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A Continuum Of Systems Thinking: From Systematic To Systemic

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A CONTINUUM OF SYSTEMS THINKING: FROM SYSTEMATIC TO SYSTEMIC

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ABSTRACT

Systems thinking is an umbrella term which encompasses both systematic thinking and systemic thinking. Systematic thinking is characterized by a logic flow of repeatable and predictable actions in order to accomplish an aim in a system. Systemic thinking is characterized by the understanding of the interconnections between systematic processes and parts of the larger organizational system. Additionally, systemic thinking includes the understanding that systems are both concrete and abstract with both internal and external factors serving as linkages to the systems. Systems thinking leadership in education is critical as the landscape is dynamic as it relates to what is valued and thus defined as an accountability metric for schools and districts. Systems thinking leaders understand that the accountability metric becomes the aim of their organizations, thus their organization's systems must align to the determined aim. When leaders are able to think and act systemically, they are able to advocate for what should be valued in education in a manner that understands both the internal and external factors that contribute to critical conversations for students.

This dissertation study utilized a comprehensive literature review in order to determine and define seven constructs of systems thinking along with 84 statements that constituted a Continuum of Systems Thinking (COST) survey for research administration. Through gathering and analyzing COST survey data through an exploratory factor analysis, followed up with a confirmatory factor analysis, five factors of systems thinking were able to be determined and defined. Fifty-three survey statements remain after the statistical analyses in order to constitute

the final COST survey encompassing the factors: (1) Leveraging Interconnections Through Systemic Thinking, (2) Data-Based Analysis Leading to Action, (3) Leading by Engaging, (4) Concrete and Abstract Systems, and (5) Systematic Process Knowledge.

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CHAPTER 1

FOUNDATIONS AND RATIONALE FOR THE STUDY

"One of the difficulties in education is seeing the whole system at once" (Jenkins, 2005, p. 85). Systems theory provides a conceptual framework to draw parallels to educational organizations in order to understand and analyze system components for continuous improvements. It includes elements that serve as tenets that take on either a systematic categorization or a systemic categorization. Systematic categorizations include processes and procedures that are repeatable, predictable, and can be written out in a job-aid format (Richmond, 1994; Senge, 1990; Shipley, 2015). Systemic categorizations include decisions and actions that continuously analyze the interconnectedness of the systematic processes in order to leverage linkages for school improvements (Deming, 1994; Jenkins, 2005; Shipley, 2015). Systemic thinking not only comprises considerations of the linkages among systematic processes, but also includes the knowledge and understanding of intangible factors such as external and internal culture, governance, and relationships as variables. As Wheatley (1999) posited, "Systems influence individuals, and individuals call forth systems" (p. 36).

Leading an organization with an understanding of systems theory, which includes the elements needed to create and maintain systematic processes along with the systemic understanding to make decisions and act in a manner that leverages linkages, increases the effectiveness of organizations (Nguyen & Bocsh, 2014; Palaima & Skarzauskiene, 2010; Senge,

1990; Zaraza, 1995). Those who approach issues within an organization with a systematic default may find that the process or procedure created to remedy the original issue eventually and unintentionally create ineffectiveness in multiple parts of the organization. As Wheatley (1999) positioned,

> In our day-to-day search for order and prediction, we are driven crazy by non-local causality. We all have been forced to deal with unintended consequences of our well-intended plans. We thought we were doing something helpful to solve a problem, and suddenly we are confronted with eight new problems created by our initial solution. (p. 42)

Thus, the identification of how leaders approach organizational problems becomes a critical element of identifying the level of systems thinking in an organizational leader. To take systematic action in an effort to remedy a systemic problem has the potential to create further problems; however, experiencing action paralysis due to viewing every problem as needing a systemic solution has the potential to create an ineffective organization as well. Senge (1990) explained the capacity to understand this type of dynamic decision making as "the ability to carry on 'learningful' conversations that balance inquiry and advocacy" (p. 11).

This quantitative study focused on developing an instrument that measures the level of systems thinking in organizational leaders in education settings. The statements for the Likert-like scale continuum of a systems thinking instrument will be developed through constructs defined throughout the literature review. Although a systems thinking continuum was drafted in the business sector (Stave & Hopper, 2007), an educational systems thinking spectrum was the focus of this research study.

Statement of the Problem

Systems thinking enables organizational leaders to understand and leverage the linkages between system structures in an organization in order to engage in a cycle of continuous improvement. A leader who exhibits a high level of systems thinking is able to analyze complex problems through a systemic lens in order to take measures in solving root causes over immediate causes (Fullan, 2004; Senge, 1990; Shipley, 2016). Organizational leaders who do not operate with a systems thinking approach do not create aligned processes and practices for individuals within the organization to reach a common aim effectively (Deming, 1994; Richmond, 1994; Palaima & Skarzauskiene, 2010; Stave & Hopper, 2007). As Shipley (2015) posited, "Alignment between systems is as important as alignment within a system" (p. 19). Ultimately, as Deming (1994) indicated, only 6% of the problems in an organization can be attributed to individuals within the systems, with 94% of the problems in an organization being due to the systems. Therefore, it is paramount that leaders in education understand and act in a manner that embodies systems thinking.

Background of the Problem

A lack of systems theory research and application in the educational sector is a reality of the past and present state in education. Systems theory research, as it relates to education, is needed to support leaders in understanding and applying systems theory on a widescale platform (Fullan, 2005, 2006; Senge, 1990; Shipley, 2016). Even as this need is present in educational research literature, the historical background of policy in education has continuously attempted to streamline the educational sector into mirroring the business sector. A historical policy review in education is present in the literature review in order to draw attention to the attempt of inching educational organizations toward a business model (Rhodes, 2012; Urban & Wagoner, 2014).

Even as schools are not businesses, substantial implications are present for continuous improvement models striving toward excellence to be adapted from a business to an educational model. By adapting systems theory literature and models into practice in an educational setting, an elevated mindset on the interconnectedness of education as a whole can be formed in order to bring about the systemic reform needed in our current educational state (Best & Holmes, 2010; Jenkins, 2005; Stroh & Zurcher, 2018). After all, "interdependency demands systems thinking" (Richmond, 1994, Systems Thinking is a Paradigm section).

Contemporary Challenges

The terms systematic and systemic are used interchangeably and yet do not yield the same meaning. They are often stated synonymously under the umbrella of systems thinking. Systematic and systemic are not synonymous; thus, the terms create different results when applied to a complex organization. In fact, instances where systematic processes are deployed to solve systemic issues often convolute the original issue, as it may create a space in which people charged with leading systems are blamed for problems (Deming, 1994; Wheatley, 1999; Shipley, 2016). Systemic thinking is not superior to systematic thinking; rather, these are two types of thinking that both have their place in continuous improvement cycles (Richmond, 1994; Senge, 1990; Shipley, 2015).

Systematic thinking mirrors flowchart-oriented thinking in that it embodies the processes and procedures that are implemented in the systems of an organization (Nguyen & Bocsch, 2014, Thornton et al., 2004). Systemic thinking is looking at the interconnectedness of systematic processes, examining the siloed systems of an organization as one whole, and determining how to leverage the relationships between the systems and systematic processes for desired organizational outputs (Vineyard et al., 2018). Without a systemic understanding and

application, leadership in organizations has the potential to implement solutions to problems that do not create sustainability and may create unforeseen further problems in multiple systematic parts of the larger system (Fullan, 2005; Senge, 1990).

As an educational example, a leader whose systems understanding reflects that of solely a systematic thinker may view low student engagement as an instructional problem. Therefore, the educational leader sends a staff of teachers to a professional development workshop over deep thinking in the classroom. The professional development may impact some teachers enough to increase the engagement in the classroom on a short-term basis. However, when thinking systemically, the educational leader would also consider curriculum, assessment, and their own coaching when analyzing the problem of low engagement in the classroom, to name a few other variables to be considered throughout the organization. In this example, systemic thinking would encourage the educational leader to leverage the relationships between curriculum, instruction, assessment, and environment to create a sustainable solution to the identified problem. Furthermore, the solution to the identified problem would focus on the system as a whole, over-focusing on the people within the system as people act according to the system. As Stroh and Zurcher (2018) stated when implementing a systematic thinking solution to a complex problem, "When the problem recurs, people fail to see their responsibility for the recurrence and blame others for the failure" (Stroh & Zurcher, 2018, para. 8).

Purpose of the Study

The purpose of this quantitative study is to create an instrument that identifies the level of systems thinking in an organizational leader. The research will further define the constructs of systematic thinking, systemic thinking, and systems thinking through the literature review in order to develop an instrument to administer to district and building leadership in education to

assess an individual's level of systems thinking. The results from an exploratory factor analysis of the instrument will create categories encompassing the characteristics of systems thinking. If the continuum of systems thinking (COST) instrument can adequately identify the level of systems thinking in an organizational leader, then a vast number of correlational studies can be conducted in order to determine if there is a relationship between the placement of organizational leaders on the continuum of systems thinking and the effectiveness of different variables of outputs in an organization.

Research Questions and Hypotheses

Research Questions

Research questions will include the following:

1. What are the domains of systemic leadership that should be considered for the development of an instrument to measure systems thinking?
2. Can a self-reported, Likert-like scale instrument be developed to assess the measure of systems thinking in an organizational leader?

Null Hypotheses

Null Hypothesis 1: There are no domains of systemic leadership that can determine the position of organizational leaders on a continuum of systems thinking for instrumentation.

Null Hypothesis 2: A self-reported, Likert-like scale instrument cannot be developed and adequately assess the measure of systems thinking in an organizational leader.

Significance of the Study

If a profile of systems thinking in an organizational leader can be determined via an instrument, it could create a positive contribution for hiring practices and professional learning cycles within organizations. If such an instrument existed, then organizations could utilize this

instrument to vet leadership candidates based on their abilities to think and thus act in accordance with a systemic lens. Additionally, organizations may administer the systems thinking instrument in order to generate systems thinking profiles of current leaders. Such profiles would allow organizations to prioritize targeted professional learning that fosters the ability to engage in continuous improvements which elevate the practices essential to the effectiveness of systems, and conversely analyze the root causes for their ineffectiveness. It is also an aim of this research to create distinct definitions for the terms systematic and systemic for a common understanding of how these two terms relate and support one another in a continuous improvement cycle. Barry Richmond (1994) is known as a prominent scientist on systems thinking and the implications it has on human thought and decision making. Richmond (1994) stated, “People who generate insights for themselves learn much more than those who are fed them. The more people who have the capacity for generating systemic insight, the more likely the planet will be to arrive at some desirable steady-state” (p. 6).

If the continuum of systems thinking (COST) instrument can identify a profile of systems thinking in an organization leader, then further correlational studies can take place, such as to determine relationships between the level of systems thinking and teacher and student achievement, teacher and student engagement, along with a multitude of additional variables. If these findings demonstrate a significance, then the implications are for learning cohorts on systems thinking and hiring practices at the leadership level.

Methodological Brief

The literature review in this quantitative research study will support the development of an instrument to administer to educational leaders in the form of a survey. The survey will utilize a five-point Likert-like scale to collect interval data for an exploratory factor analysis. With the

survey items serving as the independent variables in the study and the scores of the survey items serving as the dependent variables, categories for a continuum of systems thinking will emerge during the process of the exploratory factor analysis.

Limitations

Limitations are factors that are uncontrollable by the researcher; therefore, measures are taken to lessen the impact of the uncontrollable factors (Leedy & Ormrod, 2005). A limitation of this study is the survey design of a Likert-like scale in which participants self-report their answers. In order to control for this limitation, a large sample size will be surveyed. Additionally, several statements pertaining to the same surveyed item will be presented in different formats to minimize the amount of inflation of self-reporting.

Another limitation of this study is the bias the researcher has about the effectiveness of systems thinking in an organizational leader. In order to control for this bias, the dissertation committee members will read the survey statements in order to ensure bias statements indicating the preference for systems thinking is not present. Additionally, the committee members will provide feedback to minimize the researcher's bias that systemic thinking is superior to systematic thinking that may be implicitly demonstrated through survey questions. A further limitation of this study is the prior knowledge of systems thinking that organizational leaders in education possess. In order to control for this limitation, participants will be asked to identify previous training in systems thinking prior to taking the continuum of systems thinking survey.

Delimitations

Delimitations define the guardrails for the study as identified by the researcher (Leedy & Ormrod, 2005). Delimitations tell us who will be involved and why. The continuum of systems thinking survey will be administered to educational leaders in the PK-12 sector. Therefore, the

survey results for exploratory factor analysis will not take into account the understanding of systems thinking outside of the education sector. Thus, the results will be generalizable only to PK-12 educational organizations.

The continuum of systems thinking survey will be administered to PK-12 educational leaders in Indiana. Due to this delimitation, the results of the survey for exploratory factor analysis will derive from one state's understanding of systems thinking through educational leaders. Thus, the results will be generalizable for educational organizations in Indiana.

The continuum of systems thinking survey will be administered to educational leaders defined in the role of principal, director, assistant superintendent, or superintendent of an educational organization. Due to this delimitation, the results of the survey for exploratory factor analysis will not include leaders within an organization who do not hold the listed official titles. Thus, the results will be generalizable for educational leaders with the title of principal, director, assistant superintendent, and superintendent.

Definition of Terms

Systems theory encompasses layers of terms utilized to define systems and systems thinking. In order to support common language usage throughout the research and to develop survey items for the continuum of systems thinking instrument, the following terms are defined via research conducted in the literature review.

Accumulation is the concept of a stock continuously increasing as inflows are more prevalent than outflows in a system (Cronin et al., 2009).

A *complex problem* is a problem that is recurring and interconnected to the point of being defined as a systemic problem. Complex problems will not be solved with simple solutions.

Rather complex problems require a root cause analysis to understand the history of the problem through a systemic lens (Stroh & Zurcher, 2018).

A *continuum of systems thinking* is a visual that represents different levels of systems thinking, from the basic understanding of the interconnectedness of systematic processes to stock, flow, and feedback cycle relationships. Thus, a continuum provides "a yardstick against which to measure the level of systems thinking achieved by individuals and groups" (Stave & Hopper, 2007, p. 2).

Feedback cycles are present in a closed system as data are fed back to the input of a system in order to adapt the input to match the desired output (Sweeney & Sterman, 2000). For example, in a curriculum feedback cycle, the curriculum serves as the input, with student formative assessment data serving as the data fed back to the input of the system in order to adapt the input for the desired output of the delivery of a guaranteed and viable curriculum. The presence of student formative assessment data being fed back to the input in order to adjust to reach the desired output indicates that a *feedback cycle* is an element in the curriculum system.

Flows in a system are variables that are inputs and outputs of a system. Examples of flows in a system include water in a bathtub and money going in and coming out of accounts (Cronin & Gonzalez, 2007; Fischer & Gonzalez, 2016; Gonzalez & Wong, 2011; Kainz & Ossimitz, 2002).

Interconnected thinking is defined by the understanding that the organizational whole is greater than its parts. As such, interconnected thinking is present when linkages between systems inside of an organization are understood in order to see both the system as a whole and the smaller systems within the whole as its parts (Deming, 1994).

Linear thinking is demonstrated when leaders implement solutions to problems utilizing a one cause –one effect ideology. Using linear thinking to solve complex problems results in a short-term solution to a long-term problem that does not support sustainability nor systemic change (Stroh & Zurcher, 2018).

A *stock* is the amount of a variable at any point in time. For example, the amount of water in a bathtub at any point in time is a stock of water. The amount of money in an account at any point in time is a stock of money (Cronin & Gonzalez, 2007; Fischer & Gonzalez, 2016; Gonzalez & Wong, 2011; Kainz & Ossimitz, 2002).

Systematic thinking is characterized by a logic flow of repeatable and predictable actions in order to accomplish an aim in a system. Systematic thinking includes the reasoning that coincides with processes in a building, such as taking daily attendance, administering interim assessments, and following a data analysis protocol during collaborations (Shipley, 2016).

Systemic thinking is characterized by the understanding of the interconnections between systematic processes and parts of the larger organizational system. Systemic thinking includes conducting root cause analyses to create solutions to complex problems, leveraging linkages between systems to impact systemic change, and leading by understanding that the system creates the structures for individuals to actualize effectiveness (Ackoff, 1994; Deming, 1994; Shipley, 2016).

Systems thinking includes understanding both systematic thinking and systemic thinking in order to analyze a system for both its parts and its whole. Overall, “systems thinking is a tool which helps to understand complexity and to see an order in chaos” (Palaima & Skarzauskiene, 2010, p. 338).

Summary

Systemic thinking now more than ever is amplified as global, complex issues arise for leadership to analyze and construct plans for implementing systemic changes. Without the ability to view and understand the various interconnected parts of a complex system alongside various viewpoints and relationships within and outside the system, the absence of systemic and sustainable actions will exacerbate global issues that impact our students, our teachers, and our communities. Systems theory provides a framework for analyzing our current educational state in order to embark upon strategic changes that support the vision for equitable and invaluable education. As such, it is pivotal to support educational leaders in their growth of the dynamic understanding of both systematic and systemic planning and action through a continuum of systems thinking.

Chapter 1 introduced the research study by presenting the rationale for the study, statement of the problem, purpose of the study, research questions and hypotheses, significance of the study, limitations, delimitations, and definitions for terms that will be revealed throughout chapter 2. Chapter 2 includes a literature review of the history of education through the lens of leadership traits that are valued through federal policy, present and future valued educational leadership traits aside from federal policies, systems theory, systems theory as it applies to education, literature dedicated to ascertaining the differences between systematic and systemic, change theory, and the divergence of systems theory and culture. Chapter 3 will then explain the method of research and present the survey statements for the continuum of systems thinking instrumentation to be administered for an exploratory factor analysis. Chapter 4 will detail the findings of the statistical analyses utilizing data collected through the research. Lastly, chapter 5 will synthesize the findings along with provide implications for future academic research.

CHAPTER 2

LITERATURE REVIEW

The literature review will include sections dedicated to presenting (1) the history of educational leadership traits that are implicitly and explicitly valued according to legislative policies over time, (2) leadership traits that have researched benefit for student achievement in regards to organizational changes and continuous improvement, (3) systems theory through the lens of different researchers in their respective field, (4) the implications of systems thinking leadership, (5) the difference between systematic thinking and systemic thinking, (6) change theory through the lens of different researchers in their respective fields, and (7) the intersection of organizational culture and systems theory. The focus of the research is to determine the characteristics that emerge from systemic thinking and effective leadership in order to develop an instrument that has the capability to determine the level of systems thinking in organizational leaders.

A History of Valued Educational Leadership Traits

This section of the literature review will sequence key educational policies that categorize the leadership traits valued in education from a past to present lens. The explicit and implicit value on traits of an effective educational leader (Public Broadcasting Service, 2005) will be presented through an examination of The Elementary and Secondary Educational Act of 1965, A Nation at Risk report of 1983, Goals 2000: Educate America report of 1994, the No Child Left

Behind Act of 2002, and The Every Student Succeeds Act of 2015. Although federal policies contain an abundance of elements that require schools to educate students in an equitable manner, this section will seek only to elevate the components of federal policies that have implications on valued leadership traits. Therefore, this section does not serve as an exhaustive review of educational policies, but rather serves as a review to identify leadership traits of value in education.

