and interpreted is highly influential on the industry writ large. This document's framing of leadership, then, illuminates how the field currently conceives of the concept and how future civil engineers will learn related competencies. In order to focus on the underlying assumptions of the BOK's definition(s) of leadership, the authors use rhetorical and leadership theory as an analytical frame for this research.

2.1 Rhetorical Analysis

The study of rhetoric – originating with Ancient Greek philosophers such as Aristotle, Isocrates, and Plato – examines the art of effective speaking, writing, and communication. Rhetorical analyses focus not only on *what* a text says, but *how* a text is presented or framed – the means by which a speaker or writer attempts to persuade their audience. Adding to Aristotle's contention that rhetorical inquiry investigates "all available means of persuasion" [15, p. 19], contemporary rhetorical theorists, such as Robert Toulmin and Kenneth Burke, posit that the study of rhetoric can also illuminate the assumptions, biases, or paradigms underlying a given text. According to Burke, the way communities see the world – the questions they ask and the problems they understand – is reflected in and dictated by their terminology, what he calls "terministic screens" [16]. Burke provides an analogy to describe his concept:

> I have particularly in mind some photographs I once saw. There were *different* photographs of the same objects. The difference being that they were made with difference color filters. Here something so "factual" as a photograph revealed notable distinctions in texture, and even in form, depending upon which color filter was used for the documentary description of the event being recorded. [16, p. 45]

Similarly, terms import particular paradigmatic understandings within different cultures: "much that we take as observations about 'reality' may be but the spinning out of possibilities implicit in our particular choice of terms" [16, p. 46]. The terms we use reflect aspects of reality while also selecting and deflecting other aspects, as well. "Liberty," for example, imports particular meanings, images, and even emotions for an American as this word is deeply embedded in the American cultural milieu. The present study takes as a point of departure, then, that the language of and surrounding a concept, such as leadership, necessarily dictates the way practitioners understand and practice that concept. This study uses rhetorical analysis to uncover the underlying paradigms and assumptions laden in the BOK's discussion of the concept of leadership.

The present study uses a hermeneutic approach called cluster analysis which employs close reading and interpretation of discourse. The goal of cluster analysis is to interpret the meaning of terminology based on surrounding clusters of terms and phrases in a given text. Drawing from Burke [16–18] and other scholars [19, 20], the present study applies a four-step process of cluster analysis:

Step One: Establish *leadership* as the key term. Identify places in the text that discuss this key term, which include any version of the word (i.e. lead, leader(s), leading, etc.). The authors discount the term if it is used irrelevantly. For example, "climate change will *lead* to increased risk" [14, p. 40, emphasis added].

Step Two: Identify terms and phrases the BOK uses when defining and describing *leadership*. Also, identify the frequency of specific terms and phrases.

Step Three: Identify patterns in the discourse of leadership, and relate such patterns to broader narratives about leadership. To do so, the authors draw from leadership theories, which are discussed below.

Step Four: Determine the "motives" of the text. It is important to note that motives are "systems of interpretation" [19] that dictate how individuals understand the world [17]. As such, the authors do not aim to identify the *intentions* of the BOK or

its creators, but instead to uncover the assumptions or paradigms about leadership that undergird the text.

2.2 Leadership Theory

To facilitate an interpretation of the BOK's rhetorical presentation of *leadership*, the present study draws from leadership theory. Leadership theory development throughout the 20th century was dominated by a leader-centric paradigm; for example, the trait approach focuses on the skills and abilities of leaders, the skills approach focuses on the learned process of developing leadership skills, and the behavioral approach focuses on what leaders do and how they act [21]. Though some theories, such as the situational approach and path-goal theory, consider context and followers; leaders and their skills, attributes, and behaviors are the focus [21]. As Simon Western points out, leadership in the 19th and 20th century was understood as great leaders manipulating and controlling their environments and contexts [22]. The new 21st century period of leadership, however, marks a paradigm shift from a focus almost exclusively on leader development to an exploration of leadership as a holistic process that considers environments, systems, followers, and relationships [7].

The present study focuses on and espouses one such holistic approach called eco-leadership. A forerunner to this approach is the distributed theory of leadership, which posited that leadership is not grounded in an individual's position or role, but in action instead. Within this approach, human activity is understood as being distributed across webs of actors, artifacts, contexts, and language; thus, understanding how leadership tasks are enacted entails an investigation of these distributed webs [23]. The eco-leadership approach uses language, concepts, and practices aligned with the term ecology, and as such focuses on ''the inter-relations of living systems and the environment'' [24, p. 183]. This understanding of leadership arises from environmental social activism and stresses the interdependence of humans on one another and on the planet [22]. Furthermore, an eco-leadership approach conceptualizes leadership as an engagement process which acknowledges the impact of all individuals within a community or ecosystem [22]. Thus, this approach to leadership runs counter to leadership by control and focuses instead on devolved power and dispersed leadership [22]. As such, within an eco-leadership approach, leadership and power are not centralized and as such the focus is on power within a system as opposed to the skills, attributes, and behaviors of one dominant person or a group of people. Understanding leadership through an ecological approach is beneficial in myriad ways. Ecosystems allow everyone within a team to contribute their own talents. While some team members are adept at devising unconventional and innovative solutions, others are better at tuning those solutions for better marketability and rollout. Thus, teams become greater than the sum of their parts [25], as complex tasks demand diverse ways of thinking and problem-solving styles [26]. Indeed, recent scholarship has found that teams that engage in leadership training as a whole are significantly more effective than teams that do not [27].

The present study utilizes this theoretical tradition to deepen the cluster analysis delineated above, namely to relate patterns in the discourse of leadership to broader narratives from leadership theory. After identifying patterns of discourse (Step Two), the authors categorized such patterns as forwarding a leader-focused paradigm or an eco-leadership paradigm (Step Three). Each paradigm is briefly summarized in Table 1.

