COMPARING TWO-YEAR COLLEGES UNDER A COMMON SUSTAINABLE DEVELOPMENT FRAMEWORK: PERSONAL EGOCENTRIC NETWORKS AND PERSPECTIVES

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COMPARING TWO-YEAR COLLEGES
UNDER A COMMON SUSTAINABLE DEVELOPMENT FRAMEWORK:
PERSONAL EGOCENTRIC NETWORKS AND PERSPECTIVES

DISSERTATION

A dissertation submitted in partial fulfillment of the
requirements for the degree of Doctor of Philosophy in the
College of Education at the University of Kentucky

By

Bobby Ann Lee

Murray, Kentucky

Director: Dr. Beth Rous, Professor of Educational Leadership Studies

Lexington, Kentucky

2018

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ABSTRACT OF DISSERTATION

COMPARING TWO-YEAR COLLEGES UNDER A COMMON SUSTAINABLE DEVELOPMENT FRAMEWORK: PERSONAL EGOCENTRIC NETWORKS AND PERSPECTIVES

The study purpose is to advance implementation of sustainable development at colleges, and to contribute to organizational change research using social network analysis. The researcher conducted document analysis using 2012-2016 sustainability reports of 16 purposefully selected two-year colleges under a common framework. Interpreting and coding resulted in ranking sustainable development activities as well as grouping colleges using cluster analysis. A survey and interviews were employed by the researcher to determine major themes as challenges to sustainability implementation, and personal network themes using social network analysis measures and sociograms. Challenges to sustainability implementation identified as study themes were: (1) college leadership transition; (2) communication networks; and (3) sustainability funding and resources. Personal network themes based on network analysis were: (1) sustainability leadership typologies; (2) network communication bridges and cliques; and (3) social capital for sustainability funding and resources.

The research found personal egocentric network techniques an effective methodology in identifying attributes of communication links to inform transformational leaders implementing innovation. Study implications are that sustainability leaders within informal networks of staff, administrators, and faculty influence and actively participate in innovation diffusion. Faculty and staff work on specific projects and activities advancing sustainability such as community gardens or working with environmental groups, and administrator support provides social capital in terms of funding and resources. Striking the right balance among types and communication ties is a challenge for transformational leaders. Personal network techniques help leaders recognize organic network cliques and bridges during implementation stages, allowing for informed support and advancement of college sustainability. From this study, sustainability practitioners may be interested in using sustainability activity frequencies for planning and sharing with other colleges, as well as using personal network techniques to develop sociograms identifying important network positions, cliques, and bridges for sustainability implementation.

KEYWORDS: Social Networks, Sustainability, Associate Colleges, Transformational Leadership, Sociograms, Formative Evaluation

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October 17, 2018
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UNDER A COMMON SUSTAINABLE DEVELOPMENT FRAMEWORK:
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CHAPTER ONE: INTRODUCTION

Chapter One is an overview introducing the study problem statement, purpose, research questions, and context. Theoretical frameworks, study significance and limitations are introduced, although these areas are more fully described in following chapters. Definitions of social network analysis (SNA) terms are included in this chapter.

Statement of the Problem

Concern over human use of natural resources is not a new concept. Influential American writers such as Henry David Thoreau (1817-1862), Aldo Leopold (1887-1948), and Rachel Carson (1907-1964) called for the protection of our environment as population growth and development increasingly affected the landscape. Established in 1970 in the United States (US), the Environmental Protection Agency is a cabinet level government agency responsible for implementing a number of laws such as the Clean Water Act and Clean Air Act to address environmental problems as human development and resource use expands. In 1987, the United Nations (UN) Brundtland Commission released *Our Common Future* where the term sustainable development is described as a means to raise human living standards while maintaining a viable environment, “Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs” (UN, 1987, p. 16).

Global environmental consequences and awareness are increasing, and sustainable development as a balance among social and economic development with conservation of Earth’s resources is gaining momentum (Kates et al., 2001; Pisani, 2007). In an effort to move beyond concept and policy stages, higher education institutions are
called upon to implement sustainable development on their campuses and teach sustainability to constituents (Reynolds, Brondizio, & Robinson, 2010; Barlett & Chase, 2013; Johnston, 2013; Sterling, Maxey, & Luna, 2013; Barth, 2014). Theoretical and applied research of sustainability at universities and colleges is expanding as evidenced by the *International Journal of Sustainability in Higher Education* established in 2000, and the Association of the Advancement of Sustainability in Higher Education (AASHE) in 2006. A few institutions such as the University of Colorado Boulder (Krizek, 2012) and California State University (Kurland, 2011) are examples of institutional leaders in implementing sustainability, however, in the US and internationally, widespread adoption is slower than expected (Cotton, Warren, Maiboroda, & Bailey, 2007; Djordjevic & Cotton, 2011). Sustainability implementation on college campuses is challenged by complexity on multiple levels such as the dual nature of academic governance between administration and faculty (McNamara, 2010), and inclusion of many fields of study (Bettencourt & Kaur, 2011). Cultural aspects including distrust of scientific data or disdain for administration driven programs may hinder adoption of sustainable development (Caldas et al., 2015). The term *sustainability* itself is not well understood (Leal Filho, 2000; Grosskurth & Rotmans, 2005; Djordjevic & Cotton, 2011). The UN Decade of Education for Sustainable Development which ended in 2015, resulted in research beyond policy adoption to institutional implementation to help determine challenges and opportunities for widespread diffusion in higher education. Recent published books describe both theoretically implementation strategies (Barth, 2014; Sterling et al., 2013) and empirical case studies typically of individual institutions (Reynolds et al., 2010; Barlett & Chase, 2013; Johnston, 2013). The problem statement
for this statement is that further research using multiple institutions is needed to identify successful diffusion strategies at colleges and universities to advance and lead sustainable development in the US.

**Purpose of the Study**

The purpose of this study is twofold, (1) to increase understanding of sustainable development implementation at two-year colleges, and (2) to contribute theoretical research in leading organizational change related to social networks and sustainable development. To increase understanding of sustainability implementation, the researcher used quantitative and qualitative methods including investigating personal egocentric networks (personal networks) of sustainability actors and comparing colleges with high versus low numbers of sustainability activities. Comparisons of results were interpreted to infer what is working and not working in sustainability implementation. Results of the study are intended to be both useful to sustainability practitioners and to advance leadership and organizational change theories using social network (Wasserman & Faust, 1994; Borgatti, Everett, & Johnson, 2013; Crossley, Bellotti, N, Edwards, G, Everett, M., Koskinen, J. & Tranmer, M., 2015), innovation diffusion (Rogers, 2003), and transformational leadership concepts (Burns, 1978; Bass & Riggio, 2008; Burke, 2014). Informed by social network analysis (SNA), diffusion, and transformational leadership frameworks, the researcher constructed a mixed methods research design to interpret sustainable development within a two-year public college statewide system. The research was conducted in three stages: (1) document analysis of reported biannual sustainability activities for participant colleges were interpreted and coded; (2) concurrently, a survey was distributed to college sustainability actors to gain perceptions on sustainability
implementation and to identify network relationships involved in sustainability; and (3) a purposefully selected survey participants were interviewed for deeper information gathering on personal networks and sustainability for thematic analysis and to triangulate findings (Creswell, 2013; Maxwell, 2012; Rice, Holloway, Barman-Adhikari, Fuentes, Brown, & Palinkas, 2014).

**Research Questions**

To further understand sustainability implementation within higher education institutions, the three research questions guiding this study were,

1. What sustainable development activities are implemented by the two-year colleges, and at what frequencies? Using these activities to cluster colleges into groups, what traits emerge across groups?

2. What challenges to sustainable development challenges do sustainability leaders at the two-year colleges identify? Are there notable differences in responses among college groups?

3. What network relationships are identified in implementing sustainable development activities at the two-year colleges? Do the college groups identify different relationship typologies?

**Theoretical Frameworks**

Sterling, Maxey, & Luna (2013) describe a sustainable campus as having a participatory culture in developing goals and ongoing strategies to meet the challenges of sustainability. Higher education leaders, both formal and informal, would need to adopt transformational leadership strategies such as safety from retribution for followers, support for lateral networks, and balancing consistency with innovation for deep rather than superficial organizational change (Burns, 1978; Rost, 1993; Sterling et al. 2013; Burke 2014). The importance of individual relationships in spreading new information and practices is recognized in leadership organizational change theories, and the
frameworks for this study are specifically transformational leadership (Burns, 1978; Bass & Riggio, 2008; Burke, 2014), innovation diffusion by Rogers (2003), and SNA (Wasserman & Faust, 1994; Borgatti, Everett, & Johnson, 2013; Crossley et al., 2015).

Within organizations, innovation adoption is studied to improve dissemination rates in areas such as health practices, product marketing, and technology efficiencies to name a few. Rogers (2003) describes stages in organization innovation with implementation involving internal “redefining/restructuring” and “clarification” (p. 420) of the innovation prior to full integration. During these stages, organization members socially construct the meaning of an innovation to fit within their perceptions, and without internal member involvement in these processes, implementation may be unsuccessful. SNA continues this emphasis on relationships among members of a group, and provides quantitative measures of social network concepts within a framework for diffusion of innovations (Wasserman & Faust, 1994, Crossley et al., 2015). Review of SNA results are useful for participants to learn from others working on similar projects within the same organization or network (Cross, Borgatti & Parker, 2002a). This research examined sustainable development within higher education institutions using SNA, innovation diffusion, and transformational leadership as primary frameworks.

**Context of the Study**

The purposeful selection of study participants was sustainability actors working at 16 two-year colleges under a common statewide sustainable development framework. Written biannual sustainability activities are reported to the state system Board of Regents as part of the framework passed in 2012. This context allowed for comparisons among the colleges in adoption, implementation, and social networks for sustainable development.
development using a mixed methods approach designed in three stages. In stage 1, a coding process was developed using national assessment sustainability descriptions as an initial guide to interpret and quantify activities in biannual college Sustainability Reports. Once coded, descriptive statistics and cluster analysis were used to group colleges into different levels of implementation based on similarities in mean frequencies of codes using SPSS software (Grosskurth & Rotmans, 2005; Green & Salkind, 2014).

Stage 2 of the study used an online survey to gather individual perceptions (Fowler, 2009; Creswell, 2009; Wright, 2010) and to identify personal egocentric networks (Rice et al., 2014; Crossley et al., 2015) implementing sustainability within the colleges. Initial lists of sustainability coordinators/contacts, herein referred to as sustainability contacts and sustainability committee members were listed in college Sustainability Plans (2013) available online. The statewide Sustainability Project Manager and sustainability contacts provided updated lists of sustainability committee members for each college as additional survey participants. The survey asked demographic, sustainable development, and networking questions to reveal perceptions of sustainability actors and their personal networks involved in sustainability implementation within the colleges.

In Stage 3 data were collected from interviews of five sustainable actors working as key informants. Interviews with the researcher as the instrument provided a richer description (Ponterotto, 2006) of their challenges in implementing sustainability activities at their institutions, and triangulation (Maxwell, 2012; Rice et al., 2014) to validate personal network sustainability actors. Study interviews were transcribed and open coded for thematic analysis using constant comparison and coding to generate theoretical integration (Creswell, 2009; Merriam, 2009). Network diagrams known as sociograms.
were generated using UCINet software (Borgatti et al., 2013; Crossley et al., 2015), identifying position titles and ties of personal networks in sustainability implementation. Sociograms have been found to be useful in interpreting and communicating sustainability networks to participants (Kolleck, 2013).

Survey and interview results revealed sustainability actors’ perceptions and attitudes. Quantitative and qualitative comparisons were explored to show potential differences among college clusters with different levels of sustainability activities. Differences in personal network measures and themes by college groups were analyzed for association with network attributes and perceptions revealed from survey and interview results (Borgatti, Mehra, Brass, & Labianca 2009) to identify areas for improving sustainability implementation (Kolleck 2013).

**Significance of the Study**

Sustainable development is an effort to educate and actively engage constituents in activities balancing environmental protection, economic development, and social justice (UN, 2012). The American Association of Community Colleges (AACC) aligns with these objectives stated in a resolution of sustainable development (AACC, 2007). Research literature on sustainable development adoption has largely focused on four-year universities rather than two-year colleges. Yet two-year colleges’ focus on local communities, curricula including applied technical programs, economic development, and service to underrepresented students may be well structured for adapting to sustainability initiatives. Significant numbers of undergraduates begin higher education at two-year colleges, yet published research describing sustainable development at these institutions is lacking.
Public community colleges pledge to enrich student lives, but contend with continuous change from external forces within their community, open enrollment of students, and budget constraints. In *Shared Vision: Transformational Leadership in American Community Colleges*, the authors make the case for community college leaders to embrace a transformational leadership framework (Roueche, Baker & Rose, 1989). A founder of leadership theory, Burns (1978) described transforming leaders as sharing common moral and motivational purposes with followers, transcending transactional relationships. Transactional leadership, according to Burns, involves simple exchanges between leaders and followers based on motivations more akin to hierarchical structures. The term transformational leadership was coined by Bass (1999) who more fully explored the differences between the two types of leadership and developed a questionnaire to identify an individual’s tendencies for the two types. Unlike Rost (1993), who defined leadership more narrowly by excluding transactional relationships between managers and followers because of uneven power, Bass described the existence of both transactional and transformational leadership traits within an individual.

Theoretical frameworks and SNA techniques guided this study by applying organizational change and leadership theory to campus sustainability implementation. SNA is an appropriate method for an inductive approach for research from specific observations to patterns for generalized theory (Kolleck, 2013; Meuser, Gardner, Dinh, Hu, Liden, & Lord, 2016). According to Kolleck (2013), “SNA provides us with empirical tools that capture the social context and help to better understand how innovations are implemented and diffused and why social change takes place” (p. 1).
This study builds upon previous social network and leadership organizational change theories through researcher analysis of data and interpretation. Both quantitative and qualitative results were used to describe and compare sustainability actor perceptions and personal network attributes to better understand sustainability implementation in higher education. Research results and interpretation are intended to be of practical use to college leaders to help understand sustainable actors’ perceptions, and rethink network collaborations and inclusions to advance sustainability leadership.

As the importance of studying social networks expand to multiple disciplines, mixed methods of SNA provide measures for researchers accustomed to quantitative based studies. Additionally, some studies on informal networks have been criticized for being academic pursuits and “often inaccessible to practitioners” (Cross et al., 2002a p. 27). SNA sociograms and measures provide a way to discuss and compare informal networks for advancing sustainability, as has been done in other sustainability research outside of higher education institutions (Ryan & Creech, 2008; Prell, Hubacek, & Reed, 2009; Kolleck, 2013). The use of SNA is an emerging approach in leadership studies (Borgatti et al., 2009; Cross et al., 2002a; Borgatti & Halgin, 2011; Kezar, 2014) as well as sustainable development. Cross et al. (2002a) describes the usefulness of SNA,

[r]ich discussions will often evolve simply by showing network diagrams to the members of a group and asking them to diagnose the patterns they see, as well as the issues facilitating or impeding their effectiveness. Often this process simultaneously creates common awareness of problems, helps define solutions, and gains agreement on actions—all critical steps to effecting organizational change (p. 39).

The study is intended to be both useful to practitioners and advance theory related to sustainable development leadership in higher education by applying personal network techniques.
Limitations

Limitations of the study include researcher bias, a reliance on participant perceptions, and a bounded selection of participants. As an employee of the participant college state system and a sustainability actor, analysis of data may have had researcher bias to the data analysis and interpretation based on previous experiences as a sustainability leader and faculty member at one of the 16 two-year colleges in the system. Study respondents may have had reservations in answering survey and/or interview questions, and may have responded based on supposed expectations of the researcher. The study relied on perceptions of college sustainability actors for study data, and recall bias of participants may have been high (Crossley et al. 2015). Participants were purposely selected, thus transferability and generalization of findings is limited to the colleges within the study.

Definition of Terms

SNA terms are defined below (Wasserman & Faust, 1994; Borgatti et al., 2013; Crossley et al., 2015).

Alter is a node tied to an ego center in personal networks

Bridge is the only tie between two networks and without this one tie a network could be broken into separate components. The ease of breaking a network into components is a measure of network connectivity.

Clique is a network subgroup where each actor (minimum of three) is tied to all others

Complete or whole networks contain all ties among a set of actors

Degree of an actor indicates the number and/or type of ties

Dyad is two actors, a triad is three actors

Group degree is the number of ties to actors outside the group, and has a positive association with group social capital
Heterophily and homophily are differences and similarities respectively, in attributes between an ego and network alters.

Pathway is the linking of untied actors through other dyads, a cohesion measure. Average distance is the mean of the shortest pathway ties between all dyads.

Personal egocentric network or personal network analysis focuses specifically on networks of one actor, known as the central actor or ego.

Social capital refers to the benefits of network relationships to individual actors.

Social network is composed of individual entities known as actors/nodes, and their social relationships are termed ties and interactions edges.

Sociograms are two-dimensional diagrams of networks using points to represent nodes and lines to represent ties.

Tie dispersion is the spread of similarities and differences in relations among actors. Blau’s H and Agresti’s Index of Qualitative Variation are measures.

Typology between dyads form a matrix of data representing network relationships, 1 in the matrix if a tie exists, or 0 if no dyad tie exists. Typical typologies are similarities, social relations, interactions, and flows. Studies postulate that different network structures/typologies are associated with different outcomes.

Chapter Summary

Chapter One introduces the study by first describing the purpose and research questions. The purpose of the study was to increase understanding of sustainable development implementation at two-year colleges, and to contribute theoretical research in leading organizational change related to social networks and sustainable development. Study context, significance and limitations are also presented - subsequent chapters provide more information summarized in this chapter. Chapter Two provides a review of the literature, including details on theoretical frameworks, the researcher's conceptual framework, and examples of related empirical research. Chapter Three describes the methodology mentioned in this chapter including a table depicting the three
methodological phases of the study. Results are presented in three chapters: Chapter Four document analysis results; Chapter Five survey results; and Chapter Six interview results. The final Chapter Seven is a summary and discussion of the study.
CHAPTER TWO: REVIEW OF THE LITERATURE

Chapter Two is organized by describing literature associated with sustainability within higher education and theoretical frameworks related to organizational change leadership, including aspects of innovation diffusion and social network theory (SNA). Empirical research related to sustainability at campuses and application of SNA is then presented, followed by a chapter summary.

**Defining Sustainability**

The dictionary definition of sustainable is defined as a “the quality of being able to continue over a period of time” (Cambridge Dictionary, 2018). Various perceptions abound as sustainability is applied to environmental resources and economic practices, and yet, an argument for continuing use of the term has merit. “While the word ‘sustainable’ is undoubtedly overplayed, and often misused and misunderstood, both in debate and literature, it is nevertheless almost unsubstitutable, carrying rich layers of both descriptive and normative meaning” (Sterling et al., 2013, p. 23). Sustainability and sustainable development terms are used interchangeably, often *sustainable development* used as a process while the term *sustainability* used as an outcome or goal. In 1987, the United Nations (UN) Brundtland Commission released a 300-page report *Our Common Future*, describing *sustainable development* as a means to raise human living standards while maintaining a viable environment. The oft-cited definition from the UN (1987) is derived from the first sentence below, although most of the 300-pages is devoted to justifying and explaining sustainable development as a process:

> Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs. The concept of sustainable development does imply limits -
not absolute limits but limitations imposed by the present state of technology and social organization on environmental resources and by the ability of the biosphere to absorb the effects of human activities. But technology and social organization can be both managed and improved to make way for a new era of economic growth. The Commission believes that widespread poverty is no longer inevitable. Poverty is not only an evil in itself, but sustainable development requires meeting the basic needs of all and extending to all the opportunity to fulfill their aspirations for a better life. A world in which poverty is endemic will always be prone to ecological and other catastrophes (p. 16).

The Brundtland report and subsequent Agenda 21 from the 1992 UN Earth Summit is credited for both introducing the concept of sustainable development, and initiating discussion on its meaning to an international audience. The expanded use of the term sustainability in relation to sustainable development is thought to originate from forestry, as sustainable yield describes the management of renewable resources (Leal, 2000; Daly, 2015). As an international movement, personal interpretations of sustainable development vary and “there is unlikely to be a consensus” (Leal, 2000, p. 1) due to individual training, work experience, and political and economic settings. Identifying approaches and processes provide the commonality missing in the definition of sustainable development. Two examples of different perspective definitions by Leal (2000) are given below,

- The type of development which is socially just, ethically acceptable, morally fair and economically sound (referring to the social ramifications of development)

- The type of development where environmental indicators are as important as economic indicators (here referring to the close links it bears with economic growth. (p. 3)

Others view the term sustainable development in a negative way for different reasons including its ambiguity (Jickling, 1992; 2012), or its compromise to anthropocentric economic growth (Daly, 2015). Jickling states education for sustainable development as possibly damaging to environmental education. “Typically, when
environment-related education is making political and practical advances, there can be significant push-back” (Jickling, 2012, p. 3). Daly describes the emergence of sustainable growth as a distasteful, vague compromise, “good growth rather than bad growth” (Daly, 2015, p. 238). Highly critical of the past and current emphasis on limitless growth in economics, Daly’s ecological economics concepts elevate natural capital provided by the environment as all encompassing, with traditional economics of input, throughput, output a subset within the natural system.

Nevertheless, the vagueness of the terms sustainability and sustainable development are acknowledged, but as a “guiding principle” (Barth, 2014, p. 14) sustainability provides a platform for discourse on shared environmental and social values, as well as discussing actions for the future in adopting sustainability. Using a sustainability framework allows for strategic planning to achieve organizational objectives, as well as providing principles for “basic and operational definitions” (Robèrt, 2012, p. 168). A sustainability framework should avoid constraints, be inclusionary, and allow “backcasting” (p. 169), that is, aligning with sustainability principles when evaluating actions or strategies. According to Robèrt (2012), an organization should consider the following operational practices,

1. Certain minerals that are scarce in nature can often be substituted by others that are more abundant. And it includes using all mined materials efficiently, and systematically reducing dependence on fossil fuels and nuclear power.

2. Certain persistent and unnatural compounds can often be substituted by others that are normally abundant or break down more easily in nature. All substances produced by society should be used efficiently.

3. Resources should be drawn only from well-managed ecosystems. The most productive and efficient use of both those resources and land should be systematically pursued. Caution should be exercised in all modifications of nature, including the introduction of new species.
4. Thought should be given to how our behavior has consequences for people, now and in the future, how it can restrict their opportunities to lead fulfilling lives. The key question is whether we would like to be subjected to the conditions we create. (p. 169)

The term *sustainability* may appear problematic when defining its meaning as multiple interpretations may be inferred. However, the ambiguity of the term may provide acceptance of sustainability action to a diversity of people by allowing each individual to construct meaningful perceptions relative to their own lives (Sterling et al., 2013; Barth, 2014).

Shriberg (2002) was one of the first to discuss the need for sustainability assessment tools to catalog and compare activities among colleges to move sustainable development forward. Grosskurth and Rotmans (2005) identified three defining areas to evaluate and contend with the subjectivity, ambiguity, and complexities of sustainability strategies, while other assessments had four or five areas. “A common denominator of these [sustainable development] definitions is an implied general balance of economic, ecological and social developments” (p. 2). Their SCENE model uses as its base three forms of capital: social, environmental, and economic. Each of the three have multiple associations called *stocks* with multiple quantitative as well as qualitative descriptors known as characteristics. In turn, each characteristic is associated with indicator and flow terms acting as keywords in cluster analysis. By describing sustainable development activities using the SCENE model and using cluster analysis, different strategies are analyzed and assessed within its complexity of relationships. Each strategy can be clustered with others sharing flow and characteristic keywords, and associations with the social, economic, and environmental capitals are revealed, including degrees of overlaps.
among the three. Recognized today as the three pillars of sustainability, social, economic, and environmental/ecological terms provide a common base with which outgrowth descriptors may be constructed.

A national self-reporting assessment system, Sustainability Tracking Assessment and Rating System (STARS) was developed by AASHE on the recommendation by the Higher Education Associations Sustainability Consortium in August 2006. By September 2009, STARS was released, and higher education institutions began to utilize the self-reporting system. The scoring system was originally adapted from sustainability assessments used in business. Updated versions of STARS undergo revisions through a defined revision process using considerations such as: contributing to environmental, economic and/or social justice; stakeholders gaining sustainability knowledge and skills; non-duplication in other scoring items (AASHE, 2016). Sustainability assessments allow for institutional comparisons rather than individual case study analysis.

**Sustainability in Higher Education**

Higher education institutions are recognized as leaders in sustainable development initiatives, as evidenced by the *International Journal of Sustainability in Higher Education* established in 2000, and the Association of the Advancement of Sustainability in Higher Education (AASHE) in 2006. Originating from environmental concerns with a goal of conserving our natural resources as economic development expands, sustainability is identified as having three interacting environment, societal, and economic components (AACC, 2007; AASHE, 2012; United Nations, 1987; 2012; University Leaders for a Sustainable Future, 1990). The National Academy of Sciences (NAS) states the challenge of sustainability is “meeting the needs of present and future
generations while substantially reducing poverty and conserving the planet’s life support systems” (NAS, 2015, para. 1). Global environmental consequences and awareness are increasing in the 21st century, and sustainable development as a balance among social and economic development with conservation of Earth’s resources has gained momentum (Kates et al., 2001; Pisani, 2007). Higher education leaders are formally supporting the goals of sustainability through the signing of commitments such as the Talloires Declaration (USLF, 1990), the Resolution of Sustainable Development (AACC, 2007), and the American College and University Presidents’ Climate Commitment. Barth (2014) describes a chronology of important sustainability education events from 1992 to 2013, summarized in Table 2.1.

In the United States (US), sustainability policy at colleges and universities is growing with 672 US institutions of higher education members of Association for the Advancement of Sustainability in Higher Education (AASHE) in 2016. However, less than a third were using the formal sustainability institutional assessment provided to AASHE members at that time. In the US and internationally, widespread adoption is slower than expected (Cotton, Warren, Maiboroda, & Bailey, 2007; Djordjevic & Cotton, 2011). Sustainability calls for transformational change within an organization, yet many colleges and universities continue in initial phases of adopting sustainability projects (Sterling, Maxey, & Luna 2013; Barth, 2014). Sterling et al., (2013) suggests further much further change is required, “…the challenge for higher education, as for other key institutions, is to reorient itself accordingly, to place sustainability and securing the future at the heart of its raison d’etre (p. 18)”.

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Table 2.1.

*Sustainability education initiatives and events summarized (Barth, 2014, pp. 27-30).*

<table>
<thead>
<tr>
<th>Period</th>
<th>Major chronological events of sustainability and education</th>
</tr>
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<tbody>
<tr>
<td>1992-1997</td>
<td>The United Nations Earth Summit Agenda 21 results in establishing a UN Commission on Sustainable Development. The UN Educational, Scientific and Cultural Organization (UNESCO) is responsible for action items such as developing sustainable development education materials.</td>
</tr>
<tr>
<td>2009-2013</td>
<td>Reflections on implementation a focus at The World Conference on Education for Sustainable Development. Identifying barriers, opportunities, and assessments of implementation were detailed in the subsequent report, described by Barth as “the first systematic analysis of contributions at policy level – in formal as well as in informal and non-formal education” (2014, p. 29).</td>
</tr>
<tr>
<td>2013-beyond</td>
<td>Academic journals focused on sustainability established and many institutions moving beyond initial stages of implementing sustainability projects to institutional adoption of sustainability principles. Barth questions whether the social aspects including education reform of sustainability will grow, or if existing environmental education will dominate growth.</td>
</tr>
</tbody>
</table>

Sustainable development on college campuses is challenged by complexity on multiple levels such as the dual nature of academic governance between administration and faculty (McNamara, 2010), and inclusion of many fields of study (Sharp, 2002; Bettencourt & Kaur, 2011). Cultural aspects including distrust of scientific data or disdain for administration driven programs may hinder adoption of sustainable development (Caldas et al., 2015). The term *sustainability* itself is not well understood (Leal Filho, 2000; Grosskurth & Rotmans, 2005; Djordjevic & Cotton, 2011; Barth, 2014), and its
ambiguity allows constructing meaning through collaboration. According to Barth, “[s]ustainability does not offer clear pathways or distinctive solutions which need to be followed. On the contrary, the transition towards sustainability relies on constant negotiation and learning processes” (p. 19).