The Elementary and Secondary Educational Act of 1965 (ESEA)

The Elementary and Secondary Educational Act of 1965 (ESEA) was crafted under the presidential leadership of President Lyndon B. Johnson. ESEA held a large aim to close the disparity between affluent student achievement and the achievement of students in poverty. Through this aim, Congress found through research that students in poverty were mostly residing in the nation's largest cities and were predominately students of color. In order to support the closure of the education gap as highlighted in the ESEA plan, supplemental title dollars were allocated to schools of poverty in order to support "cultural and social enrichment programs, library innovations, parental involvement activities, nutrition programs, social and medical services, and innovations in teaching practices" (Urban & Wagoner, 2014, p. 296).

With the supplemental money from the government came a need for a federal partnership between the government and education sector through the National Education Association (NEA). As the NEA rode the wave of politics, this particular organization supported Jimmy Carter's presidential campaign, ultimately leading to the presidency in 1977. One promise made by President Carter involved creating a federal Department of Education. This promise became a reality in October of 1979 when Congress passed the Department of Education Organization Act in order to: (1) reinforce the federal commitment to guaranteeing an equal opportunity for

education to every student; (2) improve the quality of education through supplemental efforts in correlation with state, local, private, and community-based organizations; (3) support parent involvement in Federal education programs; (4) improve the quality of curriculum and instruction through federally funded research and evaluation; (5) ensure effective coordination of federal education programs; (6) act as ethical stewards of federal education dollars in providing funds to schools without unnecessary paperwork or duplicative burdens; and (7) to "increase the accountability of education programs to the President, the Congress, and the public" (United States Department of Education, 2010, para. 4).

With the allocation of supplemental funding to support an equitable education for all students came the explicit expectation that education would decrease the discrepancies between achievement among classes and races in the United States. This expectation required educational leadership to understand and tackle a systemic, deep-rooted situation utilizing funds allocated from the Federal government with a large level of autonomy. As Rhodes (2012) noted, "In a nod to the prerogatives of state and local policymakers, the ESEA and its progeny delegated substantial discretion to states and localities to design and implement compensatory education programs" (p. 33).

The Nation at Risk Report of 1983

The Nation at Risk Report of 1983 was published by the National Commission on Excellence in Education under the presidential leadership of Ronald Reagan. The essence of the report included comparative data from ally countries that justified the rationale that education was failing our country in economic production and business. Urban and Wagoner (2014) noted, "The core of their economic superiority was alleged to be the educational superiority of these other nations, the evidence of which was their higher scores on international measures of

educational achievement in subjects such as reading, mathematics, and science" (p. 319). In framing an American education as subpar in the report, business and political leaders gathered in order to determine a reform path for education. The publicized meetings and publications stemming from the Nation at Risk Report created an environment in which reform commissions and new statutes were created.

> This commission activity set the stage for an unprecedented wave of state-level lawmaking during the 1980s. All told, the states adopted more than seven hundred statutes related to graduation requirements, standards, testing, and teacher quality between 1984-1986—more than they had in the previous twenty years—and continued to adopt additional policies through the end of the decade. (Rhodes, 2012, p. 63)

With statutes in place, government agencies were determined to institute policies to ensure an environment in which excellence and equity could be simultaneously present. Although critics of the report crafted publications and forum speeches about the need for the government to place false blame on education for global economic placement, the statutes remained a fixture in school buildings across America. These statutes constructed an environment in which management was valued as leadership, and a business model approach to leading was held in high regard. "By framing the nation's challenges as problems of pervasive student underperformance, the various supporters of excellence in education established grounds for an agenda focused on thoroughly reforming school institutions, rather than merely providing supplemental programs for historically disadvantaged groups" (Rhodes, 2012, p. 58). Reform aimed at increasing student achievement via global test scores caused a business and managerial value to leadership as the report indicated, "school leaders had failed American youths by setting low standards for students, teachers, and themselves" (Rhodes, 2012, p. 59).

Goals 2000: Educate America Report of 1994

Educational discourse after the Nation at Risk report revolved heavily around federal involvement in school reform and the creation of common standards by which schools would be held accountable to obtain the ideology behind both equity and excellence cohabiting in our educational system. President Bill Clinton's legislative agenda focused on a comprehensive renovation of the role that the federal government played in education. Clinton's educational platform led to the passing of two legislative policies in which school reform would be defined and mandated for all public schools. "The Goals 2000: Educate America Act" established a process for creating national educational standards and provided grants to states to adopt their own systems of aligned standards, tests, and school report cards" (Rhodes, 2012, p. 96). This policy, in particular, communicated the theme that equity in education was defined at the federal level as every student receiving the same content of education no matter their zip code. It also paved the way for standardized assessment measures to determine the effectiveness of teaching and learning in schools with The Improving America's Schools Act.

> The Improving America's Schools Act (IASA) was even more ambitious, reconfiguring a venerable Great Society program, the Elementary and Secondary Education Act (ESEA), to require states to adopt educational standards in math and reading, institute aligned tests, develop district and school report cards, and ensure that all students made progress towards the same high standards. (Rhodes, 2012, p. 96)

The theoretical base behind The Goals 2000: Education America Act and IASA harkens historically to the work of E. D. Hirsch, Jr. Hirsch's (1988) view of the goal of education contrasts with that of other important educational philosophers such as Jean Jacques Rousseau and John Dewey. Whereas Rousseau and Dewey valued organic learning through experiential

designs, Hirsch held a more standardized belief in a high-quality education. Thus, Hirsch coined the idea of providing all students with a vertically aligned cultural literacy by which all literate Americans should know and utilize with proficiency in context. Hirsch viewed cultural literacy as the key to closing achievement gaps between advantaged and disadvantaged student groups magnified by reports of the educational system.

> Literate culture is the most democratic culture in our land: it excludes nobody; it cuts across generations and social groups and classes; it is not usually one's first culture, but it should be everyone's second, existing as it does beyond the narrow spheres of family, neighborhood, and region. (Hirsch, 1988, p. 19)

With the theory that common curricular expectations for all students would provide the opportunity to close the achievement gap between socio-economic status and race came the continued emphasis on managerial leadership as district and building administers set numerical goals as aims with little to no guidance on process. As is noted by Rhodes (2012),

> Another important feature of the Goals 2000 legislation – the National Education Standards and Assessment Council, which would help develop voluntary national standards, tests, and 'opportunity to learn' standards, review and certify state content and performance standards, and conduct research on standards-based reforms also bore the mark of business influence. Such a panel had long been supported by the National Alliance of Business, which believed that a federally legislated body was needed to have the continuing responsibility for developing and applying measures and standards for determining progress against the national goals. (p. 105)

No Child Left Behind Act of 2002

The renewal of the Elementary and Secondary Education Act of 1965 by the administration of President George Bush in 2001 resulted in the No Child Left Behind Act (NCLB) of 2002. With NCLB came an increase in accountability through annual standardized assessments, consequences for schools not demonstrating proficiency on accountability measures, and an increased federal oversight of state and local educational agencies. In addition, increased federal funds were to be utilized for scientific, research-based educational programs for students as well as to ensure each teacher was highly qualified in their respective subject area (Rhodes, 2012).

As such, Title I federal funding was released by the government in order to support states, and thus local agencies, in ensuring the policies set forth through NCLB were actualized in every classroom. With this funding came the expectation of numerical outcomes for schools with no direct guidance for process. As stated by McDonnell (2005) about the intended state standardized assessment goals of NCLB, "However, for that goal to be operationalized, institutions from state educational agencies (SEAs) down to local school districts and individual classrooms have to change their priorities and organizational behavior" (p. 20). This shift in the amount of autonomy for process provided via the federal government created an environment in which educational leaders, both at the state and local level, were expected to think and act systemically in order to influence the greatest amount of change within the existing educational system.

This statement is further evidenced by the four pillars that the U.S. Department of Education claims as essential elements to the No Child Left Behind Act, which include; "(1) stronger accountability for results, (2) more freedom for states and communities, (3) proven

education methods, and (4) more choices for parents" (United States Department of Education, 2004, paras. 1-4). Specifically, the pillar denoting increased flexibilities for educational agencies stated, "Under No Child Left Behind, states and school districts have unprecedented flexibility in how they use federal educational funds" (United States Department of Education, 2004, para. 2). These pillars, as well as the statement providing increased flexibility of funding, came with the action that, "NCLB would move federal regulation away from an emphasis on fiscal audit trails and give states and localities more discretion over how they spent Title I funds, but would also hold them accountable for student outcomes" (McDonnell, 2005, p. 33). With a spotlight on school report cards based primarily on student performance on state standardized assessments, educational leaders were faced with fiscal decisions that needed to address the interconnectedness of curriculum, instruction, assessment, and environment on student and educator success. This could be viewed as the beginning of a systemic approach being promoted in school leadership.

The Every Student Succeeds Act of 2015

The Every Student Succeeds Act of 2015 (ESSA) was signed by President Barack Obama in communication as a bi-partisan reauthorization of the Elementary and Secondary Education Act of 1965. Among ESSA's provisions was the tenet that the law

> maintains an expectation that there will be accountability and action to effect positive change in our lowest-performing schools, where groups of students are not making progress, and where graduation rates are low over extended periods of time. (U.S. Department of Education, 2020, para. 9)

Of the most noted differences between NCLB and ESSA was the flexibility for states to create their own academic standards and accountability metrics. With this type of autonomy comes the

increased responsibility and obligation to create state-mandated decisions that take into account both the process by which schools will provide an equitable education for all students, as well as the metrics by which to hold them accountable. As was stated by Heise (2017),

> Nesting standards-setting and accountability mechanisms in federal authority under NCLB was among NCLB's hallmarks. ESSA, in contrast, affords states greater autonomy, both in terms of control over substantive standards setting and the consequences for states that fail to achieve their own self-defined achievement goals. (p. 1873)

In an effort to provide federal guidance to state level education agencies in supporting local education agencies to close the achievement gaps between underperforming schools and student groups, the United States Department of Education mandated that federal funds allocated to local education agencies from the state level were required to reach an evidence-based threshold as defined under ESSA. The evidence-based threshold indicates a continuum, from strong to promising evidence, based on the statistically significant effect an action has on improving student outcomes through a well-designed and well-implemented study. As the Council of Chief State School Officers noted, "To date, states and local education agencies still struggle with these evidence requirements. As states assist LEAs in understanding and building strategies to identify and implement evidence-based interventions, they seek examples of guidance" (Council of Chief State School Officers, 2020, para. 4).

As ESSA aims to provide further state and local control over education with ambiguous guidance, the need for educational leadership at a state and local level to understand the systemic approach to continuous school improvement is of great need. Thus, with the authorization of ESSA came an emphasis on the shift from educational managers of systematic, clearly defined,

outcome-oriented processes to educational leaders capable of utilizing statistically sound research to create continuous improvement cycles with student achievement at the core.

Current Valued Leadership Traits for Organizational Improvements

Educational leaders who can analyze problems in a holistic manner by conducting a root cause analysis of low achievement utilizing a systemic lens of the organization, while supporting teachers in systematic processes for data-based discussions and decision making, demonstrate a positive impact on student achievement. In a simple system where processes are step-by-step oriented and siloed in nature, traditional leadership approaches of management in the delegation of cause and effect tasks are efficient and effective. However, when organizations become more complex, with interconnected systems, leadership needs to rely on the facilitation of well-defined roles and expectations with an authorization to evaluate continuously and adapt to a fluid, larger organization (Snowden & Boone, 2007).

Leadership Traits That Support Second-Order Change

As Waters and Grubb (2004) determined through a study of principal leadership conducted by Mid-continent Research for Education and Learning (McREL), change perceived as second-order change requires principals and those that prepare principals to have an understanding of not only change management but also the knowledge and skills associated with the organizational change. Table 1 depicts the findings of the meta-analysis and factor analysis as conducted by Waters and Grubb (2004) in order to determine the key responsibilities and definitions of leaders instituting second-order change with positive student achievement correlations.

Table 1
*Balanced Leadership Responsibilities and Practices Positively Associated With Second-Order Change**

Responsibility	The extent to which the principal…	Average *r*
Change agent	is willing to and actively challenges the status quo.	.30
Flexibility	adapts his or her leadership behavior to the needs of the current situation and is comfortable with dissent.	.22
Ideals/beliefs	communicates and operates from strong ideals and beliefs about schooling.	.25
Intellectual stimulation	ensures that faculty and staff are aware of the most current theories and practices and makes the discussion of these a regular aspect of the school's culture.	.32
Knowledge of curriculum, instruction, and assessment	is knowledgeable about current curriculum, instruction, and assessment practices.	.24
Monitors/evaluates	monitors the effectiveness of school practices and their impact on student learning.	.28
Optimizer	inspires and leads new and challenging innovations.	.20

Note. Reprinted from page 10 of Waters, T., & Grubb, S. (2004). *The leadership we need: Using research to strengthen the use of standards for administrator preparation and licensure programs.* McREL.

Leadership Traits that Foster Continuous Improvement

A systemic lens of education includes the implementation of an interdisciplinary curriculum that should be "conceptual, help students apply knowledge, and enable students to experience constructive learning" (Thornton et al., 2004, p. 224). Without a systemic understanding of curriculum, instruction, assessment, and environment, educational leaders narrow the curriculum in a standardized format that may not allow for the fostering of systemic thinking in both teachers and students. Ron Zaraza (1995) studied systems thinking in the classroom through a Cross Curricular Thinking Project funded by the National Science Foundation. Through the Cross Curricular Thinking Project, teachers completed a three-week training institute learning about the basics of systems thinking and developing cross-curricular units and curricular resources. The results of the Cross Curricular Thinking Project are

documented as impacting student achievement in the areas of creativity, critical thinking, and a preparedness for higher education. The study also demonstrated that systems thinking can be taught to teachers and used to improve student achievement (Zaraza, 1995). Leadership traits that support teacher's understanding of the interconnectedness of curriculum, instruction, assessment, and data analysis supports student and teacher achievement as "systems thinking is a tool which helps to understand complexity and to see an order in chaos" (Palaima & Skarzauskiene, 2010, p. 338).

Systems Theory

Systems theory is the study of systems, both concrete and abstract, in an interconnected manner. Systems theory acknowledges the complexity of organizations and the importance of leaders within those organizations to understand the dynamics of systems thinking in order to ignite high impact decision making for the effectiveness of the organizational whole. Systems theory takes into account change theories in order to make sense of the current state of an organization and implement sustainable change for continuous improvement. Fullan (2005) noted,

> The proposition is that the key to changing systems is to produce greater numbers of 'system thinkers.' If more and more leaders become system thinkers, they will gravitate toward strategies that alter people's system-related experiences; that is, they will alter people's mental awareness of the system as a whole, thereby contributing to altering the system itself. (p. 40)

Edward Deming's System of Profound Knowledge

Deming's system of profound knowledge contains five main components which will be summarized below: "(1) appreciation for the system, (2) obligation of component, (3) knowledge about variation, (4) theory of knowledge, and (5) psychology" (Deming, 1994, p. 93).

Appreciation for the system includes the qualities of understanding interdependence, having obligation of a component, and a basis for negotiation. Interdependence is identified as understanding that the whole is greater than the parts. As an example, one violinist does not create the system. The orchestra creates the system with those judging the orchestra's sound collectively over individually.

Obligation of component refers to doing what is best for the system over doing what is best for the single component. For example, cutting costs in the travel funds for an organization may save money for that component; however, it may cause the traveler to lose flexibility of time for the customer. The basis of negotiation speaks to the understanding that divisions within a larger organization must give and take for the achievement of the system. In other words, selfishness does not create a sustainably successful system.

Knowledge about variation includes the understandings that life is variation and that there are stable and unstable states. In analyzing life as variation, one must question, "What is the variation trying to tell us about a process, and about the people that work in it?" (Deming, 1994, p. 98). Along with the variation question lies the understanding of data analyzed generated from statistical control. If performance data are not presented from a state of definable statistical control, then they are not predictable and thus should not be utilized solely to make decisions. The difference between stable data and unstable data is the ability to utilize the data for prediction.

Theory of Knowledge includes the points that management is prediction, knowledge is built on theory, the use of data requires prediction, there is no true value, operational definitions matter, and information is not knowledge. Deming (1994) posited that without theory, learning cannot take place, as theory provides an avenue to prediction, and prediction provides an avenue to action. It is theory that makes our experiences meaningful as we are continually seeking to revise our theory based on data. Thus, the appropriate analysis of data requires prediction. Deming rationalized that data without a prediction are simply factual and not knowledge. He also explained that there is no true value to data until assigned through the use of operational definitions. “An operational definition is a procedure agreed upon for translation of a concept into measurement of some kind” (Deming, 1994, p. 105). Thus, without a theory with defined operational definitions in which to collect and analyze data against a prediction, then a system has information without knowledge.

Psychology holds the indicators of the phenomenon of, over justification and the differences in, motivation. In short, intrinsic motivation outweighs extrinsic motivation once a quality of life is established with the current resources of an individual. Providing compensation in monetary form over what is needed serves as an extrinsic motivation and may lead to over justification. Over justification has an inverse effect on motivation as the reward can be viewed as “meaningless and a source of discouragement” as it takes away from the self-satisfaction of a job well done (Deming, 1994, p. 110).

Russell L. Ackoff Systems Thinking

Russell Ackoff defined a system as a whole containing more than one part. As such, each part can affect the performance of the whole but cannot affect the whole as only one individual part. Thus, a system is “a whole that cannot be divided into independent parts or subgroups of

parts" (Ackoff, 1994, p. 175). Ackoff posited that there are three types of systems. There are mechanical, organismic, and social systems.

A mechanical system is causal as it serves a function over serving a purpose. For example, an automobile has no purpose, but it has a function in transportation. Mechanical systems can be characterized as either open or closed, depending on their interaction with external forces. Mechanical systems can be "closed if their behavior is unaffected by any external conditions or events, open if they are so affected" (Ackoff, 1994, p. 175).

Organismic systems hold one or more purposes, with parts inside of the organismic system serving a function to the whole. For example, the human heart is an organismic system as it serves the purpose of survival of life. However, inside of the heart are arteries that serve a function to the heart. Organismic systems are categorized as open systems as they are connected to the environment. "The environment of any system consists of the set of variables that can affect the behavior of the system" (Ackoff, 1994, p. 175). Therefore, the organismic system of the heart serves its purpose as it is influenced by its environment.

Social systems have their own purposes as a whole, contain parts that have their own purposes as well, and are a segment of a larger system that has purposes of its own as well. Social systems include "organizations, institutions, and societies" (Ackoff, 1994, p. 175). Ackoff posited that when systems include the work of people, then those systems are autonomically categorized as social systems.