Though the authors use a binary-based system of analysis, they acknowledge the importance of nuance within their subsequent discussion. The goal of this study is not to argue that the creators of the BOK intentionally espoused a specific leadership paradigm. Instead, the goal is to gain a better understanding of how the BOK can be read and interpreted and to suggest using the BOK to promote an ecological understanding of leadership in the classroom and in practice.

3. Results and Discussion

Since the steps of cluster analysis include data collection and analysis together, the authors present their results and discussion in one section. In what follows, the authors begin by presenting their analysis of the BOK Version Two's elucidation of *leadership*. Next, they analyze the BOK Version

Table 1. Underlying leadership paradigms

Eco-Leadership Paradigm	Leader-Centered Paradigm
Connectivity (holism): professionals function within ecologies.	Trait approach: focuses on the natural abilities of leaders.
Eco-ethics: professionals ethically interact in the human realm and take responsibility for the environment.	Skills approach: focuses on the learned process of developing leadership skills.
Leadership spirit: professionals acknowledge the non-rational and the creative imagination (Western 2008).	Behavioral approach: focuses on what leaders do and how they act (Northouse 2016).

Table 2. Terms and phrases related to *leadership* in the BOK Version Two

Terms	Frequency
global	7
sustainable	7
organize	6
direct	4
serve	4
ethical	4
professional society	4
manage	4
steward	2
master	2
creativity	2
communicate	2

Three and highlight the evolution of the definition(s) of *leadership.*

3.1 BOK Version Two

Version two of the BOK delineates twenty-four outcomes that encompass the knowledge, skills, and attitudes necessary to practice civil engineering. Leadership is referenced sixty-three times throughout this version of the BOK. Following the steps of a cluster-analysis, the authors identified places throughout the document that discussed leadership. Next, the authors determined the terms and phrases used to define *leadership* and identified the frequency and with which such terms and phrases were used (Table 2). In what follows, the authors identify patterns in the discourse of leadership and relate these patterns to underlying leadership paradigms (Table 1). The following discussion focuses on certain terminological patterns that arose during the cluster analysis and does not cover every word that appears in Table 2.

Throughout the BOK Version Two, leadership is discussed in two contexts: the comprehensive vision for civil engineering and the outcomes that define the knowledge, skills and attitudes necessary to practice civil engineering at the professional level (Table 3). The role of leadership in the vision for civil engineering as a field is mentioned sixteen times in the BOK, and these references demonstrate that leadership is at the center of the BOK's "vision for the future of civil engineering" [13, p. 1]. For example, the document states that "[t]he vision sees civil engineers as being entrusted by society as leaders in creating a sustainable world and enhancing the global quality of life" [13, p. 1]. Second, leadership as an educational outcome is discussed forty-seven times in the BOK. In this context, the BOK explicates how leadership should be taught and practiced in educational settings.

The cluster analysis revealed a misalignment with the way leadership is understood and developed in these two contexts. The cluster of terms related to vision for civil engineering include *global, sustainable, ethical, and steward*, which espouse elements of an eco-leadership discourse, as elucidated by Western [22, 24]. Namely, this definition of leadership focuses on global issues and thus considers the context of systems, ecologies, relationships, and connectivity. Western explains three key qualities of eco-leadership: connectivity or holism, eco-ethics or having respect and taking responsibility for other humans and the natural environment, and leadership spirit or accounting for the non-rational,

Table 3. Analysis of the BOK Version Two rubric for the leadership outcome

Level of Cognitive Achievement	Cognitive Achievement	Analysis/Explanation
1 *Knowledge*	***Define*** leadership and the role of a leader; ***list*** leadership principles and attitudes.	The knowledge students gain about leadership is solely related to leaders. Leadership becomes synonymous with leader in the second part of the description – principles and attitudes refer to those of a leader.
2 *Comprehension*	***Explain*** the role of a leader and leadership principles and attitudes.	Though leader and leadership are separate here, the BOK does not specifically distinguish between "the role of a leader" and "leadership principles and attitudes."
3 *Application*	***Apply*** leadership principles to direct the efforts of a small, homogenous group.	The verb "apply" includes only the behaviors of a leader. Leadership principles directly references how a leader acts and behaves. The followers are included, but the focus is on the leader's influence.
4 *Analysis*	***Organize*** and ***direct*** the efforts of a group.	The verbs "organize" and "direct" include only the behaviors of a leader. The focus is on the leader's influence over followers and team members.
5 *Synthesis*	***Create*** a new organization to accomplish a complex task.	The verb "create" include only the behaviors of a leader.
6 *Evaluation*	***Evaluate*** the leadership of an organization.	It can be assumed that the "leadership of an organization" refers to the actions of leaders since "leader" and "leadership" have been synonymous throughout the other levels of achievement.

creative, relational aspects of leadership (see Table 1). The BOK's vision particularly aligns with connectivity and eco-ethics. Throughout this version of the BOK, engineering *leadership* is framed as part of a larger, global system. The focus is not on civil engineers as leaders with particular traits and skills but instead on civil engineering's position in communities, society, and the world. Take, for example, the statement: ''The vision sees civil engineers as being *entrusted* by society as *leaders* in creating a *sustainable* world and enhancing the *global* quality of life'' [13, p. 1, emphasis added], which is repeated three more times throughout this version of the BOK. While this statement mentions the work of leaders – civil engineers – it focuses on systems and ecologies. This global vision is a holistic one, concerned with how civil engineers ''relate and interrelate'' [24, p. 196] with society. The needs and goals of civil engineering, then, coincide with those of their communities, and the work of civil engineers is one part of this larger ecology.