**Theoretical Frameworks**

To move beyond concept and policy stages, higher education institutions are called upon to implement sustainable development on their campuses and integrate sustainability into academic courses (Sterling et al., 2013; Barth, 2014). This is not a simple task, rather, an understanding of theories related to leadership, organizational change, and networks for innovation adoption along with sustainability frameworks is needed to research and advance sustainability in higher education.

**Leadership and Transformational Change**

Leadership is the influencing of others into action that might otherwise not be done, and leaders facilitate change by convincing others to accept, internalize and adopt change (Burns, 1978; Rost, 1993; Burke 2014). Rost describes leadership as non-coercive, multidirectional, and fluid in leadership-follower relationships. Burns (1978) introduced the concepts of transactional leadership and transforming leadership, the former simply involving a negotiation and exchange between leader and follower. There is not a binding “in a mutual and continuing pursuit of higher purpose” (p. 20). This is the difference in transforming leadership where interactions are dynamic and followers may become involved as leaders themselves as moral purpose is shared. Burke (2014) differentiates managers as transactional leaders using structural authority for maintaining efficiency while transformational leaders have authority but also lateral and bottom-up
followers based on a deep connection from “within” (p. 286) for significant change. Leaders require followers, and leadership traits such as “conceptual complexity” and “emotional intelligence” (pp. 290-291) are needed to motivate and instill confidence in those being led. Followers expect leaders to be aware of relevant factors in the rapidly changing external environment. They are more apt to follow when appropriate data drives organizational vision and strategies in an inclusive and socially meaningful manner.

Transformational leadership is one of the six focal leadership theories based on 864 articles published from 2010-2013 (Meuser, Gardner, Dinh, Hu, Liden & Lord, 2016). The role of leaders in transformational change is for strategic decision-making by analyzing the externalities, selecting opportunities, then developing, implementing, and continuous assessment of organizational strategies using external and internal feedback loops to refine and sustain these changes (Burke, 2014). Pathways to such system wide change are the focus of many authors. To become a change agent, a leader has multiple roles as “vision setter, motivator, analyzer and taskmaster” (Quinn, 1996, p. 151). Fullan (2008) describes specific actions for leaders as change agents, such as providing meaningful work and relationships through professional development and transparency. Rather than outside workshops, the focus should be on what works internally, thus supporting team building, learning, and a systems viewpoint to help align organizational goals with personal goals. Balancing “consistency with innovation” (p. 75) is a challenge for leaders, thus leadership should be shared with discussions on the future using data-driven feedback. Transformational change occurs on an individual level through reflection and acceptance of change as ongoing. Roueche, Baker and Rose (1989) propose transformational leadership is needed at community colleges where external
forces are continuously changing, student enrollment is open, and college leaders are expected to respond by enhancing both student lives and their community. Leadership themes from interviews of college presidents included building collaboration, open two-way communications, participatory decision-making, empowering followers, foster creativity around tasks, shared vision and values with a focus on students from their study.

Bolman and Deal (2013) describe the “evolution of the idea of leadership” (p. 344) as starting with research focused on the traits associated with leaders. As cause and effect research did not offer generalizable results, leadership research led to more complexity that “takes account of individual, relationship, and context” (p. 344). Supportive of the earlier work of Rost (1993), Bolman and Deal (2013) used qualitative research of leadership with extensive use of observational and interview studies, leading to five propositions: “(1) Leadership is an activity, not a position…(2) Leadership is different from management…(3) Leadership is multilateral, not unilateral…(4) Leadership is distributed rather than concentrated at the top…(5) Leadership is contextual and situated not in the leader but in the exchange between leader and constituents” (pp. 345-346).

Formal mechanistic versus organic structures were described by Burns and Stalker (1961) in describing organizational systems and change. Formal hierarchical structures tend to inhibit creativity, motivation and involvement of skilled professionals in problem-solving. Organic systems encourage lateral communication and lateral responsibilities - hierarchical structures are of lesser importance. The well-being of the organization is recognized as coinciding with the well-being of individual workers, thus
skilled professionals are more likely to be involved in problem-solving and innovation implementation in organic systems. However, formal structures provide continuity and clarity of roles, thus work well in stable environments. Burns and Stalker emphasize the benefits of leaders able to recognize and apply appropriate mechanistic or organic strategies for different organizational situations.

**Innovation Diffusion in Higher Education**

According to Dill and Friedman (1979), scholarly literature on innovation in higher education is both “voluminous” and “overly descriptive” (p. 412). They describe four change frameworks to “organize the literature” and to provide direction for empirical studies. The four frameworks are described below with further details on the diffusion framework most applicable to this study. First, according to Dill and Friedman, complex organization framework attempts to correlate structural or functional variables with rates of added innovations to an organization. Structural variables include complexity, centralization, and formalization. Complexity associations may be related to the stage and type of innovation, thus broad cause and effects models are more difficult to justify compared to longitudinal studies. Second, conflict framework involves distribution of power as change decisions become politicized, and has been used in case studies. Conflict is to be expected during the change process as different groups determine their level of interest in an innovation (Owens, 2004). Studies using this framework emphasize the social environment prior to the change, rather than the effect of an innovation itself. Third, planned change framework involves a step-wise process of utilizing an external change agent to initiate a process of organizational self-diagnosis, treatment, and internal feedback to continue without the external agent. Dill and Friedman characterize this
framework as human relations oriented, using action research methodology such as intervention longitudinal studies. Finally, the diffusion framework compares groups with different levels of adoption and is commonly applied in longitudinal and correlation research. Adoption rates are compared by differences in change agents, social structure, innovation trial ability, and ability to view potential benefits. Criticisms of the diffusion framework often are based on the divisions that define adopter groups.

Stemming from Rogers’ *Diffusion of Innovation* first introduced in 1962, diffusion is defined as “the process in which an innovation is communicated through certain channels over time among the members of a social system” (Rogers, 2003, p. 5). In this frame, diffusion is limited to two-way communication for understanding of new ideas, and the innovation may be the adoption of the idea, but also may simply be defined as knowledge of a new idea that reduces uncertainty. Diffusion research involves structural and/or functional social change with three other elements beyond the innovation: channels of communication, time, and the social system. Studies often focus on diffusion rates in relation to differences among early and late adopters, innovation attributes, and widespread adoption as it relates to social networks. Rogers notes that at “about 10-20% adoption, when interpersonal networks become activated” (p. 12) widespread adoption typically follows. Adoption rates are positively associated with perceived advantages, ease or complexity of understanding, compatibility with values, and visibility of an innovation. When potential adopters are able to participate in “customizing” (p. 17) an innovation, diffusion is faster and longer lasting. Four phases related to time element are knowledge, persuasion, decision, implementation, and confirmation of an innovation by an adopter. Rogers identifies initiation and
implementation stages for innovation diffusion within organizations, and identifies “innovation champions” (Rogers, 2003, p. 414) as important for successful implementation. Rogers (2003) further states,

[w]hen a new idea is first implemented in an organization, it has little meaning to the organization’s members and is surrounded by uncertainty [...] As the people in an organization talk about the innovation, they gradually gain a common understanding of it. Thus their meaning of the innovation is constructed over a period of time thorough a social process of human interaction (p. 428).

Face-to-face interactions with peers who have already adopted are a primary means of diffusion. Rogers’ descriptions of communication channels and social systems parallel concepts and terms of social network analysis (SNA). His descriptions of communication channels between two persons are called ties and actors, respectively. The terms homophily, actors with similar traits, and heterophily, actors with dissimilar traits, are terms used in both diffusion research and SNA (Borgatti & Halgin, 2011, Kezar, 2014). Rogers also describes the lack of new information among homophily groups, and the need for heterophily to introduce innovation – this is the same SNA concept by Granovetter (1983), Strength of Weak Ties. Important to communication networks are opinion leaders, defined as frequently influential to others and with many informally linked ties through expertise, accessibility, and culture. They are different from change agents who purposefully attempt influence in “a direction deemed desirable by a change agency” (Rogers, 2003, p. 27).

Potential influence of social systems on adoption and innovation diffusion is recognized in multiple fields including business and sociology. The use of early and late adopter concepts has been especially used in product marketing to examine adoption rates based on cost/benefits to individuals; however, these concepts are also applicable to
sociology research (Abrahamson & Rosenkopf, 1997). Complex systems with unclear benefits of an innovation rely on social pressure for diffusion, called “bandwagon pressure” (p. 295) whereby feedback loops of adopters influence non-adopters for increasing innovation acceptance. This pressure may be great enough to influence adoption even when perceptions are that costs outweigh benefits. The organizational complexity of higher education together with ambiguous meaning of sustainability is ripe for study using diffusion frameworks concepts.

**Social Capital and Network Theory**

Borgatti and Halgin (2011) argue that SNA is more than a methodology, with network theory as a framework involving *social capital* of actors and groups. Social capital refers to the benefits of network relationships to individual actors (Burt, 1992). SNA encompasses a set of measures derived from actors interacting within a group. The field has defined terminology and theoretical concepts. A *network* is composed of individuals known as *actors/nodes*, and their relationships are termed *ties* and interactions *edges* (Hanneman, 2001). SNA evaluates network structures and four typical “typologies” (Borgatti, Mehra, Brass, & Labianca 2009, p. 893) which are (1) similarities (e.g., age); (2) social relations (e.g., coworker); (3) interactions (e.g., gives advice); and (4) flows (e.g., information). Studies postulate that different network structures/typologies are associated with different outcomes (Borgatti et al., 2009). For example, an SNA measure is *density*, defined as the number of actual ties among actors over the total possible ties (0-100%), and density has a positive association with ease of information flow within a group. SNA measures for one actor may infer importance of that actor to network flows, such as number and type of ties, known as *centrality*. Both
individual actor and group measures are analyzed to address research questions on networks, with personal egocentric network or personal network analysis focusing specifically on one actor (Borgatti et al., 2009, Crossley, Bellotti, Edwards, Everett, Koskinen, & Tranmer, 2015). SNA calculations provide numerical measures indicating connectivity of actors and cohesion of the group. Actors not directly tied are of interest in analysis, and dyads with ties linking untied actors are pathways. Length of pathways, for example, is a cohesion measure. A bridge is the only tie between two networks and without this one tie a network could be broken into separate components. The ease of breaking a network into components is a measure of network connectivity (Wasserman & Faust, 1994).

SNA data are typically from actor answers on survey and/or interview questions about relationships with others both inside and outside the group (Cross, Borgatti, & Parker, 2002b; Rice, Holloway, Barman-Adhikari, Fuentes, Brown, & Palinkas, 2014). The inferential statistics assumption of observations independence is not achieved since the item of SNA interest is relationships (Borgatti et al., 2013). Other violations of statistical assumptions are nonrandom samples and lack of normal distribution. Instead, SNA mixed methods approach provides empirical analysis of data based on graph theory and permutation tests for some statistic tests such as correlation and differences in means. A permutation test compares the SNA statistic results to a run of statistic results using the same SNA data but purposely randomized thousands of times via computer software. The probability of obtaining the same test statistic results is compared between the actual results and the randomized results, and a low p-value indicates a low probability of getting the actual results by chance (Borgatti, Everett, & Johnson, 2013).
Cross, Borgatti, and Parker (2002a) justify the application of SNA to organizations both to discover network structure and communications, and to use visualizations of SNA diagrams with network actors to improve functionality. SNA is “particularly helpful for improving collaboration, knowledge creation and knowledge transfer in organizational settings” (2002b, p. 3). As organizations face increasingly complex and uncertain issues, understanding informal networks are important as individuals give and request support and expertise from those with which they are familiar. Informal networks are associated with organization innovation and adaptation, but may be obstructed by “formal structure, work processes, geographic dispersion, human resource practices, leadership style, and culture” (Cross et al., 2002a, p. 25). These naturally occurring networks may not be apparent, as opposed to formally written, hierarchical structures, thus informal networks are more difficult to identify and manage for improvement. SNA is especially suited for investigating networks involving collaboration among different functional departments (Cross et al., 2002a). SNA is emerging in organizational management studies to understand effective network structure for strategic objectives. Identifying important hidden networks and their key actors allows managers to help build better network structures and interactions if needed.

SNA diagrams known as sociograms are useful in both identifying structure but also for discussing with actors improvements to the network. For example, two different SNA diagrams reveal differences in network structure in Figure 2.1, with actors as points/nodes, and ties as lines. The two sociograms were generated using UCINet and NetDraw software, mapping 16 actors (nodes) but with different sets of relationships (ties). The diagram on the right shows a bottleneck to information flow compared to the
other as well as a lower density of ties due to subgroups of actors, known as *cliques*.

Sociograms are used to discuss communication structures with the actors and possible improvements. Cross et al. (2002b) describes effectiveness of using sociograms,

Social network analysis maps take on a life of their own when they represent your own relationships with your colleagues. Simply asking people to spend five minutes, either on their own or in groups of two or three, to identify what they “see” in the map, the structural issues impeding or facilitating group effectiveness, and the performance implications for the group is an extremely effective intervention. (p.11)

*Figure 2.1. Sociograms with the same number of nodes/actors but different lines/ties.*

Cross, Parker, and Borgatti (2002b) describe four dimensions of information flow within networks, (1) awareness of who knows what; (2) access to others; (3) engagement in interaction with others; and (4) feelings of safety within relationships (p. 12). SNA in context with these four dimensions (knowledge, access, engagement, and safety) provide a tool to discuss with actors specific interventions to improve network functions. For example, an actor acting as a bottleneck to information flow may need assistance in handling requests for information. Or, introducing specific actors in a clique to actors outside the clique in a safe and engaging intervention might increase all four dimensions. Actor attributes such as demographics (e.g., age, gender) or affiliations to other groups (e.g., departments, formal roles) also provide network insights (Daly & Ferrare, 2016).

One-node SNA provides relationship data between actors with identical matrix rows and columns and a numeric value at each intersection. Two-mode analysis uses actor
attributes in addition to relationships for further inquiries of networks. For example, cliques may simply be a function of department membership. Larger studies may use groups as actor/nodes, with ties among groups within an organization rather than individual people. However, using SNA is an investment in time and resources, and should be targeted to specific networks that are important, hidden, and would benefit from SNA (Cross et al., 2002b; Ryan & Creech, 2008).

SNA in longitudinal studies provide a means for evaluating changes in network measures after an intervention or organizational restructuring (Cross et al., 2002a). However, administrative interventions and change are not always necessary. Actors are encouraged to develop personal networks as they learn about SNA; thus increases in self-connectivity may result simply by discussing SNA and network theory with actors, resulting in improvements in the network for the organization. Other researchers focus on the group level rather than on the individual. These studies analyze social capital of network ties within and outside the group, with social capital related to the good of the group rather than an individual actor. Granovetter’s strength of ties concepts (1983) rely on a social network theory that homophily occurs among actors with strong ties, that is, actors choose strong ties with others like them, and become more alike with frequent encounters over time. Weak ties with outside group actors provide new opportunities not available within the group. Other group level studies support findings that networks with ties outside group boundaries are associated with innovation and completion of tasks (Borgatti, Jones, & Everett, 1998). The importance of outside group ties use SNA measures conceptualized to have positive or negative associations to social capital for the group. For example, the number of group ties to actors outside the group, group degree,
has a positive association with group social capital while the total ties counting minimum pathways from inside actors to actors outside the group, *group closeness*, has negative association with group social capital (Borgatti et al., 1998; Everett & Borgatti, 1999).

Direction of ties may also be a unit of analysis, with in-degree and out-degree representing actors as receivers, senders, or both in a dyad. SNA *centralization* measures indicate the level of group cohesion due to one or a few actors. According to Borgatti et al. (1998) analysis of internal versus external group ties differentiates studies more so than individual versus group levels since an actor/node could be considered either an individual or a group. Thus, an individual in Burt’s personal egocentric networks could apply as well to a group within a larger organization, that is, a node within the network structure could be a group such as a college department. Theoretical development in SNA is primarily concerned with why a node (individual or group) has more or less success compared to others. Social network concepts agreed upon by experts in the field include the following: actors tend to group with those having similar attributes (homophily); actors with frequent interactions tend to become more similar; peripheral actors are important for providing new information and opportunities for innovation especially those with strong ties to other groups; networks with high levels of communication tend to be more resilient than low density networks; and networks with central actors bridging subgroups or outside groups and dense within group ties are related to network resilience and growth (Granover, 1983; Borgatti, Jones, & Everett, 1998; Borgatti & Halgin, 2011; Cross, Borgatti, & Parker, 2002; Kezar, 2014).

Network theory development focuses on associations between network structure and outcomes on both group and individual levels. Borgatti et al. (1998) identify camps
of SNA researchers studying social capital on these two different levels. Burt (1992) analyzes networks in terms of benefits to an individual actor, associating promotions and salary increases to actors with increased structural holes in a business environment. Social capital of an individual is based on network ties and is influenced by human capital factors such as charisma and trustworthiness (Burt, 1992). Individual efficiency, power, and freedom of choice are described in terms of personal egocentric network structures in Burt’s structural holes theory. Conceptually, SNA measures may have positive or negative influences on social capital (Burt 1992; Borgatti et al., 1998), such as degree size is the number of node (alter) ties to an actor and has a positive association on the actor’s social capital, while density is a measure of actual ties divided by total possible ties, and has a negative association on an actor’s social capital.

**Literature**

**Sustainable Development in Higher Education**

Much of the scholarly literature is from international sources, with the European Union guiding some UN policy development on sustainability (Barth, 2014). A number of studies have focused on identifying factors impacting sustainability in higher education using case studies of individual institutions. For example, Djordjevic and Cotton (2011) used a case study of a United Kingdom university to research barriers in implementing higher education sustainability practices. Purposeful selection of participants was three individuals closely tied to sustainability efforts, and seven individuals marginally associated. Semi-structured interviews were conducted with the three knowledgeable individuals, while the other seven participated in a focus group. The identified barriers based on the case study were: varying definitions of sustainability;
perceived conflict with university mission; change resistance; and needs of staff (pp. 385-390). The research findings recommended ongoing two-way communication among leaders and staff, clarification of the term sustainability, and leadership consistency with democratic participation. Developing niches rather than all encompassing goals were a strategy for success, along with leadership guidance rather than forced change (p. 392).

European and US political systems differ, with individual freedoms highly emphasized in the US (Robèrt, 2012). Through interviews, Posey (2012) found a negative association with sustainability from coal producing versus non-coal producing US states. “What is clear after analyzing the two interviews is that sustainability is on the agenda for some state higher education systems yet is subject to factors such as decreased funding, dependence upon coal, and the influence of institutional autonomy” (p. 57). As individual colleges and universities use different language to define sustainability and interpret environment, social, and economic aspects at their institutions, the meaning and focus of sustainability will differ.

Using three decades of data, Kurland (2011) as a participant observer describes a California university and its “evolution of a sustainability network” (p. 395). She identifies three stages of organizational change: (1) administrative and campus facilities leadership promoting energy efficiency and student recycling; (2) academic affairs involvement and campus networking culminating in the formation of a sustainability institute including all deans of the university; and (3) the current and ongoing stage of increasing stakeholder knowledge and adoption of sustainability practices campus-wide. Proposed future research suggests “social network analysis techniques” to map an
institution’s sustainability relationships among stakeholders to provide greater analysis detail.

Books on higher education sustainability implementation argue for a transition from teacher-centered to student-centered learning environments at universities to understand and engage in the complexities of sustainable development (Barth, 2014; Johnston, 2013; Sterling et al., 2013). Paul Rowland, the Executive Director of AASHE, writes in the foreword to *Higher Education for Sustainability*, “There has been no single pathway to success (and I would argue that there should not be) in developing and implementing the sustainability education curriculum” (Johnston, 2013, p. ix). Rowland describes three primary approaches: institutions integrating sustainability as part of their mission; development of sustainability programs; and multidisciplinary pedagogy of sustainability curriculum (Johnston, 2013). Descriptive case studies of institutions leading sustainability efforts is a focus in a number of US higher education sustainability studies (Reynolds et al., 2010; Barlett & Chase, 2013; Johnston, 2013) while European authors of sustainability texts such as Sterling et al. (2013) and Barth (2014) describe sustainability as a more mainstream concept than in the US.

Faculty adoption of sustainability practices in academics is a focus in a number of studies (Thompson & Green, 2005; Cotton et al., 2007; Hegarty, 2008; Wahr, Underwood, Adams, & Prideaux, 2013). Narratives of three Australian university faculty implementing sustainability into a textile program suggest the need for transformational change and collaboration to teach sustainability as a holistic concept (Wahr et al., 2013). Reynolds (2013), an Associate Professor of Biology, describes the actions taken to transition from a “greening the campus” stage to a “greening the curriculum stage” at
Indiana University. She received grant funding to pursue and document findings of the Environmental Literacy and Sustainability Initiative (ELSI) that used “campus conversations” (p. 31) to develop participatory activities and outcomes to advance sustainability. The ELSI model has four phases: building on foundations; locating resources; designing the seminar, and gauging outcomes (p. 3). A core group of participants first identified existing multidisciplinary networks of people and activities related to sustainability and potential resources such as grants, and campus units. Next, they developed the goals of the seminar, with a degree of flexibility in starting the conversation on environmental literacy and sustainability on campus. Seminar outcomes included defining environmental literacy and using participant feedback to identify additional sustainability actors and issues for future discussions. Three themes developed for teaching environmental literacy - an understanding of ecological processes, human consumption of resources, and a need for balance in human use of ecological processes and resources. Seminar participants were asked to discuss the information, skills, and ethics needed for an understanding of these themes in the context of their expertise or role at the university. For example, a philosophy professor discussed “the importance of sense of place, in local communities and in the larger economy of nature, as fundamental to the attachment to and defense of place” (Part 2, p. 25), while a communications professor saw the need for students to engage in rhetoric to help shape the understanding of environmental issues and to prepare them for future discussions and debates on these issues.

Defining the meaning of sustainability and developing implementation actions have a certain dependency on place, time, and participants (Reynolds, Brondizio, &
Robinson, 2010), thus generalization of research is difficult due to institutional differences. Each institution develops policy statements on the meaning of sustainability and sustainable development using external information but ultimately meaning of innovations is determined from within (Rogers, 2003). An inherent complexity of sustainable development is recognized as including spatial, temporal, and multidisciplinary issues, leading to varied language in describing sustainability actions and strategies. An assessment survey developed by University Leaders for a Sustainable Future (ULSF) contain the following categories: curriculum; research and scholarship; operations; faculty and staff development and rewards; outreach and service; student opportunities; and institutional mission, structure and planning. Using the ULSF survey and related documents, eighteen Canadian universities were ranked, identifying exemplary campuses and best practices (Beringer, Wright, & Malone, 2008). One of the researchers conducted additional research to identify perceived barriers from interviews of presidents and vice presidents of Canadian universities. Using open and closed questions, interviews provided data for thematic development of barriers to implementation: cost, lack of awareness, resistance to change, and unfamiliarity with the concept of a sustainable university (Wright, 2007; 2010).

Assessment measures provide vehicles for communicating best practices and feedback for continuous improvement at higher education institutions (Shriberg, 2002). Assessments help define collective approaches to an idealized “sustainable campus” (p. 254), and help identify what support is needed to lead campuses to this amorphous vision. Eleven different assessment tools were evaluated by Shriberg using the following criteria considered important: identify important issues; calculable and comparable; move
beyond eco-efficiency; measure processes and motivations; and stress comprehensibility. Development of a “universal tool” (p. 268) was recommended to provide the ability for college comparisons and possible rankings of sustainability implementation. AASHE developed an assessment tool coinciding with Shriberg’s suggestions. Data from 86 participant surveys and 20 interviews of AASHE members were used to determine factors related to sustainability progress (McNamara, 2010). The measures considered important in implementing sustainability in higher education institutions were: a formally adopted sustainability plan, a sustainable leadership group, broad constituent support, and strong institutional support.

**Social Network Analysis Studies**

Social network theory is a branch of sociology, and the study of social relationships and behaviors from an empirical viewpoint dates back to Comte (1798-1857). Comte’s positivism approach combines social studies with the scientific method to yield social sciences (Gutek, 2004), and sociologists as well as other researchers have continued this line of study to today. Social network theory with its mixing of quantitative and qualitative methods attempts to describe meaningful network principles with applications in multiple settings (Wasserman & Faust, 1994; Borgatti et al., 2009; Miller, 2011). Theoretical underpinning of SNA is an integration of mathematical/physical sciences and social science research. Borgatti et al. (2009) trace the history of SNA research in the well-known journal *Science*. The terms *nodes/vertices* and *lines/edges* are from graph theory while the equivalent *actors* and *ties/relations* are from social network theory. Biology and physics analyze structures of organismal communities and atomic bonding, respectively, while sociology by its definition
encompasses the study of human relationships (Cross et al., 2002a). A familiar social network diagram is a family tree showing generations of parents, offspring, and siblings. Dr. J. L. Moreno a psychiatrist, is credited for publishing in 1934 a diagram of “‘sociometry’ a technique for eliciting and graphically representing individuals’ subjective feelings toward one another” (Borgatti et al., 2009, p. 892). Graph theory used in social science studies during the next two decades began to formalize mathematical terms and measures for social network research. Communication studies conducted at the Massachusetts Institute of Technology generated interest in network structure on outcomes such as network communication speed. Milgram’s “six degrees of separation” (Borgatti et al., 2009, p. 893) concept is derived from network studies during this time period, including two collaborators from math and social sciences. The idea is that through networks, any two actors in the US could be linked through a maximum of six ties through other actors. Mathematical matrices and graph theory applied to social network studies established SNA quantitative and qualitative methods, thus determining a common set of terms and measures to discuss and build research concepts and applications in an emerging field (Borgatti & Halgin, 2011). For example, two actors are known as a *dyad*, and the typology between dyads form a matrix of data representing network relationships (1 in the matrix if a tie exists, or 0 if no dyad tie exists). Mapping the matrix allows visual analysis of networks in the context of similarities, social relations, interactions, and flows.

Social science fields such as anthropology embraced social network theory early on as relationships among individuals and societies are integral to these areas of study. In 1977 the International Network for Social Network Analysis (INSNA) was established
for researchers in a wide diversity of professions. During the 1990s, the number of articles using SNA grew rapidly especially in health fields and business management, both areas with significant research funding. More recently, application of SNA in education settings is quickly growing (Daly, 2010).

Granovetter’s (1983) strength of weak ties concept is well known in the field, and explores the benefits of strong and weak ties to the network. Strength of weak ties suggests personal peripheral actors (weak ties) provide a diversity of information and increased opportunities to an actor. Strong ties are relationships defined by frequent connectivity, and actors strongly tied tend to increase their similarities over time (Burt, 1992). Weak ties have less frequent communications; however, weak ties may provide access to information not provided by one’s strong ties as shown by Granovetter’s 1983 study on higher frequency of job referrals coming from weak ties compared to strong ties. Weak ties provide access to information not as easily available compared to strong ties. In other words, you already know what your strong ties know. Redundant knowledge is not as valuable as new knowledge. The strength of weak ties discussion continues with the acknowledgement that not all weak ties are equally beneficial; rather, weak ties bridging to other networks are more powerful than weak ties with few relationships outside the network (Granovetter, 1983; Burt, 1992).

Social network concepts and theories continue to emerge and are expanded upon as SNA application and research grows. Burt’s structural holes (1992) concept in personal egocentric networks contributes to the discussion on Granovetter’s strength of weak ties, but focuses on individual actor benefits such as job promotions. Personal egocentric networks do not attempt to study whole networks, rather ego or central actor is
the actor of interest, and other actors are known as *alters*. Data are from the ego’s perceptions of network ties - alter perceptions often are not collected. Structural holes are lack of ties among alters as in Figure 2.2, and Burt conceptualizes that an increase in structural holes provide more power and choice to the ego actor. Increased ties among alters require less dependence on flow from the ego as the central actor. Thus self-interest may provide the ego motivation for identifying and maintaining structural holes within networks (Burt, 1992; Stevenson, Bartunek, & Borgatti, 2003; Borgatti et al., 2009). Burt studies competitive business settings, and recommends focusing on specific relationships for self-enhancement, such as non-redundant ties and alters with high centrality in other groups for efficient use of time. His work indicates that network measures should be interpreted relative to other measures. For example, a density value alone may be considered positive (ease of information flow) or negative (lack of leadership) thus should be analyzed along with centrality measures to help indicate the existence of key actors as network leaders (Burt, 1992: Ryan & Creech, 2008). According to Borgatti et al., (2009), an actor/node position in a network likely influences node outcomes.