Ackoff (1994) attributed the three types of systems to changes in the culture of the workforce occurring from the Industrial Revolution to the conclusion of World War I to the post-World War II era. The Industrial Revolution emphasized machine-style work processes and ethics in individuals. As such, individual people engaged in jobs that resembled those of

mechanical systems. Employment during the Industrial Revolution emphasized low-level tasks at low wages wherein people were expendable. However, by the end of World War I, the workforce realized a need to increase the educational and skilled capacity of workers. Therefore, organizations began creating purposes in which the people inside of the organization serve as a function. Thus, the organismic system was formed in which corporations were viewed within human characteristic analogies. As Ackoff stated, "Biological adjectives came to be applied to enterprises, for example, healthy, sick, paralyzed, energetic, mature, and dying" (1994, p. 177). Post-World War II found an era in which individuals demanded respect and a stimulating work experience. Pay was not the main factor in workplace satisfaction as much as feeling as if their work was meaningful in society.

> Because of internally and externally applied pressures, corporate managers became aware of the need to take into account the purposes and interests (1) of the parts of the systems they managed, and (2) of the larger systems that contained them – for example, society – and other systems that were also parts of the same containing systems. In addition, managers of enterprises obviously had to be concerned (3) with the purposes of the system they managed. (Ackoff, 1994, p. 179)

In taking a historical view of the emergence of the three types of systems, Ackoff posited that a system's performance is "never equal to the sum of the actions of its parts taken separately; it is a function of their interactions" (Ackoff, 1994, p. 180). With this being stated, Ackoff also believed that if each part of the whole is highly effective, then the system as a whole cannot be as effective as possible. This stance relates to the allocation of resources as defined through time, talent, and treasure. As resources in any organization are limited, systems thinking leaders must identify where resource allocation will yield the greatest impact.

Ackoff (1994) theorized that social systems behave in the manner in which they are organized and led, or managed. The leader determines the type of system it is. Thus, if a social system is managed in siloes, then the social system will behave in accordance with the traits of a mechanical system. The mechanical system traits provide little variability for the parts and are "associated with bureaucracies, which, of course, are mechanistically conceived organizations" (Ackoff, 1994, p. 181). Organizations managed under an organismic system structure provide a pre-determined measurable objective for the parts of the system with variability as to how the objective is attained. Although the process by which results are attained in an organismic system may vary, "they cannot change the functions they perform" within the greater system (Ackoff, 1994, p. 181). Organizations managed as a social system foster an environment in which both the results and the process demonstrate variability based on the ever-changing social system.

> Within an organization there is a close relation between centralization and reducing variety, and decentralization and increasing variety. The more centralized decision-making is, the less is the variety of choices available to decision makers below the top; the more decentralized it is, the greater is the variety of choices available to those below the top. (Ackoff, 1994, p. 181)

The categorization of the three management styles, as Ackoff (1994) described, leads to the difference between analyzing an organization for improvement and synthesizing an organization for improvement. Ackoff recommended that an analysis of an organization leads to knowledge of how the parts of a system work. However, synthesis of an organization leads to understanding of the interconnections between the parts of a system, thus understanding the whole. "When analysis reduces a system to its parts, it loses that system's essential properties" (Ackoff, 1994, p. 182). Therefore, when a problem arises in an organization, it is not of the

utmost benefit to tackle the problem in a disciplinary manner. Attempting to solve a problem in a disciplinary manner will not lead to dissolution of the problem; rather it may lead to absolution or resolution. As problems are viewpoint-dependent, it is important in solving organizational issues involving a "collaboration of multiple points of view, a transdisciplinary point of view" (Ackoff, 1994, p. 187). Solving problems in this manner fosters a social system organization.

Systems Theory Applied to Education

Educational organizations are complex entities with internal and external systems, along with a multitude of linkages within and among the systems (Wheatley, 1999). Applying systems theory to the education sector has the capability to support leadership in making decisions that ripple across the organization to create the highest yield in educational effectiveness. By adopting a systems theory approach to continuous improvement in education, leaders are creating a learner-centric ethos in which targeted capacity building for sustainability ensures the lasting effectiveness of the organization (Fullan, 2005; Senge, 1990; Shipley, 2016).

A Continuum of Systems Thinking From System Dynamists

Systematic thinking and systemic thinking are different constructs positioned underneath the larger umbrella of the term, systems thinking. As noted in several sections of research, systems thinking is a term commonly utilized yet less commonly defined. Defining systems thinking is essential when attempting to determine the level of systems thinking in an organizational leader. Stated simply, "without a yardstick against which to measure the level of systems thinking achieved by individuals and groups, it is hard to evaluate the effect of our efforts to facilitate systems thinking" (Stave & Hopper, 2007, p. 2). Stave and Hopper (2007) built an initial continuum of systems thinking to present to an audience of systems dynamists in order to receive feedback for further development shown in Figure 1.

Figure 1

First Cut at a Systems Thinking Continuum

Level of Systems Thinking	
0% *not at all a systems thinker*	100% *a fully realized systems thinker*
Sees things, not relationships	Sees relationships rather than things
Sees cause-effect relations as one-way	Sees cause-effect relationships as reciprocal
One cause/one effect	Multiple causes/ multiple effects
External events cause system reaction	System structure causes system behavior

The initial continuum created by researchers Stave and Hopper (2007) relied on the following systems thinking characteristics to gain feedback for further development: "recognizing interconnections, identifying feedback, understanding dynamic behavior, differentiating types of flows and variables, using conceptual models, creating simulation models, and testing policies" (p. 8). Stave and Hopper presented the initial continuum to a group of experts in systems dynamics at an international conference. After receiving feedback from 75 attendees at the international conference, a further refined system thinking continuum is displayed in Figure 2.

Figure 2

Systems Thinking Continuum

Low Level of Systems Thinking			High Level of Systems Thinking
Recognizing Interconnections Identifying Feedback	Understanding Dynamic Behavior Differentiating Types of Variables and Flows Using Conceptual Models		Creating Simulation Models Testing Policies
Basic	Intermediate		Advanced

Ultimately, the feedback received from the construction of a system thinking continuum by researchers Stave and Hopper (2007) generated a list of proposed assessment measures in order to determine the level of systems thinking in individuals displayed in Table 2 (p. 18).

Table 2

Proposed Assessment Measures by Level of Systems Thinking

Systems Thinking Levels	Indicators of Achievement A person thinking at this level should be able to:	Products, Assessment Tests
Recognizing interconnections	Identify that a system is made up of parts and wholes with causal connections and relationships	Create a diagram of system parts and connections, as well as describe the interconnections of the system
Identifying feedback	Identify closed loops and describe linkages related to causal loops	Explanation of linkages and causal loops, along with polarities, by diagram and explanation
Understanding dynamic behavior	Understand that behavior is a function of the causal loops and linkages within a system and that behavior occurs over time in a delayed format	Explanation of how the system has caused specific behaviors and how the change of one part of the system might change one behavior yet impact another
Differentiating types of variables and flows	Categorize parts of a system according to their stocks, flows, and functions of variables	Identify and interpret quantitative and qualitative variables to determine their position as either a stock or flow and their respective function in the system
Using conceptual models	Understand the utilization of a conceptual model in order to workshop solutions to problems	Draw and explain how specific actions will be deployed to solve problems and how those solutions will impact other aspects of the larger system
Creating simulation models	Utilize variable data in order to build and test solutions to problems before active implementation; choose the	Create a simulation model based on quantitative and qualitative data with hypotheses created for simulation testing

	most effective model via simulation to deploy	
Testing policies	Design policies with a systemic understanding in order to intervene problems within the larger system	Policy design along with rationale of policy changes via a variable and hypothesis approach to explanation

Attributes to Consider when Constructing a Systems Thinking Continuum in Education

Researchers Ross Arnold and Jon Wade studied several definitions in the literature in order to define systems thinking as "a set of synergistic analytic skills used to improve the capabilities of identifying and understanding systems, predicting their behaviors, and devising modifications to them in order to produce desired effects. These skills work together as a system" (Arnold & Wade, 2015, p. 675). The preceding definition includes three main characteristics of systems: elements, interconnections, and a purpose or objective. Empirical evidence demonstrated that systemic thinking cannot occur without the tenet of systematic understanding and action. In order to comprehend complex problems of practice, basic knowledge of systems is required to think through 'wicked problems.' A critical understanding of the relationships between the parts of a larger system is a key lever to systemic thinking and problem-solving. Richmond (1994) alluded to this difference when he described systems thinking as leadership in an organization positioning themselves to "see both the forest and the trees (one eye on each)." Further, Richmond (1994) described the theory:

> The positioning has both structural and behavioral implications. Structurally, systems thinkers see both the generic and the specific—not just the latter! Behaviorally, they see both the pattern and the event— not just the latter! (p. 7)

Systemic thinking requires several factors such as engagement, transdisciplinary understanding, innovation, criticality, and decisiveness (Vare et al., 2019). The movement to

systemic thinking from systematic thinking includes experiences of factors such as engagement in transdisciplinary decision making and action planning.

> Users of knowledge are active problem-solvers and generators of their own knowledge base instead of merely passive receptacles of information and expertise. So as each of us interprets, uses and re-uses knowledge, we are also creating new knowledge. (Parent et al., 2017, p. 84)

Edward Deming (1994) defined a system as "a network of interdependent components that work together to try to accomplish the aim of the system" (p. 50). Deming posited that an organization cannot have a system without a clear and communicated aim. The aim of the system includes the different components that actualize the target. Therefore, "management of the system requires knowledge of the interrelationships between all the components within the system and of the people that work in it" (Deming, 1994, p. 50). With the knowledge of the components and people in the system, leadership should be able to predict effects of expected change. Deming rationalized that managing a system should include encouraging cooperation in and amongst the different system components and breaking down the barriers between collaboration and competition. Competition between the components of a system causes a breakdown in the system and an eventual destruction of the organization.

Implementing a systems approach to solving a wicked problem in a complex organization includes (1) identifying the current reality with various stakeholder groups in order to understand the issue from multiple perspectives, (2) engaging various stakeholders in determining why the wicked problem remains as a need for improvement even with past efforts of solutions, (3) completing a root cause mapping visual with stakeholder input connected in order to provide a complete picture of the problem, (4) supporting people in understanding how an initial solution

to a problem may unintentionally make the problem worse, and (5) utilizing the information learned about the wicked problem in order to create a sustainable, system-wide change in alignment with the measurable vision of the organization (Stroh & Zurcher, 2018). Whereas Stroh and Zurcher (2018) highlighted a cause-mapping strategy to determine the root cause of an issue, Page and Hale (2013) recommended utilizing a five-why root cause analysis strategy to determine the need for action. The five-why root cause analysis strategy includes determining the root cause of the problem by asking why-based questions at least five times to find the targeted problem in order to create a plan for a solution.

In approaching issues with a systemic, problem-solving framework, the capacity of human capital in an organization can also be built to understand systems-based improvements. Michael Fullan (2005) messaged the importance of capacity building throughout his research stating, “Capacity building involves developing the collective ability—dispositions, skills, knowledge, motivation, and resources—to act together to bring about positive change” (p. 4). An experiment of students participating in the program, *Ecopolicy*, demonstrated the trait of an immersion into situations that require systemic thinking to solve problems results in “the ability to think in systems and understand the implications of the high degree of interconnectedness between components of the system” (Nguyen & Bocsch, 2014, p. 249).

Effects of Systems Thinking Leadership

Palaima and Skarzauskiene (2010) conducted a quantitative study to determine the effect of systems thinking on leadership performance. The study aimed at identifying the construct of systems thinking as cognitive intelligence with six subconstructs of dynamic thinking, interactivity, systems logic, process orientation, continuous learning, and understanding of mental models. Each subconstruct became a hypothesis to test for a significant positive impact

on leadership performance. The administration of a leadership current performance self-assessment instrument to a total sample size of 201 participants in both the retail and manufacturing sector yielded results of statistical significance in four subconstructs. Results derived from a multiple linear regression to test hypotheses and measure the relationships between systems thinking competencies and leadership performance with an alpha level of 0.05. The subconstruct competencies of process orientation, dynamic thinking, systems logic, and interactivity presented statistical significance to leadership performance. However, the two subconstructs of continuous learning and understanding of mental models did not demonstrate a statistical significance in the retail and manufacturing sector participants. Palaima and Skarzauskiene's (2010) study concluded, "systems thinking is most important and valuable in explaining organizational/strategic leadership results" (p. 350).

Systematic Versus. Systemic Characteristics

The terms systematic and systemic are often used interchangeably in the educational environment today. Whereas systematic refers to the processes and procedures developed and implemented in education, systemic refers to both the concrete and abstract way the systematic processes interact with one another in the organization (Shipley, 2016; Wheatley, 1999). Acknowledging the attributes that create the differences between systematic thinking and systemic thinking aids in the construction of a continuum of systems thinking in education.

Systematic Attributes

Systematic attributes refer to processes that are repeatable, predictable, and completed on a scheduled basis on an ongoing calendar. Systematic processes are job-aid oriented (Shipley, 2016). Education, business, and government organizations are trained to take a complex issue arising in a complex environment and "break it up into component parts and tackle them

separately" (Nguyen & Bocsch, 2014, p. 242). Systematic processes in education include those in which a detailed plan is implemented with transparent documentation of student data, data-based decisions are acted upon as a cause and effect of data analysis, and feedback loops of the systematic processes in which decisions are made by teachers for student learning are siloed and cyclical (Thornton et al., 2004). With only a systematic mental model of thinking, focusing a plan of remedy on the components of malfunction has the opportunity to become linear and siloed in design. However, it is paramount to understanding systematic processes in order to create a clear path for actions to remedy problems that builds capacity and thus sustainability (Fullan, 2005). A strictly systematic process for problem-solving can be coupled with the educational framework of specializations in order to create a system organized to follow systematic thinking and behaviors (Nguyen & Bocsch, 2014).

Linear thinking models view knowledge as a product from a largely one-way communication process that moves through a predictable pattern. Linear thinking models, in order to accomplish the movement of knowledge to action, have demonstrated success when non-complex information is disseminated in a highly structured environment (Best & Holmes, 2010). Linear thinking models are successfully implemented in the educational sector for non-complex processes such as state standardized test administration and procedures for dismissal. When actions are not conducive to a linear model, questions of stifling systemic thinking may occur. For example, as the scientific method is a systematic process, questions arise of the barriers presented through this type of linear method. The effects of following a systematic process may have stifled scientists such as Galileo and Copernicus from important discoveries over the connective inquiry, or systemic approach they chose for their research and experimentation (Feyerabend, 1988).

Consequently, systematic processes in education are frequently utilized as solutions to ongoing, deeply rooted problems. The over-reliance on simple solutions not rooted in evidence-based understandings of the past are a reliable indicator of non-systemic thinking (Senge, 1990). Ultimately, systematic knowledge of the processes in an organization is a critical piece to be able to analyze practices systemically in order to plan for and implement sustainable improvement. As Robert Deming (1994) explained, "One may learn a lot about ice, yet know very little about water" (p. 101).

Systemic Attributes

Systemic refers to the interconnectedness of people and parts within a larger organization. Systemic decisions include the knowledge of how actions affect other people and parts in the larger organization (Shipley, 2016). Systemic thinking includes systematic knowledge.

> With a systems perspective, you use your measures, indicators, core competencies, and organizational knowledge to build your key strategies, link these strategies with your work systems and key processes, and align your resources to improve your overall performance and your focus on customers and stakeholders. (Vineyard et al., 2018, p. 2)

Systemic thinking utilizes the systematic processes within an organization to measure continuous improvement towards data-oriented accountability. As Holzman (1993) suggested, "systemic means systematic" as decision-makers must acknowledge both "horizontal and vertical structures" (p. 18) when impacting change at the larger, organizational level. Both systematic and systemic thinking is thus important when affecting the need for fundamental, deep-rooted change.

Systems themselves exist within other dynamic, ever-changing systems such that when changes to one part of the system occur, the other parts of the system can have unexpected changes. Changes can be nonlinear and often occur as a result of feedback cycles for improvement (Best & Holmes, 2010). Which system adjustment will cause the most change in the interconnected systems of the organization depends on the hierarchy of systems within the larger institute. "The systems view of the world maintains that the universe represents a systemic hierarchy of integrated complexity—a series of wholes within wholes, all of which are interconnected and interdependent" (Parent et al., 2017, p. 85). As such, decisions made from a systemic lens foster the sustainability of desired change through complex organizations. Table 3 (Stroh & Zurcher, 2018) details the difference between linear thinking and systems thinking within key organizational elements.

Table 3

Distinguishing Linear Thinking From Systems Thinking

	Linear Thinking	Systems Thinking
Causality	There is a direct connection between problem symptoms and their underlying causes.	System performance is largely determined by interdependencies among system elements that are indirect, circular, and non-obvious.
Time	A policy that achieves short-term success ensures long-term success.	The unintended and delayed consequences of most quick fixes neutralize or reverse immediate gains over time.
Responsibility	Most problems are caused by external factors beyond our control.	Because actions taken by one group often have delayed negative consequences on its own performance as well as the behavior of others, each group tends to unwittingly contribute to the very problems it tries to solve and to undermine the effectiveness of others.
Strategy	To improve the performance of the whole, we must improve the performance of its parts.	To improve the performance of the whole, improve relationships among the parts.

Tackle many independent initiatives simultaneously to improve all the parts.	Identify a few key interdependencies that have the greatest leverage on system-wide performance (i.e., leverage points) and shift them in a sustained, coordinated way over time.

Systems thinking includes the understanding of systematic processes as the parts of the interconnected, or whole, organization. Thinking in terms of how the systematic processes impact the interconnected organization indicates systemic thinking. With this approach in mind, it is the leader's responsibility to work on the systems at the systemic level in order for the individuals in an organization to work effectively in the systems at the systematic level (Shipley, 2016).

Ascertaining the Difference Between Systematic and Systemic Thinking

To further delineate between systematic and systemic thinking, Table 6 presents examples of each type of thinking utilizing Baldrige's criteria for performance excellence framework (Vineyard et al., 2018). Of note, the examples presented are thought of in a vertical fashion to represent systematic thinking and a horizontal fashion to represent systemic thinking (Holzman, 1993). Ascertaining the difference between the nuances of systematic and systemic thinking in education, utilizing Baldrige's Criteria for Performance Excellence in Table 4 creates a mental model for the development of a continuum of systems thinking (National Institute of Standards and Technology, 2020; Shipley, 2015, 2016).

Table 4

Systematic Versus Systemic Thinking Utilizing Baldrige's Criteria for Performance Excellence

	Systematic Thinking	Systemic Thinking
Leadership	The mindset can be focused on fixing the problem over understanding what is truly causing the problem (Richmond, 1994).	Developing and implementing a system improvement plan to build systems capacity through developing and integrating the system components identified as needing improvement in the system assessment (Shipley, 2016). Leaders work at the strategic level **on** the system and rely on those who do the work on the day-to-day basis to work **in** the system (Shipley, 2016).
Strategy	Aligned goals and measures at all levels (Shipley, 2016).	Adopting a change management strategy to implement a systems approach (Shipley, 2016).
Customers	Lack of agreement on who the customer is (S. Gruenert, personal communication, November 3, 2020).	A focus on all activities on the learning needs of students. The emphasis is on active student learning with students taking responsibility for the management of key learning processes (Shipley, 2016).
Workforce	Holding staff accountable for applying the PDSA cycle at all levels (Shipley, 2016).	Leadership commitment to focus on improving the system, not just working on the people in the system (Shipley, 2016).
Operations	Adopting a system-wide approach to process improvement (PDSA) for all work units with the focus on one feedback loop at a time (Shipley, 2016).	The focus on several feedback loops and how they impact one another at a time. "The message is in the feedback, and the feedback is inherently interdisciplinary" (Forrester, 2009, p. 9).
Results	Developing results measured to support process improvement (Shipley, 2016).	Understanding the processes that contribute to the outcome-oriented results and how autonomy of processes cannot be successful without capacity (Fullan, 2005).
Measurement, Analysis, and Knowledge Management	Setting numerically driven SMART goals (Deming, 1994).	Analyzing the processes to obtain the numerical goals for improvement of the system (Deming, 1994).