In a further explication of this vision, the BOK Version Two asserts that ''civil engineers serve competently, collaborative, and ethically'' [13, p. 7]. The verb in this sentence, ''serve,'' denotes a degree of interdependence that works counter to an understanding of leadership as control. The term ''serve'' does not mean to control or dominate, but instead to understand and consider the needs of others within a system. As Western argues, eco-leadership discourse ''finds that the real vulnerability of leadership lies in control, hierarchy and omnipotence'' [24, p. 197]. This document's vision for the future of engineering recognizes this weakness and espouses, instead, interdependence and connectivity. Additionally, civil engineers are called to serve collaboratively, which indexes the needs to work in teams of leaders and followers, and ethically, which acknowledges a need to act with respect and responsibility toward others and the environment.

The BOK Version Two also maintains an ecological focus with its attention on sustainability. Sustainability plays a vital role in this version of the BOK; the term is mentioned forty-seven times throughout the document and is categorized as an educational outcome. This document states that civil engineers must assume a leadership role in sustainable development [13, p. 128]. Sustainability is defined as:

> The ability to meet human needs for natural resources, industrial products, energy, food, transportation, shelter, and effective waste management while conserving and protecting environmental quality and the natural resource base essential for the future. [13, p. 68]

The ethical concern for sustainability means maintaining an ecological balance within a community. The focus is off civil engineers as leaders and on the systems of which they are a part. This attention to sustainability aligns with an eco-leadership approach, which focuses on the relationships among humans as well as the relationship between humans and nature. According to the BOK, civil engineers are concerned with both the human and the natural realms. For example, the BOK states that civil engineers must act as ''stewards of the natural environment and its resources'' [13, p. 7]. The word ''steward'' denotes a caretaker and as such connotes a nurturing, affectionate relationship between civil engineers and the natural environment. As Western argues, an eco-leadership approach calls for ecosystems to be nurtured, not dominated [22]. Eco-leadership contrasts with the traditional understanding of organizations and systems that operate with hierarchical leadership. Like the word serve, stewardship also runs counter to leadership through domination and control and instead aligns with a concept of leadership as relational and holistic. The vision statement moves away from hierarchies through word choice – e.g., serve, steward – and through a focus on the place of civil engineering leadership within systems.

The definition of leadership as an educational outcome, on the other hand, aligns with more traditional, leader-centered paradigms of leadership theory. Namely, this definition focuses mainly on leaders and their traits, skills, and behaviors and deemphasizes the ecological systems in which leaders work. In turn, this definition is more aligned with leader-centric paradigms of leadership (see Table 1) and thus does not account for the vision statement analyzed above. Western points out that ''when people generally talk and think about leadership, they think of the transformational-charismatic-inspirational leader, someone who influences followers'' [24, p.174]. The definition of leadership in the BOK emphasizes the power of a leader to influence followers and thus pays little attention to the context or to the actions of the followers. For example, the BOK states that ''[l]eadership is the art and science of influencing others toward accomplishing common goals'' [13, p. 145]. The syntax of the sentence is such that the word ''leader'' is absent, supplanted by the term ''leadership,'' making the two terms synonymous. In this definition, then, *leadership* indexes the behaviors and skills of leaders.

In the BOK Version Two, leadership is defined narrowly throughout the explication of the outcome itself. For example, in a chart briefly describing each outcome and the level of achievement individuals must be able to demonstrate in order to be a practicing civil engineer, this document states that

they must be able to "*organize* and *direct* the efforts of a group" [13, p. 17] – *organize* and *direct* are frequent terms that arise alongside *leadership*. Here, *leadership* entails the actions of a leader and their influence and ability to govern group members. This leader-focused description continues in the explication of the outcome in the rubric that explains the different levels of cognitive achievement for each outcome. Each outcome defines what it means to be a leader, as shown in Table 3. While this model does not misidentify the actions, behavior, or skills of leaders, it ignores the importance followers, context, systems, and goals. These descriptions of leadership align with a more hierarchical understanding of leadership compared to the vision statement discussed above.

This cluster analysis thus reveals that the "motives" of the BOK Version Two are mixed – the general view of *leadership* espouses elements of an eco-leadership discourse, while the description of the actual leadership outcome in some ways reverts to traditional leader-centric understandings of the concept.

3.2 BOK Version Three

The BOK Version three includes 21 revised outcomes in four categories, including Foundational, Technical, Engineering Fundamentals, and Professional. In addition to the updated number of outcomes, the updated version includes an "affective domain" as well as a "cognitive domain" for demonstrating each outcome. The affective domain "recognizes the need for civil engineers to internalize and have a value system that supports practice at the professional level" [14, p. xiii]. Again, following the steps of a cluster-analysis, the authors identified usage of the term *leadership* and determined other relevant terms and phrases (Table 4). In this section, the authors identify patterns in the discourse of leadership, relate these patterns to underlying leadership paradigms (Table 1), and compare motives to those of the BOK Version Two. The following discussion focuses on certain terminological patterns that arose during the cluster analysis and does not cover every word that appears in Table 4.

Leadership is referenced 112 times throughout the BOK Version Three. There are two major differences between BOK Versions Two and Three, which the authors discuss in this section. One, version three does not include an overarching vision statement in which leadership features heavily, as version two does. Additionally, version three combines the two outcomes Leadership and Teamwork. Thus, as shown in Table 4 *team* is the most frequent word to appear in the context of leadership. In what follows, the authors discuss the patterns within the leadership discourse, beginning with the words *team*, *diversity*, and *inclusion*.