Two personal egocentric sociograms are mapped in Figure 2.2, generated using UCINet and NetDraw software, each with the focus central actor centered in the diagrams. The ego network on the right has structural holes with a lack of ties among alters.

*Figure 2.2. Sociograms with no structural holes and multiple structural holes.*

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SNA has been used in education settings outside of higher education to investigate school reform implementation (Coburn, Choi, & Mata, 2010) and leadership (Finnigan & Daly, 2010; Penuel, Frank, & Krause, 2010; Spillane, Healey, & Kim, 2010). Results suggest the importance of informal networks in diffusion of new practices.

In the case of mathematics reform over a 3-year study, homophily and proximity were initially the basis of ties (Coburn et. al., 2010). As professional development increased to diffuse new pedagogy, ties increased in number and heterophily. In the third year, professional development ceased, and proximity again became a primary influence for relationship building. Another study concluded that when professional development is scarce, informal leaders and networks are important in influencing teachers’ change in pedagogy (Penuel, Frank & Krause, 2010).

A few studies use SNA in researching sustainability implementation. SNA results are useful for participants to learn from others working on similar projects within the same organization or network (Cross et al., 2002a). Kolleck (2013) used SNA to identify network structures of sustainability actors in five German communities. Structural holes, the absence of relationships among actors, were identified in sociograms of the five municipalities, and then used to discuss results with study participants to help build relationships. Kolleck (2015) further compared groups within the municipalities involved in education for sustainable development (ESD), finding non-governmental organizations (NGOs) and government agencies having a more central role than schools.

Prell, Hubacek, and Reed (2009) used SNA to identify stakeholders in a United Kingdom National Park for participatory management of resources. Network measures such as those actors with many versus few relationships (degree centrality), and linking
unrelated actors (*betweenness*) helped determine who to include in management discussions, and in what areas representatives were lacking – identified as “forestry and statuary bodies” (p 513).

In a global study of SNA and sustainability, Ryan and Creech (2008) found the cost and need for technical expertise to be barriers in researching participation of countries in sustainability policy. The study found SNA useful for identifying large-scale geographic differences in network connectivity to agents of the International Institute for Sustainable Development (IISD), and structural changes were made within a year including the additional of network actors and increase in ties. However, the study concluded large numbers of network actors in whole network analysis create increasing data complexity, time investment, and cost, stating, “[t]his experiment suggests that SNA can provide some useful insights to help strengthen networks, but the costs and complexity of SNA are significant barriers to its deployment as a management and evaluation tool” (p. 15). Additionally, network studies are challenged because of missing data due to errors in actor recall (Rice et al., 2014). In response to these issues related to whole network analysis, personal egocentric network analysis is growing in application where the perceptions of a few actors comprise the data collection (Borgatti & Everett, 1997; Bidart & Charbonneau, 2011; Crossley et al., 2015). While a whole network approach studies a specific population and attempts to contact and collect data from all network actors, an egocentric network is a personal network with data collected from a central actor.

**Chapter Summary**

Chapter Two provides a literature review that includes theoretical frameworks and empirical research. With sustainability implementation at two-year colleges as a research
focus, theories informing the study are in transformation leadership, innovation diffusion in organizations, and social capital and network frameworks. Literature on sustainability implementation at higher education institutions as well as social network analysis provide the context for this study. The next chapter details methodology for this study including research design, three stages of data collection, participant selection, study limitations, and a summary table of methods.
CHAPTER THREE: METHODOLOGY

Chapter Three presents the study purpose and a conceptual framework developed for the study, then details the research design, setting, instrument procedures, and study limitations. The research design involved a mixed methods approach to identify perceptions and attributes of sustainability actors and their personal networks. Participants were sustainability actors within 16 public two-year colleges under a statewide sustainable development framework. Data were gathered using documents, questionnaires, and semi-structured interviews that relate to campus sustainable development, detailed below.

**Study Purpose**

The purpose of the study was twofold, (1) to increase understanding of sustainable development implementation at two-year colleges, and (2) to contribute theoretical research in leading organizational change related to social networks and sustainable development. Social network, leadership and organizational change theories were applied to advance understanding in innovation diffusion within higher education institutions, and provide practical results intended to be meaningful to the colleges in ongoing sustainability implementation.

**Conceptual Framework**

Conceptual frameworks and concept mapping (Maxwell 2013) allow researchers to construct a starting point not only from theoretical literature, but also from other sources such as professional experience. Potential for researcher bias is acknowledged using qualitative methods such as interviews where the researcher is the instrument in
collecting and interpreting data, and in concept mapping. The concept map for this study communicated the researcher’s initial framework, and is presented in Figure 3.1.

Colleges and universities are multipurpose institutions that advance fields from human health to communication technology, along with “educating citizens for life in a democracy” (Loss, 2012, p. 6). With about 250 U.S. colleges by 1860, the Morrell Land Grant of 1862 secured public support and funding of education. Loss (2012) describes public higher education as a “parastate” (p. 2) that is not independent, but an intermediary of the government and citizens. Thus, institutions are influenced by external entities resulting in significant changes and challenges, for example the GI Bill and the Higher Education Act of 1965 with purposes to increase college education accessibility. The 1920s saw a boom to enrollment as GIs returned from World War I, and at the same time human resource theory was emerging with Follett (1926/2005) writing about the need for participatory management styles. The number of two-year colleges more than quintupled during this decade as a means to satisfy students with different educational tracts and abilities (Loss, 2012). Offering freshman and sophomore courses, two-year colleges alleviated the overcrowded universities at the time. By the 1950s, two-year colleges in the US were designated as the best fit for offering education to “adult learners (aged twenty-five years or older)” (p. 147), partially because the 540 colleges were locally available and locally controlled. In 2015, the US had 1,113 two-year colleges with fall enrollment over 6.5 million students (Carnegie Classification, 2016).

Two-year colleges have formal organizational structures typical of higher education with administration, faculty, and staff as employees. A distinctive organizational structure in higher education institutions is the shared academic
governance between administration and faculty (McNamara, 2010). Faculty are experts in a diversity of fields (Bettencourt & Kaur, 2011), and this diversity may be challenging to coordinate yet presents opportunities for professional faculty input on college initiatives. Leaders of higher education institutions encounter unprecedented situations in their internal and external environments in which they need to make decisions as we are living in an increasingly complex society with information becoming more accessible and communications faster with the digital revolution.

In the conceptual framework for this study personal networks of sustainability leaders were seen as important in adopting widespread college sustainability. Institution leaders would be better able to assist implementation by understanding network and organizational change theories and their application. This study is unique in the use of combined quantitative and qualitative methods of sustainability data coding and cluster analysis with SNA from surveys and interviews to compare attributes and networks of sustainability actors at two-year colleges.

**Concept Map**

A concept map was constructed for this study to represent three phases as a college moves to adoption and implementation of sustainable development. Three internal networks of staff, faculty, and administration within a typical community college organizational structure are shown in the concept map of Figure 3.1. Staff are responsible for campus operations, faculty for academics, and administrators lead (Roueche et al., 1989) through policy formation, budgets, and hiring. One-way arrows indicate a hierarchical structure from administrators to the other two groups in the initial Phase A.
Figure 3.1. Concept map of sustainable development in higher education.
As a growing number of international and national organizations support sustainable development through declarations and participation, administrators are influenced to adopt sustainability action at their respective colleges. As top-level administrator leaders adopt sustainability policy, the concept map moves from Phase A to Phase B with administrators interacting with campus staff leaders to implement cost savings including energy efficiencies, reduction or recycling of waste, and other campus greening initiatives (Moore, 2005; Beringer, Wright & Malone, 2007; Kurland, 2011). The Phase B intersection of administrators and staff networks illustrates early adoption and implementation relationships on campus. Faculty, with a high degree of autonomy, may or may not participate in teaching sustainability depending on individual motivations such as sustainability-discipline connectivity, personal interest, or other incentives. Faculty efforts are separated from the other two networks, and many colleges are currently at Phase B in sustainability implementation. For a college to become a deeply sustainability institution, faculty leaders would need to be broadly engaged. Phase C of the concept map represents relationships across all three network boundaries and externally to fully implement sustainability at an institution. This research was intended to help leaders identify sustainable development challenges using SNA techniques for formative evaluation of implementation practices.

**Research Questions**

1. What sustainable development activities are implemented by the two-year colleges, and at what frequencies? Using these activities to cluster colleges into groups, what traits emerge across groups?

2. What challenges to sustainable development challenges do sustainability leaders at the two-year colleges identify? Are there notable differences in responses among college groups?
3. What network relationships are identified in implementing sustainable development activities at the two-year colleges? Do the college groups identify different relationship typologies?

Research Design

A mixed methods research design (Creswell, 2009; Johnson, 2014) was used including social network analysis (Rice, Holloway, Barman-Adhikari, Fuentes, Brown, & Palinkas, 2014; Crossley et al., 2015) to capture and interpret sustainable development implementation within a two-year public college statewide system. The selected participants were sustainability actors within colleges bound by a common sustainable development framework adopted in 2012, which allowed for implementation comparisons among the institutions.

The Diffusion Framework (Rogers, 2003) provided the scaffolding for using quantitative and qualitative methods to investigate the implementation of innovations. Diffusion concepts described by Rogers (2003) apply to both organizations and individuals, "...the main idea of diffusion theory: that interpersonal communication with near-peers about an innovation drives the diffusion process" (p. 342). The units of analysis were both colleges and individuals, as organizations rely on workers to implement or reject innovations. Social network analysis (SNA) techniques included name generator and name interpreter questions (Borgatti, Everett & Johnson, 2013) focused on identifying personal networks of central actors involved in implementing sustainability (Kolleck, 2015) at their colleges. The methodology procedures were conducted in three stages using (1) document analysis; (2) a survey; and (3) semi-structured interviews. The stages are introduced below, with additional details in the Data Collection section following.
College institutions were the units of analysis for Stage 1, whereby a coding method was developed and applied to Sustainability Reports submitted by the colleges to the statewide system. Colleges were assigned unique random ID numbers for data analysis in place of college names. Interpretation and coding of sustainability activities resulted in code frequencies used to rank activities and group colleges to address the first research question. The frequency code ranking identified sustainability activities that were widespread among the 16 colleges as well as those of lesser frequency. Those codes with lesser frequency may be of interest to practitioners in expanding into these activities by using other colleges as models. After document analysis, code frequencies were used to group colleges. Rogers (2003) determined early and late adopter categories by means and standard deviations, such as innovators defined as two standard deviations from the mean and laggards as one standard deviation in the opposite direction. In this study, adopter and implementation categories were further examined using cluster analysis, whereby an iteration process clustered colleges based on minimizing frequency means within a group cluster. Differences in college clusters were identified, and comparisons are presented in the study results chapters.

Stage 2 methodology was an online survey distributed to gather data from central actors implementing sustainability at the 16 colleges, and was conducted concurrently with Stage 1. The survey included demographic questions, modified questions with permission from Wright (2010) on attitudes about sustainability, and name generator questions to identify personal network relationships involved in sustainability implementation. The statewide system Human Subjects Review Board approved the proposed research as did the university Institutional Review Board, see Appendix A and
B respectively for approval letters. Publicly available online college Sustainability Plans from 2013 listed sustainability committee members and sustainability leader(s) for each college. More current lists of sustainability leader contacts, herein referred to as sustainability contacts, as potential participants were from the statewide system Sustainability Project Manager. Each potential participant was introduced to the study and online survey by email and provided a participant consent form, see Appendix C. These sustainability contacts were asked to update sustainability committee member names for potential participation in the study. All files with names and IDs were password protected, stored on password protected computer systems, and will be destroyed when contact with respondents is no longer needed for the study.

Confidentiality was an intent of the study, and written publications of the research will use pseudonyms in place of names. Based on Stage 1 college groupings and completed survey responses, a purposeful selection of central actors was invited to participate in semi-structured interviews to further detail personal egocentric networks and respond to open-ended interview questions on sustainable development at their colleges.

Qualitative methods included the researcher as the instrument in the semi-structured interviews, interpretive coding of written sustainability activities and questionnaire responses, thematic analysis, and use of memoing throughout the study (Creswell, 2009; Merriam, 2009; Maxwell, 2014). Quantitative instruments in this study used MS-Excel for coding and descriptive statistics, SPSS (Green & Salkind, 2014) for cluster analysis, and UCINet and NETDraw software (Borgatti et al., 2013) for sociograms. A summary of the stages, research questions, and methodology are presented in Table 3.1.
Research Setting

An opportunity to study and compare sustainability implementation became feasible as a sustainable development framework for public two-year colleges was approved in 2012 within a US southeastern state. The community college system for this study has 16 public institutions with statewide administration and Board of Regents governing the colleges, along with a local President and advisory Board of Directors for each college. The state system President and Sustainability Project Manager expressed support of this research on sustainability progress at the colleges. The 2012 Sustainable Development framework document states definitions, objectives, and strategies for college sustainable development. Stated focus areas include administration, outreach and service, curriculum/workforce development, student opportunities, faculty and staff development, and operations. Strategies include recommended use of the national Sustainability Tracking Assessment and Rating System (STARS) from the Association for the Advancement of Sustainability in Higher Education (AASHE). Each of the colleges is to use the framework as guidance in developing local college sustainability plans. The system Sustainability Project Manager provided document templates and sustainability information to the colleges although template use is voluntary. Each college reports local sustainability activities twice a year, and these activities are presented to the system Board of Regents in June and December as written Sustainability Reports. Implementation of the sustainable development framework relies on local development at the individual colleges. The biannual reports and an initial 2013 sustainability plan are requirements for the local colleges to the system and reveal differences in activities among the colleges. For example, one college hired a full-time sustainability coordinator
while another hired an outside consultant to complete the STARS assessment, both were temporary assignments. Most colleges have not implemented STARS. Coordination of local activities and building of campus sustainability participation occur at the individual college level, with statewide initiatives focusing on energy efficiency and awareness of sustainability opportunities.

**Participant Selection and Data Sources**

Participants for this study were employees bounded to the two-year college system under a common statewide sustainable development framework and other organization policies. Studies of sustainability at multiple higher education institutions have used bounded purposeful selection rather than random sampling (Wright, 2007, 2010; McNamara, 2010). Purposeful selection within these 16 system colleges allows for quantitative and qualitative comparisons in implementation activities and attributes. Document analysis of biannual Sustainability Reports (2012-2016) and Sustainability Plans involved interpretation and coding of written descriptions of sustainability activities at each college. These documents are publicly available online.

An updated list of college sustainability contacts was provided by the system Sustainability Manager. Potential participants were provided informed consent forms before survey interviews, and informed consent was documented appropriately as required by the college system Human Subjects Review Board, see Appendices A. Sustainability contacts were asked to update and provide sustainability committee member names for potential participation in the survey. Potential participants for the interviews from survey respondents were selected based on maximum variation (Creswell, 2013) of sustainability activities to compare divergent viewpoints of college
clusters and participant attributes.

**Institutional Review Board.** Confidentiality of participants was an intent of the study, and a University of Kentucky Institutional Review Board (IRB) Exemption Certification letter is provided in Appendix B. Each participant was contacted by email and informed that confidentiality was the study intent, but cannot be guaranteed, and that participation is voluntary and may be stopped at any time during the study. An informed consent form for the survey is provided in Appendix B. The process of informed consent included:

1. Emailed study participants with consent form and link to survey
2. Consent form also on survey
3. Participants indicated their consent by checking **yes**

The research was exempt from Federal regulations regarding the protection of human research subjects because the study was conducted in established college educational settings involving normal educational practices; used existing publicly available documents; and participant responses to surveys and interviews were kept confidential and aggregated with other responses in written publications. The consent form for interviews is in Appendix E. Data collected from the anonymous survey questionnaires and interviews were electronically stored using password-protected personal computers of the researcher, and unique randomly assigned identification numbers in place of college names. Name identification associated with codes and interview pseudonyms were stored separately from other study data were strictly confidential, and the ID file will be destroyed six years after study publication. Actual names were not attached in any public documents - any information reported will be in aggregated or in pseudonym form.
Additionally, disclosure of responses outside the research do not reasonably place the respondents at risk of criminal or civil liability or be damaging to financial standing, employability, or reputation.

**Data Collection and Analyses**

The study data collection and data analyses were in three stages described below, and are summarized in Table 3.1.

Table 3.1

<table>
<thead>
<tr>
<th>Stage</th>
<th>Data collection methods and sources</th>
<th>Qualitative data analyses</th>
<th>Quantitative data analyses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Document analysis of biannual college sustainability reports (2012-2016) were publicly available on the Internet</td>
<td>Sustainability activities interpreted and coded</td>
<td>Ranked each activity by code frequencies. Cluster analysis determined college groups using mean code frequencies</td>
</tr>
<tr>
<td>2</td>
<td>Surveyed college sustainability contacts, and other sustainability actors at the colleges</td>
<td>Responses to open-ended questions were thematic coded</td>
<td>Determined descriptive statistics of structured and coded responses, including statistical comparisons between college clusters</td>
</tr>
<tr>
<td>3</td>
<td>Interviewed sustainability leaders, purposefully selected based on stages 1 and 2</td>
<td>Rich descriptions of sustainability perceptions by central actors were thematic coded and clusters compared</td>
<td>Standard SNA measures such as heterophily and degree</td>
</tr>
</tbody>
</table>
Stage 1: Document Analysis of Sustainability Activities

Analysis determined differences and similarities in written descriptions of college sustainability activities to answer research questions on implementation and college comparisons. Sustainability Reports were publicly available online from Board of Regents meeting documents, June and December from 2012 to 2016. The biannual documents provided written descriptions of sustainability activities at college campuses, and these descriptions were interpreted and coded to represent sustainable development implementation for the study. Individual college names were randomly assigned an ID number in a roster file, and these ID numbers were used for study data files and kept confidential - storage in password protected computer systems were only available to the researcher. The roster file will be destroyed six years after research publication.

Activities were qualitatively interpreted and coded using a set of 63 Sustainable Development Codes established for this study, initially guided by the national Sustainability Tracking Assessment and Rating System (STARS). The Sustainable Development Codes did not reflect completion of STARS items, instead individual sustainability activities were coded by the researcher based on interpreted implementation support of STARS items, not achievement of STARS items for assessment scoring. STARS was first offered by AASHE in 2010, and in 2016 has 787 institutions as self-reporting users. STARS was developed by AASHE on the recommendation by the Higher Education Associations Sustainability Consortium in August 2006, and by September 2009, STARS was released and higher education institutions began to utilize the self-reporting system. The scoring system was originally adapted from sustainability assessments used in business. STARS 2.1 assessment has undergone revisions through a
defined revision process using considerations such as: contributing to environmental,
ecoconomic and/or social justice; stakeholders gaining sustainability knowledge and skills;
and non-duplication in other scoring items (AASHE, 2016). STARS 2.1 has 63 items
described online, in four primary categories: Academics (11 items), Engagement (15
items) Operations (23 items), and Planning (14). Unlike STARS, the study codes are not
weighted and multiple codes could be selected for each sustainability description. Codes
for this study were determined by the researcher through the following steps:

1. Read and copied sustainability activity description for each college into MS-Excel
as a row, and 63 study codes as column headings. Keywords and college ID were
added for each sustainability activity.

2. Reviewed online definitions for each item heading in the STARS Technical
Manual 2.x as needed, and determined unique Sustainable Development codes for
the study. Memos were noted throughout the process to define study codes, for
example:

   EN4 Outreach Materials and Publications requires ongoing use,
   EN5 Outreach Campaign requires measurable outcomes not just awareness,
   EN 13 Community Service must involve students,
   PA2 Planning must have published material.

3. Study codes were selected for each activity based on interpreting whether the
activity was helping implement STARS item descriptions rather than fully
achieving the STARS item. A description often had more than one code
associated.

4. The matrix of rows (sustainability activity descriptions) and columns (63 codes,
keywords and college ID) were sorted by keywords to determine consistency in
coding. Sorting and review for consistency were conducted among all colleges by
keywords.

   After interpretive coding, the resulting data matrix contained descriptions of
activities from Sustainability Reports in rows, and the 63 Sustainable Development
Codes (A01-A11, E01-E15, O01-O23, P01-P14), keywords, and college ID in columns.
Descriptive statistics based on counts of codes (frequencies) were calculated including
ranks, means, sums by college ID, and sums by the four code categories. Code ranking from high to low frequency counts indicated widespread and scarce types of sustainability activities at the colleges. Frequency of codes were also summed for each of the 16 colleges, and for each code category to investigate college group clusters. Mean and standard deviations code frequencies by college ID were calculated to analyze grouping of colleges. For example, Rogers (2003) defines the “innovator” (p. 281) adopter group as being two standard deviations from the mean. College groups in the study were determined using cluster analysis in SPSS software based on minimizing distances between means by code category, resulting in three cluster groups (A,B, and C) with different frequency centers. Study results and findings were compared using these clusters. Individual names of colleges were assigned random ID numbers stored in a roster file. Results were cumulative or by college clusters. Files identifying individual colleges were stored separately from data analysis files and will be destroyed six years after publication. All research files were electronically password protected and stored on a computer system available only to the researcher.

**Stage 2: Surveys to Collect Central Actor Perceptions**

All 16 college sustainability contacts were contacted by email to introduce the study and provide a consent form, as well as provide a link to the online survey. The consent form addressed individual confidentiality and use of data in aggregate form for publication, see Appendix C for the consent form. The survey includes 5 demographic questions, 13 questions on attitudes about sustainability in higher education, and 5 social network analysis name generator questions to identify sustainability actors at the college. Demographic and attitude questions provided attribute data of the respondents, and the
name generator questions were an initial step to collect network node data for SNA. One participant college acted as a pilot for refining research design protocols. Memoing during the pilot was used to improve the methodological process (Maxwell, 2012) before contacting other participants. Minimal changes in the protocol were determined after the pilot, and other sustainability central actors were contacted by email for survey participation after the pilot. Emails and telephone calls were conducted to encourage completion of surveys. Stage 2 survey was distributed concurrently with Stage 1 document analysis.

**Sustainable development survey questions.** Attitude questions were intended to gauge respondents’ perceptions on sustainability implementation within higher education institutions. Seven of these questions were derived from a previous study at Canadian universities (Wright, 2010), and used with the author’s permission (see Appendix D for survey questions). Sustainability questions were multiple-choice, but each has a choice of Other for open-ended responses by participants. All open-ended responses were thematically coded in the data analysis. Percent distribution of responses for applicable survey questions were calculated for all respondents and by college cluster groups for analysis. Two-way contingency table analysis using Crosstabs in SPSS statistical software compares cluster group survey responses where appropriate. A two-way contingency analysis using Pearson Chi-square of alpha < 0.05 for significant difference in distribution between clusters was used, but valid only when 20% or more responses are over 5 counts (Green & Salkind, 2014, p. 333).

**Personal network survey questions.** In this study, both name and position generator questions were asked to identify key college positions and outside groups
helping implement sustainability within colleges. Responses were coded into administrator, faculty, and staff typologies as well as other categories for internal and external groups. Central actors in personal egocentric network studies typically answer questionnaires to generate names and attributes of other network actors centered on research questions and theoretical frameworks. Depending on the research questions, other actors, known as *alters* may remain anonymous in the “name generator” (Borgatti, et. al, 2013, p. 263) stage, instead, “position generator” (p. 264) identifies individual types such as professional title. Questions about alter attributes, the “name interpreter” (p. 267) questions, also depend on the specifics of the research, with personal egocentric network analysis often used to associate network attributes with a dependent variable, or central actor traits associated with variable network attributes (Borgatti, et. al, 2013). In personal networks of the study, job position titles were the unit of analysis in network diagrams.

**Stage 3: Interviews to Increase Validity and Richness of Descriptions**

A purposeful selection of central actors were asked to participate in interviews for more detailed responses to network survey questions and to provide an opportunity for open-ended responses related to sustainability implementation at their colleges. A balance between data collection efficiency with accuracy in representing an individual’s personal network was needed while keeping in mind that describing a complete personal network of even one individual is “illusory” (Bidart and Charbonneau, 2011, p. 269) as a single network may include thousands of ties to other actors. Personal egocentric network analysis relies on perceptions of one central actor providing relevant research data, and this network method is growing in social network studies (Bidart & Charbonneau, 2011;
Borgatti & Everett, 1997). Borgatti et al., (2009) states, “… social scientists would note that even when objective measures are available, it is often more useful for predicting behavior to measure a person’s perception of their world than to measure their actual world.” (p. 895).

Emails and telephone calls were used to encourage completion of surveys and to invite participants for interviews. Interview consent forms was sent by email for confirmation by interviewees. Selection of the interviewees were based on completion of name generator survey questions, agreement to be interviewed, and representation from each of the college clusters and alter types (faculty, staff, and administrator). Five colleges were selected for interviews to represent all three college clusters for maximum variation of sustainability code frequencies and typologies. Researcher memos were used throughout as well as follow-up communications as needed to clarify interview data to verify data reliability. Information from interviewees was stored using pseudonyms in place of actual names during data analyses. The roster file with interviewee names and pseudonyms was stored separately from thematically coded attribute data to ensure confidentiality.

The researcher was the instrument in interview data collection for rich descriptions of participant perceptions (Ponterotto, 2006; Creswell, 2009; Merriam, 2009). For this study, a focus of the interviews were an SNA phase known as name interpreter, as additional questions about alter attributes were asked, such as frequency of communication to help designate strong versus weak network ties, and affiliations with outside groups (see interview questions in Appendix F). Interviewees were asked specifically to name individuals, groups, and job positions involved in sustainability
implementation at their respective colleges. Those named are alters/nodes for the interviewees personal network. For each alter, *interpreter questions* were asked to generate alter attributes: role in sustainability implementation (lead, plan, manage, or other); importance (high, medium, or low); meeting frequency, and sustainability communications frequency (more than once a month, about once a month, once every three or four months, once or twice a year). The last interview question was open-ended, asking interviewees if they had contributions to the study that had not been asked, or any additional comments about sustainability implementation at their college.

Interviews were digitally recorded using a recorder and backup recorder, and transcribed using Pages word processing software. Ordinal responses to network questions were numerically coded to calculate standard SNA measures for relative comparisons and for thematic development. Numeric ordinal coding of responses, shown in Appendix F, are used to calculate standard SNA measures for relative comparisons. After all interviews were transcribed the SNA measures were calculated for each network. Descriptions of SNA measures in Table 3.2 follow: *degree* is simply the number of alters in a personal network; *sustainability impact* central tendency is calculated from ordinal responses to sustainability role and importance questions for each alter; *tie strength* central tendency calculations are from ordinal responses to meeting and communication questions. *Heterophily* is a measure comparing typology of the ego center to alters using the following EI index (Crossley et al., 2015, p. 81),

\[
EI = \frac{E - I}{E + I}
\]

where E is the number of alter types different from the ego, and where I is the number of alter types the same as the ego.


*Alter dispersion* is a measure of equal distribution of alter types (administrator, faculty, or staff) using a Blau H and Agresti’s Index of Qualitative Variation (IQV) described by Crossley et al., 2015. IQV is determined by (p. 79),

\[
IQV = H/(1-1-r)
\]

where \( r \) is the number of relation types, and

where \( H \) is calculated by determining degree, then proportions (P) of alter types,

\[
H = 1-P_1^2-P_2^2-P_3^2
\]

An IQV of 1.0 is high dispersion and 0.0 is low. These SNA measures were calculated as advantages and disadvantages to the same and dissimilar typologies are an area of ongoing research in network theory and application. For example, *heterophily* is hypothesized to be more influential than a *homophily* network in innovation diffusion.