Underpinning the seven criteria for performance excellence via Baldrige are core values and concepts which demonstrate the characteristics of organizations exuding performance excellence. The difference between an organization with good performance and an organization with excellent performance is demonstrated in Table 5 (Vineyard et al., 2018).

Table 5

Organizational Good Performance vs. Organizational Performance Excellence

Good Performance	Performance Excellence
Directive leadership	Visionary leadership
Product/service-driven	Customer-focused excellence
Meet standards or "status quo"	Organizational learning & agility
Suppliers and unions as adversaries	Valuing people
Respond in time allotted	Managing for innovation
Focus on next quarter's results	Focus on success
Employees follow procedures	Ethics & transparency
Management by intuition	Management by fact
Compliance with regulation	Societal responsibility
Focus on the "bottom-line" exclusively	Delivering value & results
Functional perspective	Systems perspective

Of note, performance excellence does not replace good performance. Performance excellence is actualized when good performance is critically analyzed in order to build upon improvement cycles to reach performance excellence. As such, the design concepts presented by Baldrige in the performance excellence framework are integrated through three competencies of

performance excellence: (1) strategic leadership, (2) execution excellence, and (3) organizational learning (Vineyard et al., 2018).

Assessing Capacity to Understand Systems Thinking

Sweeney and Sterman (2000) conducted a research experiment of participants, including students at the MIT Sloan School of Management in order to determine the inherent understanding of systems thinking among their classes. The researchers identified critical systems thinking skills needed as the ability to understand dynamics of behavior, hold the ability to identify and understand feedback cycles and how those impact behaviors, interpret stock and flow relationships, understand what delays are and how those delays impact data and behavior, recognize when nonlinearities are present, identify and think critically about the benefits and barriers of formal and mental models.

The researchers in the MIT Sloan study also identified basic system thinking skills that are believed to be present in the greater population, which are the ability to construct and interpret graphs from data, analyzing graphs in order to form a story, identify the units of measure in data graphs, and hold a basic proficiency level in probability logic and algebraic thinking (Sweeney & Sterman, 2000). Data are inclusive of both a quantitative and qualitative design.

The results of their study, which required students to activate systems thinking skills in order to interpret graphs, build understanding of those graphs, and create graphic models, demonstrated that the ability to identify and interpret stock and flow relationships exhibited the most difficulty in terms of proficiency. Coupled with the misunderstanding of a stock and flow relationship was the lack of understanding about the concept of delays and the impact delays have on behavior, data, and feedback.

After analyzing participants' responses to a series of systems thinking tasks, Sweeney and Sterman (2000) concluded, "These subjects suffer from 'spreadsheet thinking'—assuming that change occurs suddenly between time periods, as in a spreadsheet where time is broken into discrete intervals" (p. 254). The inability to understand stock and flow relationships, as well as how stock and flow relationships are impacted by delays and impact feedback, are "highly systematic, and indicate violations of basic principles" (Sweeney & Sterman, 2000, p. 260).

The research findings of Sweeney and Sterman (2000) hold implications for future research, including the continuation of identifying a spectrum of systems thinking, as well as dissecting the differences between systematic thinking and systemic thinking under the systems thinking theory. The misunderstanding of the relationship of stocks and flows is present in several systems thinking empirical studies as researchers seek to challenge Sweeney and Sterman's findings.

Fischer and Gonzalez (2016) analogized stocks and flows to the "building blocks of dynamic systems" (p. 496). Several researchers have provided analogies of stock and flow relationships as the inflow and outflow of water flowing into and out of a bathtub, money being deposited into and out of a bank account, and calorie consumption as the inflow with calorie burning as the outflow in order to maintain a desired weight (Cronin & Gonzalez, 2007; Fischer & Gonzalez, 2016; Gonzalez & Wong, 2011; Kainz & Ossimitz, 2002).

Research suggests that although the basic understanding of what a stock and flow is in a system is present, the ability to understand accumulation over time in a non-linear fashion is not present (Gonzalez & Wong, 2011). The incorrect application that an outflow is a direct, one-on-one byproduct of the inflow and that a stock is increased or decreased based on that one-on-one relationship is termed "correlation heuristic" (Cronin et al., 2009).

Cronin et al. (2009) cited two defined difficulties for directing one-on-one thinking of stocks and flows. First, people have difficulty in identifying the stock in a situation, or the accumulation of one item, in order to identify the inflows and outflows correctly. As an educational example, assessment data are a stock that schools contain in a district-wide system with the quantity and quality of assessments administered and discontinued as the inflow and outflow. The second finding from Cronin et al. is that people demonstrate difficulty identifying the characteristics of accumulation, especially when the inflow exceeds the outflow of a stock, creating a surplus of the stock.

Circling back to the educational example, when additional assessments are administered to students on an annual basis, with no assessments being discontinued, then a surplus of assessment data are present in a district. This misunderstanding of a stock and flow relationship may lead to a district that is data rich, yet information poor. As the educational example and researchers suggest, “correlation heuristics can lead to erroneous judgments in situations that have important public policy implications” (Cronin et al., 2009, p. 5).

Knowing the difficulty of stock and flow understandings, Kainz and Ossimitz (2002) conducted preliminary experimental studies in order to determine if students could learn stock and flow thinking through direct instruction. University students took a pretest, were provided a 90-minute-long course of direct instruction explaining stocks and flows, and then took a posttest in order to analyze results. Results correlated directly in a positive sense on posttest performance on both the inflow chart task provided (t =-5.20, p <.01) and the outflow chart task (t =-3.73, p <0.01). Statistical research findings from Kainz and Ossimitz are an indication that systems thinking can be developed in individuals.

Sterman (2010) set out to provide additional statistical data to further validate or invalidate the finding from Kainz and Ossimitz (2002), showing that a deep level of systems thinking can be developed in individuals. Thus, Sterman provided students a course of systems thinking as it relates to stocks and flows, utilizing a common store front scenario as a pretest and posttest data point to actualize growth in the understanding of stock and flow principles. After students received eleven 80-minute sessions spanning six weeks of instruction on the principles of stocks and flows, posttest results demonstrated a statistically significant drop in the rate of incorrect responses (p <.00001). Further, the "incidence of erroneous use of the correlation heuristic among all subjects fell from 32.6 percent to 12.7 percent (p <0.00001)" (Sterman, 2010, pp. 329-330). Although several variables need to be considered when interpreting empirical results of the impact of direct instruction on systems thinking, the studies presented provide justification for further experimental designs in order to determine pedagogical implications for systems thinking, which includes both systematic processes and analyzing processes from a systemic lens.

Change Theory

Systems thinking is a perfect accommodation for the ability to engage in an inquiry cycle for continuous improvement of the organization in which one leads (Deming, 1994; Senge, 1990; Shipley, 2016). However, instituting change without the knowledge of change theory has the opportunity to create an environment of hostility and discontinuity in the organization (Schein, 2011). Examining research on change theory supports the construction of a continuum of systems thinking for educational leaders.

Kurt Lewin's Change Theory

Kurt Lewin's change theory (1951) consisted of three basic theoretical phases: unfreezing, changing, and refreezing. Several researchers have created concept models from Kurt Lewin's change theory as well as intellectualized each phase of change to create connections to various fields of study. In particular, Edgar Schein (1996) focused on the application of Kurt Lewin's change theory to systems of education. In analyzing the phase of unfreezing, Schein determined that three main characteristics embody unfreezing. Disconfirmation, induction of guilt or survival anxiety, and creation of psychological safety or overcoming of learning anxiety are anchor traits in the succession of unfreezing relative to an educational setting (Schein, 1996). Disconfirmation is defined as "frustration generated by data that disconfirms [*sic*] our expectations or hopes" (Schein, 1996, p. 29). Induction of guilt or survival anxiety is defined as "the feeling that if we allow ourselves to enter a learning or change process, we will lose our effectiveness, our self-esteem, and maybe even our identity" (Schein, 1996, p. 29). Lastly, the creation of psychological safety is defined as "the ability to balance the amount of threat produced by disconfirming data with enough psychological safety to allow the change target to accept information and become motivated to change" (Schein, 1996, p. 29).

Once motivated to change, Schein (1996) pinpointed an array of terms defining the fundamental process of cognitive restructuring during the change phase of Kurt Lewin's change theory. New information delivered while motivated to learn creates an opportunity for semantic redefinition, cognitive broadening, and new standards of judgment or evaluation. Semantic redefinition is characterized by learning "that words can mean something different from what we had assumed" (Schein, 1996, p. 30). Cognitive broadening is characterized by learning "a given concept can be much more broadly interpreted than what we had assumed" (Schein, 1996, p. 30).

Additionally, new standards of judgment or evaluation are characterized by learning "that the anchors we used for judgment and comparison are not absolute, and by using a different anchor, our scale of judgement shifts" (Schein, 1996, p. 30). An important note in Schein's work was the explanation that learning to change once unfrozen can occur in a positive or negative direction depending on new information being digested. Learning can occur through a multitude of sources; however, only when the learning fits the "personality and culture of the learning system" will refreezing become sustainable (Schein, 1996):

> The key, of course, was to see that human change, whether at the individual or group level, was a profound psychological dynamic process that involved painful unlearning without loss of ego identity and difficult relearning as one cognitively attempted to restructure one's thoughts, perceptions, feelings, and attitudes. (p. 33)

Michael Fullan's Change Theory

Michael Fullan's (2006) research on change theory concluded that holding a 'theory in use' is not as impactful as having a 'theory in action.' In order to move a theory from being a 'theory in use' to a 'theory in action,' particular tenets must be established. These particular tenets include "a focus on motivation, capacity building with a focus on results, learning in context, changing context, a bias for reflective action, tri-level engagement, and persistence and flexibility in staying the course" (Fullan, 2006, p. 8). Detailing each tenet supported Fullan's research on the essentials of change theory. Motivation incorporates a mixture of moral drive, aptitude, means to change, multi-leveled supports, and personal identity within an organization.

Change is not sustainable without a continuous level of motivation. Capacity building, with a focus on results, emphasizes the support of people first with an accountability measure following the supports. Capacity building is defined as "any strategy that increases collective

effectiveness of a group to raise the bar and close the gap of student learning" (Fullan, 2006, p. 9). According to Fullan, capacity building can occur not only on the basis of acquiring further knowledge but also on the number of resources and motivation built by an individual and group in an organization. Within building capacity utilizing supports, with an ultimate focus on results, comes the warning that too heavy of a focus on results tips the equilibrium of support and accountability in a negative direction. Therefore, the balance of support and accountability is taken into consideration in accordance with the current culture of an organization. As Gruenert (2000) explained, "Assessing the type of culture that exists in a particular setting provides valuable insight for leaders who are looking to improve their schools" (p. 14).

The change theory tenet of learning in context indicates that continuous improvement or change is directly impacted by, and also directly impacts, the very context it is immersed in when learning, growing, and thus changing. As in test statistic bell curves, "learning in context actually changes the very context itself" as contexts evolve over time (Fullan, 2006, p. 9). A changing context also refers to the entities within a context. Fullan's change theory illuminated that in order to establish a system-wide change, the context must move from a competitive state to a collaborative state in order to form, implement, and sustain systemic, organizational change.

Holding a bias for reflective action indicates that action trumps planning, and that critical thinking and revisions occur on a continuous cycle on and in the theory of action. Tri-level engagement emphasizes system-wide reform and the transparent collaboration of "school and community, district, and state" to leverage influence and plan for and implement real change. The last tenet in Fullan's change theory was that of persistence and flexibility. With the prediction that large-scale change works when it is constantly analyzed and adjusted through thinking and learning follows the characteristics of persistence and flexibility in the theory of

action and in the leaders implementing the change. As Fullan (2006) stated, “The change knowledge is not a disembodied set of facts, but rather a deeply applied phenomenon in the minds of people” (p. 13).

J. Stewart Black and Hal B. Gregersen Change Theory

Black and Gregersen (2008) theorized that change must occur in individuals first before an organization can change as a whole. In other words, “to change your organization, you must first change individuals, and sometimes (maybe even often) this means changing yourself as well” (Black & Gregersen, 2008, p. 1). Changing individuals is difficult as humans are biologically built to resist change and not deviate from the “mental maps” gripped in our brain through experience and predicted behaviors. However, change is inevitable as change is unpredictable and oftentimes occurs quickly on a large-scale. Due to an ever-changing environment focused on the future of innovation, a leader of change must exhibit the very qualities expected of individuals working in the organization. As Black and Gregersen (2008) noted, “Rarely, if ever, are changes required of an organization, a business, a unit, or a team that require no change from the one leading that organization, business, unit, or team” (p. 9).

With this change philosophy in mind, it is elevated that individuals will not change unless and until the leader creates an example through a visible change, in which the individuals will change, causing the organization to change. When thinking through systemic change in a change theory context, the statement that “systemic means systematic” indicates that a leader must demonstrate and transparently engage in systematic actions in order to create systemic change (Holzman, 1993; Black & Gregersen, 2008). By engaging in new processes and procedures, new mental maps can be created to support the active application and sustainability of change.

However, implementing too much change too quickly can create a "brain barrier" wherein an individual or organization's mental maps cannot adapt to the change.

Black and Gregersen (2008) identified three barriers to change: see, move, and finish. The "see barrier" indicates that individuals and groups fail to see the need for change even if and when it is blatantly apparent. The "move barrier" posits that individuals or organizations fail to move even after the realization of a need to change is seen. The "finish barrier" occurs when the need to change is seen and moved upon, but not implemented enough for sustainability (Black & Gregersen, 2008, p. 14). With this change theory in mind, Black and Gregersen (2008) created a framework for organizational change with the foundational components being: "do the right thing and do it well, discover that the right thing is now the wrong thing, do the new right thing but do it poorly at first, and eventually do the new right thing well" (p. 18).

Organizational Culture Applications

Underlying the research of the characteristics of systems thinking, from systematic processes to systemic understanding, is organizational culture. Culture can be illustrated by "not a problem that needs to be solved, but rather a framework that a group can use to solve problems" (Gruenert & Whitaker, 2015, p. 6). Simply stated, culture includes the daily routines and mindsets that a group of people know and live by but rarely discuss.

Culture can encourage practices, whether they be negative or positive for the organization, and can discourage practices or beliefs that do not fit into the current culture (Gruenert & Whitaker, 2015). In explaining their work on change theory, Black and Gregersen (2002) identified organizational culture as "ways of getting things done that a group of people have used so successfully for so long that they simply come to assume that doing things the same way is the only way to get the needed results" (p. xviii). With the defining characteristics of

culture in mind, Deming (1994) stated, “A leader of transformation, and managers involved, need to learn the psychology of individuals, the psychology of a group, the psychology of society, and the psychology of change” (p. 95). Additionally, Edgar Schein (2011) noted that “new leaders cannot initiate any change until they understand the norms, traditions, and practical drifts of the group or department that is being taken over” (p. 131). Thus, it is not enough to understand the systematic processes that need to be deployed to change fundamentally; rather the leader of change also needs an awareness and ability to plan for change in relation to the culture. Doing so indicates a systemic leader.

Cultures as Systems

Espejo (1994) argued that “defining a system is viewpoint-dependent” (p. 202). As such, Espejo defined systems as the individual constructs people have developed individually and as groups in an organization. Therefore, characteristics one person uses to define a system could be different from the characteristics that another person uses to define a system in the same organization. System definition discrepancies are then a byproduct of autonomous behaviors of both individuals and groups in an organization based on their construct of the system. The incongruity of a system defined by systematic process elements and a system defined by human construct from viewpoint alone creates the elevation of the term systemic leadership. According to Espejo (1994), systemic thinking is not only “understanding how the system works, that is, understanding the mechanisms underlying the preceding processes,” but in addition, “learning how to manage situational complexity” (p. 210).

Cultures are systems that have systematic procedures in place to keep the culture strong. Leaders who understand this will be better prepared for potential changes that come to the organization (S. Gruenert, personal communication, November 3, 2020). The components of

culture as defined by Gruenert and Whitaker (2015), provide a perspective of how the culture acts as a system. The subsequent paragraphs will describe each component of culture as identified by Gruenert and Whitaker and then relate each culture component to the characteristics of a system. Thus, each paragraph will serve to identify how the components of culture act as a system.

The student achievement component of culture is described as the degree to which teachers discuss student achievement and the implications of their current practices (Gruenert & Whitaker, 2015). The component of student achievement as a system relates to feedback cycles that are created when discussing student data. These feedback cycles reinforce either the unwelcome or welcoming culture to engage in transparent conversations of continuous improvement in pedagogical practices (Forrester, 2009; Shipley, 2016).

The culture component of collegial awareness is described as the degree to which teachers actively learn from one another's practices (Gruenert & Whitaker, 2015). Learning from one another can occur during structured or unstructured collaborations. The collegial awareness component relates to a system in that high functioning learning organizations include opportunities to learn from one another in a collaborative over competitive environment in which system-to-system collegiality is encouraged and prioritized (Jenkins, 2005; Senge, 1990).

The culture component of shared values is defined "when the teachers at a school are in agreement about the building's educational values, they are not able to hide what they do because the culture itself, in the form of their peers, will hold them accountable" (Gruenert & Whitaker, 2015, p. 70). To be a system, an aim must be clearly communicated, and progress monitored with leading and lagging indicators of success (Deming, 1994). The culture will

determine if the written aim is the same as the unwritten aim through shared values (S. Gruenert, personal communication, November 3, 2020).

The decision-making component of culture is the degree to which teachers participate in decision-making in the organization (Gruenert & Whitaker, 2015). Continually engaging various stakeholders from all levels of the organization ensures that actions deriving from a strategic plan are commonly understood and supports the planning of capacity building for sustained implementation (Fullan, 2005). Strategic plans focused on capacity building for sustainability are core pillars of a system.

Risk taking as a component of school culture is the degree to which teachers engage in translating theory learned to practice and share the findings from the implementation of pedagogical ideas (Gruenert & Whitaker, 2015). Risk taking as a system is designed through professional learning collaborations in education. Engaging in an inquiry cycle for continuous improvement includes the systematic process of analyzing data in order to determine needs for improvement and sharing pedagogical practices (National Institute of Standards and Technology, 2020; Shipley, 2016).

Trust as a component of school culture is described when "members are confident that they can share their professional struggles with anyone else in the culture without invalidating their work" (Gruenert & Whitaker, 2015, p. 72). Systems are created for transparency. Systems theory and thinking relies on the understanding that most of the problems in an organization are due to the system, not the people within the system. Therefore, trust is established when systems thinking leaders consult the system when the people within the organization are struggling (Deming, 1994; Richmond, 1994; Shipley, 2016).