Table 4. Terms and phrases related to *leadership* in the BOK Version Three

Terms	Frequency
team	58
diversity	41
inclusion	38
solutions	11
communicate	6
multidisciplinary	5
integrate	4
manage	3
self	3
responsibility	3
master	2
technical	2
organize	2

Throughout the BOK Version Three – both in the explication of the Leadership and Teamwork outcome and elsewhere – the concepts of teamwork and leadership arise in tandem. For instance, in the explanation of the Communication outcome, the BOK states, "Leaders and team members cannot be successful without effective and persuasive communication skills" [14, p. 44]. In the explanation of the Leadership and Teamwork outcome, the BOK highlights these two concepts as "distinct, yet complementary skill sets" [14, p. 47]. Additionally, the document portrays these roles as somewhat fluid: "Roles change with experience, project scope, and circumstances," the text states, "Therefore, engineers must be able to function effectively on teams, and to understand and fulfill different roles including that of a leader" [14, p. 47]. Here, leadership is portrayed as non-hierarchical and distributed – leadership may shift among members in an organization depending on context and circumstances as civil engineers "relate and interrelate" [24, p. 196]. As such, *all* civil engineers, not just those that display traditional leadership qualities, must be prepared to demonstrate leadership competencies.

The Leadership and Teamwork outcome provides an opportunity for civil engineering practitioners and educators to promote an ecological understanding of leadership in the education and practice of engineering leadership. In the explication of the Leadership and Teamwork outcome, the BOK Version Three emphasizes both concepts – portraying them as two sides of the same coin. This change in the framing of *leadership* takes focus off leaders and their characteristics and skills and

instead espouses an eco-leadership paradigm in which "professionals function within ecologies" [24, p. 196]. For example, the document states:

> Engineers frequently work in teams, either as team members or leaders. This requires an understanding of team formation and evolution, personality profiles, team dynamics, collaboration among diverse disciplines, problem solving, time management, and being able to foster and integrate diversity and inclusion of perspectives, cultural backgrounds, knowledge, and experience. [14, p. 47]

Here, the BOK aligns with an eco-leadership approach through its decentralized focus on a diverse set of individuals within a team and their backgrounds, knowledge, and influence. In elucidating this outcome, the document also states that "[i]n a broad sense leadership is developing and engaging others in a common vision, clearly planning and organizing resources, developing and maintaining trust, sharing perspectives, inspiring creativity, heightening motivation, and being sensitive to competing needs" [14, p. 47]. This passage acknowledges the importance of connectivity – "common vision," "sharing perspectives" and engaging followers "developing and maintaining trust," "inspiring creativity, heightening motivation, and being sensitive to competing needs" [22, p. 145]. This understanding of leadership and teamwork suggests a holistic process that considers the leader-follower relationship, characteristic of contemporary leadership theories [7].

After *team*, the next two most frequent terms to appear alongside *leadership* are *diversity* and *inclusion*. In the cognitive domain level of achievement, future civil engineers are expected to able to identify, explain, apply, select, and integrate "concepts and principles of teamwork and leadership, including diversity and inclusion," and in the affective domain, they are expected to acknowledge, practice, value, display, and advocate for "the principles of teamwork, leadership, diversity, and inclusion" [14, p. 46]. Unlike the previous version of the BOK, version three explicitly identifies the importance of acknowledging and respecting diverse perspectives – including race, ethnicity, gender, and discipline – within the context of leadership and teamwork. In this way this recent iteration of the BOK highlights a key component to a successful teamwork environment – the diverse perspectives of leaders, followers, team members, etc. In doing so, this outcome indexes an ecological understanding of leadership in which professionals ethically interact within organizations and systems.

Despite the combination of the Leadership and Teamwork outcomes, and the corresponding eco-leadership discourse, at times the BOK Version Three continues to focus on *leaders* as opposed to *leadership* as a concept. More specifically, similar to the BOK Version Two, the updated version occasionally uses the terms *leadership* and *leader* interchangeably. Throughout the explication of the Leadership and Teamwork outcome, the document continually refers to "principles of leadership" [14, p. 46]. In the explication of the outcome, leadership principles are defined as such:

> Leadership principles include being technically competent, knowing oneself and seeking self-improvement, making sound and timely decisions, setting the example, seeking responsibility and taking responsibility for one's actions, communicating with and developing subordinates both as individuals and as a team, and ensuring that the project is understood, supervised, and accomplished. [14, p. 46]

In this passage, leadership principles are connected to the behaviors and attributes of leaders. There are connections to other members of the team. For example, "setting the example" implies an audience and "communicating with and developing subordinates" directly references followers or team members. However, the focus in this definition is on the behaviors of leaders and does not account for the goals and influence of the "subordinates" [14, p. 46]. They, then, are passive recipients of the leader's influence. This focus on the actions of leaders continues in the document's definition of leadership; that is, "leadership is the art, science, and craft of influencing others to accomplish a task and improve the organization" [14, p. 47]. This definition is the same one that appears in the BOK Version Two, and thus the syntax of the sentence is such that the word "leader" is absent, supplanted by the term "leadership," making the two terms synonymous. Doing so aligns the definition of *leadership* with a leader-focused paradigm.

Like the previous version of the BOK, then, the current iteration uses terms and phrases that index both leader-focused and eco-leadership paradigms, indicating that the "motives" of version three are mixed. Notably, version three does not include a broad vision of civil engineering which positions engineers as leaders within complex global systems, promoting connectivity and eco-ethics. As such, it might be prudent for practitioners and educators not to completely abandon the older version in favor of the updated one. As highlighted in the previous section, this vision of the field is a vibrant one that aligns with a progressive, eco-leadership paradigm. On the other hand, the current version's updated Leadership Outcome – namely the combination of leadership and teamwork – marks a significant shift from an understanding of *leadership* as focused on *leaders* to leadership as focused on teams, circumstances, systems, and inclusivity. While the document focuses on leadership occa-

sionally, the discursive patterns – particularly the frequency of *team, diversity, and inclusion* – indicate the emergence of an ecological discourse. As such, the results of the cluster analysis suggest that the current BOK provides a significant starting point from which practitioners and educators might promote an eco-leadership paradigm in the classroom and the workplace.