Table 3.2

<table>
<thead>
<tr>
<th>Social Network Analysis Measure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree</td>
<td>Number of alters</td>
</tr>
<tr>
<td>Alter Central Tendency: Sustainability Impact</td>
<td>Mean of coded responses to two questions on sustainability role and importance</td>
</tr>
<tr>
<td>Tie Central Tendency: Tie Strength</td>
<td>Mean of coded responses to two questions on meetings and communications</td>
</tr>
<tr>
<td>Ego-Alter Similarity: Heterophily</td>
<td>EI index of Administration, Faculty, Staff Types</td>
</tr>
<tr>
<td>Alter Dispersion by Type</td>
<td>Index of Qualitative Variation (IQV) of Administration, Faculty, Staff Types</td>
</tr>
</tbody>
</table>

**Descriptive Statistics and Thematic Coding**

Data collected from surveys and interviews were both closed and open-ended questions (see Appendices D and F). Closed questions generate responses based on a given list while open questions have no lists and instead respondents generate answers. Descriptive statistics of survey questions were used for closed questions. However, many

63
of these questions have an *Other* option for an open response. Interviews also generated participant responses from an unstructured discussion. Thematic coding of these open and unstructured responses were thematically interpreted (Creswell, 2009; Merriam, 2009). Thematic coding involved identifying shared and unique responses and interpreting relevance to the study purpose. Digital transcriptions using Pages and Microsoft Excel software were used for organizing, coding and thematic interpretations of data.

**Limitations of the Study**

**Researcher Bias**

Employed at one of the two-year colleges and engaged in sustainability implementation, the researcher has some degree of bias in study design and interpretation, and needs to be transparent in her role as both researcher and practitioner. College sustainability activities written in Sustainability Reports were evaluated and coded based on researcher interpretations of the STARS category descriptions. The researcher was aware of activities at some of the colleges and may have been influenced when coding activities, or when coding interview transcripts. Bias may be especially true when interpreting data from the researcher's participant college.

**Participant Reliability and Validity**

SNA studies rely on actor responses for relationship network data, and actor bias was recognized as an error in recall resulting in missing data. To improve reliability in SNA studies, Rice et al. (2014) recommends using a survey as a name generator in combination with interviews. They found surveys alone as name generators "led to many omissions" (p. 265), and that interviews tended to lessen participant fatigue and expand network data. The study followed the recommendation by first using an online survey
including name generator questions, then follow-up interviews to expand data.

Perceptions from survey and interview participants were triangulated with document analysis. However, the reliability of participant responses likely contained some error in recall. Participants may also have had reservations in providing responses to work-related questions. Participants may also have been aware of the researcher's position within the college system and may have influenced responses to be more favorable. To increase the validity of results, the researcher used both surveys and interviews (Creswell, 2013; Maxwell, 2012; Rice, et. al, 2014) as well as references to documented college sustainability activities during interviews.

**Generalization**

Participant colleges were bounded and limited in number. Thus generalization validity to other colleges was a limitation. SNA is an appropriate method for an inductive approach from specific observations to patterns for generalized theory (Kolleck, 2013; Meuser et al., 2016). However, generalization to other colleges outside the participant colleges was suspect in studies not using randomized participant selection. Therefore, results and interpretations may simply apply to the colleges involved in the study. Providing detailed research design and data analysis helps others to decide applicability to other institutions.

**Chapter Summary**

This chapter reiterated the study purpose and research questions introduced in Chapter One. The researcher constructed and presented a concept framework and visual map showing relationships among faculty, staff, and administrators in three sustainable development adoption phases along with other considerations such as student
collaboration and community partnerships. Research design was expanded upon including setting, participant selection, and data sources. Data collection and analysis occurred in three stages of (1) document analysis and coding; (2) an online survey; and (3) interviews. Approval by the community college system Human Subjects Research Board and University IRB were addressed. Details on survey and interview questions, SNA measures, statistics, cluster analysis, and thematic coding procedures used in this study were described in this chapter. Limitations including researcher bias, participant reliability and validity, and generalization of the study were also included in this chapter. The next three chapters present study results corresponding to the stages above.
CHAPTER FOUR: RESULTS OF STAGE ONE - SUSTAINABILITY CODING

The study purpose is an investigation of sustainability implementation at higher education institutions, specifically at 16 Associate degree colleges within a statewide system. The researcher and practitioners were interested in learning what activities are implemented among colleges, as these activities may act as models within the statewide system. Results from document analysis of written Sustainability Reports are presented in this chapter to address the following research question, what sustainable development activities are implemented by the two-year colleges, and at what frequencies? College sustainability activities for a five-year period were interpreted and coded by the researcher using a process developed for this study. Code frequencies were then used for descriptive statistics and exploratory cluster analysis to group colleges for survey response comparisons to address the research question, using sustainability activities to cluster colleges into groups, what traits emerge across groups?

The study methodology used a multistep approach: (1) development of a coding process for document analysis to quantify college sustainability activities, then used code frequencies to rank activities and for cluster analysis to group colleges; (2) survey sustainability leaders on implementation, then analyzed questionnaire responses including by college cluster groups; and (3) conducted interviews of college sustainability leaders to further identify challenges and personal networks in sustainability implementation. This chapter presents results from sustainability activity coding and grouping of colleges based on code frequencies. Survey responses are presented in Chapter Five, and interview results are presented in Chapter Six.
Document Analysis: Sustainable Development Coding

Document analysis of biannual Sustainability Reports for five years (2012-2016) compiled for the 16 colleges involved development of a coding process that identified widespread and less frequent sustainability activities implemented at the 16 colleges. Activities were coded using a set of 63 Sustainable Development Codes established for this study, initially guided by descriptions of the national Sustainability Tracking Assessment and Rating System (STARS). The study Sustainable Development Codes did not reflect completion of STARS items; instead, individual sustainability activities were interpreted and coded by the researcher based on implementation and support of code headings, not achievement of STARS items for national assessment scoring. Only two of the 16 colleges had undergone national STARS assessment, yet many sustainability activities were occurring at the 16 colleges and were quantified using the study coding process. This process associated one or more codes to each written sustainability activity described in the biannual reports. A total of 1,456 descriptions of sustainability activities were included, resulting in 2,904 associated codes. The 63 study codes were in four categories and not weighted: Engagement (codes E01-E15), Operations (codes O01-O23), Academics (codes A01-A11), and Planning (codes P01-P14). The number of counts for each code (frequency) was ranked both within the four code categories (see Tables 4.1-4.4), and listed in frequency quartiles regardless of category (see Tables 4.5). The frequency mean was 46.1 and a standard deviation of 70.7 with a range of 374. Ten codes were at zero frequency, resulting in a high standard deviation, thus central tendency median of 19 was also calculated.
Engagement Codes

The sum of the 15 Engagement code frequencies were the highest of the four categories with a total of 1,447 counts with just one code, *Trademark Licensing* at zero frequency, see Figure 4.1. Fifty-three percent of Engagement codes were above the overall mean of 46.1, and the number of colleges with these codes, 12 to 15, indicated these types of activities were widespread, shown in Table 4.1.

![Figure 4.1. Distribution of Engagement sustainable development codes.](image)

Sustainability activity descriptions showed that community events open to the public and organized by colleges with other groups were pervasive. An example from the June 2012 Sustainability Report is below to provide richer detail on sustainability implementation.

Attended by more than 750 people, the April 22, 2012, Earth Day annual event is an exemplary example of collaborative effort, involving the contributions from the following: Other [statewide system] colleges… local secondary schools; Appalachian Science in the Public Interest; U.S. Forest Service; U.S. Army Corps of Engineers; U.S. Department of Agriculture; National Resources Conservation Services; [county] Conservation District; [state] Department of Fish and Wildlife Resources; [state] Agriculture Extension Office; Student Clubs represented include Phi Theta Kappa, Multicultural Club, PRIDE (Personal Responsibility in a Desirable Environment) Clubs… Girl Scouts [state] Wilderness Road staff and scout troops; [county] Public Library; Culinary Arts, Cosmetology, and Interdisciplinary and Early Childhood Education students; Relay for Life Team. Several classes involved in service learning projects on sustainability presented their work at the conference. Farmers Market representatives were onsite selling
their products. Three car dealers were present to discuss hybrid and electric cars and private businesses brought solar products available for homeowners. (p. 15)

Table 4.1

<table>
<thead>
<tr>
<th>Frequency Total=1447</th>
<th>Sustainable Development Code</th>
<th># Colleges with Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>374</td>
<td>E13 Community Service</td>
<td>16</td>
</tr>
<tr>
<td>271</td>
<td>E10 Community Partnerships</td>
<td>16</td>
</tr>
<tr>
<td>172</td>
<td>E07 Employee Educators Program</td>
<td>16</td>
</tr>
<tr>
<td>152</td>
<td>E04 Outreach Materials and Publications</td>
<td>16</td>
</tr>
<tr>
<td>148</td>
<td>E03 Student Life</td>
<td>16</td>
</tr>
<tr>
<td>94</td>
<td>E09 Staff Professional Development</td>
<td>16</td>
</tr>
<tr>
<td>68</td>
<td>E11 Inter-Campus Collaboration</td>
<td>15</td>
</tr>
<tr>
<td>56</td>
<td>E05 Outreach Campaign</td>
<td>16</td>
</tr>
<tr>
<td>43</td>
<td>E14 Participation in Public Policy</td>
<td>12</td>
</tr>
<tr>
<td>38</td>
<td>E01 Student Educators Program</td>
<td>15</td>
</tr>
<tr>
<td>17</td>
<td>E12 Continuing Education</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>E02 Student Orientation</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>E08 Employee Orientation</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>E06 Assessing Sustainability Culture</td>
<td>3</td>
</tr>
<tr>
<td>0</td>
<td>E15 Trademark Licensing</td>
<td>0</td>
</tr>
</tbody>
</table>

Other examples of community service events included clean-up of public spaces, social services awareness such as personal finance workshops, speakers for Black History month, management of community gardens, clothing and food drives.

Two code frequencies, participation in public policy and student educators program, fell below the mean but above the overall median of 19.0. Examples of the former included participation in national, state, and local government grants and programs such as a US Department of Energy Better Buildings Challenge project, piloting energy management curricula developed by the Environmental Protection Agency, Partnership for a Green City program, and faculty serving on a statewide Environmental Quality Commission. Student educators program activities included
sustainability events by student clubs, and courses with embedded student leadership activities such as recycling, clean-up, gardening, and community service.

Five Engagement codes were below the median and conducted by fewer than half of the colleges. Codes with lower frequencies were of interest as potential growth areas to other colleges. Code E06 applied to three colleges with national assessment ratings using STARS. Continuing education descriptions were often related to workforce training such as from the June 2014 Sustainability Report:

Sessions highlighted sustainability opportunities and practices for how Industrial Businesses, small Businesses/Start-Ups, Restaurants, Non-profits, and Apartment/Property Management could save money with green initiatives and eco-friendly business practices. Participants also received continuing education credit toward LEED Design (USGBC Continuing Education Credits) credentials. (p. 32).

General community workshops offered in the December 2016 Sustainability Report include:

Community education classes frequently offer direct or indirect education about one of the pillars of sustainability. For example, topics have included gardening and natural landscaping; home canning; edible gifts; and various craft programs that use recycled, found, or natural items. (p. 39)

**Operations Codes**

With 23 codes, Operations had the second highest total frequency at 614, much less than the Engagement codes total. Four were coded for all 16 colleges, and two coded for 15 colleges. Three Operation codes, 13% were above the overall mean of 46.1 as shown in Figure 4.2. Campus recycling activities were coded as *waste minimization and diversion*, the highest frequency code in this category. The next highest code, *landscape management* included campus trails, no mow zones with signage, disc golf, water detention, campus living laboratories for classes such as greenhouses, vegetable gardens,
native plantings, and wetlands. The building energy consumption code was next highest even though the study coding does not count contracts coordinated by the statewide system office for all colleges; instead, activities initiated by individual colleges that were reported and compiled in the biannual reports were counted. The seven Operation codes below the frequency mean and at or above the median were nonetheless activities distributed across the colleges with a range of 10 to 16 colleges with these codes (see Table 4.2, “# Colleges with Codes”): water use; sustainable procurement; support for sustainable transportation; employee commute modal split; clean and renewable energy; electronics purchasing; building design and construction; and campus fleet. Hybrid vehicles, bicycle use, and shared commuting were supported by some colleges, as was use of alternative energy technology. Solar, wind, and geothermal were not major campus energy sources; rather, their use was primarily for demonstration. Half of the Operation codes were below the median with two at zero frequency, greenhouse gas emissions, and rainwater management. The other 9 codes below the 19 median are in Table listed in 4.2.
Table 4.2

<table>
<thead>
<tr>
<th>Sustainable Development Code</th>
<th>Frequency</th>
<th># Colleges with Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>O19 Waste Minimization and Diversion</td>
<td>148</td>
<td>16</td>
</tr>
<tr>
<td>O09 Landscape Management</td>
<td>85</td>
<td>15</td>
</tr>
<tr>
<td>O05 Building Energy Consumption</td>
<td>82</td>
<td>16</td>
</tr>
<tr>
<td>O03 Building Operations and Maintenance</td>
<td>44</td>
<td>16</td>
</tr>
<tr>
<td>O22 Water Use</td>
<td>34</td>
<td>16</td>
</tr>
<tr>
<td>O11 Sustainable Procurement</td>
<td>30</td>
<td>15</td>
</tr>
<tr>
<td>O18 Support for Sustainable Transportation</td>
<td>28</td>
<td>12</td>
</tr>
<tr>
<td>O17 Employee Commute Modal Split</td>
<td>24</td>
<td>13</td>
</tr>
<tr>
<td>O06 Clean and Renewable Energy</td>
<td>21</td>
<td>10</td>
</tr>
<tr>
<td>O12 Electronics Purchasing</td>
<td>20</td>
<td>12</td>
</tr>
<tr>
<td>O04 Building Design and Construction</td>
<td>19</td>
<td>9</td>
</tr>
<tr>
<td>O15 Campus Fleet</td>
<td>19</td>
<td>10</td>
</tr>
<tr>
<td>O13 Cleaning and Janitorial Purchasing</td>
<td>14</td>
<td>11</td>
</tr>
<tr>
<td>O10 Biodiversity</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>O16 Student Commute Modal Split</td>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td>O14 Office Paper Purchasing</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>O07 Food and Beverage Purchasing</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>O08 Sustainable Dining</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>O21 Hazardous Waste Management</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>O02 Outdoor Air Quality</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>O20 Construction and Demolition Waste Diversion</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>O01 Greenhouse Gas Emissions</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>O23 Rainwater Management</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

While some colleges practice sustainable purchasing for specific products such as paper or janitorial supplies, one college had implemented a Green Purchasing Policy described in the June 2016 Sustainability Report:

To ensure products that conserve energy, are recycled and sustainable are purchased at the college, a Green Purchasing Policy has been implemented. When determining whether a product is environmentally preferable, all phases of the product’s life cycle are considered, including: raw materials acquisition, production, manufacturing, packaging, distribution, operation, maintenance, disposal, potential for reuse and ability to be recycled. In addition, employees are counseled and educated at the time of request of the benefits regarding purchasing
sustainable products. Environmental and social considerations are taken with equal weight to the price, availability and performance criteria that colleges and universities use to make purchasing decisions. (p. 55)

**Planning Codes**

The frequency total of the 14 Planning codes was 456, see Figure 4.3. Three of the codes (21%), *sustainability planning, sustainability coordination,* and *participatory governance,* were above the 46.1 mean and implemented by all 16 colleges, see Table 4.3. All colleges initiated sustainability committees in 2012 with members representing diverse campus areas, but few included students in *participatory governance.* Nine Planning codes had a frequency below the overall median. The Planning category had the highest number of zero code frequencies at five, 36% of codes in this category - three involved sustainability investing. Other Planning codes below the median of 19 are *wellness program, workplace health and safety, diversity and equity coordination,* and *assessing diversity and equity.* Two codes were below the overall mean but above the median, *support for underrepresented groups,* and *affordability and access,* indicating that events for minorities and low income community members were held to recruit and retain students, yet coordination and assessment of diversity was not widespread at the

![Figure 4.3. Distribution of Planning sustainable development codes.](chart.png)
colleges. One college had national recognition in advancing diversity with its program described below in the December 2016 Report:

The Office of Multiculturalism and Inclusion encourages multicultural students; provides diversity and cultural training to students, staff, and faculty; provides assistance to multicultural students; promotes cultural exchange within the college; and develops continuous outreach programs to under-represented populations. The outreach and services are ongoing and offered through such programs as 4-year college transfer opportunities, summer emersion camps, intramural sports, student employment, Latino outreach programs, LSAMP, and ready-to-work programs. (p. 33)

Table 4.3

<table>
<thead>
<tr>
<th>Sustainable Development Code</th>
<th># Colleges with Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Total = 456</td>
<td></td>
</tr>
<tr>
<td>197 P02 Sustainability Planning</td>
<td>16</td>
</tr>
<tr>
<td>99 P01 Sustainability Coordination</td>
<td>16</td>
</tr>
<tr>
<td>50 P03 Participatory Governance</td>
<td>16</td>
</tr>
<tr>
<td>33 P06 Support for Underrepresented Groups</td>
<td>12</td>
</tr>
<tr>
<td>30 P07 Affordability and Access</td>
<td>12</td>
</tr>
<tr>
<td>18 P13 Wellness Program</td>
<td>9</td>
</tr>
<tr>
<td>13 P14 Workplace Health and Safety</td>
<td>7</td>
</tr>
<tr>
<td>11 P04 Diversity and Equity Coordination</td>
<td>4</td>
</tr>
<tr>
<td>5 P05 Assessing Diversity and Equity</td>
<td>5</td>
</tr>
<tr>
<td>0 P08 Committee on Investor Responsibility</td>
<td>0</td>
</tr>
<tr>
<td>0 P09 Sustainable Investment</td>
<td>0</td>
</tr>
<tr>
<td>0 P10 Investment Disclosure</td>
<td>0</td>
</tr>
<tr>
<td>0 P11 Employee Compensation</td>
<td>0</td>
</tr>
<tr>
<td>0 P12 Assessing Employee Satisfaction</td>
<td>0</td>
</tr>
</tbody>
</table>

Academics Codes

Academic codes had a total frequency of 387 and the smallest number of total codes at 11, see Figure 4.4. Three code frequencies (27%) were above the overall mean, learning outcomes, campus as a living laboratory, and academic courses – these three were widespread with 15 to 16 colleges with these codes, see Table 4.4. In sustainability
activity descriptions, general education incorporating sustainability concepts include courses in English, history, political science, biology, chemistry, geography, sociology, psychology, art, communications, sustainability, physics, statics, and mathematics. An example of incorporating \textit{campus as a living laboratory} describes involvement by both technical and general education classes in the December 2012 Sustainability Report:

Due to our recent installation of a solar array, students will be using data from the array regarding our production of electricity in the following courses: ELT 114, 210, and 214; PHY 171 and 231; STA 220; and MAT 150. (p. 41)

A number of technology programs incorporated sustainability principles and/or a credential related to sustainability: Automotive; Heating Ventilation Air Conditioning; Environmental Science; Engineering and Electronics; Energy Audit Training; Construction; Agriculture; Culinary Arts; Alternative Energy Systems; Energy Management; Information Technology; Healthcare Facilities Leadership; Computer Aided Drafting and Design; Nursing; Radiography; Sonography; Surgical; Welding; Alternative Fuels; Green Production; Heavy Equipment Operations, and others such as the program described in the December 2013 Report:

..Energy Management program, with its five national, industry-recognized certificates embedded within the curriculum, prepares students for a variety of

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{frequency.png}
\caption{Distribution of Academic sustainable development codes.}
\label{fig:academic_codes}
\end{figure}
employment opportunities. Entry level positions in the energy production industry include renewable energy sales, LEED consultant, alternative energy consultants, residential audits, etc. Energy Management graduates can also find employment in the growing fields of energy audit, energy consulting, and facilities management. Employment opportunities are expected to be the greatest in metropolitan areas. (p. 45)

Table 4.4

<table>
<thead>
<tr>
<th>Academic Sustainable Development Codes Ranked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
</tr>
<tr>
<td>Total = 387</td>
</tr>
<tr>
<td>171</td>
</tr>
<tr>
<td>56</td>
</tr>
<tr>
<td>54</td>
</tr>
<tr>
<td>39</td>
</tr>
<tr>
<td>28</td>
</tr>
<tr>
<td>23</td>
</tr>
<tr>
<td>11</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>0</td>
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</tr>
</tbody>
</table>

Three code frequencies were below the mean and above the median, *immersive experience, incentives for developing courses, and undergraduate program*. These codes were fairly prevalent with 10 to 15 colleges with these codes. Five codes were below the overall median of 19, with two at zero frequency. The other Academic codes below the median were related to research. A few colleges are involved in sustainability related research as described below in the December 2014 Report:

Two biology professors… are part of a $20 million grant with the University of [state] Center for Applied Energy Research. The grant, awarded by the National Science Foundation, is for a five-year period. The grant will allow [researchers] to lead survey efforts throughout the region to study the potential of plants as a renewable energy resource. (p. 31)
Frequency codes were also ranked by quartiles below for further analysis and potential future use by sustainable development practitioners at colleges.

**Sustainability Code Frequencies by Quartiles**

The 4th quartile sum of counts was 2,227 with a frequency range of 321–374 (high) – 53 (low), see Table 4.5. The 4th quartile was 59.9% Engagement codes, supporting the previous description of Engagement activities dominating overall sustainability activities at the colleges. Although frequencies were the measure across the 63 codes, the opportunities for individual counts were not equivalent among the codes. For example, Engagement activities such as *community service* (E13) was the highest overall code frequency (f) at 374 with all 16 colleges participating. These included college activities such as Earth Day and recycling events, gardens and landscaping open to communities, and volunteer work conducted by students, staff, or faculty from different departments. Other codes, such as *student orientation* (E02) in the 3rd quartile, with just 6 colleges implementing, would typically not be conducted by multiple constituents or departments and be expected to have lower frequency compared to *Community Service*. The number of colleges with the code are also shown in Tables 4.1-4.5. This number tended to increase as frequency increased.

Operation codes were 14.1% in this quartile with *waste minimization and diversion* (f=148) the highest operation code which includes campus recycling activities. Academic codes comprised 13.3% with sustainability *learning outcomes* (f=172) the highest. Planning codes were just two codes at 12.6%, *sustainable planning* (f=197) and *sustainability coordination* (f=99). Codes in the 4th quartile were implemented by all
<table>
<thead>
<tr>
<th>Frequency</th>
<th>4&lt;sup&gt;th&lt;/sup&gt; Quartile of Sustainable Development Code</th>
<th># Colleges with Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>374</td>
<td>E13 Community Service</td>
<td>16</td>
</tr>
<tr>
<td>271</td>
<td>E10 Community Partnerships</td>
<td>16</td>
</tr>
<tr>
<td>197</td>
<td>P02 Sustainability Planning</td>
<td>16</td>
</tr>
<tr>
<td>172</td>
<td>E07 Employee Educators Program</td>
<td>16</td>
</tr>
<tr>
<td>171</td>
<td>A02 Learning Outcomes</td>
<td>16</td>
</tr>
<tr>
<td>152</td>
<td>E04 Outreach Materials and Publications</td>
<td>16</td>
</tr>
<tr>
<td>148</td>
<td>E03 Student Life</td>
<td>16</td>
</tr>
<tr>
<td>148</td>
<td>O19 Waste Minimization and Diversion</td>
<td>16</td>
</tr>
<tr>
<td>99</td>
<td>P01 Sustainability Coordination</td>
<td>16</td>
</tr>
<tr>
<td>94</td>
<td>E09 Staff Professional Development</td>
<td>16</td>
</tr>
<tr>
<td>85</td>
<td>O09 Landscape Management</td>
<td>15</td>
</tr>
<tr>
<td>82</td>
<td>O05 Building Energy Consumption</td>
<td>16</td>
</tr>
<tr>
<td>68</td>
<td>E11 Inter-Campus Collaboration</td>
<td>15</td>
</tr>
<tr>
<td>56</td>
<td>A8 Campus as a Living Laboratory</td>
<td>16</td>
</tr>
<tr>
<td>56</td>
<td>E05 Outreach Campaign</td>
<td>16</td>
</tr>
<tr>
<td>54</td>
<td>A01 Academic Courses</td>
<td>15</td>
</tr>
<tr>
<td>50</td>
<td>P03 Participatory Governance</td>
<td>16</td>
</tr>
<tr>
<td>44</td>
<td>O03 Building Operations and Maintenance</td>
<td>16</td>
</tr>
<tr>
<td>43</td>
<td>E14 Participation in Public Policy</td>
<td>12</td>
</tr>
<tr>
<td>39</td>
<td>A05 Immersive Experience</td>
<td>14</td>
</tr>
<tr>
<td>38</td>
<td>E01 Student Educators Program</td>
<td>15</td>
</tr>
<tr>
<td>34</td>
<td>O22 Water Use</td>
<td>16</td>
</tr>
<tr>
<td>33</td>
<td>P06 Support for Underrepresented Groups</td>
<td>12</td>
</tr>
<tr>
<td>30</td>
<td>O11 Sustainable Procurement</td>
<td>15</td>
</tr>
<tr>
<td>30</td>
<td>P07 Affordability and Access</td>
<td>12</td>
</tr>
<tr>
<td>28</td>
<td>A07 Incentives for Developing Courses</td>
<td>13</td>
</tr>
<tr>
<td>28</td>
<td>O18 Support for Sustainable Transportation</td>
<td>12</td>
</tr>
<tr>
<td>24</td>
<td>O17 Employee Commute Modal Split</td>
<td>13</td>
</tr>
<tr>
<td>23</td>
<td>A03 Undergraduate Program</td>
<td>10</td>
</tr>
<tr>
<td>21</td>
<td>O06 Clean and Renewable Energy</td>
<td>10</td>
</tr>
<tr>
<td>20</td>
<td>O12 Electronics Purchasing</td>
<td>12</td>
</tr>
</tbody>
</table>
Table 4.5 (continued)

Sustainable Development Code Frequencies by Quartiles

<table>
<thead>
<tr>
<th>Frequency</th>
<th>2nd Quartile of Sustainable Development Code</th>
<th># Colleges with Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>O04 Building Design and Construction</td>
<td>9</td>
</tr>
<tr>
<td>19</td>
<td>O15 Campus Fleet</td>
<td>10</td>
</tr>
<tr>
<td>18</td>
<td>P13 Wellness Program</td>
<td>9</td>
</tr>
<tr>
<td>17</td>
<td>E12 Continuing Education</td>
<td>7</td>
</tr>
<tr>
<td>14</td>
<td>O13 Cleaning and Janitorial Purchasing</td>
<td>11</td>
</tr>
<tr>
<td>13</td>
<td>P14 Workplace Health and Safety</td>
<td>7</td>
</tr>
<tr>
<td>12</td>
<td>O10 Biodiversity</td>
<td>8</td>
</tr>
<tr>
<td>11</td>
<td>A09 Research and Scholarship</td>
<td>7</td>
</tr>
<tr>
<td>11</td>
<td>O16 Student Commute Modal Split</td>
<td>6</td>
</tr>
<tr>
<td>11</td>
<td>P04 Diversity and Equity Coordination</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>O14 Office Paper Purchasing</td>
<td>7</td>
</tr>
<tr>
<td>6</td>
<td>E02 Student Orientation</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>O07 Food and Beverage Purchasing</td>
<td>5</td>
</tr>
</tbody>
</table>

1st Quartile of Sustainable Development Code

<table>
<thead>
<tr>
<th>Frequency</th>
<th>1st Quartile of Sustainable Development Code</th>
<th># Colleges with Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>E08 Employee Orientation</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>O08 Sustainable Dining</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>P05 Assessing Diversity and Equity</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>A10 Support for Research</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>E06 Assessing Sustainability Culture</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>O21 Hazardous Waste Management</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>A11 Open Access to Research</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>O02 Outdoor Air Quality</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>O20 Construction and Demolition Waste Diversion</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>A04 Graduate Program</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>A06 Sustainability Literacy Assessment</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>E15 Trademark Licensing</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>O01 Greenhouse Gas Emissions</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>O23 Rainwater Management</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>P08 Committee on Investor Responsibility</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>P09 Sustainable Investment</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>P10 Investment Disclosure</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>P11 Employee Compensation</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>P12 Assessing Employee Satisfaction</td>
<td>0</td>
</tr>
</tbody>
</table>
colleges except for 3 codes at 94% (15 of 16 colleges), see Table 4.5. The 3rd quartile had a total of 484 counts and a frequency range of 32 = 52 (high) -20 (low). Operation codes dominated the 3rd quartile with 41.4%, Planning codes were 23.2% of this quartile, Academics codes were 18.6% and Engagement comprised 16.7% of the 3rd quartile. Most of the colleges, 63-100%, implemented these coded activities.