The culture component of openness is the degree to which teachers are open to giving and receiving constructive criticism about their craft (Gruenert & Whitaker, 2015). Systems in the educational organization are intended to track leading indicator data in order to predict the outcomes of identified lagging indicator data (Deming, 1994). The ability to analyze leading indicator data consistently to hold vulnerable and transparent conversations about needed changes can be created as a systematic process, but the culture will determine the level of openness for data-driven collaborations (S. Gruenert, personal communication, November 3, 2020; Shipley, 2016).

Parental relationships as a culture component is the degree to which parents are valued in voicing their perspectives on school-related actions (Gruenert & Whitaker, 2015). Systemic thinking incorporates the understanding that although organization-wide systems are in place to implement on a day-to-day basis, both internal and external factors determine the extent to which the systems are implemented (Fullan, 2006; Jenkins, 2005; Senge, 1990). For example, a school may have a systematic process by which teachers are to engage with parents; however, the culture of the learning organization will determine the depth to which teachers engage in conversation with family members (S. Gruenert, personal communication, November 3, 2020).

The culture component of leadership is the extent to which teachers are empowered to take on leadership roles in the building in order to hold critical conversations of ineffectiveness to move the organization forward in shared best practices (Gruenert & Whitaker, 2015). Systems thinkers understand that providing autonomy to organizational leaders is not impactful without capacity. Thus, in a true learning organization, pinpointing the need and building capacity to have critical conversations creates sustainability and continuity of leadership (Fullan, 2004).

Communication as a component of culture is the degree to which teachers comfortably converse with all levels of the learning organization about strengths and opportunities for improvement (Gruenert & Whitaker, 2015). Systematic processes can be established in order to increase the volume of opportunities for communication (Page & Hale, 2013). However, the culture will determine the discourse of the communication and thus the impact that communication has on the learning environment (S. Gruenert, personal communication, November 3, 2020).

Socialization as a component of culture is described when "the best school cultures ensure that new teachers spend a lot of time with the best teachers in the building and discourage new recruits from spending too much time around less effective teachers who might indoctrinate them with poor habits" (Gruenert & Whitaker, 2015, p. 74). Systems in an educational organization include those under the umbrellas of curriculum, instruction, assessment, and environment. Systems thinking leaders ensure that systematic processes, such as master schedules and mentoring programs, are in place to support positive socialization, with the culture determining if the systematic processes will be rooted in positive or negative socialization characteristics (Ackoff, 1994; S. Gruenert, personal communication, November 3, 2020; Waters & Grubb, 2004).

The organizational history component of culture is the extent to which stories of school failures and successes determine who the teachers and positional leaders get to show up as on a daily basis in the organization (Gruenert & Whitaker, 2015). Identifying the root cause of an issue when looking at organizational problems through the lens of a systems-issue versus a people-issue includes diving into the organizational history to determine how the institution created the ways in which people behave in the organization (Espejo, 1994; Schein, 2011;

Wheatley, 1999). Without identifying the root cause from a systemic lens, a solution could exacerbate the problem and perpetuate a negative organizational historical element.

Summary of Literature Review

The literature review started with a history of leadership traits valued in education as legislative changes used by the business sector to fix the perceived problems in education based on various outcome-oriented results. The review then went on to identify diverse leadership traits that are valued in embodying a continuous improvement mindset and transformational change as an educational leader. The understanding of leadership traits valued in education led to an explanation of systems theory as researched by key authors in their respective fields. Systems theory then was applied to creating a continuum of systems thinking both in the system dynamics field and considerations for attributes to include in a systems thinking continuum for the educational field. The unweaving of these attributes led to ascertaining the differences between the characteristics of systematic and systemic thinking, along with studies that have been conducted to measure the degree to which one can assess the capacity to understand systems thinking as a whole. Systems thinking uncovered the need to understand change theory at a deeper level; thus, a review of change theory through acknowledged experts was presented in the literature review as well. As the theme of the intersection of cultures and systems was prevalent throughout the literature review, chapter 2 concluded with analyzing the culture as a system. Ultimately, the content in the literature review supports the development of an initial instrument presented in chapter 3, which is designed to develop constructs of systems thinking and measure the level of systems thinking in an organizational leader in the educational field. Chapter 4 will then detail the statistical analyses from the data collected through the research. Chapter 5 will

synthesize the dissertation process by presenting the final conclusions from the research results as well as implications for future academic studies.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

Systems thinking was identified throughout chapter 2 as an understanding of both systematic processes at an engaged level, as well as how those systematic processes interconnect in a systemic manner. Additional external factors are taken into account when systemic thinking is present, creating an ethos of vertical and horizontal understanding for strategic decision making in an organization (National Institute of Standards and Technology, 2020). As Fullan (2004) explained,

> A new kind of leadership is necessary for breaking through the status quo. To change organizations and systems will require leaders to get experience in linking to other parts of the system. These leaders in turn must help develop other leaders with similar characteristics. (p. 8)

Chapter 3 will restate the purpose of the study along with the research questions and null hypotheses presented for this dissertation. The research design rationale will be provided as well as the variables for the study. The participant information will be detailed, along with an explanation of instrumentation and data collection. Lastly, a summary will provide a generalized understanding of the research design and methodology.

Purpose of Study

This quantitative study's purpose is to analyze theoretical constructs and determine factors of systems thinking in educational leadership in order to develop a continuum of systems

thinking for instrumentation. The continuum of the systems thinking instrument (COST) is intended to identify the key elements of systems thinking, determine if there is a spectrum of systems thinking from systematic to systemic, and define the statements that build each systems thinking construct. Thus, the COST is designed to possess the ability to identify the level of systems thinking in an organizational leader in the education sector. As is evidenced throughout the literature review, leaders who live and breathe systems thinking are essential when leading for sustainable, continuous improvement (Fullan, 2004; Richmond, 1994; Senge, 1990; Shipley, 2015).

Research Questions and Null Hypotheses

Research questions are the following:

1. What are the domains of systemic leadership that should be considered for the development of an instrument to measure systems thinking?
2. Can a self-reported, Likert-like scale instrument be developed to assess the measure of systems thinking in an organizational leader?

Null hypotheses will include the following:

Null Hypothesis 1: There are no domains of systemic leadership that can determine the position of organizational leaders on a continuum of systems thinking for instrumentation.

Null Hypothesis 2: A self-reported, Likert-like scale instrument cannot be developed to assess the measure of systems thinking in an organizational leader.

Research Design Rationale

The literature review in chapter 2 supports the development of statements to be positioned as variables for an exploratory factor analysis utilizing a Likert-like scale for the

administration of the instrument. Of note, "Although both exploratory and confirmatory approaches seek to account for as much variance as possible in a set of observed variables with a smaller set of latent variables, components, or common factors, exploratory factor analysis is particularly appropriate for scale development" (Hayton et al., 2004, p. 192). Further, exploratory factor analysis is a statistical method utilized not only to determine variables that correlate significantly to one another along with defined constructs but also is a "method used to *generate* theory as researchers use EFA to search for the smaller set of *k* latent factors to represent the larger set of *j* variables" (Henson & Roberts, 2006, p. 395).

Thus, in order to determine the theoretical constructs of systems thinking that would serve as the umbrellas for the statements to correlate through an exploratory factor analysis, the literature review was conducted. Additionally, statements for the COST instrument constructs were crafted via the literature review and then considered through *The System Test*, as created by Ross Arnold and Jon Wade (2015). The *System Test* contained the following elements:

> Purpose: (1) describes the purpose of systems thinking in a way that can be clearly understood, Elements: (2) describes the characteristics of systems thinking, such as the ability to do X, and Interconnections: (3) describes the ways the systems thinking elements feed into and relate to each other. (Arnold & Wade, 2015, p. 671)

Statements as variables in the constructs of systematic process knowledge, data-based decision making, strategic planning, leading by engaging, leveraging interconnections, awareness of the culture, and systemic thinking was presented utilizing a Likert-like survey with the following Likert scale responses demonstrating the level of confidence for each participant: (1) not at all confident, (2) only slightly confident, (3) somewhat confident, (4) moderately confident, or (5) very confident. The Likert-like scale is defined as the following; ***Not at all***

confident: I do not have enough knowledge of this topic in order to plan for or lead implementation. ***Only slightly confident***: I have surface level knowledge of this topic and would need support in planning for and leading implementation. ***Somewhat confident***: I have knowledge of this topic and could develop an outline of a plan for implementation. I would need support in creating a comprehensive plan for implementation along with capacity building to lead as it relates to this topic. ***Moderately confident***: I have a strong knowledge of this topic, thus could develop a comprehensive plan for implementation with the proper mentor to support my leadership capacity. ***Very confident***: I have a deep knowledge of this topic and could lead a peer in developing a comprehensive plan for implementation along with serving as a mentor during implementation.

Variables to be Studied

The literature review supported the development of seven constructs of systems-thinking. Each construct was then utilized in order to develop 83 statements of systems thinking that became the survey statements for the COST survey. Each construct was defined based on the aggregated themes of systems thinking from the research. The first construct of systems thinking is that of systematic process knowledge. Systematic process knowledge is defined as understanding the structure and function of each system individually along with how each system's results generate action (Ackoff, 1994; Arnold & Wade, 2015; Best & Holmes, 2010; Richmond, 1994; Shipley, 2016; Stave & Hopper, 2007). The second construct of systems thinking is data-based decision making. Data-based decision making is defined as understanding that data are dynamic and hold the capability not only to determine outcomes, but also analyze the process by which outcomes derive, in order to predict behaviors and manage by fact (Ackoff, 1994; Deming, 1994; Palaima & Skarzauskiene, 2010; Richmond, 1994; Stave & Hopper, 2007;

Stroh & Zurcher, 2018; Sweeney & Sterman, 2000; Vineyard et al., 2018). The third construct of systems thinking is strategic planning. Strategic planning is defined as the skill and willingness to embrace the ideology that a large portion of the problems in an organization are due to the systems, not the people, with the mental flexibility and agility to analyze and synthesize the systems and course correct in a timely manner (Ackoff, 1994; Deming, 1994; Fullan, 2006; Holzman, 1993; Richmond, 1994; Schein, 1996; Stave & Hopper, 2007; Stroh & Zurcher, 2018).

The fourth construct of systems thinking is leading by engaging. Leading by engaging is defined as the commitment to lead by transparent learning in order to foster an intelligent environment continuously seeking to engage in deep thinking in order to institute continuous improvement in the organization (Black & Gregerson, 2008; Forrester, 2009; Fullan, 2005, 2006; Schein, 1996; Shipley, 2016; Stave & Hopper, 2007; Vare et al., 2019). The fifth construct of systems thinking is leveraging interconnections. Leveraging interconnections is defined as the ability to hold a keen understanding of the linkages between and among the systems in an organization with the ability to leverage those interconnections in order to make high impact decisions for the growth of the organization as a whole. Leaders analyze the organization in a manner that amplifies, “seeing both the forest and the trees” (Richmond, 1994, p. 7; Ackoff, 1994; Deming, 1994; Espejo, 1994; Forrester, 2009; Nguyen & Bocsch, 2014; Palaima & Skarzauskiene, 2010; Parent et al., 2007; Shipley, 2016; Snowden & Boone, 2007; Stave & Hopper, 2007; Stroh & Zurcher, 2018). The sixth construct of systems thinking is awareness of the culture. Awareness of the culture is defined as understanding the deep-rooted culture of the organization and how that culture has the capacity to accept and change systems over time as it relates to both the systematic processes that live within systems and the linkages that emerge between systems throughout the organizational whole (Black & Gregerson, 2002; Espejo, 1994;

Fullan, 2005; Gruenert, 2000; Gruenert & Whitaker, 2015; Jenkins, 2005; Schein, 1996, 2011; Wheatley, 1999).

The last construct of systems thinking is systemic thinking. Systemic thinking is defined as the ability to view both the systematic processes inside of systems, along with the linkages between systems in an organization, in order to make high impact decisions that will be sustainable through the knowledge of the organizational culture (Ackoff, 1994; Arnold & Wade, 2015; Deming, 1994; Forrester, 2009; Fullan, 2005; Gruenert & Whitaker, 2015; Holzman, 1993; Palaima & Skarzauskiene, 2010; Richmond, 1994; Shipley, 2016; Stave & Hopper, 2007; Stroh & Zurcher, 2018; Vineyard et al., 2018; Wheatley, 1999).

Appendix A represents the original statements and Likert-like scales developed to engage in a face validity pilot test with graduate cohort members. Twenty-five participants engaged in the face validity pilot test in which the COST was administered via Qualtrics. The results from the pilot test were analyzed in order to determine if the statements were digestible, not too repetitive, and to support the identification for the Likert-like scale that would serve the final study well. From analyzing the data from the pilot study, and through consulting with the dissertation committee, the final statements and Likert-like scale for the COST survey were determined for the dissertation study and are presented in Appendix B.

Appendix B represents the revision of the statements after analyzing the data from the pilot study with the dissertation committee. From the analysis, it was determined that using one Likert-like scale over two would be better for the study. Statements were then reworded to match the Likert-like scale and non-educational terms were deleted from the COST statements. The statements in Appendix C were then transferred to Qualtrics with a new survey link to send via

email invitation for the final study. Although the statements include literature review citations in the appendix, the literature review citations are not included in the Qualtrics survey.

Validity and Reliability of Instrumentation

Validity of an instrument is demonstrated when the statements or questions in the instrument measure what they are intended to measure (Field, 2005). Validity can be demonstrated in various forms such as face validity, content validity, construct validity, and criterion validity (Taherdoost, 2016). Face validity refers to the subjective assessment of each item in the instrument according to the characteristics of statements in the instrument to be "relevant, reasonable, unambiguous, and clear" (Oluwatayo, 2012, p. 392). The Continuum of Systems Thinking instrument (COST), as developed in this dissertation, underwent a face validity pilot test, as items were constructed and shared with colleagues in the graduate cohort in order to assess their objective design and clear intent. Content validity refers to ensuring that an effort is made to incorporate all aspects of an identified subject or topic into instrumentation design. As the COST is designed to measure the level of systems thinking in an individual, the literature review serves as a measure of content validity. As stated by Taherdoost (2016), "The judgmental approach to establish content validity involves literature reviews" (p. 30).

Construct validity is applicable when studying how an instrument's statements translate from theories as constructs to defined characteristics. "Construct validity refers to how well you translated or transformed a concept, idea, or behavior that is a construct into a functioning and operating reality, the operationalization" (Taherdoost, 2016, p. 31). As such, construct validity is actualized when both discriminant and convergent validity are present. Whereas discriminant validity tests to ensure statements in the instrument that are not meant to have a relationship indeed do not demonstrate a relationship, convergent validity verifies that statements developed

to demonstrate a relationship actually do verify a relationship. The COST instrument as developed for this dissertation will render construct validity as an exploratory factor analysis will be conducted in order to determine statements that do demonstrate a relationship to the constructs of systems thinking, along with statements that do not demonstrate a relationship to the constructs of systems thinking. Data deriving from the exploratory factor analysis will determine statements from the developed instrument to delete or keep in order to form an instrument with construct validity. "Therefore, the factor analysis results will satisfy the criteria of construct validity including both the discriminant validity and convergent validity" (Taherdoost, 2016, p. 32).

Reliability of instrumentation refers to the consistency of the data derived from the instrument's results. Thus, an exploratory factor analysis was conducted for this dissertation study along with analyzing the Cronbach alpha coefficient for each group of statements that load on a common factor within each construct of the developed instrument. The Cronbach alpha coefficient is used to determine the level of reliability utilizing the following points for reliability as presented by Hinton et al. (2004); (1) excellent reliability of 0.90 and above, (2) high reliability of 0.70 – 0.90, (3) moderate reliability of 0.50 – 0.70, and (4) low reliability of 0.50 and below. Ultimately, reliability of the COST instrument will continue to be assessed as the instrument is administered and analyzed repeatedly at the conclusion of the dissertation. As Taherdoost (2016) explained, "Reliability is also concerned with repeatability" (p. 33).

Research Study Recruitment and Safeguards of Participants

Participants for the study will be determined via a public records request from the Indiana Department of Education. The public records request will indicate the official titles and emails of public educational leaders who hold the defined roles of principal, director, assistant

superintendent, or superintendent of an educational organization. Participants determined through the public records request will receive an invitation via email to participate in the research study by engaging in identifying the level of confidence per the Likert-like scale for each statement developed on the COST instrument. The content for email invitations to participate in the study will be generated via the Indiana State University student account after approval from the Institutional Review Board at Indiana State University (see Appendix D). The invitation content will include a safeguard in which participants acknowledge that participation is voluntary and will not be utilized as an identifier to maintain confidentiality. Participants will be provided a two-week window to complete the instrument with an email to either thank or remind participants of their completion after the first week of the delivered invitation.

Data Collection and Analysis Procedures

At the conclusion of the window for participation, data from the instrument was collected via Qualtrics in order to conduct an exploratory factor analysis utilizing the SPSS statistical program. The following process details the data collection and analysis for this dissertation:

1. Develop constructs of systems thinking from the literature review. Seven constructs were identified, defined, and rooted in literature citations.
2. Craft statements that relate to each systems thinking construct as determined through the literature review. Eighty-three statements were developed and rooted in literature citations.
3. Present statements to educational colleagues in graduate cohorts via Qualtrics for a face validity pilot test. Revise statements as applicable after data analysis of pilot test. Alternative statements were crafted after feedback was received according to face validity pilot test of 25 participants.

4. Generate each revised and final statement in Qualtrics in order to develop the invitation to send to participants, including a letter of introduction, informed consent statement, and survey for instrumentation.
5. Send the invitation for participation to the educational leaders as identified through the public records request from the Indiana Department of Education. Educational leaders include titles of superintendent, assistant superintendent, director, and principal. Per the Indiana Department of Education public records request, roughly 2,000 invitations will be sent to educational leaders via email.
6. Conduct an exploratory factor analysis in order to engage in factor extractions and rotations to determine which statements should remain on the instrument, which statements should be deleted from the instrument, and which constructs demonstrate a relationship to the statements on the instrument.
7. Determine and define new factors as identified through the exploratory factor analysis.
8. Revise the COST instrument according to statistical analysis in order to demonstrate construct validity.

Controlling for Bias, Confounds, and Other Potential Errors

The statistical analyses utilized to demonstrate construct validity of the COST instrument will ultimately control for bias, confounds, and other potential errors in the study. The exploratory factor analysis will "examine the inter-correlations between all variables" (Chen, 2012, p. 72), as an item analysis, scree test, and varimax rotations were conducted in order to determine which factors align to the defined constructs of the study as determined through the literature review. Analyzing the Cronbach's alpha coefficient for groups of statements determined reliability and strength of statements as they relate to the systems thinking constructs.