3.3 Recommendations for Promoting an Eco-Leadership Praxis

The following recommendations demonstrate that the BOK is regularly adjacent to the eco-leadership paradigm as desired by a number of industry professional organizations, but the specific language used in discussing leader preparation often undermines the greater organizational ecosystem. Textual examples of leader-centric and ecological paradigms demonstrate that this document – regardless of intent – does not inherently espouse an eco-leadership approach. This is because the language used to express eco concepts is still rooted in the hierarchical managerial strategies of the 20th century.

Kotter explains the danger in conflating management and leadership by suggesting that management is primarily concerned with *processes and materials* while leadership is concerned with *people and relationships* [28]. In such a model management is necessarily hierarchical and leadership is more networked. Management and positional authority will certainly continue to remain necessary for most organizations because systematic function of the organization is required. On the other hand, the mission-driven work of organizations is accomplished by teams of people rather than technical systems and the human network thrives on leadership. In short, organizations require both good management and good leadership (here both words are thought of as verbs rather than nouns). Recognizing the difference between management training (often linked to *leader* development in the BOK) and *leadership* development is essential to understanding the nuanced potential consequences of the rhetoric within the BOK. Thus, the findings below highlight the need for practitioners and educators to be conscientious about fulfilling this latter outcome.

Here, the authors provide recommendations for promoting an ecological approach to teaching and practicing leadership using the BOK Version Three as a guide. In order to efficiently present the recommendations and in the interest of parsimony, Table 5 connects each recommendation to a passage from the current version of the BOK and then provides a leader-centric example and an ecological example for each recommendation.

First, an eco-leadership approach divorces the concepts of *leadership* and *leader* and highlights the distinction between the two. The line between these

Table 5. Recommendations for espousing an eco-leadership practice

Recommendation	Passage from the BOK Version Three	Leader-centric approach	Eco-leadership approach
Divorce the concepts of leadership and leader and highlight the distinction between the two.	"Leadership is the art, science, and craft of influencing others to accomplish a task and improve the organization" [14, p. 47].	Focus on the skills, attributes, and behaviors of individual leaders and how they are able to influence, persuade, or control their subordinates.	Focus on an organization as a whole – its common goals and outside influences. Emphasize the role of other members of the organization – their strengths and potential to take on leadership roles.
Emphasize the interconnectedness between leadership and teamwork.	"Roles change with experience, project scope, and circumstances. Therefore, engineers must be able to function effectively on teams, and to understand and fulfill different roles including that of a leader" [14, p. 47].	Highlight the behavior and role of team leaders.	Focus on the fluidity and social context of certain projects. Explore different team roles and team dynamics. Consider personal attributes that are associated with different types of team roles.
Highlight the eco-ethical approach inherent in the discussion of sustainability by connecting outcomes of sustainability and leadership.	"In a broad sense leadership is developing and engaging others in a common vision, clearly planning and organizing resources, developing and maintaining trust, sharing perspectives, inspiring creativity, heightening motivation, and being sensitive to competing needs" [14, p. 47].	Emphasize the skills and behaviors of leaders than enable them to engage others.	Explore the "wider economic, environmental, and social contexts" [22, p. 37] of a project and its common vision. Consider how trust is developed and fostered within a team and its community partners. Examine how aspects of a project and roles of team members and leaders interrelate.

two concepts is blurred in the BOK Version Two and, at times, in the BOK Version Three, as well. Focusing on leader development assumes a hierarchical process through which individuals with particularly desirous attributes and skills are trained to supervise a team. Leadership development, on the other hand, suggests a shared and contingent process in which the roles of leaders, followers, and team members are fluid [22]. With a focus on *leadership*, the goal is to develop a culture of collaborative teams with individuals acting as leaders and followers depending on the environment and context [7]. This focus on *leadership* aligns with an eco-leadership discourse and in turn aligns with the BOK Version Two's broad vision of civil engineers' role as global leaders *and* fulfills the Teamwork and Leadership outcome in the current iteration of the BOK. Table 4 provides examples of this recommendation.

Second, leadership curriculum should emphasize the interconnectedness of *leadership* and *teamwork*. Leadership education should take some of the focus off the leader and put it on the systems, environments, and other people (e.g., followers, other leaders) who play a role in the ecology. For example, one potential place to do so includes the following statement: "Roles change with experience, project scope, and circumstances. Therefore, engineers must be able to function effectively on teams, and to understand and fulfill different roles including that of a leader" [14, p. 47]. This opens space for practitioners and educators to emphasize connectivity – how being a leader sometimes means being a follower. Additionally, the only team member briefly mentioned here is the leader, leaving it up to practitioners to consider followers – their influence and role within a team. For specific examples this recommendation, see Table 3.

Third, connecting the outcomes of sustainability and leadership is one way to highlight the eco-ethical approach to leadership espoused by the vision of civil engineering in the BOK Version Two. Sustainability is a vital goal of civil engineering throughout both the BOK Version Three in which Sustainability is one of the technical outcomes. The BOK Version Three maintains that a "civil engineering system is a combination of elements or subsystems that are organized to solve a complex civil engineering problem" and as such "sustainability considers how the parts of the project interrelate and how the project fits into the wider economic, environmental, and social contexts" [14, 40]. This explanation can also be applied to the Leadership and Teamwork outcome, as it closely aligns to an eco-leadership approach. Connecting these two outcomes, then, strengthens the interconnectedness of leadership and teamwork. See Table 4 for specific examples.