At the other end of the spectrum, the 1st quartile had the smallest frequency range of 5, and a total count of 27. These were the practices least implementation by the colleges. Ten of the nineteen codes had a frequency of zero, no college was implementing these activities. Operation codes were 33.3% of this quartile, Engagement codes with counts were 29.6%, Academics and Planning codes were each at 18.5%. Five of the six planning codes were at zero frequency. The frequency range for the 2nd quartile was 13 = 19 (high) – 6 (low), with a total count of 165. Operations were 53.9% of codes in the quartile, Planning codes were 25.5%, Engagement codes were 13.9% and Academics was just 6.7% with one code, research and scholarship (f=11). The percent of colleges implementing the coded activities in the 2nd quartile range from 25-69%, indicating room for expansion to all colleges.

**Descriptive Statistics and Cluster Analysis**

Separating the 16 colleges into groups based on sustainability activities was intended to explore and compare group attributes, as stated in the research question, *using sustainability activities to cluster colleges into groups, what traits emerge across groups?* Numeric coding of college sustainability activities allowed for descriptive and cluster analysis to separate colleges by differences in Sustainable Development Code frequencies.
Descriptive Statistics

A sum total of frequency codes calculated for each college resulted in a mean of 181.6 and a standard deviation of 51.7. Radar charts were used to visualize frequency distribution of codes and show very few codes higher than one standard deviation above the mean, see Figure 4.5. Because of the large number of codes with smaller frequencies, Figure 4.6 shows a closer look at the distribution of code frequencies with smaller counts. Fourteen of the 16 colleges were within one standard deviation of the frequency mean, one college two standard deviations higher, and one college one standard deviation lower than the mean. The range was 211 = 339 (high) – 128 (low) with one outlier college at 339. The range without the outlier was 92, the mean was 171.1 with a standard deviation of 31.1. Seven colleges were within one standard deviation without the outlier, four colleges were below one standard deviation, and four colleges above.

Cluster Analysis

Cluster analysis allowed relative differences in the four categorical code frequencies (Academics, Engagement, Operations, and Planning) to be calculated and compared among cluster groups. A matrix of all 16 colleges and the code frequency totals by the four categories comprised the data for K-Means Cluster Analysis in SPSS software. K-Means analysis allowed designation of number of clusters, and the same one college outlier was grouped separately from the others whether 2, 3, 4, or 5 were designated clusters. The one college was the outlier two standard deviations from the mean. A three cluster designation was used for comparisons in this study, Cluster A had 8 colleges, Cluster B had 7, and Cluster C had the 1 college. Comparisons of the distance
Figure 4.5. Visualization of frequency distribution of all code sums.

Figure 4.6. Visualization of frequency distribution of code sums less than 100.
between the cluster centers indicated the relative degree of differences among the clusters frequencies sums, shown in Table 4.6.

Table 4.6

<table>
<thead>
<tr>
<th>Distances between Cluster Centers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cluster</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>A</td>
</tr>
<tr>
<td>B</td>
</tr>
<tr>
<td>C</td>
</tr>
</tbody>
</table>

Cluster C was more similar to Cluster B at 98.6 distance compared to Cluster A at 138.1 distance. Cluster A and B centers were more similar to each other than to Cluster C.

Shown in Table 4.7, comparisons among the clusters in Academics (A), Engagement (E), Operations (O), and Planning (P) showed that Cluster C was highest in all four categories, but less so in the Academics category. Cluster C was the one outlier college two standard deviations from the mean, defined by Rogers as an innovator in adopting innovation. For Academics, the low mean numbers with a range of 2 indicated that sustainability activities in this category might be challenging for colleges to implement.

Table 4.7

<table>
<thead>
<tr>
<th>Cluster Centers of Three College Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code Category</td>
</tr>
<tr>
<td>---------------</td>
</tr>
<tr>
<td>Academics</td>
</tr>
<tr>
<td>Engagement</td>
</tr>
<tr>
<td>Operations</td>
</tr>
<tr>
<td>Planning</td>
</tr>
</tbody>
</table>

compared to the other categories. Engagement activities had the highest cluster centers and highest range at 132, indicating more activity in this category with Cluster A the
lowest and Cluster C highest. Operations and Planning numbers were similar for Clusters A and B while Cluster C was higher. Cluster centers for Operation sums increased from Cluster A to B then C with a range of 19. Planning cluster centers have a range of 35, with Cluster A and B similar, while Cluster C higher at 62. The Cluster Centers by categories confirms the distance between clusters described previously in Table 4.6. The three clusters were similar in Academic frequencies, vary in Engagement frequencies from each other, and Cluster C differentiates itself in Operations and Planning frequency.

A two cluster K-Means without the outlier data results in the same Cluster A and Cluster B college groups compared to using all data in K-Means of three clusters. The two separate clusters were supported by descriptive statistics when the outlier was not used in analysis, with eight colleges in Cluster A including all four colleges one standard deviation below the mean, and seven colleges in Cluster B including all four colleges above the means. The final cluster centers of K-Means for Cluster A and B did not change from Table 4.7.

**Chapter Summary**

A coding process developed for the study allowed for quantitative ranking of sustainability activity code frequencies, and grouping of colleges with similar frequencies for cluster comparisons. Ranking codes by frequency and showing the number of colleges with each code allow practitioners to explore activities for possible implementation at their colleges. Those codes higher in rank and inclusion within the 16 colleges may be easier to implement while the opposite may be true for those with lower rank and inclusion. Sustainable Development coding was the basis for cluster analysis to
group colleges with similar activities. Survey and interview results were then compared by cluster groups for potential differences in study results described in chapters 6 and 7.

The total sum for all 63 codes was 2,904 individual counts for all 16 colleges. Ten codes (15.9%) were not implemented at any of the colleges, indicating difficulty to address these types of activities at the colleges. Eight codes were above one standard deviation from the mean and widespread among the colleges—these were dominated by Engagement codes. Operation codes dominated third, second, and first quartiles.

Code frequencies were also used for college comparisons and grouping through descriptive statistics and cluster analysis using frequencies by college. One college was two standard deviations from the mean. Using cluster analysis, this outlier college (Cluster C) was higher in all four categories than the cluster groups. Designating three cluster groups resulted in Cluster A with 8 colleges, Cluster B with seven colleges and Cluster C with the one college with the highest frequency means. Cluster B was higher in Engagement categories than Cluster A. Comparisons among college cluster groups are shown in the next chapters describing survey and interview results.
CHAPTER FIVE: RESULTS OF STAGE TWO – SURVEY

In addition to coding sustainability activities described in the previous chapter, a survey instrument and interviews were used to ask sustainability leaders about implementation at their colleges including leadership, social networks, and perceived barriers. This chapter presents survey results to address the following research questions:

What challenges to sustainable development do sustainability leaders at the two year colleges identify? Are there notable differences in responses among college groups?

What network relationships are identified in implementing sustainable development activities at the two-year colleges? Do the college groups identify different relationship typologies?

Survey results are presented in the following three sections: Demographics, Sustainable Development, and Social Networks. The last survey question was on whether the participant would agree to be interviewed for the study. From those responding affirmatively, five respondents participated in interviews to more fully illustrate personal networks involved in sustainability implementation, and answered an open-ended question for additional comments that would contribute to the study. Interview results are presented in Chapter Six.

**Sustainable Survey Responses**

Electronic surveys were emailed to 179 individuals identified as college sustainability committee members at the 16 Associate degree colleges within the same statewide governing board. The survey response rate was 44%, with a total of 78 respondents. Survey results are presented by percent response for each question, and are shown by total (N) and college groups (n) determined using cluster analysis of sustainability code frequencies. Cluster A had 34 respondents from eight colleges,
Cluster B had 39 respondents from seven colleges, and Cluster C had 5 respondents from one college based on K-Means cluster analysis using category code frequencies, see Table below.

Table 5.1

<table>
<thead>
<tr>
<th>Comparisons</th>
<th>Responses</th>
<th>Cluster A</th>
<th>Cluster B</th>
<th>Cluster C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survey respondents</td>
<td>N=78</td>
<td>n=34</td>
<td>n=39</td>
<td>n=5</td>
</tr>
<tr>
<td>Number of colleges</td>
<td>16</td>
<td>8</td>
<td>7</td>
<td>1</td>
</tr>
</tbody>
</table>

The composition of Cluster A and B college groups did not differ when K-Means is 2 or 3 groups in cluster analysis. Cluster comparisons of survey responses were conducted based on Pearson’s Chi Square two-way contingency table analysis using Crosstabs in SPSS statistical software, alpha < 0.05 for significant difference in distribution - valid only when 20% or more responses are over 5 counts (Green & Salkind, 2014, p. 333).

Because of the low number of five respondents from Cluster C responses, percentages were not comparable using this statistic. Survey questions and responses (Tables 5.2-5.4) are described below in three sections: Demographics, Sustainable Development, and Social Networking.

**Demographics**

Survey respondent demographics indicate a large majority, 80.8% were over 40 years of age, and mostly female, (56.0% and 44% male). Job titles later categorized into three types were: 43.4% faculty, 31.6% staff, and 25.0% administrators. More than 83% have worked at their college for 6 to over 12 years, although only 64.1% were in the same job position for that time span. Using the Pearson Chi-Square test, significant difference in age ranges between clusters was found (p = 0.001), with Cluster B colleges
higher in the 53-71 range and Cluster A colleges higher in the 41-52 age range.

Demographic responses by cluster groups showed no significant difference between Cluster A and B in years at college, years in present position, or in faculty/staff/administration job title. Survey questions and responses at the colleges are shown in Table 5.2 with N indicating all responses and n the number of responses within a cluster.

Table 5.2

**Demographic Survey Questions with Responses**

<table>
<thead>
<tr>
<th>Questions</th>
<th>Responses (N)</th>
<th>Cluster A (n)</th>
<th>Cluster B (n)</th>
<th>Cluster C (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is your age?*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under 18</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>18-21</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>22-40</td>
<td>19.5% (15)</td>
<td>21.2% (7)</td>
<td>15.4% (6)</td>
<td>40.0% (2)</td>
</tr>
<tr>
<td>41-52</td>
<td>36.4% (28)</td>
<td>54.6% (18)</td>
<td>20.5% (8)</td>
<td>40.0% (2)</td>
</tr>
<tr>
<td>53-71</td>
<td>44.2% (34)</td>
<td>24.2% (8)</td>
<td>64.1% (25)</td>
<td>20.0% (1)</td>
</tr>
<tr>
<td>Over 71</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100% (77)</td>
<td>100% (33)</td>
<td>100% (39)</td>
<td>100% (5)</td>
</tr>
<tr>
<td>What is your gender?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>56.0% (42)</td>
<td>58.1% (18)</td>
<td>51.3% (20)</td>
<td>83.0% (4)</td>
</tr>
<tr>
<td>Male</td>
<td>44.0% (33)</td>
<td>41.9% (13)</td>
<td>48.7% (19)</td>
<td>17.0% (1)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100% (75)</td>
<td>100% (31)</td>
<td>100% (39)</td>
<td>100% (5)</td>
</tr>
<tr>
<td>How long have you worked at your college?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 2 years</td>
<td>3.9% (3)</td>
<td>2.9% (1)</td>
<td>2.6% (1)</td>
<td>20.0% (1)</td>
</tr>
<tr>
<td>2 to &lt; 6 years</td>
<td>12.8% (10)</td>
<td>20.6% (7)</td>
<td>7.7% (3)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>6 to 12 years</td>
<td>28.2% (22)</td>
<td>29.4% (10)</td>
<td>25.6% (10)</td>
<td>40.0% (2)</td>
</tr>
<tr>
<td>Over 12 years</td>
<td>55.1% (43)</td>
<td>47.1% (16)</td>
<td>64.1% (25)</td>
<td>40.0% (2)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100% (78)</td>
<td>100% (34)</td>
<td>100% (39)</td>
<td>100% (5)</td>
</tr>
<tr>
<td>What is your primary job title at your college?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faculty</td>
<td>44.0% (33)</td>
<td>48.4% (15)</td>
<td>41.0% (16)</td>
<td>60.0% (3)</td>
</tr>
<tr>
<td>Staff</td>
<td>29.3% (22)</td>
<td>19.4% (6)</td>
<td>38.5% (15)</td>
<td>20.0% (1)</td>
</tr>
<tr>
<td>Administrators</td>
<td>26.7% (20)</td>
<td>32.3% (10)</td>
<td>20.5% (8)</td>
<td>20.0% (1)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100% (75)</td>
<td>100% (31)</td>
<td>100% (39)</td>
<td>100% (5)</td>
</tr>
<tr>
<td>How long have you worked in your present job position?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 2 years</td>
<td>18.2% (14)</td>
<td>23.5% (8)</td>
<td>10.5% (4)</td>
<td>40.0% (2)</td>
</tr>
<tr>
<td>2 to &lt; 6 years</td>
<td>18.2% (14)</td>
<td>23.5% (8)</td>
<td>15.8% (6)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>6 to 12 years</td>
<td>29.9% (23)</td>
<td>32.4% (11)</td>
<td>29.0% (11)</td>
<td>20.0% (1)</td>
</tr>
<tr>
<td>Over 12 years</td>
<td>33.8% (26)</td>
<td>20.6% (7)</td>
<td>44.7% (17)</td>
<td>40.0% (2)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100% (77)</td>
<td>100% (34)</td>
<td>100% (38)</td>
<td>100% (5)</td>
</tr>
</tbody>
</table>

* A significant difference (p=0.001) in age ranges between Cluster A (41-52) and Cluster B (53-71)
Sustainable Development

Survey results related to sustainable development at the colleges are in two tables, with responses that allow multiple selections for each question in Table 5.3, and responses that allow one response for each question in Table 5.4. The first three questions on perceived sustainability barriers and key issues allowed for multiple responses, and show no significant differences between Cluster A and B using the Pearson Chi-Square test (alpha < 0.05).

Finances/funding was a top response as a barrier (21.0%) and key issue (20.3%) along with enrollment (21.5%). An open ended comment states, “Budget cuts and policy changes on the national level, may result in colleges paying more for a "greener" campus. College budgets are already tight.” Social barriers are next highest with these responses: lack of understanding and awareness of the issues/sustainability (19.9%); people’s resistance to change (19.9%); social issues will become more important (17.1%); competing priorities (16.8%); and lack of/low level of commitment (16.1%). A high percent (47.0%) responded that these same challenges will exist in the future, although 19.7% view challenges will be more material/technical than psychological or political.

Open-ended comments tended toward pessimism when identifying barriers with administrative leadership as a reoccurring theme: “The administrator that was chosen to lead sustainability efforts and projects does not care and does not have the knowledge to lead,” “Lack of leadership and lack of high level commitment,” and “current Administration’s lack of understanding.” External factors as barriers also were a theme: “budget cuts and policy changes on the national level, may result in colleges paying more for a greener campus. College budgets are already tight”, “I don't think we'll have a
choice in the future about whether we operate in a more ecologically sustainable way. The earth will have the final word.” Internal factors in comments included “Morale”, “Student Engagement”, and “Need more student involvement”. The response choices of these three survey questions include one response more positive than the others, optimistic outlook regarding solutions (12%), and one comment from the Cluster C college followed suit: “I am more interested in what we can do now to have an optimistic outlook for the future”.

The next three survey questions ask about the perceived meaning of sustainable development, and the college’s role in sustainability. No significant difference is found between clusters using the Pearson Chi-Square test (alpha < 0.05). When asked about the meaning of sustainable development, responses indicated its understanding. Two questions, what role should colleges play in achieving sustainability, and the meaning of a sustainable college have the same response selections. The high to low order of response percentages are similar for the two questions. Reducing energy consumption, and sustainable policy implementation are the top two responses for both questions. Financial sustainability (16.6% and 15.0%) and green physical space (16.0% and 17.1%) follow although the two responses exchange ranking for the different questions. Social equity/accessibility for all students, and expanding enrollment/ensuring student participation follow.

Survey questions and responses related to sustainable development that allow one response for each question are in Table 5.5. A majority of total respondents were aware (69.2%), and more were unsure (18.0%) than unaware (12.8%) of the statewide college system Sustainable Development Framework. A large majority (81.8%) acknowledge
Table 5.3

*Sustainable Development Survey Questions, Each Allowing Multiple Responses*

<table>
<thead>
<tr>
<th>Questions</th>
<th>Responses (N)</th>
<th>Cluster A (n)</th>
<th>Cluster B (n)</th>
<th>Cluster C (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>What, if any, barriers to you see preventing your college from engaging in sustainability initiatives?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choose all that apply:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial barriers</td>
<td>21.0% (60)</td>
<td>19.7% (25)</td>
<td>22.7% (32)</td>
<td>16.7% (3)</td>
</tr>
<tr>
<td>Lack of understanding and awareness of the issues/sustainability</td>
<td>19.9% (57)</td>
<td>22.1% (28)</td>
<td>17.7% (25)</td>
<td>22.2% (4)</td>
</tr>
<tr>
<td>People's resistance to change</td>
<td>19.9% (57)</td>
<td>18.9% (24)</td>
<td>20.6% (29)</td>
<td>22.2% (4)</td>
</tr>
<tr>
<td>Lack of/low level of commitment</td>
<td>16.1% (46)</td>
<td>15.0% (19)</td>
<td>17.7% (25)</td>
<td>11.1% (2)</td>
</tr>
<tr>
<td>Competing priorities</td>
<td>16.8% (48)</td>
<td>18.1% (23)</td>
<td>14.9% (21)</td>
<td>22.2% (4)</td>
</tr>
<tr>
<td>Government regulations delaying sustainability initiatives</td>
<td>4.9% (14)</td>
<td>5.5% (7)</td>
<td>4.3% (6)</td>
<td>5.6% (1)</td>
</tr>
<tr>
<td>Other</td>
<td>1.4% (4)</td>
<td>0.8% (1)</td>
<td>2.1% (3)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100% (286)</td>
<td>100% (127)</td>
<td>100% (141)</td>
<td>100% (18)</td>
</tr>
</tbody>
</table>

Do you foresee different barriers and challenges in the future? Choose all that apply:

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimistic outlook regarding solutions</td>
<td>12.0% (14)</td>
<td>16.7% (8)</td>
<td>10.2% (6)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>Same challenges will exist</td>
<td>47.0% (55)</td>
<td>50.0% (24)</td>
<td>45.8% (27)</td>
<td>40.0% (4)</td>
</tr>
<tr>
<td>Social issues will become more important</td>
<td>17.1% (20)</td>
<td>18.8% (9)</td>
<td>13.6% (8)</td>
<td>30.0% (3)</td>
</tr>
<tr>
<td>Challenges will be more material/technical than psychological or political</td>
<td>19.7% (23)</td>
<td>14.6% (7)</td>
<td>23.7% (14)</td>
<td>20.0% (2)</td>
</tr>
<tr>
<td>Other</td>
<td>4.3% (5)</td>
<td>0.0% (0)</td>
<td>6.8% (4)</td>
<td>10.0% (1)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100% (117)</td>
<td>100% (48)</td>
<td>100% (59)</td>
<td>100% (10)</td>
</tr>
</tbody>
</table>

What are the key issues facing your college in the next ten years? Choose all that apply:

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Enrollment</td>
<td>21.5% (71)</td>
<td>21.6% (32)</td>
<td>23.0% (35)</td>
<td>13.3% (4)</td>
</tr>
<tr>
<td>Relationship/relevance of college to society/community Funding/budget/capital expansion/gov. funding</td>
<td>9.4% (31)</td>
<td>10.1% (15)</td>
<td>7.9% (12)</td>
<td>13.3% (4)</td>
</tr>
<tr>
<td>Physical space/building expansion</td>
<td>20.3% (67)</td>
<td>21.0% (31)</td>
<td>21.7% (33)</td>
<td>10.0% (3)</td>
</tr>
<tr>
<td>Quality academic programs/overall student experience</td>
<td>4.9% (16)</td>
<td>4.1% (6)</td>
<td>4.6% (7)</td>
<td>10.0% (3)</td>
</tr>
<tr>
<td>Maintenance of existing buildings</td>
<td>8.8% (29)</td>
<td>8.1% (12)</td>
<td>9.2% (14)</td>
<td>10.0% (3)</td>
</tr>
<tr>
<td>Energy issues</td>
<td>13.0% (43)</td>
<td>14.2% (21)</td>
<td>11.2% (17)</td>
<td>16.7% (5)</td>
</tr>
<tr>
<td>Faculty retention/recruitment/retirement</td>
<td>8.5% (28)</td>
<td>8.1% (12)</td>
<td>7.9% (12)</td>
<td>13.3% (4)</td>
</tr>
<tr>
<td>Other</td>
<td>12.7% (42)</td>
<td>12.2% (18)</td>
<td>13.2% (20)</td>
<td>13.3% (4)</td>
</tr>
<tr>
<td>OTHER</td>
<td>0.9% (3)</td>
<td>0.7% (1)</td>
<td>1.3% (2)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100% (330)</td>
<td>100% (148)</td>
<td>100% (152)</td>
<td>100% (30)</td>
</tr>
</tbody>
</table>
Table 5.3 (continued)

**Sustainable Development Survey Questions, Each Allowing Multiple Responses**

<table>
<thead>
<tr>
<th>Questions</th>
<th>Responses (N)</th>
<th>Cluster A (n)</th>
<th>Cluster B (n)</th>
<th>Cluster C (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>When you hear the term sustainable development, what does this mean to you? Choose all that apply:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Issues surrounding the environment</td>
<td>29.2% (49)</td>
<td>32.4% (23)</td>
<td>28.2% (24)</td>
<td>16.7% (2)</td>
</tr>
<tr>
<td>Non-environment-focused factors</td>
<td>4.2% (7)</td>
<td>4.2% (3)</td>
<td>3.5% (3)</td>
<td>8.3% (1)</td>
</tr>
<tr>
<td>Balancing economy, environment, and social concerns</td>
<td>40.5% (68)</td>
<td>40.9% (29)</td>
<td>41.2% (35)</td>
<td>33.3% (4)</td>
</tr>
<tr>
<td>Continued trajectory of growth/development but with some caveats</td>
<td>6.0% (10)</td>
<td>7.0% (5)</td>
<td>3.5% (3)</td>
<td>16.7% (2)</td>
</tr>
<tr>
<td>Contradiction/oxymoron</td>
<td>1.8% (3)</td>
<td>0.0% (0)</td>
<td>3.5% (3)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>Amorphous meaning</td>
<td>3.6% (6)</td>
<td>1.4% (1)</td>
<td>4.7% (4)</td>
<td>8.3% (1)</td>
</tr>
<tr>
<td>Global context/implications</td>
<td>14.3% (24)</td>
<td>14.1% (10)</td>
<td>14.1% (12)</td>
<td>16.7% (2)</td>
</tr>
<tr>
<td>Other</td>
<td>0.6% (1)</td>
<td>0.0% (0)</td>
<td>1.2% (1)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100% (168)</td>
<td>100% (71)</td>
<td>100% (85)</td>
<td>100% (12)</td>
</tr>
<tr>
<td><strong>What role, if any, do you feel colleges, in general, should play in achieving sustainability? Choose all that apply:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green physical space</td>
<td>16.0% (55)</td>
<td>17.3% (26)</td>
<td>14.5% (24)</td>
<td>18.5% (5)</td>
</tr>
<tr>
<td>Reducing energy consumption</td>
<td>21.6% (74)</td>
<td>20.7% (31)</td>
<td>22.9% (38)</td>
<td>18.5% (5)</td>
</tr>
<tr>
<td>Financial sustainability</td>
<td>16.6% (57)</td>
<td>16.7% (25)</td>
<td>16.3% (27)</td>
<td>18.5% (5)</td>
</tr>
<tr>
<td>Expanding enrollment/ensuring student participation/satisfaction</td>
<td>14.0% (48)</td>
<td>12.7% (19)</td>
<td>15.1% (25)</td>
<td>14.8% (4)</td>
</tr>
<tr>
<td>Social equity/accessibility for all students</td>
<td>15.2% (52)</td>
<td>17.3% (26)</td>
<td>13.9% (23)</td>
<td>11.1% (3)</td>
</tr>
<tr>
<td>Sustainable policy implementation</td>
<td>16.6% (57)</td>
<td>15.3% (23)</td>
<td>17.5% (29)</td>
<td>18.5% (5)</td>
</tr>
<tr>
<td>Never heard term/term is jargon</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>Other</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100% (343)</td>
<td>100% (150)</td>
<td>100% (166)</td>
<td>100% (27)</td>
</tr>
<tr>
<td><strong>When you hear &quot;sustainable college&quot; what does this mean to you? Choose all that apply:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green physical space</td>
<td>17.1% (55)</td>
<td>19.0% (26)</td>
<td>15.8% (25)</td>
<td>15.4% (4)</td>
</tr>
<tr>
<td>Reducing energy consumption</td>
<td>21.5% (69)</td>
<td>20.4% (28)</td>
<td>22.8% (36)</td>
<td>19.2% (5)</td>
</tr>
<tr>
<td>Financial sustainability</td>
<td>15.0% (48)</td>
<td>13.1% (18)</td>
<td>15.8% (25)</td>
<td>19.2% (5)</td>
</tr>
<tr>
<td>Expanding enrollment/ensuring student participation/satisfaction</td>
<td>13.1% (42)</td>
<td>13.1% (18)</td>
<td>12.7% (20)</td>
<td>15.4% (4)</td>
</tr>
<tr>
<td>Social equity/accessibility for all students</td>
<td>14.3% (46)</td>
<td>15.3% (21)</td>
<td>13.9% (22)</td>
<td>11.5% (3)</td>
</tr>
<tr>
<td>Sustainable policy implementation</td>
<td>18.4% (59)</td>
<td>18.3% (25)</td>
<td>18.4% (29)</td>
<td>19.2% (5)</td>
</tr>
<tr>
<td>Never heard term/term is jargon</td>
<td>0.3% (1)</td>
<td>0.0% (0)</td>
<td>0.6% (1)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>Other</td>
<td>0.3% (1)</td>
<td>0.7% (1)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100% (321)</td>
<td>100% (137)</td>
<td>100% (158)</td>
<td>100% (26)</td>
</tr>
</tbody>
</table>
involvement in college sustainability implementation, with over half (50.8%) involved for 2 to less than 6 years, and 30.1% longer than that range. Most are personally interested (64.8%) compared to required by college (26.8%). When asked whether a top-down (16.7%) or bottom-up (5.1%) approach is better to achieve a sustainable college, most agreed that both is needed (78.2%).

When asked to choose which statement most reflects their college, a majority (59.7%) supports some sustainability efforts, while 23.4% supports widespread involvement in sustainability development, 14.3% has incorporated sustainability in mission or vision statements, and 2.6% chose does not support sustainability efforts. Responses to the question, do you think your college will make becoming a model of sustainability a top priority, the highest response is no, it is a priority, but not a high priority at 50.0%. The response yes, with some stipulations is at 14.1%, and the response no, will never be a priority is at 9.0%. Written comments fit into previously identified themes on administration leadership and finances: “Not until our upper management adopts it as a priority”, and “It will be forced for us to conserve more and reduce energy consumption and costs as budgets tighten. I can't predict the level of priority it will achieve”. As in previous comments, pessimism about sustainability implementation was found in open-ended comments for these questions: “We've discussed options on our committee in the past but we have so many competing priorities it's difficult to know if our campuses will follow through with realistic goals”; and “I don't think we'll make ecological sustainability a top priority until we are forced to do so. Talk is cheap”.