Summary of Research Design and Methodology

This quantitative study is designed to determine the domains of systemic leadership that serve as constructs in the development of an instrument to assess the measure of systems thinking in an organizational leader. The constructs were presented and defined in chapter 3 as developed through the literature review. Additionally, this quantitative study is designed to determine if a self-reported, Likert-like scale instrument can adequately assess the measure of systems thinking in an organizational leader. Statements to develop a survey on Qualtrics for the study were presented in chapter 3 as determined through the literature review. An explanation of the validity and reliability of instrumentation was provided, along with how the study demonstrates both throughout its research design and methodology. Data procedures were detailed in relation to participation, data collection, and data analysis that controls for bias, confounds, and potential errors. Chapter 4 will present the findings from the data analysis, which will determine the revision of the COST instrument to demonstrate construct validity. Chapter 5 will synthesize the dissertation study and present implications for future academic research.

CHAPTER 4

RESULTS

Chapter four examines the results from the continuum of systems thinking (COST) survey taken by organizational leaders in the education sector. An exploratory factor analysis and confirmatory factor analysis were conducted in order to answer the research questions for this dissertation study. The research questions for this dissertation study are as follows: “What are the domains of systemic leadership that should be considered for the development of an instrument to measure systems thinking?” and “Can a self-reported, Likert-like scale instrument be developed to assess the measure of systems thinking in an organizational leader?” Chapter four will present the data relevant to answering these research questions as well as present the final factors and items, or survey statements, determined through a series of analyses.

Descriptive Analysis

Data from the COST survey were gathered through Qualtrics XM. There were 239 participants who started the survey with a varied number of participants per survey item. The only survey identifier presented asked participants to indicate their organizational leadership title. Based on the results, the survey participants almost equally represented both building and district leadership. The descriptive data from the survey identifier are presented in Table 6.

Table 6

Descriptive Statistic, Title of Organizational Leader

	N	%
Principal	118	49.4%
Director	11	4.6%
Assistant Superintendent	24	10.1%
Superintendent	84	35.1%
Other Not Indicated	2	0.8%

Preliminary Analyses

Data were analyzed via SPSS 27 after survey participant data were exported from Qualtrics XM. First, the standard deviation for each item was examined to ensure the items were not overly correlated with one another. Appendix E depicts the descriptive statistics table which includes the mean, standard deviation, and *n*-size for each item. Next, examining the survey items through a Pearson correlation ensured that high intercorrelation among two or more items was not present. The 84 items exported from Qualtrics XM were all retained after determining that the items correlate appropriately with all others and that no correlation coefficient was unreasonably large.

After this determination, reliability statistics were analyzed in order to determine the scale mean of each survey item if the item was deleted. None of the items were under a .9 threshold with the Cronbach's Alpha reliability demonstrating .987. In order to test the Cronbach's Alpha reliability statistic, a KMO and Bartlett's test of sphericity were conducted. The results of the KMO analysis demonstrated that KMO = .949, which indicated that an

adequate variability was present to further analyze the items in the study. As Glen (2016) explained, “KMO values between 0.8 and 1 indicate the sampling is adequate” (para. 2). Thus, the preliminary analyses continued to retain the 84 survey items from the research study.

The items were then analyzed through a principal component analysis in order to examine the initial eigenvalues of each component to determine the number of factors. Components with an eigenvalue greater than 1 were initially determined as a factor. Utilizing an eigenvalue greater than one to determine a factor is known as the Kaiser rule. “The reasoning is that an eigenvalue less than one implies that the scores on the component would have negative reliability” (Kayongo, 2005, p. 333). Table 7 depicts the eigenvalues of the components which demonstrated 12 factors.

Table 7

Principal Component Analysis Eigenvalues

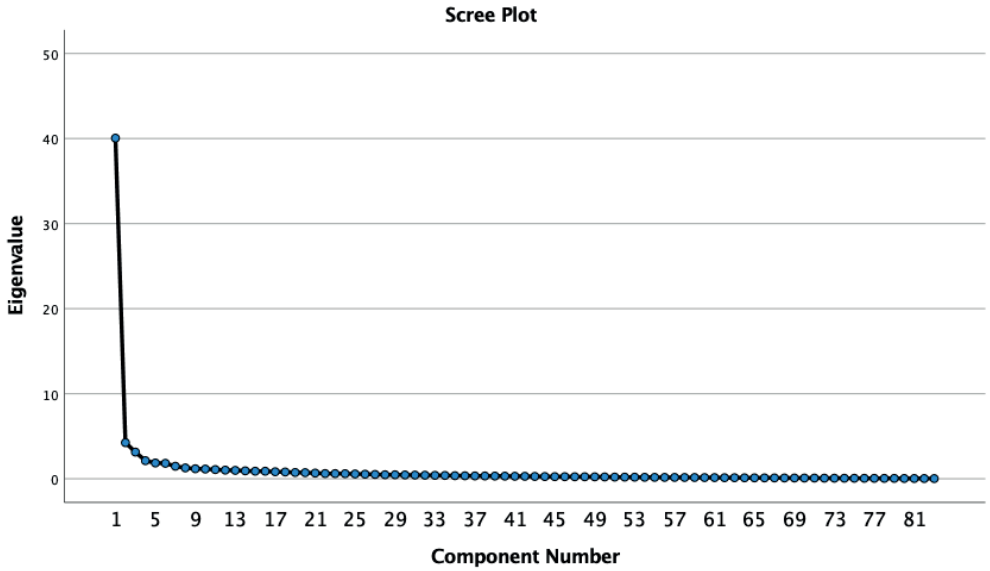
Component	Total	Initial Eigenvalue % of Variance	Cumulative %
1	40.056	48.260	48.260
2	4.254	5.125	53.385
3	3.147	3.792	57.177
4	2.136	2.573	59.750
5	1.864	2.246	61.996
6	1.828	2.202	64.198
7	1.481	1.784	65.982
8	1.286	1.549	67.532
9	1.186	1.429	68.960

Component	Total	Initial Eigenvalue % of Variance	Cumulative %
10	1.150	1.385	70.346
11	1.088	1.311	71.657
12	1.025	1.234	72.891
13	.994	1.197	74.089

In order to determine further the number of factors to consider from the items, a scree plot was generated. “In a scree plot, it is desirable to find a sharp reduction in the size of the eigenvalues (like a cliff), with the rest of the smaller eigenvalues constituting rubble” (Woods & Edwards, 2011, para. 2). The scree plot depicted in Figure 3 indicated that four to five factors were present in the data set.

Figure 3

Scree Plot



Dimension Reduction Analysis

After the preliminary analyses determined the initial number of factors, a principal component analysis with a varimax rotation method was conducted. The items were analyzed using the rotated component matrix through a .500 factor load and 1.5 cross-load criteria. "The goal of factor rotation is to rotate the factor matrix so that it can approach simple structure in order to improve interpretability" (UCLA, 2016, Orthogonal Rotation section). Table 8 depicts the items that loaded onto each factor based on the analysis of the data. Items in the table that are greyed did not load onto a factor as the item either did not meet the .500 factor load criterion, or the item cross loaded at the 1.5 criterion. Thus, the items in grey were then removed from the bank of survey statements. Appendix F defines the codes on Table 8 as the items on the survey.

Table 8

Rotated Component Matrix 12 factors, 84 items

Item	Factor											
	1	2	3	4	5	6	7	8	9	10	11	12
CIAE				.526								
CAS				.789								
CCS				.556								
SOC				.717								
COMCUR						.430						
JAFC		.516										
DATA		.723										
SPDA		.644										
QQD		.644										

Item	Factor								
ICDM			.451						
IDEO			.604						
OOSI	.462								
SIP	.392		.530						
FISD				.657					
IOCS				.739					
IOAS				.719					
FC				.521					
EDDA		.536							
DPD		.493							
DNO				.496					
LPDE					.800				
LPDL					.811				
PLC					.437				
COLL							.701		
FED						.760			
STATE						.838			
LELA		.530	.387						
DPO		.719							
SI		.570							
5Y			.760						
CMS			.794						

Item	Factor				
RCA			.582		
TRI		.545			
ANA				.430	
SYS				.412	
FORE		.628			
TREN		.513			
SPDQ		.409			
MORG			.382		
DASS	.537				
SSOT	.559			.418	
DYNA	.491				
2WAY	.496				
SUCC	.521				
MACC	.453				
STRA	.503			.469	
CICA				.493	
CLS			.724		
NEWC			.687		
T2P			.644		
T2A	.449		.546		
DPFR			.621		
P2P	.526		.398		

Item	Factor
CURO	.604
PRO	.551
CLJ	.565
SYST	.553
MMO	.630
FOR	.663
CU2A	.697
DTPC	.654
VIS	.610
VIS1	.597
VISA	.587
WPO	.698
FAC	.668
CSBA	.714
LINK	.724
LELAL	.641
CHA	.668
POLE	.730
STAK	.719
EFF	.714
IMP	.741
REAL	.764

Item	Factor
SUPP	.595
COCU	.633
DRIV	.665
DISO	.623
ICEL	.675
CAP	.668
T2AC	.712
TASY	.668

Extraction Method: Principal Component Analysis

Rotation Method: Varimax with Kaiser Normalization

Factors and Items After Dimension Reduction Analysis

The principal component analysis using a varimax with Kaiser normalization rotation method resulted in the determination of five factors with 53 items dispersed in those factors. Each factor was then analyzed for reliability by examining the Cronbach's Alpha if an item was deleted from the factor. Table 9 depicts the reliability data for each factor.

Table 9

Reliability Statistics per Factor

Factor	Cronbach's Alpha	Number of items
1	.977	30
2	.931	10
3	.845	4
4	.850	5

Factor	Cronbach's Alpha	Number of items
5	.892	4

Factors were then named by aggregating the qualitative theme of the item cluster as informed by the literature review. It is to be noted that subjectivity is a possible characteristic of the factor titles and subsequent descriptions. "Subjectivity is generally conceptualized as the way research is influenced by the perspectives, values, social experiences, and viewpoint of the researcher" (Allen, 2017, p. 3). Table 10 depicts the five factors with the items from the survey that loaded onto each factor.

Table 10

5 Factors, 53 Items After EFA

Factor 1: Leveraging Interconnections Through Systemic Thinking	• When building a strategic plan, I am able to deconstruct and analyze the systems as silos in the organization. • I am able to build a succession plan for leaders in an organization in order to avoid "discontinuity in direction" of the organizational goals. • I am able to view the culture of the organization as a foundational roadmap for determining action to implement for continuous improvement. • I can collect targeted data both formally and informally of the effectiveness of processes in the organization from the people who are charged with carrying them out daily. • I can engage with all levels of stakeholders in continuous learning journeys.

- I am able to converse about the ideology that the knowledge of systematic processes in an organization is a prerequisite for systemic thinking.
- My mental model of the systems in an organization and their interconnections is able to constantly evolve based on new learning.
- I know when to push the organization forward into new initiatives and when to allow the organization to maintain function in its current state.
- I am able to analyze the culture of the organization in order to determine my actions as a positioned leader in the organization.
- I can identify indicators to gauge the level of deep thinking present in a professional collaboration.
- I am able to construct a visual which displays the key systems that should be present in an educational organization as silos.
- I understand the difference between the whole of the organization and the parts within the organization and can detail their relationship to a colleague.
- I am able to identify the factors inside and outside of the organization for consideration when change is needed.
- When taking on a new leadership role, I would be able to observe the culture in order to determine the systematic processes that exist between and among systems.
- Determining the linkages which would yield the highest impact for continuous improvement would be identifiable for me as an educational leader.

	• Upon identifying linkages between and among systems, I can define leading and lagging data points deriving from those linkages to gather and analyze trend data. • I am able to explain the systematic processes that would be impacted by change to the identified linkages between and among systems in the organization. • I can forecast and plan for the reality that the systematic processes that I institute as a positional leader in the organization may look different when implemented due to the culture. • Before instituting change in the organization, I can discuss the extent to which the people within the organization will accept the change with various stakeholders. • I am able to create new processes or adapt current processes in order to ensure linkages are effectively serving the organization as a whole. • I am able to communicate system linkages along with the processes that are impacted by the linkages to educators within the organization. • I am able to plan for the reality that the culture of the organization has the ability to determine if system changes will be sustainable. • I am able to be a visible leader that serves to constantly support educators in realizing the interconnections between and among the systems of the organization. • I am able to define characteristics which would indicate a competitive culture vs. characteristics of a collaborative culture.

	• I am able to identify people within the organization who would best lead and drive actions that require changes to multiple parts of the larger system. • I can rationalize with peers that the appearance of disorder in an organization is not always an indicator of ineffectiveness. • In order to implement change in an organization, I am able to visually engage in the processes of change with every level of the organization. • I am able to intentionally build individual's capacity of systems thinking in an organization. • I am able to transfer theory to action in a manner that builds the collective capacity of the organization. • I am able to intentionally build the capacity of other leaders to think and act systemically.
Factor 2: Data Based Analysis Leading to Action	• I am able to create a job aid or flow chart which explains an effective assessment system. • I can create a structure to organize a vast amount of data on a common data dashboard. • I am able to provide a list of characteristics for a structured process of data analysis. • I am able to collect and analyze quantitative and qualitative data when creating continuous improvement goals. • I can identify the current amount of educational data present in my organization. • I can use data in order to predict outcomes. • When analyzing data, I am able to identify areas of strength and areas in need of improvement. • I am able to triangulate data to make fact-based decisions.

	• I can forecast needs based on data analysis. • I can analyze trend data before making decisions.
Factor 3: Leading by Engaging	• I am able to publicly admit when I need to learn more about a theory or topic. • As a leader, I am able to learn new content related to continuous improvement in my field. • I am able to engage in tasks at all levels of the organization in order to learn how the processes are implemented from theory to practice. • I am able to analyze more than one data point before providing input or feedback to a request or observation.
Factor 4: Concrete and Abstract Systems	• I am able to list the current systems for curriculum, instruction, assessment, and environment present in my educational environment. • I am able to view culture as a system of its own with systematic processes that keep the current culture in place. • I am able to identify the core characteristics that make up the structure of a system. • When taking on a new leadership role, I would be able to observe the culture in order to determine the systems that already exist. • I am able to converse with peers about the ideology that changes to a system impacts the culture of an organization.
Factor 5: Systematic Process Knowledge	• I can detail the differences between formative, interim, and summative data. • I am able to identify the inputs and outputs of a curriculum system. • I am able to identify the inputs and outputs of an assessment system.

	• I am able to explain a feedback cycle and its implications on the system.

The first factor, "Leveraging Interconnections Through Systemic Thinking," is defined as the ability to view both the systematic processes inside of systems, along with the linkages between systems in an organization, in order to make high impact decisions that will be sustainable through the knowledge of the organizational culture. The second factor, "Data Based Analysis Leading to Action," is defined as the understanding that data is dynamic and holds the capability to not only determine outcomes, but also analyze the process by which outcomes derive in order to predict behaviors and manage by fact. The third factor, "Leading by Engaging," is defined as the commitment to lead by transparent learning in order to foster an intelligent environment continuously seeking to engage in deep thinking in order to institute continuous improvement in the organization. The fourth factor, "Concrete and Abstract Systems," is defined as understanding the deep-rooted culture of the organization and how that culture has the capacity to accept and change systems over time as it relates to both the systematic processes that live within systems and the linkages that emerge between systems throughout the organizational whole. The fifth factor, "Systematic Process Knowledge," is defined as understanding the structure and function of each system individually along with how each system's results generate action within the individual system.

Confirmatory Factor Analysis

In order to further refine the COST survey items, a confirmatory factor analysis was conducted. "CFA is often the analytic tool of choice for developing and refining measurement instruments, assessing construct validity, identifying method effects, and evaluating factor invariance across time and groups" (Jackson et al., 2009, p. 6). The CFA was generated through

a principal component analysis with varimax Kaiser normalization rotation utilizing SPSS 27. The items were analyzed with the factor loading criteria of .500 and cross loading criteria of 1.5 between items. After the CFA analysis, two more items were removed from the data set. The two removed items, along with rationale for removal, are presented in Table 11. The final set of items determined through the exploratory factor analysis and follow up confirmatory factor analysis for this dissertation study is depicted in Table 12.

Table 11

*Confirmatory Factor Analysis**

Item	Factor				
	1	2	3	4	5
CU2A	.639		.507		
DRIV	.530		.567		

Note. 2 cross-loaded items removed

Table 12

Final COST Survey, 5 Factors, 51 Items

Factor 1: Leveraging Interconnections Through Systemic Thinking, 28 items	• When building a strategic plan, I am able to deconstruct and analyze the systems as silos in the organization. • I am able to build a succession plan for leaders in an organization in order to avoid "discontinuity in direction" of the organizational goals. • I am able to view the culture of the organization as a foundational roadmap for determining action to implement for continuous improvement.

- I can collect targeted data both formally and informally of the effectiveness of processes in the organization from the people who are charged with carrying them out daily.
- I can engage with all levels of stakeholders in continuous learning journeys.
- I am able to converse about the ideology that the knowledge of systematic processes in an organization is a prerequisite for systemic thinking.
- My mental model of the systems in an organization and their interconnections is able to constantly evolve based on new learning.
- I know when to push the organization forward into new initiatives and when to allow the organization to maintain function in its current state.
- I can identify indicators to gauge the level of deep thinking present in a professional collaboration.
- I am able to construct a visual which displays the key systems that should be present in an educational organization as silos.
- I understand the difference between the whole of the organization and the parts within the organization and can detail their relationship to a colleague.
- I am able to identify the factors inside and outside of the organization for consideration when change is needed.
- When taking on a new leadership role, I would be able to observe the culture in order to determine the systematic processes that exist between and among systems.
- Determining the linkages which would yield the highest impact for continuous improvement would be identifiable for me as an educational leader.

	• Upon identifying linkages between and among systems, I can define leading and lagging data points deriving from those linkages to gather and analyze trend data. • I am able to explain the systematic processes that would be impacted by change to the identified linkages between and among systems in the organization. • I can forecast and plan for the reality that the systematic processes that I institute as a positional leader in the organization may look different when implemented due to the culture. • Before instituting change in the organization, I can discuss the extent to which the people within the organization will accept the change with various stakeholders. • I am able to create new processes or adapt current processes in order to ensure linkages are effectively serving the organization as a whole. • I am able to communicate system linkages along with the processes that are impacted by the linkages to educators within the organization. • I am able to plan for the reality that the culture of the organization has the ability to determine if system changes will be sustainable. • I am able to be a visible leader that serves to constantly support educators in realizing the interconnections between and among the systems of the organization. • I am able to define characteristics which would indicate a competitive culture vs. characteristics of a collaborative culture.

	• I can rationalize with peers that the appearance of disorder in an organization is not always an indicator of ineffectiveness. • In order to implement change in an organization, I am able to visually engage in the processes of change with every level of the organization. • I am able to intentionally build individual's capacity of systems thinking in an organization. • I am able to transfer theory to action in a manner that builds the collective capacity of the organization. • I am able to intentionally build the capacity of other leaders to think and act systemically.
Factor 2: Data Based Analysis Leading to Action, 10 items	• I am able to create a job aid or flow chart which explains an effective assessment system. • I can create a structure to organize a vast amount of data on a common data dashboard. • I am able to provide a list of characteristics for a structured process of data analysis. • I am able to collect and analyze quantitative and qualitative data when creating continuous improvement goals. • I can identify the current amount of educational data present in my organization. • I can use data in order to predict outcomes. • When analyzing data, I am able to identify areas of strength and areas in need of improvement. • I am able to triangulate data to make fact-based decisions. • I can forecast needs based on data analysis. • I can analyze trend data before making decisions.