In addition to these three recommendations, this analysis also revealed that the explanations of how to teach leadership to undergraduates evade discussions of specifically including leadership in coursework, focusing instead on co-curricular activities. For example, the BOK Version Two states that students can move toward fulfillment of leadership "by active, as opposed to passive, participation in one or campus organizations" [13, p. 47]. They can "choose from student chapters of such engineering organizations as ASCE, NSPE, the Society of Women Engineers, the Society of Hispanic Professional Engineers, and the National Society of Black Engineers" [13, p. 47]. Additionally, they can hone their leadership skills "by being actively involved in such campus-wide activities and groups as student government, service clubs, sports teams, a student newspaper, and sororities and fraternities" [13, p. 47]. The BOK Version Three includes a brief mention of how to include leadership development into the curriculum. The document states: "Examples of leadership opportunities in the undergraduate program include leadership of design teams, leadership opportunities within capstone or culminating design experiences, and leadership within such organizations as ASCE's student chapters, student competitions, civic organizations, honor societies, athletic teams, student government, and fraternities and sororities" [14, p. 48]. While leadership design teams and capstone designs are curricular activities, the majority are co-curricular (e.g., professional society membership, competitions, civic organizations, sports, student government, and Greek life).

From the text of the BOK Version Three, it is difficult to surmise exactly how to include leadership development into the formal undergraduate curriculum. It is not the authors' intention to minimize the significance of out-of-class activities but to argue that the bifurcation of curricular and co-curricular activities further contributes to the already existent bifurcation of technical and professional skills [29]. Dichotomizing these two aspects of student training may further contribute to the uneven balance between them, which typically favors technical training. The bifurcation of these two aspects of the curriculum (in- and out-of-class activities) may prove problematic for leadership development. If co-curricular activities are considered subordinate to coursework, and leadership is relegated mostly to out-of-class engagement, then leadership development is also subordinate to what is gained in coursework, namely technical training. Thus, administrators and educators should actively seek ways to include leadership development in the formal undergraduate curriculum

Additionally, if leadership is discussed in the context of co-curricular activities, it is important to recognize that certain groups are at risk of low engagement and thus may be less likely to gain leadership experience. Students from lower-income families and African American students are less likely than white students to be engaged in out-of-class activities [30]. Students from lower-income families are significantly less likely to participate in preprofessional activities [30]. Students whose parents have less than a bachelor's degree are more likely than those whose parents have such degrees to have an on- or off-campus job, and thus might be less likely to engage in co-curricular activities [30]. According to the BOK Version Three, diversity is a critical component of leadership development, and given these findings certain groups might be less likely to have leadership opportunities than others. As the field moves forward developing the understanding of leadership and its importance, stakeholders must keep these vulnerable populations in mind.

4. Conclusion

The goal of this study is to identify the civil engineering field's definition(s) of leadership and examine the underlying assumptions of these definitions through a rhetorical analysis of the past two iterations of the *Civil Engineering Body of Knowledge for the 21st Century*. To do so, the authors employed the method of cluster analysis, which allows scholars to interpret the meaning of terminology based on surrounding clusters of terms and phrases in a given text. Additionally, the authors undergirded their analysis with theories of leadership, characterizing patterns of discourse as either leader-centered or ecological (see Table 1). A cluster analysis of the BOK Version Two revealed that leadership is discussed in two contexts: the comprehensive vision for civil engineering and the outcomes that define the knowledge, skills, and attitudes necessary to practice civil engineering at the professional level. Furthermore, the patterns of discourse in each context are misaligned – while the vision espouses an eco-leadership paradigm, the outcomes index a leader-focused paradigm.

A cluster analysis of the BOK Version Three revealed that this new iteration indicates a shift toward engaging leadership in ecological terms through a connection between leadership and teamwork. At the same time, this updated version continues to focus on *leaders* and occasionally uses the terms *leadership* and *leader* interchangeably. Thus, the motives – or ''systems of interpretation''[19] – of both versions two and three are mixed, suggesting the need for the field of civil engineering to continue honing a conception of leadership and a curriculum that follows. It is important to note that the results of this study provide insight into the civil engineering field's definition(s) of leadership, but since the analytical scope was relegated to two documents, these results cannot generalize definitions across the field as a whole.

The results of this cluster analysis suggest that there is no easy way to define *leadership*, and this concept becomes more difficult to explicitly outline as the field begins to adopt new, more complex paradigms, such as eco-leadership. At the same time, the field must continue to explore ways of implementing these intricate understandings of *leadership* in order to solve the problem that industry professionals continue to site: Engineering and construction students lack necessary professional skills, including leadership. This study, thus, contributes to a growing body of literature that argues for increased inclusion of leadership competencies in the curriculum [4, 5, 31, 32, 33, 34]. The authors argue that a holistic (e.g., ecological) perspective provides a possible solution to this problem since it assumes that *all* students – regardless of their skills and attributes – are potential leaders and integral team members and should be trained as such. Namely, this study suggests that guiding documents, such as the BOK, provide a roadmap for how to teach and practice leadership; however, such documents do not include every aspect of leadership education, development, and practice. Practitioners and educators have the responsibility of executing these requirements, and it is the recommendation of this study that they do so through an eco-leadership perspective.

Specifically, engineering curriculum should delineate between the concepts of *leadership* and *leader*, emphasize the interconnectedness between leadership and teamwork, connect the outcomes of sustainability and leadership, and actively include leadership development in the undergraduate curriculum. Though this study begins to address these suggestions using the BOK, further research should provide detailed explanations and examinations of these curricular developments. Continuing to integrate an ecological framework into leadership curriculum will encourage students to accomplish complex tasks using diverse ways of thinking and problem-solving styles [26].