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Table 5.4

**Sustainable Development Survey Questions, Each Allowing One Response**

<table>
<thead>
<tr>
<th>Questions</th>
<th>Responses (N)</th>
<th>Cluster A (n)</th>
<th>Cluster B (n)</th>
<th>Cluster C (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are you aware of the [Statewide System] Sustainable Development Framework?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>69.2% (54)</td>
<td>64.7% (22)</td>
<td>76.9% (30)</td>
<td>40.0% (2)</td>
</tr>
<tr>
<td>No</td>
<td>12.8% (10)</td>
<td>11.8% (4)</td>
<td>10.3% (4)</td>
<td>40.0% (2)</td>
</tr>
<tr>
<td>Unsure</td>
<td>18.0% (14)</td>
<td>23.5% (8)</td>
<td>12.8% (5)</td>
<td>20.0% (1)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100% (78)</td>
<td>100% (34)</td>
<td>100% (39)</td>
<td>100% (5)</td>
</tr>
<tr>
<td>Are you involved in implementing sustainability practices at your college?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>81.8% (63)</td>
<td>84.9% (28)</td>
<td>79.5% (31)</td>
<td>80.0% (4)</td>
</tr>
<tr>
<td>No</td>
<td>18.2% (14)</td>
<td>15.2% (5)</td>
<td>20.5% (8)</td>
<td>20.0% (1)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100% (77)</td>
<td>100% (33)</td>
<td>100% (39)</td>
<td>100% (5)</td>
</tr>
<tr>
<td>How long have you been involved in sustainability implementation at your college?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 2 years</td>
<td>19.1% (12)</td>
<td>32.1% (9)</td>
<td>6.5% (2)</td>
<td>25.0% (1)</td>
</tr>
<tr>
<td>2 to &lt; 6 years</td>
<td>50.8% (32)</td>
<td>50.0% (14)</td>
<td>51.6% (16)</td>
<td>50.0% (2)</td>
</tr>
<tr>
<td>6 to 12 years</td>
<td>22.2% (14)</td>
<td>14.3% (4)</td>
<td>29.0% (9)</td>
<td>25.0% (1)</td>
</tr>
<tr>
<td>Over 12 years</td>
<td>7.9% (5)</td>
<td>3.6% (1)</td>
<td>12.9% (4)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100.0% (63)</td>
<td>100.0% (28)</td>
<td>100.0% (31)</td>
<td>100.0% (4)</td>
</tr>
<tr>
<td>Why are you involved in sustainability implementation at your college?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Required by college</td>
<td>26.8% (19)</td>
<td>30.3% (10)</td>
<td>26.5% (9)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>Personally interested</td>
<td>64.8% (46)</td>
<td>63.6% (21)</td>
<td>64.7% (22)</td>
<td>75.0% (3)</td>
</tr>
<tr>
<td>Other</td>
<td>8.5% (6)</td>
<td>6.1% (2)</td>
<td>8.8% (3)</td>
<td>25.0% (1)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100% (71)</td>
<td>100% (33)</td>
<td>100% (34)</td>
<td>100% (4)</td>
</tr>
<tr>
<td>Do you think a top-down or bottom-up approach is better in achieving a sustainable college?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Top-down</td>
<td>16.7% (13)</td>
<td>17.7% (6)</td>
<td>18.0% (7)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>Bottom-up</td>
<td>5.1% (4)</td>
<td>5.9% (2)</td>
<td>2.6% (1)</td>
<td>20.0% (1)</td>
</tr>
<tr>
<td>Both needed</td>
<td>78.2% (61)</td>
<td>76.5% (26)</td>
<td>79.5% (31)</td>
<td>80.0% (4)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100% (78)</td>
<td>100% (34)</td>
<td>100% (39)</td>
<td>100% (5)</td>
</tr>
<tr>
<td>Please choose the one that most reflects your college:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does not support sustainability efforts at the college.</td>
<td>2.6% (2)</td>
<td>3.0% (1)</td>
<td>2.6% (1)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>Supports some sustainability efforts at the college.</td>
<td>59.7% (46)</td>
<td>51.5% (17)</td>
<td>66.7% (26)</td>
<td>60.0% (3)</td>
</tr>
<tr>
<td>Supports widespread involvement in sustainability</td>
<td>23.4% (18)</td>
<td>27.3% (9)</td>
<td>20.5% (8)</td>
<td>20.0% (1)</td>
</tr>
<tr>
<td>Has incorporated sustainability in mission or vision statements</td>
<td>14.3% (11)</td>
<td>18.2% (6)</td>
<td>10.3% (4)</td>
<td>20.0% (1)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100% (77)</td>
<td>100% (33)</td>
<td>100% (39)</td>
<td>100% (5)</td>
</tr>
<tr>
<td>Do you think your college will make becoming a model of sustainability a top priority?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes, but with some stipulations</td>
<td>14.1% (11)</td>
<td>17.7% (6)</td>
<td>10.3% (4)</td>
<td>20.0% (1)</td>
</tr>
<tr>
<td>No - it is a priority, but not a top priority</td>
<td>50.0% (39)</td>
<td>52.9% (18)</td>
<td>48.7% (19)</td>
<td>40.0% (2)</td>
</tr>
<tr>
<td>No - will never be a priority</td>
<td>9.0% (7)</td>
<td>2.9% (1)</td>
<td>15.4% (6)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>Do not know</td>
<td>20.5% (16)</td>
<td>20.6% (7)</td>
<td>18.0% (7)</td>
<td>40.0% (2)</td>
</tr>
<tr>
<td>Other</td>
<td>6.4% (5)</td>
<td>5.9% (2)</td>
<td>7.7% (3)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100% (78)</td>
<td>100% (34)</td>
<td>100% (39)</td>
<td>100% (5)</td>
</tr>
</tbody>
</table>
Social Networks

Survey participants were asked three open-ended name and position generator questions to explore personal social networks involved in sustainability implementation. Replies to the open-ended questions were interpreted into category responses, shown in Table 5.5. For the question, to whom do you turn to discuss sustainable development activities at your college each year, a significant difference in clusters was found (p=0.000) when faculty, staff, and administrators categories are compared. Cluster A has administrators as highest (61.0%), then faculty (22.0%), and the sustainability committee (17.1%). Cluster B shows faculty as highest (40.0%), then administrators (23.6%), sustainability committee (12.7%), and additional categories of staff (18.2%), and the statewide sustainability manager (5.5%).

When asked about internal groups involved in sustainability activities, both Cluster A and B had sustainability committee as the highest (55.2% and 53.8% respectively). Although statistical comparisons were not performed due to low count numbers for some responses, percentages varied widely between Cluster A and B for the other internal groups: faculty groups (Cluster A at 3.4% and Cluster B at 15.4%); staff groups (Cluster A at 0.0% and Cluster B at 10.3%); administrative committees (Cluster A at 13.8% and Cluster B at 0.0%); and campus nature committees (Cluster A at 10.3% and Cluster B at 2.6%).

The last social network survey question asked for identification of external groups involved in college sustainable development activities. Cluster B highest categorized response was regional environmental groups (18.2%) while Cluster A had zero in this
Table 5.5

*Relationship Networks Survey Questions with Open-Ended Responses*

<table>
<thead>
<tr>
<th>Questions</th>
<th>Responses (N)</th>
<th>Cluster A (n)</th>
<th>Cluster B (n)</th>
<th>Cluster C (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>To whom do you turn to discuss sustainable development activities at your college each year? Please provide a list of names and job titles.*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Administrators</td>
<td>39.3% (42)</td>
<td>61.0% (25)</td>
<td>23.6% (13)</td>
<td>36.4% (4)</td>
</tr>
<tr>
<td>Faculty</td>
<td>30.8% (33)</td>
<td>22.0% (9)</td>
<td>40.0% (22)</td>
<td>18.2% (2)</td>
</tr>
<tr>
<td>Staff</td>
<td>14.0% (15)</td>
<td>0.0% (0)</td>
<td>18.2% (10)</td>
<td>45.5% (5)</td>
</tr>
<tr>
<td>Sustainability Committee</td>
<td>13.1% (14)</td>
<td>17.1% (7)</td>
<td>12.7% (7)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>Statewide system sustainability manager</td>
<td>2.8% (3)</td>
<td>0.0% (0)</td>
<td>5.5% (3)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100% (107)</td>
<td>100% (41)</td>
<td>100% (55)</td>
<td>100% (11)</td>
</tr>
<tr>
<td>What internal groups are involved in sustainable development activities at your college each year? Please provide a list of group names and short description of group purpose.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sustainability Committee</td>
<td>52.9% (37)</td>
<td>55.2% (16)</td>
<td>53.8% (21)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>Faculty groups (programs, classes)</td>
<td>11.4% (8)</td>
<td>3.4% (1)</td>
<td>15.4% (6)</td>
<td>50.0% (1)</td>
</tr>
<tr>
<td>Student Clubs</td>
<td>11.4% (8)</td>
<td>10.3% (3)</td>
<td>12.8% (5)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>Staff groups (M&amp;O, IT)</td>
<td>7.1% (5)</td>
<td>0.0% (0)</td>
<td>10.3% (4)</td>
<td>50.0% (1)</td>
</tr>
<tr>
<td>Administrative committees</td>
<td>5.7% (4)</td>
<td>13.8% (4)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>Campus nature committees</td>
<td>5.7% (4)</td>
<td>10.3% (3)</td>
<td>2.6% (1)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>President's Leadership Team</td>
<td>5.7% (4)</td>
<td>6.9% (2)</td>
<td>5.1% (2)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100% (70)</td>
<td>100% (29)</td>
<td>100% (39)</td>
<td>100% (2)</td>
</tr>
<tr>
<td>What external groups are involved in sustainable development activities at your college? Please provide a list of group names and short description of group purpose.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local city</td>
<td>13.5% (5)</td>
<td>15.4% (2)</td>
<td>9.1% (2)</td>
<td>50.0% (1)</td>
</tr>
<tr>
<td>Charitable organizations</td>
<td>10.8% (4)</td>
<td>23.1% (3)</td>
<td>4.5% (1)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>Community gardens</td>
<td>10.8% (4)</td>
<td>23.1% (3)</td>
<td>4.5% (1)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>Regional environmental groups</td>
<td>10.8% (4)</td>
<td>0.0% (0)</td>
<td>18.2% (4)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>Local farms</td>
<td>8.1% (3)</td>
<td>7.7% (1)</td>
<td>9.1% (2)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>Other colleges</td>
<td>8.1% (3)</td>
<td>15.4% (2)</td>
<td>4.5% (1)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>Recycling organizations</td>
<td>8.1% (3)</td>
<td>0.0% (0)</td>
<td>13.6% (3)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>Energy Management</td>
<td>5.4% (2)</td>
<td>0.0% (0)</td>
<td>9.1% (2)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>Local churches/religious groups</td>
<td>5.4% (2)</td>
<td>0.0% (0)</td>
<td>9.1% (2)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>Agriculture extension service</td>
<td>2.7% (1)</td>
<td>7.7% (1)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>Chamber of Commerce</td>
<td>2.7% (1)</td>
<td>0.0% (0)</td>
<td>4.5% (1)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>Community health organizations</td>
<td>2.7% (1)</td>
<td>0.0% (0)</td>
<td>4.5% (1)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>County Conservation District</td>
<td>2.7% (1)</td>
<td>0.0% (0)</td>
<td>4.5% (1)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>Earth Day partnerships</td>
<td>2.7% (1)</td>
<td>0.0% (0)</td>
<td>4.5% (1)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>Schools</td>
<td>2.7% (1)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
<td>50.0% (1)</td>
</tr>
<tr>
<td>Statewide college system</td>
<td>2.7% (1)</td>
<td>7.7% (1)</td>
<td>0.0% (0)</td>
<td>0.0% (0)</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100% (37)</td>
<td>100% (13)</td>
<td>100% (22)</td>
<td>100% (2)</td>
</tr>
</tbody>
</table>

*A significant difference (p=0.000) between Cluster A and Cluster B in discussing sustainable development with others categorized as faculty, staff, and administrators.
category. Other Cluster B responses with Cluster A having zero responses are recycling organizations, energy management, local churches/religious groups, chamber of commerce, community health organizations, county conservation district, and Earth Day partnerships. Conversely, Cluster A responses with Cluster B having zero responses are agriculture extension service, and statewide college system. Cluster A and B both listed these outside groups: local city; charitable organizations; community gardens; local farms; and other colleges.

Chapter Summary

Survey responses are shown in percent by total (N = 78, response rate 44%) in three sections, Demographics, Sustainable Development, and Social Networks. More than half of respondents (55.1%) have worked at their college for over 12 years, 44% are faculty, 29.3% are staff, and 26.7% are administrators. Cluster percentages are also shown and Pearson Chi square tests for significant difference were conducted (alpha < 0.05) for Cluster A (n = 34) and Cluster B (n = 39) comparisons. Cluster C (n=5) with only 5 respondents was not tested for significant difference from the other clusters due to the small number of responses (Green & Salkind, 2014, p. 333). Significant differences (p = 0.001) in demographics are found between Cluster A and B in age ranges, with Cluster A higher in the 41-52 age range compared to Cluster B higher in the 53-71 range.

The top three responses chosen as barriers to college sustainable development were financial (21.0%), lack of understanding and awareness (19.9%), and people’s resistance to change (19.9%), see Table 5.3. The top three responses for the role of colleges in sustainability were reducing energy consumption (21.6%), sustainability policy implementation (16.6%), and financial sustainability (16.6%). Green physical
**space** was a close fourth choice at 16.0%. Themes interpreted from written comments when *Other* was selected were lack of administrative leadership and external factors such as funding as barriers to implementation. A majority of respondents perceived that their colleges supported *some* sustainability efforts (59.7%), as opposed to widespread (23.4%) or no support (2.6%), as shown in Table 5.4. Fifty percent perceived that sustainability was a priority, but not a top priority at their college. Over 80% of respondents were involved in sustainability implementation at their colleges, and more chose *personally interested* (64.8%) than *required by college* (26.8%) as why they are involved. A large majority perceived that both *a top down* and *bottom approach* (78.2%) was needed for implementation as opposed to one (16.7%) or the other (5.1%), respectively.

A significant difference (p=0.000) between Cluster A and Cluster B was found for the question *to whom do you turn to discuss sustainable development activities at your college each year*, when responses are categorized as faculty, staff, and administrators. Cluster A has administrators as highest (61.0%), then faculty (22.0%), and the sustainability committee (17.1%). Cluster B shows faculty as highest (40.0%), then administrators (23.6%), and staff (18.2%) as the top three. The top internal college groups are sustainability committees (52.9%), faculty groups (11.4%), and student groups (11.4%). External group name and position generator responses were also interpreted and categorized, with listings in Table 5.4. Local city government, farms, churches, extension offices were participating in sustainability at some of the colleges and provide a model to other colleges that have not yet established these types of relationships. These listings are intended to be shared amongst the colleges as examples for further sustainability planning at individual colleges.
The final survey question asked respondents for contact information if interested in a follow-up interview regarding college sustainability implementation. Five semi-structured interviews were conducted to further expand on their personal social networks and implementation challenges, and results are presented in Chapter Six.
CHAPTER SIX: RESULTS OF STAGE THREE – INTERVIEWS

To further detail sustainability leadership perspectives and personal networks, interviews were conducted as part of this study. Chapter 6 is a summary of interview results addressing the research questions,

What challenges to sustainable development do sustainability leaders at the two year colleges identify? Are there notable differences in responses among college groups?

What network relationships are identified in implementing sustainable development activities at the two-year colleges? Do the college groups identify different relationship typologies?

Interviewees were asked specifically to name those involved in sustainability implementation at their respective colleges including committee members and others to identify social network analysis (SNA) nodes and ties. Specific name interpreter questions asked perceptions for each alter to generate these attributes: role in sustainability implementation (lead, plan, manage, or other); importance (high, medium, or low); meeting frequency, and sustainability communications frequency (more than once a month, about once a month, once every three or four months, once or twice a year). Unstructured questions were open-ended, asking interviewees if they had contributions to the study that had not been asked, or any additional comments about sustainability implementation at their college.

Selection for the interviewees were based on completion of name generator survey questions, agreement to be interviewed, and representation from each of the college clusters and alter types (faculty, staff, and administrator). Twenty six survey respondents agreed to be interviewed and 15 completed the name generator questions in the survey for personal network analysis. Five interviews were conducted from different
colleges: two interviewees are administrators and college sustainability contacts from Cluster A and B colleges, one is a staff member and sustainability contact from a Cluster B college, and two are faculty members who are not sustainability contacts, but who are sustainability leaders nonetheless from Cluster A and Cluster C colleges. Pseudonyms were used in place of actual names of interviewees.

Themes on Challenges to Sustainability

Once all interviews were transcribed and thematically coded by the researcher, three themes emerged from interview responses identifying challenges in college sustainable development. The themes were (1) college leadership transition; (2) communication networks; and (3) sustainability funding and resources.

Theme: College Leadership Transition

Four of the five interviewees noted the change of college presidents and leadership as impacting sustainability implementation, with two interviewees describing the transition as a challenge, and one interviewee expressing the change more as an opportunity. The college sustainability contact who was a staff member at a Cluster B college, Jess identified leadership transition as a barrier:

The only thing that I can think of lately that has been a bit of a barrier is through the transition, our new leadership here at our college, it seems as though the system in general hasn't emphasize the importance of sustainability, and we haven't seen a lot of push from the top-down, and we kind of from the bottom up do a lot of work, but we're not really seeing a lot of push college wide coming from the top. And there's a lot of things that have to take up attention, I totally understand that, but from a sustainability aspect we certainly feel like there could be more focus there. (Personal communications, March 13, 2018)

Pat, a teaching faculty member from the college with the lowest overall Sustainable Development coding sum stated,
So in terms of top administrative leadership looking at things like a sustainability program on campus we haven't had senior leadership in place to make that a priority because we've had so much change [...] So that is a factor, you know we will hope that we have a more sustainable senior administration to have a more sustainable program. (Personal communications, March 9, 2018)

The other teaching faculty interviewee Alex was from the college with the highest Sustainable Development coding frequency, Cluster C, perceived the college leadership transition in this way:

The reorganization in some ways was a movement towards sustainability itself. We have created some pathways that are more streamlined than they were in the past, and opened up new opportunities for ourselves to be more sustainable. But when you're in these type of processes, it's a little chaotic and so there's that... we've also tried to focus on how we want to organize budget submissions, and access to, how do we want to create pathways for communication. And I think those structural changes can sometimes be, it can create a social network that allows you to have better communication. (Personal communications, March 30, 2018)

This perspective differs from the other two in that leadership transition is viewed as opportunities toward sustainability rather than as a barrier. Leadership transition is related to the next theme identified as impacting college sustainability, communication.

**Theme: Communication Networks**

Four of the five interviewees commented on communication effectiveness of sustainability leaders. Alex acknowledged the challenge of college leadership restructuring and had a goal of communicating sustainability with the new leadership, stating,

One of the goals that I have right now is making sure people understand that sustainability is kind of a three pillar subject, where you have a focus on economy and community and the environment. And because we have had a lot of restructuring at [my college] and we have a lot of new people in high level positions, I think that some of the people that I have been working with in the past that knew that, have moved on, so I kind of need to make sure that other people in leadership recognize the value of sustainability and bring tools for a number of things in terms of recruiting students, reducing costs, planning for long-term
community benefit, not just to the college but to the community it serves, and so I probably need to focus more efforts on that. I haven't done that in the way that I would like to yet. (Personal communications, March 30, 2018)

From a Cluster A college, Pat’s first comments at the start of the interview included,

“When you get my response, you’ll see what's going on in my college or not going on” (personal communications, March 9, 2018). Pat’s college sustainability committee was no longer meeting regularly for about two years, and Pat viewed that as a barrier in that little coordination and communication within the college was occurring. Pat stated an example:

One time a number of years ago, I guess all of [the statewide system] had contracted with a company. And it was really interesting we heard about it at a meeting, but we've never heard back, about you know, do we have energy savings, what's the next plan, what role could employees have, or anything like that. So we did have some things retrofitted and we did have a meeting, an introduction to the plan, and things like that, but we’ve never had any updates or ideas about things that could further be done… an area that we could address that could be from an administrative point of view would be in energy conservation and sustainable energy, and we have not. (Personal communications, March 9, 2018)

Communication was occurring at the college more on an individual level according to Pat:

So there would be programs that which individuals would wish to pursue, and are pursuing actually. And we meet with and would have our contact person, and the administration person on campus would meet with [the college sustainability contact] and we would confer with him. We don't meet as a group or committee. (Personal communications, March 9, 2018)

Kelly, a sustainability contact who was an administrator from a Cluster A college has a sustainability committee of about 30 individuals including many based on job position. Kelly considered the large committee and positional membership as barriers, stating “a small committed group would be more effective”, and “bureaucracy to get things done is
a barrier, and can discourage those who are not committed” (personal communications, February 15, 2018). Additionally Kelly states,

Most of the people that have ranked high [in sustainability importance] are because they just have the initiative, the desire, to be involved in sustainability either directly or indirectly. Very few people actually have this as part of their job, or even really do it because they are on the sustainability committee. They just do things because they think it’s the right thing to do, or they're just personally interested and invested in it. (Personal communications, February 15, 2018)

Another interviewee, Sam was an administrator and college sustainability contact but from a Cluster B college, and perceived the college communication and committee structure as effective, stating,

I think our green committee has been very effective because for one thing, it’s cut across all cross-sections of this organization here at this campus. And we’ve asked all kinds of people to come in whether you are faculty, or whether you were staff, or you were an administrator, or you were vice president, it didn't matter you were invited to be a part of this. And we invited the students too, and we had people from the outside who come in. Now can we do more, sure we can always improve. There’s always more marketing to do, there's always more PR to do, and there's always more education to do that we really don't need to stop. I think we have a good basis for it, we’ve tried to make it known what we do, and people know that. Now it’s taking it to another level, saying okay here's what we do, would you like to get involved more, would you like to participate more, those types of things. (Personal communications, June 6, 2017)

Sam identified funding and limited public resources as a challenge to sustainability implementation, another theme identified as impacting sustainability.

Theme: Sustainability Funding and Resources

Two of the interviewees spoke about the impact of funding and local resources as limits to sustainable development. Sam said that state budget cuts and being in a rural area with few public resources were barriers:

The one I think that is always overarching for any organization and that is funding, the financial side of sustainability. I've always said no matter what you do whether you invite someone in and you are having a conference, or if you are just having someone in for a meeting, and you provide refreshments for them and
a little bit of food for them, there is always a cost associated with that, and a lot of people don't think about that. As I always like to say, particularly these days, there are no free lunches anywhere anymore. Somebody is paying for that somewhere and so I think that’s one thing with sustainability that’s been one of the barriers here at the college, I think, in some ways… sometimes its funding, but sometimes its finding the resources to help you do those things. I look at that as somewhat as a barrier because we are in a rural area. Yes, we are in an urban area as far as the city goes… but we’re still in a rural area. We don’t have those types of sustainability services, recycling services that we were talking previously.

(Personal communications, June 6, 2017)

Alex had a specific example of how a “budget crisis” led to a barrier to sustainability:

I think she left the college in 2013 somewhere in there. And that was really exciting when we had her she was actually our sustainability coordinator and she put together a newsletter and was working with, and she was just really focused. Her whole reason for being at the college was just sustainability, and getting it in our operations and environmental services to be a more sustainable college.

(Personal communications, March 30, 2018)

Sam was from a Cluster B college while Alex is from the Cluster C college. The three themes identified as challenges above are further expanded upon in the next section on personal network analysis of interviewees.

**Themes on Personal Network Relationships**

A mixed methods approach of interview coding and quantitative SNA measures was used to determine network themes for the study. Name generator interview questions triangulated the identification of individuals and groups from survey responses, and name interpreter questions further identified alter attributes for relative comparisons in applying social network theories. Calculated SNA measures and sociograms from each interview are presented next to compare and visually communicate personal network results.

Network themes build upon the challenges identified above on college sustainability leadership, communication, and funding. Network themes apply SNA concepts and were:
(1) sustainability leadership typologies; (2) network communication bridges and cliques; and (3) social capital for sustainability funding and resources.

Five standard personal network measures (Crossley et al., 2015) are presented in this section: (a) Number of Alters; (b) Sustainability Impact; (c) Alter Dispersion; (d) Ego-Alter Similarities; and (e) Tie Strength for comparison purposes, see Table 6.1. Networks with larger number of alters are often associated with wider influence, however attributes matter and (b) through (e) were attribute measures based on interpretive coding and quantifying interview responses to structured questions. Sustainability Impact (b) central tendency was calculated from ordinal responses to sustainability role and importance questions for each alter as described in Chapter 3. Tie Strength (e) central tendency calculations were from ordinal responses to meeting and communication questions. The (c) and (d) measures compare college positions (faculty, staff, or administrator) for evaluation of social network concepts, for example, heterophily is more influential than a homophily network in innovation diffusion.

Table 6.1

**Personal Ego Center Network Relative Measures**

<table>
<thead>
<tr>
<th>Egos from Cluster A</th>
<th>Egos from Cluster B</th>
<th>Ego from Cluster C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pat</td>
<td>Kelly</td>
<td>Sam</td>
</tr>
<tr>
<td>a. NUMBER OF ALTERS</td>
<td>10</td>
<td>27</td>
</tr>
<tr>
<td>b. ALTER CENTRAL TENDENCY: SUSTAINABILITY IMPACT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sustainability Role and Importance Mean</td>
<td>5.50</td>
<td>5.33</td>
</tr>
<tr>
<td>c. ALTER DISPERSION: By TYPE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Index of Qualitative Variation (IQV)</td>
<td>0.99</td>
<td>0.98</td>
</tr>
<tr>
<td>d. EGO-ALTER SIMILARITY: Admin., Faculty, Staff Heterophily (EI)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.43</td>
<td>0.28</td>
</tr>
<tr>
<td>e. TIE CENTRAL TENDENCY: TIE STRENGTH</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meetings and Communications Mean</td>
<td>3.70</td>
<td>4.63</td>
</tr>
</tbody>
</table>
Sociograms are personal network diagrams with interviewees as *ego centers* showing job positions and group names as attribute types/typologies (Borgatti, Mehra, Brass, & Labianca, 2009), generated using UCINet and NetDraw software. These sociograms were useful to visually compare network similarities and differences. In Figures 6.1-6.5 ego centers are black in color, alters are gray to represent sustainable committee members, and white represents non-members. *Types* are shown as different node shapes in the sociograms based on categories as *staff*, *administrator* (includes vice presidents, deans, and directors), *faculty* (teaching instructors), and *group* (internal or external). Ties between nodes and the ego center are represented as lines, and line size was based on the summed responses to meeting and communication questions. The attribute *Sustainability Impact* represented the calculated mean of ego center responses to two structured questions on role and importance of alters on sustainability implementation. Tie lines and node sizes in the sociograms are larger as sums are higher. Alter-alter ties were not specifically asked about during interviews, however when interviewees described ties among alters these ties were included in their sociograms.

**Theme: Sustainability Leadership Typologies**

Of the 16 college sustainability contacts, network job position types were 56% administrators, 25% staff, and 19% faculty. Two of the interviewees were high-level administrators at their colleges, however their sustainability sociograms greatly differ (Figures 6.1 and 6.2). Kelly with the largest number of sustainability committee members was a public services administrator acting as the college sustainability contact, and from a Cluster A college. *Alter Dispersion of Types* was balanced at 0.98 for Kelly’s personal
network, with administrators the largest network type at 33%, faculty and staff both at 27%, see Table 6.2. Four outside groups (8%) were identified in sustainability implementation related to specific events. Tie Strength was second highest for Kelly’s network, while Sustainability Impact was second lowest, see Table 6.1, suggesting relatively high communications and meetings, but lower role and importance in sustainability compared to the other four ego networks. The large number of alters, although balanced, was considered a barrier. Kelly recommended reducing the number to those more fully committed to sustainability, “30 members are too large, 7 or 8 would be a lot more effective” (personal communications, February 15, 2018). Further, the college was a Cluster A college with lower sustainability activity coding frequencies than the other clusters. Crossley et al., (2015) surmise that large networks may result in “making demands upon her time, which may not always be a good thing”, (p. 19).