Factor 3: Leading by Engaging, 4 statements	• I am able to publicly admit when I need to learn more about a theory or topic. • As a leader, I am able to learn new content related to continuous improvement in my field. • I am able to engage in tasks at all levels of the organization in order to learn how the processes are implemented from theory to practice. • I am able to analyze more than one data point before providing input or feedback to a request or observation.
Factor 4: Concrete and Abstract Systems, 5 statements	• I am able to list the current systems for curriculum, instruction, assessment, and environment present in my educational environment. • I am able to view culture as a system of its own with systematic processes that keep the current culture in place. • I am able to identify the core characteristics that make up the structure of a system. • When taking on a new leadership role, I would be able to observe the culture in order to determine the systems that already exist. • I am able to converse with peers about the ideology that changes to a system impacts the culture of an organization.
Factor 5: Systematic Process Knowledge, 4 items	• I can detail the differences between formative, interim, and summative data. • I am able to identify the inputs and outputs of a curriculum system. • I am able to identify the inputs and outputs of an assessment system. • I am able to explain a feedback cycle and its implications on the system.

Summary

The purpose of this dissertation study was to determine the answers to the questions: "What are the domains of systemic leadership that should be considered for the development of an instrument to measure systems thinking?" and "Can a self-reported, Likert-like scale instrument be developed to assess the measure of systems thinking in an organizational leader?" The comprehensive literature review supported the creation of seven constructs and 83 statements to create the COST survey in order to administer via Qualtrics XM to organizational leaders in the education sector in Indiana. The data gathered from Qualtrics XM were then exported to SPSS 27 in order to determine the factors that emerged for the COST survey along with the items that load onto each factor. The analyses that encompassed the exploratory factor analysis determined that five factors and 53 items were to remain on the COST survey. A confirmatory factor analysis was then conducted in order to further refine the COST survey. In the end, five factors were identified, labeled, and defined with 51 survey items to constitute the final COST survey. The two null hypotheses were rejected.

CHAPTER 5

DISCUSSION

The structure of chapter five will synthesize the dissertation study findings, describe implications and recommendations based on the findings, present additional limitations found in the study, provide recommendations for future research, and conclude with a summary of the dissertation. The purpose of this dissertation study was to determine if a self-reported, Likert-like scale instrument could be developed from constructs created through the literature review in order to measure the level of systems thinking in an organizational leader. Systems thinking, as defined in this dissertation study, is the understanding of both systematic process knowledge and systemic cognizance. Systemic cognizance includes a key component of awareness of organizational culture. Most recently, Michael Fullan (2021) aimed to identify and define the convergence of systemic thinking and organizational culture awareness creating the term, systemness. Fullan (2021) described:

> Systemness is defined as the sense that people have at all levels of the system that they are indeed *the system*. This means they have a responsibility to interact with, learn from, contribute to and be a living member of the system as it evolves. (p. 33)

Fullan's timely publishing brings to light the importance of leaders who epitomize the characteristics of systems thinking, as education is in the midst of unprecedented, complex challenges and opportunities for second order change to the macro, meso, and micro-level

systems. Fullan posited, “System change cannot be only top down, nor only bottom up, nor only middle out. It turns out that the system cannot be changed without “the system” layers all having ownership of the change” (Fullan, 2021, p. 34). The COST survey developed through this dissertation study mirrors the findings from Michael Fullan and many other respected systems theorists and researchers.

Discussion of Findings

An invitation to engage in the COST survey via Qualtrics XM was sent to approximately 2,000 organizational leaders in the education sector in Indiana. At the conclusion of sending an email to eligible participants, 76 emails were immediately returned as undeliverable with several others returning with an automated message of being out of the building for a varied duration of time due to COVID-19. Overall, 251 participants engaged with the survey with varied completion rates. Although 251 participants engaged with the survey, 239 participants completed at least one of the items presented through Qualtrics XM. Seven participants commented that the survey was lengthy and complex with three other participants commenting that COVID-19 needs were a barrier to their ability to completing the survey. Although this accounts for only ten participants, it can be inferred that the length and complexity of the survey, along with current pandemic variables, were a cause for a lower number of participants than desired. Of the 239 participants to engage in the COST survey with at least one item completed, half of the participants (49.4%) were building-level education leaders with the other half (49.8%) of participants being district-level education leaders.

The results from the survey were then analyzed utilizing SPSS 27 in order to conduct an exploratory factor analysis and confirmatory factor analysis to identify the factors and items that would constitute the final COST survey for this dissertation study. These two types of analyses

decreased the items in the COST survey from 84 items to 51 items loading onto five factors. The five factors were then given titles and definitions to encompass the concepts of the survey items loading onto each factor.

The first factor was identified by the title, Leveraging Interconnections Through Systemic Thinking, and contained 28 items. The 28 items related to understanding the interconnections between and among the systems in an organization along with the ability to view the culture of an organization as a system in and of itself in order to support sustainable, continuous organizational improvement. Acknowledging that 28 items was high for one factor, the concept of overdetermination is presented as an explanation for this conclusion. “Highly overdetermined factors are those that exhibit high loadings with a substantial number of variables as well as good simple structure” (MacCallum et al., 1999, p. 90). Overdetermination can only be considered if high communalities are present in the study of the data. As found through simulation studies, high communalities among items can lead to reliable factor extractions even with small research sample sizes (Winter et al., 2009). “The communality of a variable is the portion of the variance of that variable that is accounted for by the common factors” (MacCallum et al., 1999, p. 85). Osborne (2014) suggested that a strong communality presents at or above 0.60 (Osborne, 2014). The communalities for each item in the first factor of the COST survey are presented in Table 13.

Table 13

Communalities for 28 Items in Factor One

Coded Item	Initial	Extraction
DASS	1.00	.794
Coded Item	Initial	Extraction

SUCC	1.00	.662
CURO	1.00	.708
PRO	1.00	.681
CLJ	1.00	.602
SYST	1.00	.718
MMO	1.00	.740
FOR	1.00	.639
DTPC	1.00	.667
VIS	1.00	.751
WPO	1.00	.730
FAC	1.00	.675
CSBA	1.00	.741
LINK	1.00	.750
LELAL	1.00	.757
CHA	1.00	.833
POLE	1.00	.789
STAK	1.00	.771
EFF	1.00	.769
IMP	1.00	.760
REAL	1.00	.784
SUPP	1.00	.637
LOCU	1.00	.648
DISO	1.00	.685

ICEL	1.00	.641
CAP	1.00	.701
T2AC	1.00	.797
TASY	1.00	.734

Extraction Method: Principal Component Analysis

The second factor deriving from the analyses of data was identified by the title, Data-Based Analysis Leading to Action. Factor 2 contained 10 items that encompassed the concepts of identifying data inputs and outputs with the ability to analyze both of these system components in order to act according to what the data demonstrated is best for the system. As Capra and Luisi (2014) explained in the context of the Newtonian laws of motion, "All that happened had a definite cause and gave rise to a definite effect, and the future of any part of the system could – in principle – be predicted with absolute certainty if its state at any time was known in all details" (p. 102).

The third factor deriving from data analyses was identified by the title, Leading by Engaging. Factor 3 contained four items which indicated that an organizational leader is able to actively take part in a continuous learning cycle by engaging with stakeholders at all levels both inside and outside of the organization. As Fullan and Quinn (2016) eloquently exclaimed:

> "You can't just align the policies on paper. This theoretical or delivered alignment has little to do with how people in the field experience it. Coherence making, in other words, has to be achieved at the receiving end, not the delivery end." (p. 6)

Engaging in continuous learning with multiple stakeholders thus includes the consistent and continual quest to determine how the systems are impacting the people within the organization.

The fourth factor deriving from the data analyses was titled, Concrete and Abstract Systems. Factor 4 contained five items which encompassed the concept of being able to identify the visible and non-visible systems in an organization. Thus, this particular factor included the convergence of systems and culture. The idea of viewing the culture as a system that either creates a pathway or barrier to system change is an emerging concept. Fullan (2021) began to write about the convergence of systems and culture by stating, "The breakthrough idea arising from systemness is that all three levels of the system, individually and together, are essential for and have independent, and conjoint responsibility for changing the system" (p. 34).

The fifth factor deriving from the analyses of data was titled, Systematic Process Knowledge. Factor 5 contained four items which indicated that an organizational leader is able to detail and identify the parts that contain a system including inputs and outputs as flows, the amount at any given time as the stock, and the impact that a feedback cycle has on the system. As posited throughout the literature review, the knowledge of systematic processes is a prerequisite for systemic thinking and action.

As the comprehensive literature review was utilized in order to determine the initial constructs and items that constituted the COST survey to administer for the research study, and the emergence of five factors through data analysis were present, the first null hypothesis for this dissertation was rejected. There are domains of systemic leadership that can determine the position of organizational leaders on a continuum of systems thinking for instrumentation. Further, as the exploratory and confirmatory factor analyses resulted in 51 items loading throughout the five factors, the second null hypothesis was also partially rejected. A self-reported, Likert-like scale instrument can be developed to measure systems thinking in an organizational leader. However, this dissertation study was not able to measure if a self-reported,

Likert-like scale instrument can adequately assess the measure of systems thinking in an organizational leader, yet. The latter half of this dissertation hypothesis will be addressed when future research is detailed in the subsequent sections.

Implications and Recommendations Based on Findings

The creation of the COST survey holds implications for developing an understanding of thinking and acting systemically in organizational leadership in the education sector. Leaders who understand and act according to the characteristics of systems thinking are continually able to create and sustain effective and healthy organizations. Effective leadership through systems thinking is reinforced through business, medical, and education research. Collins, J. & Hansen, M., (2011) researched companies around the globe in order to determine the core characteristics that identify why they continually thrive. A theme of those characteristics emerges as the ability to think and act systemically through "fanatic discipline, empirical creativity, and productive paranoia" (p. 19). Medical research prioritizes the obligation to teach systems thinking to healthcare providers:

> Systems thinking provides strategies and tools to help clinicians recognize different perspectives; question personal assumptions; identify structural and functional relationships, drivers of change, and change processes; and recognize the impact of social and environmental factors on patient care. (Plack et al., 2019, p. 2)

Education has valued systems thinking with further research and literature needed on the importance of recruiting and retaining district and building-level leaders who understand how to think and thus act systemically to improve the macro, meso, and micro-level organizations in education continuously. As stated by Fullan and Quinn (2016), "Leaders at system, district, and school levels need to influence the culture and processes that support learning and working

together in purposeful ways at every level of the organization if they are to produce greater learning in students" (p. 53).

Based on the findings of this dissertation study, a substantial focus on both quantitative and qualitative research that determines the impact of systems thinking on educational organizations is needed. If a high level of systems thinking is present in educational leaders demonstrating data points such as an increased impact on student achievement, staff retention and effectiveness, and community partnerships is determined, then an importance of building the capacity of other educational leaders on systems thinking is necessary. Further, it is imperative to build the capacity of the education sector on systems thinking at all levels of the organization in order to create a flywheel of questioning the macro system for equitable change. Collins and Hansen (2011) coined the flywheel effect as the relentless pursuit of a vision as a process of interconnected changes one act at a time. An educational example of the flywheel in action in order to question the macro system for equitable change is presented in the scenario detailed in the next paragraph.

An educational organization has focused on developing the capacity of systems thinking at all levels of the organization to create sustainable, second-order change. In doing so, teachers in the organization are consistently challenged to determine if the identified problems in the organization are due to the people within the system or due to the system itself. Being empowered to question the system, along with the ability to view the siloed systems of curriculum, instruction, assessment, data analysis, and environment within the organization, along with their interconnections, has caused powerful professional learning community collaborations.

One such professional learning collaboration focused on data analysis of student literacy assessment scores in fifth-grade classrooms, which is where this particular flywheel gained further momentum. Upon analyzing student literacy assessment data at a granular level, teachers were able to examine not only the student scores as student problems but also the student scores as possible assessment system problems. In engaging in this type of root cause analysis and dissecting the problem at a systems level over a people level, the fifth-grade teachers in this scenario were able to uncover that the reading passage provided through the interim assessment program was presented at an eighth-grade readability level. Uncovering this realization led the fifth-grade team to then test the readability of the state standardized assessment passages as released from the item repository provided through the state Department of Education. Upon downloading and analyzing the readability of the fifth-grade passages that students would be expected to read and comprehend for the state standardized assessment, it was found that the readability presented itself at a seventh-grade reading level.

These actions in the flywheel of questioning the system for equitable change catapulted an email and follow-up conversation with the state Department of Education on the appropriateness of the readability levels on the state standardized literacy assessment. This example is just one of many that can occur when building the capacity of systems thinking at all levels of the educational organization to influence the long-term effectiveness of education as a whole.

Limitations of the Study

As stated in chapter 1 of this dissertation study, limitations are factors that are uncontrollable by the researcher; therefore, measures were taken to lessen the impact of the uncontrollable factors (Leedy & Ormrod, 2005). A limitation of this study was the survey design

of a Likert-like scale in which participants self-reported their answers. In order to control for this limitation, it was a goal to gain a large sample size for data analysis. It was found through the study that the complexity and length of the COST survey, along with the complexities for education leaders that arose during the COVID-19 pandemic, created several barriers to being able to engage fully with the survey. These realities resulted in a smaller sample size than desired by the researcher.

A further limitation of this study as presented in chapter 1 is the prior knowledge of systems thinking that organizational leaders in education possess. It is to be noted that four survey participants commented to inform the researcher that their district engaged in professional learning on systems thinking. This information allowed the researcher to gain insight into companies that seek to engage district and building leaders on the importance of systems thinking in organizational leadership.

Recommendations for Future Research

Based on the findings of this research study, further exploration is needed in order to confirm the findings of this study. Future research will include administering the COST survey as developed through this dissertation study to a larger sample size of organizational leaders in the education sector. The data collected from the larger sampling will again be analyzed utilizing an exploratory factor analysis and confirmatory factor analysis to affirm the current COST survey for instrumentation. The statistical analysis will also serve to conclude if the first factor of the COST survey continues to demonstrate overdetermination. After a finalized, more succinct COST survey is developed, further research is needed to decide if the instrument can indeed determine the level of systems thinking in organizational leaders in education through the generation of a systems thinking profile. If such a profile can be generated, then there are

opportunities to determine if correlations exist between a multitude of educational variables and systems thinking leadership. If correlations do exist between variables such as student achievement or teacher retention to systems thinking leaders, then the implications for professional learning starting at the university level on systems thinking is imperative to generating a field of effective educational leaders.

An additional recommendation for future research focuses on the intersection of systems and culture. This intersection is an emerging concept to understand and operationally define as the field of education is in a current paradigm shift of determining what is valued in education as a society. Through this research and observing second order change in education, a further analysis of systems and culture has the ability to further unpack the findings that: Systems can impact cultures and create subcultures. Cultures can create or impact systems and make subsystems. Systems can change cultures over time. Cultures can change systems over time. A system has the ability to make either a collaborative culture a fragmented culture, or to make a fragmented culture a collaborative culture. Culture has the ability to make a comprehensive system fragmented in implementation. Both cultures and systems have the ability to make ineffective people uncomfortable and empower effective people.

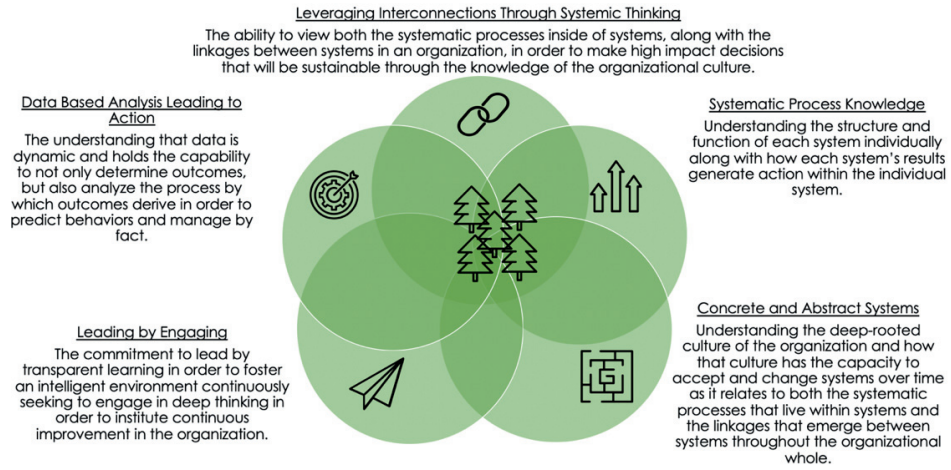
By acknowledging the culture, systems can be built for immediate implementation without much variance. By not acknowledging the culture, system implementation could take longer and hold greater variance in implementation. When people cite culture as the main reason to protect an organization's current state, the organizational leader needs to make sure whether the culture is continuously pushing the people within the organization to improve over allowing them to be comfortable in the status quo.

Summary

Collins and Hansen (2011) posited, “We don’t choose study questions. They choose us” (p. 2). A focus on systems thinking in education has the ability to move our society at large to a closer version of equitable through the opportunities provided to all students no matter their current reality. Through an understanding of systems thinking at all levels of the organization, the systems can be challenged and thus strengthened to impact a sustainable focus on what matters in education. In order to create an educational culture in which systems thinking is valued, further research and capacity building on the tenets of systems thinking in education is needed. This dissertation study identified and defined five factors of systems thinking presented in Figure 4. It is the researcher’s suggestion that we metaphorically not only need to be able to see the forest through the trees, but we also need to be able to see the leaves and identify the healthiest environment for them to grow.

Figure 4

Systems Thinking, 5 Factors



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APPENDIX A: COST STATEMENTS FOR FACE VALIDITY PILOT TEST

Continuum of Systems Thinking Statements as Variables for EFA

System: A set of interrelated parts that work together to form a whole that is interconnected to other parts and wholes within an organization.