Acknowledgements – The authors gratefully acknowledge the National Science Foundation for supporting this work under grant number 1463802 and 1931371. Any opinions, findings, conclusions, or recommendations expressed here are those of the authors and do not necessarily reflect the views of the National Science Foundation.

References

1. S. M. Ahmed, C. Yaris, R. U. Farooqui and M. Saqib, Key attributes and skills for curriculum improvement for undergraduate construction management programs, *International Journal of Construction Education and Research*, **10**(4), pp. 240–254, 2014.
2. Y. H. Ahn, R. P. Annie and H. Kwon, Key competencies for US construction graduates: Industry perspective, *Journal of Professional Issues Engineering Education and Practice*, **132**(2), 10.1061/(ASCE)EI.1943-5541.0000089, 2012.
3. K. D. Pandya, The key competencies of project leader beyond the essential technical capabilities, *IUP Journal of Knowledge Management*, **12**(4), p. 39, 2014.
4. V. Sakhrani, P. S. Chinowsky and J. E. Taylor, Grand challenges in engineering project organization, *Engineering Project Organization Journal*, **7**(1), pp. 4–20, 2017.
5. R. Shelby, F. Ansari, E. Patten, L. Pruitt, F. Walker and J. Wang, Implementation of leadership and service learning in a first-year engineering course enhances professional skills, *International Journal of Engineering Education*, **29**(1), pp. 85–98, 2013.
6. Y. Hsiu-Ping, Engineering students' perceptions of and reflections on portfolio practice in leadership development, *International Journal of Engineering Education*, **29**(1), pp. 99–106, 2013.
7. D. R. Simmons, N. A. Clegorne and T. Woods-Wells, Leadership paradigms in construction: Critical review to inform research and practice, *Journal of Management in Engineering*, **33**(4), 10.1061/(ASCE)ME.1943-5479.0000518, 2017.
8. D. Myton, Graduates lacking 'soft skills' necessary for workplace success, *Higher Education Consulting Group*, https://campusmorningmail.com.au/news/graduates-lacking-soft-skills-necessary-for-workplace-success/?utm_campaign=website&utm_source=sendgrid.com&utm_medium=email, Accessed March 2019.
9. C. Seemiller, and T. Murray, The common language of leadership, *Journal of Leadership Studies*, **7**(1), pp. 33–45, 2013.
10. B. L. Hartmann, C. Stephens and C. T. Jahren, Surveying industry needs for leadership in entry-level engineering positions, *Proc., 122nd Conf. & Exp.*, American Society of Engineering Education, Seattle, Washington, 2015.
11. J. Walther, N. Kellam, N. Sochacka and D. Radcliffe, Engineering competence? An interpretive investigation of engineering students' professional formation, *Journal of Engineering Education*, **100**(4), pp. 703–740, 2011.
12. S. Toor and G. Ofori, Developing construction crofessionals of the 21st century: Renewed vision for leadership, *Journal of Professional Issues in Engineering Education and Practice*, **143**(3), 10.1061/(ASCE)1052-3928(2008)134:3(279), 2008.
13. American Society of Civil Engineers, *Civil Engineering Body of Knowledge for the 21st Century: Preparing the Civil Engineer for the Future*, second edition, https://www.asce.org/uploadedFiles/Education_and_Careers/Body_of_Knowledge/Content_Pieces/body-of-knowledge.pdf, Accessed January 2018.
14. American Society of Civil Engineers, *Civil Engineering Body of Knowledge for the 21st Century: Preparing the Civil Engineer for the Future*, third edition, https://www.asce.org/civil_engineering_body_of_knowledge/, Accessed June 2019.
15. G. Kennedy, *The Art of Persuasion in Greece*, Princeton University Press, Princeton, NJ, 1963.
16. K. Burke, *Language as Symbolic Action*, University of California Press, Berkeley, CA, 1966.
17. K. Burke, *A Rhetoric of Motives*, University of California Press, Berkeley, CA, 1950.
18. K. Burke, *Attitudes Toward History*, Hermes, Los Altos, CA, 1959.
19. A. Angel and B. Bates, Terministic screens of corruption: A cluster analysis of Columbian radio conversation, *The Journal of Kenneth Burke Society*, 10, https://www.researchgate.net/profile/Adriana_Angel3/publication/295104119_Terministic_screens_of_corruption_A_cluster_analysis_of_Colombian_radio_conversations/links/57fe913a08ae56fae5f23f20/Terministic-screens-of-corruption-A-cluster-analysis-of-Colombian-radio-conversations.pdf, 2014.
20. C. Berthold, Kenneth Burke's cluster-agon method: Its development and an application, *Central States Speech Journal*, **27**, pp. 302–309, 1976
21. P. G. Northouse, *Leadership: Theory and practice*, Sage, Thousand Oaks, CA, 2013.
22. S. Western, Eco-leadership, towards the development of a new paradigm. In B. W. Redekop (ed), *Leadership for environmental sustainability*, Routledge, New York, pp. 36–54, 2010.
23. J. P. Spillane, R. Halverson, and J. B. Diamond, Towards a theory of leadership practice: A distributed perspective, *Journal of Curriculum Studies*, **36**(1), pp. 3–34, 2004.
24. S. Western, *Leadership: A critical text*, Sage, London, 2008.
25. S. J. Zaccaro, B. Heinen and M. Shuffler, Team leadership and team effectiveness, In E. Salas, G. F. Goodwin, C. S. Burke (eds), *Team effectiveness in complex organizations: Cross-disciplinary perspectives and approaches*, Routledge, New York, pp. 83–111, 2009.
26. M. Basadur, G. Gelade and T. Basadur, Creative problem-solving process styles, cognitive work demands, and organizational adaptability, *Journal of Applied Behavioral Sciences*, **50**(1), pp. 80–115, 2014.
27. J. P. Santos, A. Caetano and S. M. Tavares, Is training leaders in functional leadership a useful tool for improving the performance of leadership functions and team effectiveness?, *The Leadership Quarterly*, **26**(3), pp. 470–484, 2015.
28. J. P. Kotter, What leaders really do, *Leadership: Understanding the dynamics of power and influence in organizations*, **2**, pp. 23–32, 2007.
29. E. Fromm, The changing engineering educational paradigm, *Journal of Engineering Education*, **92**(2), pp. 113–121, 2003.
30. D. R. Simmons, Y. Ye, M. E. Ohland and K. Garahan, Understanding students' incentives for and barriers to out-of-class participation: A profile of civil engineering student engagement, *Journal of Professional Issues in Engineering Education and Practice*, **144**(2), 10.1061/(ASCE)EI.1943-5541.0000353, 2018.
31. D. Bairaktarova, M. F. Cox and M. Srivastava, A project-based approach professional skills training in an undergraduate curriculum, *International Journal of Engineering Education*, **31**(1B), pp. 425–433, 2015.
32. M. H. Handley, S. C. Ritter and D. H. Lang, Design your future: Embedding leadership and career development into a cornerstone design course, *International Journal of Engineering Education*, **34**(2B), pp. 632–643, 2018.
33. K. W. Jablokow. Developing problem solving leadership: A cognitive approach, *International Journal of Engineering Education*, **24**(5), pp. 936–954, 2008.
34. M. L. Sein-Echaluce, A. Fidalgo-Blanco, J. Esteban-Escaño, F. J. García-Peñalvo, J. Francisco and M. Á. Conde, Using learning analytics to detect authentic leadership characteristics in engineering students, *International Journal of Engineering Education*, **34**(3), pp. 851–864, 2018.