In comparison, Sam was an operations administrator and the college sustainability contact from a Cluster B college. Sam had a distinct sociogram with an internal group separate from what Sam identified as the college sustainability “team” members. The Green Committee was separate forming a network subset which has alter-alter ties in addition to ego center ties, see Figure 6.2. Sam was a Green Committee member with

<table>
<thead>
<tr>
<th></th>
<th>Percentage (n)</th>
<th>Pat</th>
<th>Kelly</th>
<th>Sam</th>
<th>Jess</th>
<th>Alex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrator</td>
<td>18% (2)</td>
<td>33% (10)</td>
<td>22% (2)</td>
<td>23% (3)</td>
<td>31% (5)</td>
<td></td>
</tr>
<tr>
<td>Faculty</td>
<td>27% (3)</td>
<td>27% (8)</td>
<td>33% (3)</td>
<td>62% (8)</td>
<td>25% (4)</td>
<td></td>
</tr>
<tr>
<td>Staff</td>
<td>27% (3)</td>
<td>27% (8)</td>
<td>22% (2)</td>
<td>8% (1)</td>
<td>25% (4)</td>
<td></td>
</tr>
<tr>
<td>Group</td>
<td>27% (3)</td>
<td>13% (4)</td>
<td>22% (2)</td>
<td>8% (1)</td>
<td>19% (3)</td>
<td></td>
</tr>
</tbody>
</table>
strong ties to the committee chair. Five members of the committee were perceived by Sam as part of his personal network for sustainability implementation, but not all Green Committee members which represent different college groups, were ties. “I think our Green Committee has been very effective because for one thing, it’s cut across all cross-
sections of this organization here at this campus” he explained. Sam also had strong ties
to workforce development outside of the Green Committee. This personal network had
the highest relative mean score, 6.0 for Sustainability Impact and lowest number of
network alters at eight. Tie Strength was second lowest, indicating lower levels of
communications relative to the other networks, yet the high Sustainability Impact score
suggests he was well connected to those important in implementing sustainability.

Comparing the two networks with administrators as egos, Sam and Kelly, showed
that although Number of Alters and Tie Strength were higher for the Cluster A college
Sustainability Impact was lower, compared to the Cluster B college. The Cluster A ego
stated that structural changes in sustainability committee memberships were needed while
the Cluster B ego perceived his college sustainability committee as effective. SNA
concepts related to Tie Strength to further explore network communications are
introduced in the following theme.

**Theme: Network Communication Bridges and Cliques**

Sociograms of the other interviewees are presented here and show application of
SNA terms such as bridges and cliques. Bridges are links between two separate networks,
and cliques are networks where alters are all connected to each other (Crossley et al.,
2015, p. 15). The second highest Sustainability Impact mean was 5.67, also from a
Cluster B college. Jess was an administrative assistant and the college sustainability
contact. Jess was the sole staff person in her sociogram with 12 alters, which included
one outside group representing local churches, see Figure 6.3. Advantages and
disadvantages to the same and dissimilar typologies are an area of ongoing research using
network measures, such as heterophily and Alter Dispersion by Type. The highest
heterophily score of 1.0 in Jess’ personal network shows no alter was a staff member; instead, alters were 62% faculty and 23% administrators, see Table 6.2. Jess may have been acting as a bridge between two networks, faculty and administrators involved in sustainability. A network bridge plays a pivotal role in communication between separate groups. Alter-alter measures were not asked about in this study, but faculty likely form a clique as do administrators. The second highest heterophily score is from the other

![Sociogram of Jess, staff member and college sustainability contact.](image)

**Figure 6.3.** Sociogram of Jess, staff member and college sustainability contact.

Cluster B college, Sam’s personal network. Kelly from a Cluster A college has the lowest heterophily score at 0.28, representing the large number of alters who are the same type as the ego center, an administrator. Another measure, Alter Dispersion by Type, indicates the relative balance of different types across alters. Except for Jess’ network, the other four networks are evenly dispersed among faculty, staff, and administrators. Jess has a higher percentage of faculty compared to the other networks as seen in Table 6.2.
Faculty as sustainability leaders was investigated as two study interviewees were teaching faculty who are not college sustainability contacts. Although invited, their college sustainability contacts did not agree to participate in interviews. They were from colleges with the highest and lowest Sustainable Development Code frequencies, and had the lowest two Sustainability Impact scores of the five personal networks. Both identified potential cliques within their personal networks of sustainability actors.

Alex was from the Cluster C college with the overall highest Sustainable Development code frequency. Alex, a geology professor teaching sustainability courses was not the college sustainability contact. Alex personal network measures were median among the five for Tie Strength and Heterophily, see Table 6.1. Alter Dispersion is balanced at 0.98, with 35% of nodes administrators. In the interview Alex described her previous role as a faculty chair, with strong ties to administrators as shown in Figure 6.4.

![Figure 6.4. Sociogram of faculty member Alex, not the college sustainability contact.](image-url)
A network subset centers on the Business Operations Specialist in the sociogram, and is likely a clique within that department. In the interview, Alex described a former sustainability coordinator position who worked with the current Business Operations Manager:

And that was really exciting when we had her she was actually our sustainability coordinator and she put together a newsletter and was working with, and she was just really focused her whole reason for being at the college was just sustainability. (Personal communications, March 30, 2018)

Other cliques within the college were also likely, two biology faculty were identified as having an alter-alter tie in developing sustainability coursework. Administrator leaders within the college likely form a communication clique although not specifically on sustainability implementation. Alex may be acting as a bridge among network groups, as well as involved in network cliques implementing sustainability.

Pat, the other faculty ego center, was heavily involved in sustainability activities, yet did not have a strong network tie to the college sustainability contact, a facilities administrator, as shown in the Figure 6.5 sociogram. Pat had the lowest Tie Strength score of the five personal networks at 3.70, and is from the Cluster A college with the lowest frequency of Sustainable Development codes. Alter Dispersion by Type indicates a balance in Pat’s network, although heterophily was fewer than the Alex’s network, with less administrators. The sociogram and interview revealed Pat along with three alters were involved in a local Health and Garden group for sustainability activities. This external group acted as a subset of alters likely forming a clique and providing strong communication ties among these nodes. Pat spoke extensively about the planned and current activities with the group and these alters in initiating sustainability related programs at the college and community. Pat was weakly tied to the college sustainability
contact and repeatedly expressed the need for more frequent meetings and communications among sustainability actors at the college. The next SNA theme is on social capital as it applies to the personal networks of this study.

\[\text{Figure 6.5. Sociogram of faculty member Pat, not the college sustainability contact}\]

**Theme: Social capital for Sustainability Funding and Resources**

Social capital involves benefits of network ties to individual actors (Burt, 1992; Lin, 1999). A larger number of alters represents a larger network and potential influence; however, social network research hypothesize that node attributes and network structure matter in social capital (Granovetter, 1983; Burt, 1992; Lin, 2005). Distribution of funding and resources in higher education institutions are largely the responsibility of administrators rather than other typologies. Ties to administrators with access to resources is a form of social capital, and two interviewees Jess and Pat, perceived that more college leadership involvement was needed to improve college sustainable development, perhaps to gain social capital for sustainability activities. Conversely, Kelly
with the large number of alters and a high percent of administrators perceived his sustainability committee network was too large and needed to limit membership to those interested in sustainability issues. Striking the right balance among types and ties was indicated by Sam and Alex at their colleges. Sam was an administrator and Alex had close ties to administrators, and both had ties to cliques outside their type within their sustainability ego networks.

Integration of hierarchical and informal networks to advance innovation are an area of research (Sharp, 2002; L. Sharp, personal communications June 26, 2018), and were evidenced by this study with hierarchies as administrators and informal networks as sustainability committees and subsets of networks, or cliques. Informal networks possess social capital influence in a variety of spheres, and faculty especially are likely influential both internal and external to their colleges, by their discipline connections. Leaders within informal networks, whatever typology, have influence on innovation diffusion. Faculty and staff work on specific projects and activities advancing sustainability such as community gardens or working with environmental groups, and administrator support provides social capital in terms of funding and resources.

Chapter Summary

Personal networks provided glimpses of partial whole networks involved in college sustainability based on perspectives and recall of interviewees. Potential interviewees were determined from those survey participants who agreed to an interview and completed network questions. Interview selection was based on maximum variation of position typology and cluster groups, and again agreement to participate. Interviewees were two administrators (from Cluster A and B colleges) and one staff (Cluster B) as
sustainability contacts, and two faculty as sustainability leaders, not sustainability contacts. The two faculty represented colleges with Sustainable Development code frequencies at the opposite ends of the spectrum from a Cluster A and the C college. Because of the small number of interviewees, quantitative trends by college groups were not clearly shown. However, cluster B and C interviewees appear to have personal networks with bridges and cliques connecting administrators with faculty than Cluster A. Social capital of these two typologies differ, and their coordination and communication for advancing innovations throughout a college was implicated in the study. Discussion of these network concepts and findings as they apply to the study are presented in Chapter Seven.
CHAPTER SEVEN: SUMMARY AND DISCUSSION

In this final chapter elements of the research design are first summarized, followed by results and major findings. Findings are organized by addressing these questions: what are the colleges doing in sustainability, who is doing it, and how might implementation practices be improved? Discussion and conclusions follow including implications for research and practice. Also presented in this chapter are limitations of the study.

Study Purpose

The purpose of the study was twofold, (1) to increase understanding of sustainable development implementation at two-year colleges, and (2) to contribute theoretical research in leading organizational change using social network analysis theory and techniques. An urgency to face collective environmental crises is reverberating in diverse sectors of society, and two-year colleges have a role in educating individuals both in the classroom and by example through campus sustainability. Higher education institutions are responding to the call for educating communities about sustainable development (Reynolds, Brondizio, & Robinson, 2010; Barlett & Chase, 2013; Johnston, 2013; Sterling, Maxey, & Luna, 2013; Barth, 2014). Much of the previous research were case studies of individual colleges or universities (Reynolds, Brondizio, & Robinson, 2010; Barlett & Chase, 2013; Johnston, 2013); studies comparing multiple institutions would be informative. Assessment tools have been developed with the express purpose of sharing sustainability activities among institutions (Shriberg, 2002, Grosskurth & Rotmans, 2005; AASHE, 2016). The problem statement for this study was that multiple institution research is needed to compare successful implementation strategies at colleges.
An opportunity to explore sustainability in a meaningful way presented itself when the researcher was invited to become a leader in sustainability implementation at her college. As part of a public two-year college system with 16 institutions and one statewide governing body, the researcher recognized the value of comparing and sharing sustainability implementation strategies from multiple colleges all under the same sustainable development framework. In this study, quantitative and qualitative methods were employed to explore college sustainability activities, actor perceptions, and personal egocentric networks in leading implementation practices. Research questions guiding the study were:

1. What sustainable development activities are implemented by the two-year colleges, and at what frequencies? Using these activities to cluster colleges into groups, what traits emerge across groups?

2. What challenges to sustainable development do sustainability leaders at the two-year colleges identify? Are there notable differences in responses among college groups?

3. What network relationships are identified in implementing sustainable development activities at the two-year colleges? Do the college groups identify different relationship typologies?

**Methods Summary**

The mixed methods research design included three stages: (1) document analysis of written sustainability reports; (2) a survey; and (3) interviews of college sustainability leaders. Document analysis of biannual 2012-2012 reports describing the 16 colleges sustainability activities, the first stage of data collection and analysis, involved developing a coding process to quantify activities through researcher interpretation and comparisons of written descriptions. Quantitative ranking of the 63 sustainability codes
by frequency counts represent the most and least implemented sustainability activities at the colleges. Code frequencies were also summed for each college to calculate descriptive statistics and conduct cluster analysis to group colleges for comparisons. Document analysis and coding addressed the research question, *what sustainable development activities are implemented by the two-year colleges*. An online survey emailed to college sustainability actors and follow-up interviews to select survey participants addressed the research questions on *sustainability challenges* and *networking relationships*. Stage 2 of data collection was a survey with 5 demographic, 13 sustainable development, and 3 social network questions. The online questionnaire was purposely distributed to sustainability contacts and committee members at the 16 colleges. Five follow-up interviews, stage 3, provided in-depth responses to personal egocentric network (personal network) attributes and comments on implementation strategies at individual colleges. Interviewees identified college sustainability actors by job positions and group names, then answered network questions for each. Social network analysis (SNA) calculations and network diagrams known as sociograms were generated for each to compare and identify personal network themes for the study, see Table 6.1 and Figures 6.1-6.4. The final open-ended interview question provided for additional comments that contributed to the study.

**Results Summary and Findings**

Three major findings of the study are summarized below, followed by more detailed descriptions of findings addressing these questions: what are the colleges doing in sustainability, who is doing it, and how might implementation practices be improved?
First, by coding written descriptions of sustainability activities, quantitative comparisons among the colleges were possible. In comparing activity categories, Engagement activities were the most frequent, Operations followed, then Academics and Planning categories. By ranked quartiles, percentages of individual codes in the fourth quartile followed this same pattern of Engagement highest, Operations, then Academics and Planning. More frequent activities were implicated as easier to implement than those with less frequency. Ease of implementation may be influenced by the complexity of network relationships required. This is because collaboration among different college groups (network cliques) requires more effort than if little input is needed from others. For example, a community project already organized then adopted by a faculty member is easier to implement than a project needing input from multiple college departments to develop and implement.

Second, work relationships among sustainability actors in different college groups matter in sustainability implementation. Those in the same typology meet more regularly with each other and have more opportunities for interactions than those in different job position types. Sustainability actors in this study were faculty, staff and administrator typologies, and gaps in communication networks were identified as implementation barriers. Social capital of faculty and staff includes direct contact with students and community groups, while administrators control funding and other college resources. Sustainability efforts would benefit by formatively evaluating sustainability collaborations within a college to identify gaps and form communication bridges where needed.
Third, personal egocentric network analysis was valuable as a tool to evaluate network structures for innovation diffusion. Personal network techniques in this study were straightforward procedures without a high level of cost or time investment required. Resulting sociograms were effective in visualizing communication structures in implementing sustainability, including absence or presence of network bridges to important sustainability cliques. Communication networks, both formal and informal, provide social capital of individuals to others in their network. These networks and the associated social capital that individuals bring are unique for each college as cultures and environments differ. A primary research recommendation is to use personal network techniques for sustainability leaders to evaluate existing sustainability networks at individual colleges, and to:

a. Identify those individuals personally interested in implementing sustainability at each college, and harness their enthusiasm for wider inclusion and dispersion.

b. Recognize sustainability leaders are from different college typologies (faculty, staff, and administrators). Provide support such as transformational leadership professional development and access to those with social capital in decision-making.

c. Identify and support lateral networks and communication bridges to help collaboration among those responsible for leading college sustainability efforts. Reoccurring position types involved in sustainability such as biology faculty and operations managers, may not have strong relationship ties within a college.
d. Organize sustainability teams and regular sustainability meetings. A large number of sustainability actors for inclusivity should have less frequent meetings than the smaller teams/cliques (8-10 individuals) involved in implementation. Large sustainability committees should have subgroups of smaller cliques to work on specific projects. One team should be identified as responsible for overall sustainability planning and evaluation at the college as well as building bridges to cliques within the college.

**Sustainability Activities: What are Two-year Colleges Doing?**

The majority of Engagement codes were implemented by all or nearly all (15 of 16) colleges. The top two in frequency were *Community Service* and *Community Partnerships*, such as involvement with the Watershed Watch program sponsored by the state Division of Water or Earth Day campus events open to the community. Frequency trended with the number of colleges with each code (see Table 4.5). Of particular interest are activities implemented by less than half of the colleges as these are potential areas for expansion within the college system. *Student and New Employee orientations* about sustainability were coded for only about a third of the colleges. *Sustainability Assessment* was only implemented by three colleges. Sharing implementation strategies amongst the colleges would be helpful to expand these activities to all colleges in the system.

All or nearly all colleges were practicing about a quarter of the Operation activities. *Waste Minimization and Division* (recycling), *Landscape Management*, and *Building Energy Consumption* were the top three. These activities are typically managed within college operations departments. Codes implemented by less than half of the colleges included purchasing policies (*Office Paper Purchasing, Food and Beverage*...
Purchasing, Sustainable Dining) which likely need to include departments outside of operations alone.

Twenty seven percent of Academic activities were implemented by all or nearly all the colleges. Both technical and general education programs were implementing courses with sustainability learning outcomes. All colleges had Campus as a Living Laboratory for sustainability learning. Most colleges provided some incentive to develop sustainability related courses. Very few colleges were supporting research in sustainability, however, these colleges found support through grants and student research opportunities.

Three of the Planning activities (25%) were adopted by all 16 colleges, Sustainability Planning, Sustainability Coordination, and Participatory Governance. Planning activities that had room for growth were related to workplace health and diversity and equity, with some but not all of the colleges implementing these activities. Five of the fourteen Planning codes were not implemented by any of the colleges. Sustainability activities that were not adopted by all colleges warrant discussion for applicability and goal setting by those leading sustainability at individual colleges.

**Sustainability Implementation: Who is Doing it?**

The survey responses provided a glimpse into college actors implementing sustainability. Over 80% of survey respondents were involved in sustainability implementation at their colleges, and more chose personally interested than required by college as why they were involved. Over 78% of survey respondents perceived that their colleges supported some sustainability efforts as opposed to widespread or no support. A large majority perceived that both a top down and bottom approach is needed for
implementation as opposed to one or the other. The top three internal groups identified in implementing were sustainability committees, faculty groups, and student clubs; the top external groups were local municipalities, charitable organizations, community gardens and regional environmental groups, see Table 5.4 for the complete list.

Interviews using personal egocentric network questions provided a way to more fully understand network structure of those involved in college sustainability adoption. Interviewees identified sustainability actors by job positions and groups, then answered network questions for each. Standard SNA calculations and sociograms (Table 6.1 and Figures 6.1-6.4) were analyzed by the researcher to identify these network themes: (1) sustainability leadership typologies; (2) network communication bridges and cliques; and (3) social capital for sustainability funding and resources. The association among these three themes is the importance of communication networks among faculty, staff, and administrators as these position typologies bring essential social capital in advancing college sustainability. Interviewees with smaller administrator percentages as alters expressed a need for administrator involvement for access to decision-making and funding. However, large group size may be perceived as less effective than smaller size by group members (Kerr 1989). The largest committee of 30 members which also had the highest percentage of administrators, was perceived as too bureaucratic with too many position typologies. The interviewee recommended a smaller number of committed individuals would be more effective at sustainability implementation.

Sociograms of the interviewees reveal multidirectional leadership-follower relationships and the importance of network bridges and cliques. Cliques in network analysis are groups of tightly knit individuals, and access may be through a single
individual acting as a bridge to a particular group. Sociograms in the study identified specific cliques working on sustainability projects, often led by faculty members. A network bridge is an individual linking two cliques, and essential in communications between the two. Interviewees at colleges with higher sustainable activities had personal networks with a balance of faculty and administrators and bridges between these two college typologies, while interviewees from colleges with lower sustainability activities identified communication gaps (structural holes) in their personal networks of sustainability actors. Sociograms were very useful for analysis and are intended to be shared as examples to advance sustainability planning and network structures. For example, biology professors and operations administrators were in all five personal networks. Local city government, farms, churches, extension offices were participating in sustainability at some of the colleges, providing a model to other colleges that have not yet established these types of relationships.

**How might Sustainability Implementation be Improved?**

To implicate best practices in sustainability implementation, cluster analysis grouped the colleges into three clusters based on frequencies of coded activities. Cluster C is one outlier college with the highest number of activities in all four categories (Academics, Engagement, Operations and Planning) while Cluster A (8 colleges) is lower than Cluster B (7 colleges). Cluster A and Cluster B colleges had a Pearson Chi Square (alpha < 0.05) significant difference in answering the question, to whom do you turn to discuss sustainability? After responses were categorized by position typology, *Administrators* was highest for Cluster A colleges while *faculty* was highest for Cluster B. Administrators and faculty form distinct groups in higher education institutions.
Communication links between the two are necessary to advance innovation within a community college as they bring different social capital. Distribution of funding and resources in higher education institutions is largely the responsibility of administrators, while faculty offer professional expertise in their discipline as well as working directly with students.

Themes interpreted and coded by the researcher as challenges from study interviews were (1) college leadership transition; (2) communication networks; and (3) sustainability funding and resources. Taken together, the three themes are associated by organizational leadership responsibilities. Interviewee comments from all college clusters indicated a need for administrator involvement. Survey responses support the three interview themes - comments when Other was selected were coded as lack of administrative leadership and funding constraints coincide with themes (1) and (3) above. The top three responses chosen as barriers in the study survey were financial, lack of understanding and awareness, and people’s resistance to change. These results are consistent with the top three results found by Wright (2009) in interviews with university presidents in Canada. Two of the barriers, lack of understanding and awareness and people’s resistance to change, were challenges related to communication networking and organizational change functions of leaders. Given these challenges, leaders require techniques to identify sustainability barriers within their own organizations and strategies to resolve them.

Identifying communication structures at individual colleges was achieved using personal network techniques of individual sustainability leaders in the study. Personal network sociograms illustrated a method to analyze sustainability implementation more
specifically at a college, and then identified areas for improvement. This study recommends individual leaders develop their own personal network sociograms to self-discover where ties are weak or nonexistent to important cliques, and to focus on building potential bridges to expand their network. Kolleck (2013) found sociograms useful in discussing implementation strategies to sustainability actors within their network. Personal network analysis as an effective tool for leading sustainability implementation is discussed next, with study results placed in context with previous research.

**Discussion and Implications**

The importance of individual relationships in spreading new information and practices is recognized in organizational change theories, and this study analyzed implementation of sustainability innovation as a focus. The leadership framework for the study centers upon transformational leadership (Burns, 1978; Bass, 1999; Burke, 2014). The use of social network analysis combined with organizational theory is an area ripe for research, and “remains a major gap in the literature” (Kezar, 2014, p. 93). SNA is a tool to study relationships among individual actors, and is suitable for evaluation of implementation (Wasserman & Faust, 1994; Borgatti, Everett, & Johnson, 2013; Kollack, 2013; Kezar, 2014; Crossley et al., 2015). In this research, personal egocentric network techniques together with a survey and document coding were found to be useful in formative evaluation of sustainable leadership implementation. The results and interpretations were intended to be of practical use to college leaders to understand sustainable actors’ perceptions and to help rethink network collaborations and inclusions to advance sustainability. The study also contributes to organizational leadership theory in recognizing the importance of informal social networks within hierarchical structures,
supporting emerging research on integrating informal within formal networks (Sharp, 2009; L. Sharp, personal communications June 26, 2018). The following discussion presents implications to theory and practices relevant to the research.

**Theoretical Implications**

Burns and Stalker (1961) used the terms mechanistic and organic to describe opposing leadership traits and structures. Mechanistic is more hierarchical and controlling with positional roles clearly defined. However, formal hierarchical structures tend to inhibit creativity, motivation and involvement of skilled professionals in problem-solving. Organic systems differ by encouraging lateral communication and lateral responsibilities - hierarchical structures are of lesser importance. The well-being of the organization is recognized as coinciding with the well-being of individual workers, thus skilled professionals are more likely to be involved in problem-solving and innovation implementation in organic systems. Burns and Stalker emphasized the benefits of leaders able to recognize and apply appropriate mechanistic or organic strategies for different organizational situations. More recent studies suggest successful integration of formal and informal networks is associated with an organization’s stage of maturity (Sine, Mitsuhashi, & Kirsch, 2006) or distinct context (Sharp, 2009). Sine et al. found new organizations perform better in more mechanistic structures rather than organic in the Internet industry. The study concludes that larger more mature organizations in a changing industry might be better suited to implement organic behaviors because formal structures are already well established. Sharp (2009) recognizes the importance of a “systems thinking approach” (p. 8) in higher education sustainability, calling for all important parts within an institution to be involved for sustainability planning and
implementation. Transformational shifts in leadership, collaborations, and continuous planning are needed, according to Sharp.

A successful leader is able to determine when to use different modalities appropriate to specific situations (Burns & Stalker, 1961; Bass, 1999; Bass & Riggio, 2008; Bolman & Deal, 2013). A founder of leadership theory, Burns (1978) described transforming leaders as sharing common moral and motivational purposes with followers, transcending transactional self-interest relationships. Both transformational and transactional leadership exist within organizations with the latter involving simple exchanges between leaders and followers based on motivations while transformational leadership involves motivating followers beyond personal self-interest. Bass (1999) coined the term transformational leadership and further studied traits and behaviors akin to transformational and transactional frameworks, designing questionnaires to help reveal personal leadership styles for practical use. Support for lateral communication, balancing consistency with innovation for deep rather than superficial organizational change are traits of transformational leaders as understood by leadership researchers (Rost, 1993; Quinn, 1996; Fullan, 2008; Sterling et al. 2013; Burke 2014).

In Shared Vision: Transformational Leadership in American Community Colleges, the authors make the case for community college leaders to embrace a transformational leadership framework as continuous adaptation to their communities is required for success (Roueche, Baker & Rose, 1989). Higher education administrators, faculty, and staff leaders, both formal and informal, are advised to adopt transformational leadership strategies as change agents. A distinctive organizational structure in higher education institutions is the shared academic governance between administration and
faculty (McNamara, 2010). Faculty are experts in many fields of study (Bettencourt & Kaur, 2011) and may lead individual or teams of researchers. This diversity may be challenging to coordinate yet presents opportunities for professional faculty input on college initiatives. Cultural aspects including distrust of scientific data or disdain for administration driven programs may hinder adoption of innovation such as sustainable development (Sharp, 2002; Caldas et al., 2015). Institutional administrative leaders influence their college culture in both formal and informal ways. At the top of the hierarchy, presidents may restructure hierarchical positions as well as determine the power of informal structures in decision-making. The integration of vertical and horizontal communication networks and the role in budgeting and resource partitioning is largely determined by the administration. A new administration will likely alter structure and culture for the organization, causing some level of concern for constituents as found in this study.

Beyond theoretical leadership frameworks, the study analyzed implementation of sustainability as the focus. This research used tools to evaluate the application of the transformational framework, and discussed the effectiveness of these tools. Developing and implementing sustainability requires educating diverse people from multiple disciplines and backgrounds for support and direct involvement (Reynolds et al., 2010; Barlett & Chase, 2013; Johnston, 2013; Sterling et al., 2013; Barth, 2014). Dynamic, ongoing participatory approaches are recommended to implement sustainability within higher education institutions (Sterling et al., 2013; Barth, 2014). Sustainability implementation in higher education institutions is very much related to the general concepts of innovation diffusion described by Rogers (2003). Rogers identifies initiation
and implementation stages for innovation diffusion within organizations, and identifies “innovation champions” (Rogers, 2003, p. 414), or change agents, as important for successful implementation. Diffusion research involves structural and/or functional social change with three other elements beyond the innovation: channels of communication, time, and the social system. Adoption rates are positively associated with perceived advantages, ease or complexity of understanding, compatibility with values, and visibility of an innovation. When potential adopters are able to participate in “customizing” (p. 17) an innovation, diffusion is faster and longer lasting. Four phases related to time element are knowledge, persuasion, decision, implementation, and confirmation of an innovation by an adopter. Face-to-face interactions with peers who have already adopted are a primary means of diffusion.

Rogers’ descriptions of communication channels and social systems parallel concepts and terms of social network analysis (SNA). His descriptions of communication channels between two persons are ties and actors in SNA, respectively. The terms homophily, actors with similar traits, and heterophily, actors with dissimilar traits, are terms used in both diffusion research and SNA (Borgatti & Halgin, 2011, Kezar, 2014). SNA is a productive way to analyze social relationships in implementing organizational change both theoretically and practically (Wasserman & Faust, 1994; Borgatti, Everett, & Johnson, 2013; Kollack, 2013; Kezar, 2014; Crossley et al., 2015) and is further discussed below. The use of SNA is an emerging approach in leadership studies (Cross et al., 2002a; Borgatti et al., 2009; Borgatti & Halgin, 2011; Kezar, 2014), and sustainable development research (Kolleck, 2013; 2015; Ryan & Creech, 2008). This study uses social network concepts as analysis tools in evaluating sustainability implementation.
within educational institutions. The cost, time, and near impossibility of completing a whole network analysis is prohibitory for some sustainability implementation studies (Ryan & Creech, 2008; Kolleck, 2013; 2015), thus personal egocentric analysis was used and evaluated for this research. Study results exemplify the usefulness of individual personal network analysis in identifying attributes of communication networks to evaluate implementing innovation.