Katie L. Garahan, PhD is an assistant professor in the Department of English in the College of Humanities and Behavioral Sciences at Radford University. She holds a bachelor of arts degree in English Education from Gardner-Webb University as well as a master of arts in English, a PhD in Rhetoric and Writing, and a graduate certificate in Women's and Gender Studies from Virginia Tech. Dr. Garahan has a decade of experience working in education. She spent four years teaching in K-12 public schools and six years teaching and tutoring in higher education. Currently, she teaches undergraduate courses in rhetoric and composition and directs Radford University's Writing Center. As the writing center director, Dr. Garahan trains and mentors undergraduate, graduate, and professional writing tutors, develops and facilitates writing workshops, and provides support for Radford faculty related to creating and assessing writing assignments. Her research uses mixed-methods approaches, which combine rhetorical and empirical methodologies, to study educational questions from across the disciplines.

Nicholas A. Clegorne, PhD is an associate professor in the Department of Educational Leadership in the Bagwell College of Education at Kennesaw State University. He holds a Bachelor's Degree and Master's Degree, both in Education, from the University of Florida and PhD in Educational Leadership with dual emphases in Higher Education and Curriculum and Instruction from Louisiana State University. He has 12 years of experience as a university administrator in student affairs. During his time as an administrator, Clegorne oversaw numerous co-curricular programs at The University of Florida, Louisiana State University, and Virginia Tech. As a faculty member, Clegorne teaches courses on human resources, education law, finance, and curriculum design, implementation, and assessment across the P-20 spectrum. He situates his career around recognizing that all operational elements of education support the primary curricular efforts of the institution. As such, the broader impact of Dr. Clegorne's work lies in understanding how P-20 educational preparation pathways ready individuals for effective productivity and citizenship within their professional and personal lives. Clegorne particularly interested in the interplay of curricular, co-curricular, and extra-curricular educational experiences and their role in the holistic development of students. He has led numerous qualitative and quantitative projects examining these phenomena in both post-secondary engineering education and P-20 educational leadership. This work has spanned several disciplines across university and K-12 school systems nationwide and contributes to innovative educational solutions for the challenges of the 21st century. Clegorne's work is currently supported by the NSF and is focused on the preparation of engineers and educational leaders.

Denise R. Simmons, PhD, PE, LEED-AP, is an associate professor in the Department of Civil and Coastal Engineering in the Herbert Wertheim College of Engineering at the University of Florida. She holds a BS, MS, and PhD in civil engineering and a graduate certificate in engineering education – all from Clemson University. She has over ten years of construction and civil engineering experience working for energy companies and as a project management consultant. Dr. Simmons oversees the Simmons Research Lab (www.denisersimmons.com), which is home to a dynamic, interdisciplinary mix of graduate researchers and postdoctoral researchers who work together to explore human, technology and society interactions to transform civil engineering education and practice with an emphasis on understanding hazard recognition, competencies, satisfaction, personal resilience, organizational culture, training, informal learning and social considerations. The broader impact of this work lies in achieving and sustaining safe, productive, and inclusive project organizations composed of engaged, competent and diverse people. She is a leader in research that prepares students and professionals with the competencies to compete in and sustain the construction workforce. She has extensive experience leading and conducting multi-institutional, workforce-related research and outreach. The SRL is supported by grants, including a CAREER award, from the National Science Foundation (NSF). Dr. Simmons is a former project director of the Summer Transportation Institute (STI) at South Carolina State University and Savannah River Environmental Sciences Field Station (SRESFS). Both programs were aimed at recruiting, retaining and training women and minorities in transportation, environmental science and engineering and natural resources-related fields of study.