Study implications were that sustainability leaders as change agents are within informal networks of staff, administrators, and faculty, influencing and actively participating in innovation diffusion. Faculty and staff work on specific projects and activities advancing sustainability such as community health projects or working with government agencies, and administrator support provides social capital in terms of college funding and resources. Balancing typologies and communication ties is a challenge for leaders embracing a transformational leadership framework. SNA techniques would help leaders recognize organic network cliques and bridges during implementation stages of their particular college, allowing for informed support and advancement of college sustainability. Identifying personal networks in sustainability implementation would reveal communication structures and areas for expansion and improvement which may be unique for each institution. SNA has practical application to understand implementation practices at a particular point in time and maturity of an organization. Findings of this study support the application of personal egocentric networks to discover sustainability actors and communication structures, and to use visualizations of sociograms to improve functionality. Identifying important informal
networks allows leaders to help build better network structures and interactions if needed (Cross, Borgatti, and Parker, 2002a).

**Implications for Practice**

Social capital of administrators, faculty, and staff differ, and the importance of their communication networks for advancing innovations throughout an institution was supported by study results. Within a specific organization, social capital of individuals vary and the use of personal network analysis would be useful as a formative evaluation or self-evaluation tool to reveal relevant cliques and bridges or lack thereof in integrating social capital through networks. Sociograms are a good starting point in discussing implementation practices with sustainability actors unfamiliar with leadership theory or SNA. Each sociogram may be unique to individual colleges, and would be useful to stimulate discussion among college leaders to identify potential leaders and network bridges to improve implementation activities. The study found using personal networks rather than whole network analysis were cost and time effective.

Network bridges are important for sustainability activities involving different network groups/cliques, and was supported by findings from document coding. Implications were that a larger number of Engagement and Operations activities might be considered “low hanging fruit” in ease of implementation. Planning and Academic sustainability activities likely require more network crossover in typologies compared to the other two categories. For example, the decision to implement sustainable Landscape Management practices may reside within the Operations department, while Diversity Assessment Planning may require high level administrators from multiple departments as well as external factors. The need for multiple bridges for communication among
different groups may constrain sustainability implementation where bridges between cliques are missing.

Interview study questions identified sustainability alters by position, the frequency of communication between the ego center and each alter, and perceived importance of each alter in sustainability implementation. The resulting sociograms revealed unique sustainability networks for each interviewee. Of the two interviewees from Cluster A colleges, one wanted more administrative communication while the other suggested a smaller committee with a strong interest in sustainability would be “more effective” at his college. Cluster B college interviewees differed as well in leadership perceptions, as one wanted more top-down support while the other is satisfied with the level of support. Another finding from sociograms was that Cluster B and C interviewees have personal networks with bridges and cliques connecting administrators with faculty more so than Cluster A interviewees. Network themes of the study highlight the importance of communication networks among faculty, staff, and administrators as these position typologies bring essential social capital in advancing college sustainability. Survey results also support the importance of typology inclusion and social capital. Two significant differences in survey results between Cluster A (lower sustainability code frequencies) and Cluster B (higher sustainability code frequencies) implicate the importance of seniority and faculty connections. Demographic age was highest in the 41-52 range for Cluster A compared to 53-71 age range for Cluster C. Seniority likely has increased social capital and network connections within an organization. The other significant difference was in the responses to who is turned to in discussing sustainability. Cluster A was higher in administrators than faculty, while Cluster B was
the reverse. The implication is the importance of networking with faculty for sustainability, as Cluster B was greater in overall code frequencies than Cluster A. Balancing sustainability actor membership and communication bridges between administrator and faculty cliques were implicated as important, although networks were unique for each college.

**Conclusions and Future Research**

Integration of hierarchical and informal networks to advance innovation were evidenced by this study with hierarchies as administration and informal networks as subsets of networks, or cliques. Informal networks possess social capital influence in a variety of spheres, and faculty especially are likely influential both internally and externally to their colleges through their discipline connections and continuous interactions with students. Administrator social influence is as decision makers with control of funding. Within higher education, work focus differ among typologies: faculty are more involved in academic shared governance, staff in operations, and administration in planning and control. This study implicates leaders within informal networks whatever typology, have influence on innovation diffusion. Faculty and staff work on specific projects and activities advancing sustainability such as community gardens or working with environmental groups and students, and administrator support provides social capital in terms of funding, management, and resources.

This study focused on the importance of social networks in implementing an innovation such as sustainability. Revisions to the original concept map (p. 47) of this study reflect the study findings in moving from Phase B to Phase C in sustainable development implementation. A critical first step is to identify individuals who are
leaders within the organization that are committed to the innovation. These individuals may not be managers within an organizational hierarchy, thus would need access to decision-makers (lateral communications) and transformational professional development as change agents. A concept map revision, Figure 7.1, illustrates the identification of informal networks and leaders, and to build bridges across typologies to broaden innovations across typologies. SNA techniques, as shown in this study, identify informal networks working on innovation implementation, and show gaps within communication networks which act as barriers.

Figure 7.1. Additions to concept map. Study recommendation is to identify informal networks including leaders, ties, and potential bridges within an organization.

To broaden implementation across an institution, leaders would need to support the ongoing building of bridges for collaboration through lateral networks and cross-typology meetings for inclusivity. Organizing subgroups/teams of up to 8-10 individuals to work on specific projects would be partially based on existing networks rather simply on position typologies. These teams would meet on a more regular basis than the overall
group, with one team as an overall lead for planning, organizing, and evaluation. This lead team is illustrated in the intersections between typologies in Figure 7.2. SNA sociograms would be helpful in forming and evaluating teams.

Figure 7.2. Concept map revised symbolizing the integration of formal and informal networks to lead higher education initiatives. A team of individuals leading an initiative are represented in overlapping circles.

Striking the right balance among types and ties is a challenge for leaders in implementing sustainability. Recognizing organic network cliques and bridges unique to their college culture and implementation stage is possible using personal network analysis of key sustainability leaders. Subsequent discussions using sociograms and other network measures through transformational leadership tenants would inform leaders and followers in improving implementation communication and practices. Practitioners within the 16 colleges bounded by the Sustainable Development Framework are encouraged to share the rankings, written Sustainability Reports and sociograms to learn strategies on implementing sustainability activities from each other. The revised concept map, Figure 7.3, reflects the integration of formal and informal job positions and networks within a college, and the identification of sustainability actors, leaders, and ties.
to support widespread implementation of sustainable development in moving from Phase B to Phase C.

Future research

This study supports the use of personal network techniques as an effective method for evaluating innovation diffusion by leaders attempting to integrate transformation leadership in their organizations. Future research is recommended in the areas of shared leadership or distributed leadership to empower individuals outside of formal structures as leaders to gain wider sustainability implementation. SNA measures and personal network data provided measures and sociograms as a way to evaluate transformational leadership and informal networks for advancing innovations such as sustainability.

Transformational leadership concepts fit well at community colleges and in sustainable development as there is a continuous need for adapting to external forces and opportunities. Institutions would be well served to include leadership support outside of traditional command and control hierarchical structures for innovation adoption.

Sustainability leaders may be interested in using activity frequencies for planning and discussing with actors, as well as using sociograms to identify job positions and visualizing important network cliques and bridges for sustainability implementation at their own college. Tapping into those personally interested individuals and providing support using transformational leadership are recommended. This would involve professional development to train and support potential leaders from various college positions about leadership and diffusion frameworks as well as use of SNA.
Figure 7.3. Concept map revised to include use of social network analysis and transformative leadership in moving from Phase B to Phase C.
Limitations of Study

Limitations of the study were researcher bias, a reliance on participant perceptions, a bounded selection of participants, survey response rate, and small number of interviewees. The researcher was an employee of the participant college state system and a sustainability actor, and analysis of data may be biased based on previous experiences as a sustainability leader and faculty member at one of the 16 two-year colleges in the system. Study respondents may have had reservations in answering survey and/or interview questions, and may have responded based on supposed expectations of the researcher. The study relied on perceptions of college sustainability actors for study data, and recall bias of participants may be high (Crossley et al. 2015). Participants were purposely selected, thus transferability and generalization of findings is limited to the colleges within the study. In addition, the number of interviews (five) and survey participants (response rate of 44%) may not be representative of the sustainability actors and college groups.

Researcher Bias

Employed at one of the two-year colleges and engaged in sustainability implementation, the researcher has some degree of bias in study design and interpretation, and needs to be transparent in her role as both researcher and practitioner. College sustainability activities written in Sustainability Reports were evaluated and coded based on researcher interpretations of the STARS category descriptions. The researcher was aware of activities at some of the colleges and may have been influenced when coding activities, or when coding interview transcripts. Bias may have been especially true when data were interpreted from the researcher's participant college. For
example, researcher bias in this process might tend to code college activities based on previous knowledge rather than solely on the use coding.

**Participant Reliability and Validity**

SNA studies rely on actor responses for relationship network data, and actor bias is recognized as an error in recall resulting in missing data. Using a survey as a name generator in combination with a semi-structured interview is recommended by Rice et al. (2014) to improve reliability in SNA studies. They found surveys alone as name generators "led to many omissions" (p. 265), and that semi-structured interviews tended to lessen participant fatigue and expand network data. The proposed study followed their sequence recommendation by first using an online survey including name generator, then a follow-up semi-structured interview to expand data. Perceptions from survey and interview participants were triangulated with document analysis. However, the reliability of participant responses may contain some error in recall. Participants may have had reservations in responses to work-related questions. Participants may have been aware of the researcher's position within the college system and may have influenced responses to be more favorable. To increase the validity of results, the researcher used both surveys and interviews (Creswell, 2013; Maxwell, 2012; Rice, et. al, 2014) as well as was knowledgeable of documented sustainability activities at colleges during interviews.

**Generalization**

Participant colleges were bounded and limited in number, thus generalization validity to other colleges was a limitation. SNA is an appropriate method for an inductive approach from specific observations to patterns for generalized theory (Kolleck, 2013; Meuser et al., 2016). However, generalization to other colleges outside the participant
colleges is suspect in studies not using randomized participant selection. Therefore, results and interpretations may simply apply to the colleges involved in the study. Providing detailed research design and data analysis in this document helps others to decide applicability to other institutions.
Appendix A: Human Subjects Research Board Approval Letter

4/6/2017

Bobby Ann Lee
4810 Alben Barkley Dr.
P.O. Box 7390
Paducah, KY 42002

RE: Comparing 2-year Colleges Under a Common Sustainable Framework: Personal Networks and Perspectives

Dear Bobby:

After careful consideration of your application to the KCTCS Human Subjects Review Board, I have determined that you are eligible for exemption from federal regulations regarding the protection of human subjects based on your research using a procedure that meets the exempt review criteria section 7 (2).

Thank you for your cooperation in meeting the federal requirements for conducting research that utilizes human subjects. We appreciate your notification to this board and we will keep your information on file.

Sincerely,

Rhonda R. Tracy, Ph.D.
KCTCS Chancellor

Pamela M. Duncan
Associate General Counsel
Chair, KCTCS Human Subjects Review Board

cc: Alicia Crouch
Vice Chancellor of Research & Policy Analysis
Appendix B: Institutional Review Board Exemption Certification Letter

EXEMPTION CERTIFICATION

MEMO: Bobby Lee  
277 Country Club Lane  
Murray, KY 42071  
PI phone #: (270)534-3237

FROM: Institutional Review Board  
c/o Office of Research Integrity

SUBJECT: Exemption Certification for Protocol No. 17-0362-X4B

DATE: May 22, 2017

On May 22, 2017, it was determined that your project entitled, *Comparing two-year colleges under a common sustainable development framework: Personal networks and perspectives*, meets federal criteria to qualify as an exempt study.

Because the study has been certified as exempt, you will not be required to complete continuation or final review reports. However, it is your responsibility to notify the IRB prior to making any changes to the study. Please note that changes made to an exempt protocol may disqualify it from exempt status and may require an expedited or full review.

The Office of Research Integrity will hold your exemption application for six years. Before the end of the sixth year, you will be notified that your file will be closed and the application destroyed. If your project is still ongoing, you will need to contact the Office of Research Integrity upon receipt of that letter and follow the instructions for completing a new exemption application. It is, therefore, important that you keep your address current with the Office of Research Integrity.

For information describing investigator responsibilities after obtaining IRB approval, download and read the document "PI Guidance to Responsibilities, Qualifications, Records and Documentation of Human Subjects Research" from the Office of Research Integrity's IRB Survival Handbook web page [http://www.research.uky.edu/ori/IRB-Survival-Handbook.html#Piresponsibilities]. Additional information regarding IRB review, federal regulations, and institutional policies may be found through ORI's web site [http://www.research.uky.edu/ori]. If you have questions, need additional information, or would like a paper copy of the above mentioned document, contact the Office of Research Integrity at (859) 257-9428.
Appendix C: Informed Consent Form for Survey

KCTCS personnel has identified you as a sustainability actor, and we invite you to participate in a study for the purpose of advancing understanding of sustainable development within higher education. This study is part of dissertation research in the College of Education at the University of Kentucky, and uses a survey instrument and interviews to collect information on sustainable development implementation at two-year colleges. You will be asked questions regarding your perceptions, experiences and working relationships on implementing sustainable development at your institution. This study has been approved by the KCTCS Human Subjects Review Board. Although you will not get personal benefit from taking part in this research study, your responses may help us understand more about implementing sustainable development at higher education institutions. We hope to receive completed questionnaires from about 70 people, so your answers are important to us. Of course, you have a choice about whether or not to complete the survey, but if you do participate, you are free to skip any questions or discontinue at any time. There are no known risks to participating in this study.

All information obtained will be treated confidentially and every effort will be made to keep private all research records that identify you to the extent allowed by law. Your responses will be combined with others taking part in this study, and when we write about the study, information will be combined, and you will not be personally identified in published materials. Please be aware, while we make every effort to safeguard your data once received from the online survey/data gathering company, given the nature of online surveys, as with anything involving the Internet, we can never guarantee the confidentiality of the data while still on the survey/data gathering company’s servers, or while en route to either them or us. It is also possible the raw data collected for research purposes may be used for marketing or reporting purposes by the survey/data gathering company after the research is concluded, depending on the company’s Terms of Service and Privacy policies.

If you have questions about the study, please feel free to ask; my contact information is given below. If you have complaints, suggestions, or questions about your rights as a research volunteer, contact the staff in the University of Kentucky Office of Research Integrity at 859-257-9428 or toll-free at 1-866-400-9428. Thank you in advance for your assistance with this important project. To ensure your responses/opinions will be included, please complete this survey within 2 weeks of receiving it. If you are under 18, please do participate in this survey.

Sincerely,
Bobby Ann Lee, Principal Investigator
Education Sciences, University of Kentucky
Cell (270) 748-5955
E-mail: bobby.lee@kctcs.edu

Your signed consent will be indicated by using the link below to take the online survey and checking YES.

LINK TO ONLINE SURVEY – The survey should take about 30 minutes to complete. The Institutional Review Board number for this study is 17-0362-X4B.
Appendix D: Online Survey Questions

Q1 Although you will not get personal benefit from taking part in this research study, your responses may help us understand more about implementing sustainable development at higher education institutions. We hope to receive completed questionnaires from about 70 people, so your answers are important to us. Of course, you have a choice about whether or not to complete the survey, but if you do participate, you are free to skip any questions or discontinue at any time. There are no known risks to participating in this study. All information obtained will be treated confidentially and every effort will be made to keep private all research records that identify you to the extent allowed by law. Your responses will be combined with others taking part in this study, and when we write about the study, information will be combined, and you will not be personally identified in published materials. Please be aware, while we make every effort to safeguard your data once received from the online survey/data gathering company, given the nature of online surveys, as with anything involving the Internet, we can never guarantee the confidentiality of the data while still on the survey/data gathering company’s servers, or while en route to either them or us. It is also possible the raw data collected for research purposes may be used for marketing or reporting purposes by the survey/data gathering company after the research is concluded, depending on the company’s Terms of Service and Privacy policies. Your signed consent to participation in this study is indicated by "Yes" below.

- Yes
- No

Q2 What is your age?
- Under 18
- 18-21
- 22-40
- 41-52
- 53-71
- Over 71

Q3 What is your gender? ______________________________________________

Q4 What is the name of your college?
- Ashland Community & Technical College
- Big Sandy Community and Technical College
- Bluegrass Community & Technical College
- Elizabethtown Community & Technical College
- Gateway Community & Technical College
- Hazard Community & Technical College
- Henderson Community College
- Hopkinsville Community College
- Jefferson Community & Technical College
- Madisonville Community College
- Maysville Community & Technical College
Q5 How long have you worked at your college?
- < 2 years
- 2 to < 6 years
- 6 to 12 years
- Over 12 years

Q6 What is your primary job title at your college?

Q7 How long have you worked in your present job position?
- < 2 years
- 2 to < 6 years
- 6 to 12 years
- Over 12 years

Q8 Are you aware of the KCTCS Sustainable Development Framework?
- Yes
- No
- Unsure

Q9 Are you involved in implementing sustainability practices at your college?
- Yes
- No

Q10 Why are you involved in sustainability implementation at your college?
- Required by college
- Personally interested
- Other ________________________________________________

Q11 How long have you been involved in sustainability implementation at your college?
- < 2 years
- 2 to < 6 years
- 6 to 12 years
- Over 12 years

Q12 Please choose the one that most reflects your college:
- Does not support sustainability efforts at the college.
- Supports some sustainability efforts at the college.
- Supports widespread involvement in sustainability development at the college.
- Has incorporated sustainability in mission or vision statements at the college.
Q13 Do you think a top-down or bottom-up approach is better in achieving a sustainable college?
  o Top-down
  o Bottom-up
  o Both needed

Q14* What are the key issues facing your college in the next ten years? Choose all that apply:
  o Enrollment
  o Relationship/relevance of college to society/community
  o Funding/budget/capital expansion/government funding
  o Physical space/building expansion
  o Quality of academic programs/overall student experience
  o Maintenance of existing buildings
  o Energy issues
  o Faculty retention/recruitment/retirement
  o Other ________________________________

Q15* When you hear the term sustainable development, what does this mean to you? Choose all that apply:
  o Issues surrounding the environment
  o Non-environmental-focused factors
  o Balancing economy, environment, and social concerns
  o Continued trajectory of growth/development but with some caveats
  o Contradiction/oxymoron
  o Amorphous meaning
  o Global context/implications
  o Other ________________________________

Q16* What role, if any, do you feel colleges, in general, should play in achieving sustainability? Choose all that apply:
  o Green physical space
  o Reducing energy consumption
  o Financial sustainability
  o Expanding enrollment/ensuring student participation/satisfaction
  o Social equity/accessibility for all students
  o Sustainable policy implementation
  o Never heard term/term is jargon
  o Other ________________________________

Q17* When you hear “sustainable college” what does this mean to you? Choose all that apply:
  o Green physical space
  o Reducing energy consumption
  o Financial sustainability
  o Expanding enrollment/ensuring student participation/satisfaction
Q18* What if any, barriers to you see preventing your college from engaging in sustainability initiatives? Choose all that apply:

- Social equity/accessibility for all students
- Sustainable policy implementation
- Never heard term/term is jargon
- Other ________________________________

Q19* Do you foresee different barriers and challenges in the future? Choose all that apply:

- Optimistic outlook regarding solutions
- Same challenges will exist
- Social issues will become more important
- Challenges will be more material/technical than psychological or political
- Other ________________________________

Q20* Do you think your college will make becoming a model of sustainability a top priority?

- Yes, but with some stipulations
- No – it is a priority, but not a top priority
- No – will never be a priority
- Do not know
- Other ________________________________

Q21 To whom do you turn to discuss sustainable development activities at your college each year? Please provide a list of names and job titles.________________________

Q22 What internal groups are involved in sustainable development activities at your college each year? Please provide a list of group names and short description of group purpose._________________________________________________________

Q23 What external groups are involved in sustainable development activities at your college? Please provide a list of group names and short description of group purpose.

Q24 Thank you for participating in this survey. Would you be interested in participating in a follow-up interview regarding sustainability implementation at your college? If yes, please provide your preferred contact information: _________________________

*Q14 to Q20 adapted with permission from Wright, 2010*
10/3/2016

Hello Dr. Wright,

I would like your permission to use some of your survey questions as a starting point for research I am conducting in Kentucky, USA. The questions are in: Wright, Tarah. "University Presidents' Conceptualizations of Sustainability in Higher Education." *International Journal of Sustainability in Higher Education* 11.1 (2010): 61-73. I appreciate your sustainability research and continued involvement as I have found your publications informative and helpful in providing guidance for my research.

I am studying sustainable development at Associate’s colleges and am a practitioner teaching ecology courses as well as helping lead sustainability initiatives at my college. I plan on using document analysis, surveys, and semi-structured interviews of sustainability leaders at 16 colleges. The primary measures will be related to sustainability outcomes and social network attributes. I have completed coursework and am in the proposal stage for my PhD in Educational Sciences at University of Kentucky.

Thank you for your consideration,

Bobby Ann Lee
4810 Alben Barkley Drive
Paducah, KY 42001
(270) 534-3237

10/6/2016

Hi Bobby! So sorry for the delay – I am currently on a year away from the university and living on a sailboat with my family. I often go weeks without access to internet given the places we are visiting. I would be more than happy for you to use the survey questions from our study. Do you need me to send you anything, or do you have them from the publication? Just let me know. Please also keep in touch about your study – I would love to hear what you find. Perhaps there is room for a comparative paper to be written on the subject (US vs. Canada) in the future? Take care, Tarah

Tarah Wright, PhD
Dalhousie University
Environmental Science
1355 Oxford St.
PO BOX 15000
Halifax, NS B3H 4R2

T: 902.494.3683
F: 902.494.1123
Appendix E: Informed Consent Form for Interviews

KCTCS personnel has identified you as a sustainability actor, and we invite you to participate in a study for the purpose of advancing understanding of sustainable development within higher education. This study is part of dissertation research in the College of Education at the University of Kentucky, and uses a survey instrument and interviews to collect information on sustainable development implementation at two-year colleges. For this study, you have been selected to participate in an interview that will be digitally recorded and transcribed verbatim. You will be asked questions regarding your perceptions, experiences and working relationships on implementing sustainable development at your institution. Although you will not get personal benefit from taking part in this research study, your responses may help us understand more about implementing sustainable development at higher education institutions. We hope to complete interviews from about 4-6 people, so your answers are important to us. Of course, you have a choice about whether or not to complete the interview, but if you do participate, you are free to skip any questions or discontinue at any time. There are no known risks to participating in this study.

All information obtained will be treated confidentially and every effort will be made to keep private all research records that identify you to the extent allowed by law. Your responses will be combined with others taking part in this study, and when we write about the study, information will be combined, and you will not be personally identified in published materials. If you have questions about the study, please feel free to ask; my contact information is given below. If you have complaints, suggestions, or questions about your rights as a research volunteer, contact the staff in the University of Kentucky Office of Research Integrity at 859-257-9428 or toll-free at 1-866-400-9428.

Thank you in advance for your assistance with this important project.

Sincerely,

Bobby Ann Lee, Principal Investigator
Education Sciences, University of Kentucky
Cell (270) 748-5955
E-mail: bobby.lee@kctcs.edu

___________________________ ___________
Signature of Participant Date

Your signed consent will be indicated by the email check box stating YES
  o  YES
  o  NO

The Institutional Review Board number for this study is 17-0362-X4B.
**Appendix F: Interview Questions with Ordinal Coding of Responses**

**Name Generator and Interpreter Questions.** Introduce questions to be named for each sustainability actor listed from survey and sustainability plans of the college. Ask if there are other individuals or groups that have helped lead campus sustainability activities. For each alter name ask the following, ordinal scoring is in parentheses:

Q1 What is his/her formal position at the college? Department:__________________

Q2 What role does he/she have in sustainability
   Lead activity (4)
   Plan activity (3)
   Manage activity (2)
   Other (1)

Q3 How important is (alter name) in implementing sustainability at your college?
   High (3)
   Medium (2)
   Low (1)

Q4 How often are you in meetings with (name).
   More frequently than once a month (4)
   About once a month (3)
   Once every three to four months (2)
   Once or twice a year (1)
   None (0)

Q5 Outside of college meetings, how often do you communicate with (name) about sustainability?
   More frequently than once a month (4)
   About once a month (3)
   Once every three to four months (2)
   Once or twice a year (1)
   None (0)

**Sustainability Attitudes.** Review Sustainability Attitudes questions from survey with interviewee. Ask if other items on sustainability implementation at the college have not been asked, or if there are any other comments or additions that the interviewee would like to discuss that would contribute to the study.
REFERENCES


Finnigan, K. S., & Daly, A. J. (2010). Learning at a system level: Ties between principals of low-performing schools and central office leaders. In A. J. Daly (Ed.), *Social...


doi:10.1177/097340821100600111


doi:10.1126/science.1059386


VITA

Bobby Ann Lee

EDUCATION

1995  Murray State University, Murray, KY
      **Master of Science** in Biology, College of Science
      Thesis: Littoral zones in a reservoir: Groundwater flow paths and *Justicia americana*

1986  Southern Illinois University, Carbondale, IL
      **Bachelor of Science** in Journalism, College of Communications, minor in Economics

PROFESSIONAL EXPERIENCE

August 1998 – present.  **Instructor to tenured Professor, Biology**
      West Kentucky Community & Technical College (WKCTC) formerly Paducah Community College, Paducah KY

August 2017–present.  **Sustainability Project Coordinator**
      West Kentucky Community & Technical College, Paducah KY

August 1996 – July 1998.  **Adjunct Instructor, Biology**
      Paducah Community College, Paducah, KY

December 1995– August 1998.  **Research Technician**
      Hancock Biological Station, Murray State University, Murray, KY

      Murray State University, Murray, KY

      Center for Reservoir Research, Murray State University, Murray, KY

1986-1990 **Marketing Manager**
      VisionLink, Inc. Carbondale, IL

AWARDS

1999: Sigma Xi Teaching Award
PUBLICATIONS


PROFESSIONAL PRESENTATIONS (2007 to present)

January 2018: WKCTC Professional Development Session, “KCTCS Sustainability Framework: What does this mean for our college?”

November 2017: WKCTC Presidents Leadership Team presentation: “WKCTC Sustainability Update”

October 2016: WKCTC Professional Development Workshop, “Using Blackboard e-Collaborate to Engage Online Students”


October 2014: WKCTC Campus Sustainability Day, Paducah, KY, “Sustainable Development - South Africa to West Kentucky”


May 2010: Kentucky Conference on the Scholarship of Teaching and Learning, Lexington KY, “Critical Thinking in Introductory College Courses”

September 2009: WKCTC Professional Development for Adjunct Faculty, Paducah, KY, “What is Critical Thinking?”

March 2009: Environmental Management Site Specific Advisory Board National Meeting, Savannah, GA, Chair Representative and Presenter for the Paducah Citizens Advisory Board, Department of Energy

October 2008: Association of College and University Biology Educators, Hopkinsville, KY, “Simplifying & Refining General Education Outcomes in Introductory Biology Courses”


September 2008: Environmental Management Site Specific Advisory Board National Meeting, Washington, D.C., Chair Representative and Presenter for the Paducah Citizens Advisory Board, Department of Energy

July 2008: Paducah Gaseous Diffusion Plant Citizens Advisory Board meeting, Paducah, KY, “Proposal for the Citizens Advisory Board to Initiate Scenario Planning”

April 2008: Watershed Watch Training Workshop, Murray State University, KY, Presenter and Facilitator, “Aquatic Habitats and Assessments”


LEADERSHIP

Chair, WKCTC Green Sustainability Committee (2009-present)
Chair and Science Advisor, Four Rivers Watershed Watch (1998-present)
Chair, WKCTC General Education Outcomes Committee (2009-2017)