Construct of Systems Thinking	Statements as Variables for EFA Statements for study will not include citations on Qualtrics.
Systematic Process Knowledge Understanding the structure and function of each system individually along with how each system's results generate action within the individual system (Ackoff, 1994; Arnold & Wade, 2015; Best & Holmes, 2010; Richmond, 1994; Shipley, 2016; Stave & Hopper, 2007). Participants will answer via a 5-point Likert scale of confidence level indicating; (1) Not at all confident, (2) Only slightly confident, (3) Somewhat confident, (4) Moderately confident, or (5) Very confident.	1. I am able to identify the core characteristics that make up the structure of a system (Arnold & Wade; Stave & Hopper, 2007; Sweeney & Sterman, 2000). 2. I am able to list the current systems for curriculum, instruction, assessment, and environment present in my educational environment (Ackoff, 1994; Jenkins, 2005; Wheatley, 1999). 3. I am able to explain the components that build a comprehensive curriculum (Snowden & Boone, 2007; Thornton, Peltier, & Perreault, 2004; Waters & Grubb, 2004; Zaraza, 1995). 4. I am able to create a job aid or flow chart which explains an effective assessment system (Shipley, 2016; Stave & Hopper, 2007; Waters & Grubb, 2004). 5. I am able to provide a list of characteristics for a structured process of data analysis (Deming, 1994;

	Shipley, 2016; Vineyard, Yanovsky, & Mackert, 2018). 6. I am able to describe an inquiry cycle that can be utilized to determine decision making (Palaima & Skarzauskiene, 2010; Shipley, 2016). 7. I am able to create and help others understand outcome-oriented school improvement goals for the district, building, and teacher level (Deming, 1994). 8. I am able to identify the inputs and outputs of a curriculum system (Cronin & Gonzalez, 2007; Fischer & Gonzalez, 2016; Gonzalez & Wong, 2011; Kainz & Ossimitz, 2002). 9. I am able to identify the inputs and outputs of an assessment system (Cronin & Gonzalez, 2007; Fischer & Gonzalez, 2016; Gonzalez & Wong, 2011; Kainz & Ossimitz, 2002). 10. I am able to explain a feedback cycle and its implications on the system (Ackoff, 1994; Best & Holmes, 2010; Forrester, 2009; Stave & Hopper, 2007). 11. I am able to verbalize the core components of an evidence-based lesson plan design (Waters & Grubb, 2004). 12. I am able to verbalize the core components of an evidence-based lesson plan delivery (Waters & Grubb, 2004). 13. I am able to create a structure in which to hold high quality professional learning collaborations (Shipley, 2015; Shipley, 2016; Waters & Grubb, 2004).

Data-Based Decision Making Understanding that data is dynamic and holds the capability to not only determine outcomes, but also analyze the process by which outcomes derive in order to predict behaviors and manage by fact (Ackoff, 1994; Deming, 1994; Palaima & Skarzauskiene, 2010; Richmond, 1994; Stave & Hopper, 2007; Stroh & Zurcher, 2018; Sweeney & Sterman, 2000; Vineyard, Yanorsky, & Mackert, 2018). Participants will answer via a 5-point Likert scale of agreement level indicating; (1) Strongly disagree, (2) Somewhat disagree, (3) Neither agree nor disagree, (4) Somewhat agree, or (5) Strongly agree.	1. I understand how to create a structure to organize a vast amount of data on a common data dashboard (Stave & Hopper, 2007; Stroh & Zurcher, 2018). 2. I understand how to detail the differences between formative, interim, and summative data (Vineyard, Yanorsky, & Mackert, 2018; Waters & Grubb, 2004). 3. I understand how to identify the current amount of educational data present in my organization (Cronin & Gonzalez, 2007; Fischer & Gonzalez, 2016; Gonzalez & Wong, 2011; Kainz & Ossimitz, 2002). 4. I understand how each data point in my educational organization informs decisions (Cronin & Gonzalez, 2007; Fischer & Gonzalez, 2016; Gonzalez & Wong, 2011; Kainz & Ossimitz, 2002). 5. Student achievement is a direct byproduct of the instruction received in the classroom (Shipley, 2016; Waters & Grubb, 2004). 6. I understand how to use data in order to predict outcomes (Deming, 1994; Sweeney & Sterman, 2000). 7. I understand how to identify and track leading indicator data that correlates to lagging indicator data points and goals (Stroh & Zurcher, 2018; Vineyard, Yanovsky, & Mackert, 2018). 8. I understand how to triangulate data to make fact-based decisions (Deming, 1994). 9. I understand how to use data to analyze the process by which numerical outcomes derive (Ackoff,

	1994; Deming, 1994; Stroh & Zurcher, 2018). 10. Quantitative and qualitative data should be collected and analyzed when creating continuous improvement goals (Ackoff, 1994; Stave & Hopper, 2007). 11. I understand the Federal accountability model in education enough to explain it to a peer (Deming, 1994; Shipley, 2015). 12. I understand the State accountability model in education enough to explain it to a peer (Deming, 1994; Shipley, 2015). 13. I understand how to forecast needs based on data analysis (Stroh & Zurcher, 2018). 14. When analyzing data, I understand how to identify areas of strength and areas in need of improvement (Stave & Hopper, 2007; Stroh & Zurcher, 2018). 15. I do not make decisions without first analyzing trend data (Richmond, 1994; Stroh & Zurcher, 2018). 16. I understand how to analyze more than one data point before providing input or feedback to a request or observation (Richmond, 1994; Stroh & Zurcher, 2018).
Strategic Planning The skill and willingness to embrace the ideology that a large portion of the problems in an organization are due to the systems, not the people, with the mental flexibility and agility to analyze and synthesize the systems and course correct in a timely manner (Ackoff, 1994; Deming, 1994; Fullan, 2006; Holzman, 1993; Page & Hale, 2013;	1. When a complex problem is evident, I am able to lead a root cause analysis in order to determine a solution (Ackoff, 1994; Stave & Hopper, 2007; Stroh & Zurcher, 2018). 2. The five-why strategy is effective when determining the root cause of a problem (Page & Hale, 2013).

Richmond, 1994; Schein, 1996; Shipley, 2015; Shipley, 2016; Stave & Hopper, 2007; Stroh & Zurcher, 2018). Participants will answer via a 5-point Likert scale of agreement level indicating; (1) Strongly disagree, (2) Somewhat disagree, (3) Neither agree nor disagree, (4) Somewhat agree, or (5) Strongly agree.	3. The cause mapping strategy is effective when determining the root cause of a problem (Stroh & Zurcher, 2018). 4. Forming a team with members at all levels of the organization is the most impactful way to build a strategic plan (Shipley, 2015; Shipley, 2016; Stroh & Zurcher, 2018). 5. When problems occur in an organization, my first instinct is to analyze the system for ineffectiveness (Deming, 1994; Richmond, 1994; Shipley, 2015). 6. When building a strategic plan, I am able to deconstruct and analyze the systems as siloes in the organization (Ackoff, 1994; Deming, 1994; Holzman, 1993; Richmond, 1994; Stave & Hopper, 2007). 7. When building a strategic plan, I am able to synthesize the systems in an organization to identify trends between and among systems (Ackoff, 1994). 8. I believe that a strategic plan alone is not enough to improve an organization (Fullan, 2005; Fullan, 2006; Schein, 1996). 9. I believe that two-way communication is vital for strategic planning (Shipley, 2015; Shipley, 2016). 10. I lead with actions that demonstrate the belief that a strategic plan is not an event, but a continuous improvement cycle (Shipley, 2015; Shipley, 2016). 11. I have the mental agility to course correct if a strategic plan's data is proving to be unsuccessful (Black &

	Gregerson, 2008; Fullan, 2005; Fullan, 2006; Schein, 1996). 12. I believe that data to inform a strategic plan must come from multiple stakeholder groups (Stave & Hopper, 2007; Stroh & Zurcher, 2018). 13. I believe that data to inform a strategic plan must include both quantitative and qualitative measures (Deming, 1994; Richmond, 1994; Stave & Hopper, 2007; Stroh & Zurcher, 2018). 14. Having a succession plan for leaders in an organization avoids "discontinuity in direction" of the organizational goals (Fullan, 2005, p. 31).
Leading by Engaging The commitment to lead by transparent learning in order to foster an intelligent environment continuously seeking to engage in deep thinking in order to institute continuous improvement in the organization (Black & Gregerson, 2008; Forrester, 2009; Fullan, 2005; Fullan, 2006; Schein, 1996; Shipley, 2016; Stave & Hopper, 2007; Vare et al., 2019). Participants will answer via a 5-point Likert scale of agreement level indicating; (1) Strongly disagree, (2) Somewhat disagree, (3) Neither agree nor disagree, (4) Somewhat agree, or (5) Strongly agree.	1. As a leader, I always seek to learn new content related to continuous improvement in my field (Black & Gregerson, 2008; Schein, 1996; Shipley, 2016). 2. As a leader, I consistently formulate theories to implement into action based on knowledge gained through continuous learning (Fullan, 2005; Fullan, 2006). 3. I engage in tasks at all levels of the organization on a consistent basis in order to learn how the processes are implemented from theory to practice (Shipley, 2016; Vare et al., 2019). 4. I engage with all levels of stakeholders in continuous learning journeys (Forrester, 2009; Shipley, 2016; Vare et al., 2019). 5. I am able to publicly admit when I need to learn more about a theory or topic (Black & Gregerson, 2008;

	Fullan, 2005; Fullan, 2006; Schein, 1996). 6. I intentionally create structures in the organization in which peers learn from one another, no matter their hierarchical position (Fullan, 2006; Schein, 1996; Shipley, 2016). 7. I identify indicators to gauge the level of deep-thinking present in a professional collaboration (Fullan, 2005; Fullan, 2006). 8. I collect data both formally and informally of the effectiveness of processes in the organization from the people who are charged with carrying them out daily (Black & Gregerson, 2008; Schein, 1996; Shipley, 2016). 9. The knowledge of systematic processes in an organization is a prerequisite for systemic thinking (Ackoff, 1994; Arnold & Wade, 2015; Deming, 1994; Holzman, 1993; Palaima & Skarzauskiene, 2010; Shipley, 2016). 10. My mental model of the systems in an organization and their interconnections is constantly evolving based on new learning (Deming, 1994; Gruenert & Whitaker, 2015; Richmond, 1994; Vineyard et al., 2018).
Leveraging Interconnections Holding a keen understanding of the linkages between and among the systems in an organization with the ability to leverage those interconnections in order to make high impact decisions for the growth of the organization as a whole. Leaders analyze the organization in a manner that amplifies "seeing both the forest and the trees" (Richmond, 1994, p. 7).	1. I understand the difference between the whole of the organization and the parts within the organization and can detail their relationship to a colleague (Deming, 1994; Richmond, 1994). 2. I am able to construct a visual which displays the key systems that should be present in an educational organization as silos (Nguyen &

(Ackoff, 1994; Deming, 1994; Espejo, 1994; Forrester, 2009; Nguyen & Bocsch, 2014; Palaima & Skarzauskiene, 2010; Parent, Roy, & St-Jacques, 2007; Richmond, 1994; Senge, 1990; Shipley, 2016; Snowden & Boone, 2007; Stave & Hopper, 2007; Stroh & Zurcher, 2018; Vare et al., 2019; Vineyard et al., 2018; Wheatly, 1999). Participants will answer via a 5-point Likert scale of confidence level indicating; (1) Not at all confident, (2) Only slightly confident, (3) Somewhat confident, (4) Moderately confident, or (5) Very confident.	Bocsch, 2014; Parent, Roy, & St-Jacques, 2007; Senge, 1990; Shipley, 2016; Stroh & Zurcher, 2018; Wheatley, 1999). 3. I am able to construct a visual which includes key systems that should be present in an educational organization along with the defined, one-on-one linkages that exist between those systems (Nguyen & Bocsch, 2014; Parent, Roy, & St-Jacques, 2007; Senge, 1990; Shipley, 2016; Stroh & Zurcher, 2018; Wheatley, 1999). 4. I am able to construct a visual which includes key systems that should be present in an educational organization along with the abstract linkages that exist among those systems (Nguyen & Bocsch, 2014; Parent, Roy, & St-Jacques, 2007; Senge, 1990; Shipley, 2016; Stroh & Zurcher, 2018; Wheatley, 1999). 5. Upon identifying linkages between and among systems, I can define leading and lagging data points deriving from those linkages to gather and analyze trend data (Shipley, 2016; Stroh & Zurcher, 2018; Vineyard et al., 2018). 6. Determining the linkages which would yield the highest impact for continuous improvement would be fairly easily identifiable for me as an educational leader (Shipley, 2016; Stroh & Zurcher, 2018; Vineyard et al., 2018). 7. I am able to explain the systematic processes that would be impacted by change to the identified linkages between and among systems in the

	organization (Richmond, 1994; Shipley, 2016; Vineyard et al., 2018; Wheatley, 1999). 8. I am able to create new processes or adapt current processes in order to ensure linkages are effectively serving the organization as a whole (Deming, 1994; Stave & Hopper, 2007; Stroh & Zurcher, 2018; Vare et al., 2019). 9. I am able to communicate system linkages along with the processes that are impacted by the linkages to educators within the organization (Shipley, 2016; Stroh & Zurcher, 2018; Vineyard et al., 2018). 10. I am able to be a visible leader that serves to constantly support educators in realizing the interconnections between and among the systems of the organization (Fullan, 2005).
Awareness of the Culture Understanding the deep rooted culture of the organization and how that culture has the capacity to accept and change systems over time as it relates to both the systematic processes that live within systems and the linkages that emerge between systems throughout the organizational whole (Black & Gregerson, 2002; Espejo, 1994; Gruenert, 2000; Gruenert & Whitaker, 2015; Fullan, 2005; Schein, 2011; Schein, 1996; Wheatley, 1999). Participants will answer via a 5-point Likert scale of agreement level indicating; (1) Strongly disagree, (2) Somewhat disagree, (3) Neither agree nor disagree, (4) Somewhat agree, or (5) Strongly agree.	1. When taking on a new leadership role, it would be fairly easy for me to observe the culture in order to determine the systems that already exist (Fullan, 2005; Gruenert, 2000; Gruenert & Whitaker, 2015; Schein, 2011; Wheatley, 1999). 2. When taking on a new leadership role, it would be fairly easy for me to observe the culture in order to identify the systematic processes that already exist between and among the systems (Fullan, 2005; Gruenert, 2000; Gruenert & Whitaker, 2015; Schein, 2011). 3. I feel confident in being able to define characteristics that would indicate a competitive culture vs. characteristics of a collaborative culture (Gruenert & Whitaker, 2015).

	4. The culture of the organization determines my actions as a positioned leader in the organization (Fullan, 2005; Gruenert & Whitaker, 2015; Schein, 2011). 5. I feel confident in viewing the culture of the organization as a foundational roadmap for determining actions to implement for continuous improvement (Black & Gregerson, 2002; Espejo, 1994; Fullan, 2005; Gruenert, 2000; Gruenert & Whitaker, 2015; Schein, 2011; Wheatley, 1999). 6. Before instituting change in the organization, I feel confident in discussing the extent to which the people within the organization will accept the change with various stakeholders (Espejo, 1994; Gruenert, 2000; Gruenert & Whitaker, 2015; Schein, 2011; Schein, 1996). 7. School improvement action plans cannot be implemented in the same manner from one organization to the next organization (Black & Gregerson, 2002; Fullan, 2005; Schein, 2011; Wheatley, 1999). 8. The systematic processes that I institute as a positional leader in the organization may look different when implemented due to the culture (Espejo, 1994; Fullan, 2005; Gruenert, 2000; Gruenert & Whitaker, 2015). 9. The culture of the organization has the capacity to determine if system changes will be sustainable (Fullan, 2005; Wheatley, 1999). 10. In order to implement change in an organization, the positional leader must visually engage in the processes

	of change with every level of the organization (Black & Gregerson, 2008). 11. I feel confident in viewing culture as a system of its own with systematic processes that keep the current culture in place (Gruenert, personal communication, 2020). 12. Changes to a system impact the culture of an organization (Fullan, 2005; Fullan, 2006; Schein, 1996; Wheatley, 1999). 13. The appearance of disorder in an organization is not always an indicator of ineffectiveness (Schein, 1996; Wheatley, 1999).
Systemic Thinking The ability to view both the systematic processes inside of systems, along with the linkages between systems in an organization, in order to make high impact decisions that will be sustainable through the knowledge of the organizational culture (Ackoff, 1994; Arnold & Wade, 2015; Deming, 1994; Forrester, 2009; Fullan, 2005; Fullan, 2006; Gruenert, 2000; Gruenert & Whitaker, 2015; Holzman, 1993; Palaima & Skarzauskiene, 2010; Richmond, 1994; Shipley, 2016; Stave & Hopper, 2007; Stroh & Zurcher, 2018; Vineyard, Yanovsky, & Mackert, 2018; Wheatley, 1999). Participants will answer via a 5-point Likert scale of confidence level indicating; (1) Not at all confident, (2) Only slightly confident, (3) Somewhat confident, (4) Moderately confident, or (5) Very confident.	1. I am able to identify people within the organization that would best lead and drive actions that require changes to multiple parts of the larger system (Fullan, 2006; Gruenert & Whitaker, 2015; Stave & Hopper, 2007). 2. I know when to push the organization forward into new initiatives and when to allow the organization to maintain function in its current state (Deming, 1994; Forrester, 2009; Gruenert, 2000; Gruenert & Whitaker, 2015; Richmond, 1994). 3. I am able to consistently engage in an inquiry cycle with multiple stakeholder groups to ensure the organization's strategic plan is dynamic and relevant to the culture's readiness level to accept changes (Fullan, 2006; Gruenert & Whitaker, 2015; Richmond, 1994; Stave & Hopper, 2007; Stroh & Zurcher, 2018).

	4. I am able to categorize which problems are in need of systematic solutions and which problems are in need of systemic solutions in the organization (Ackoff, 1994; Richmond, 1994; Shipley, 2016; Stroh & Zurcher, 2018). 5. I am able to transfer theory to action in a manner that builds the collective capacity of the organization (Deming, 1994; Fullan, 2006; Richmond, 1994; Stave & Hopper, 2007). 6. I am able to intentionally build individual's capacity of systems thinking in an organization (Forrester, 2009; Fullan, 2006; Richmond, 1994; Stroh & Zurcher, 2018). 7. In my role as a leader, I am able to intentionally build the capacity of other leaders to think and act systemically (Fullan, 2006; Richmond, 1994; Stroh & Zurcher, 2018). 8. I am able to find value in collaborating with other educational organizations in my geographical location for a common goal (Fullan, 2006; Vineyard et al., 2018). 9. I am able to identify the factors inside and outside of the organization for consideration when change is needed (Ackoff, 1994; Fullan, 2006; Gruenert & Whitaker, 2015; Richmond, 1994; Wheatley, 1999).

APPENDIX B: REVISED COST STATEMENTS AFTER FACE VALIDITY PILOT TEST FOR FINAL STUDY

Continuum of Systems Thinking Statements as Variables for EFA

System: A set of interrelated parts that work together to form a whole that is interconnected to other parts and wholes within an organization.

Construct of Systems Thinking	Statements as Variables for EFA Statements for study will not include citations on Qualtrics.
Systematic Process Knowledge Understanding the structure and function of each system individually along with how each system's results generate action within the individual system (Ackoff, 1994; Arnold & Wade, 2015; Best & Holmes, 2010; Richmond, 1994; Shipley, 2016; Stave & Hopper, 2007). Participants will answer via a 5-point Likert scale of confidence level indicating; (1) Not at all confident, (2) Only slightly confident, (3) Somewhat confident, (4) Moderately confident, or (5) Very confident. Likert Scale Definitions: ***Not at all confident***: I do not have enough knowledge of this topic in order to plan for or lead implementation. ***Only slightly confident***: I have surface level knowledge of this topic, thus would need support in planning for and leading implementation.	1. I am able to identify the core characteristics that make up the structure of a system (Arnold & Wade; Stave & Hopper, 2007; Sweeney & Sterman, 2000). 2. I am able to list the current systems for curriculum, instruction, assessment, and environment present in my educational environment (Ackoff, 1994; Jenkins, 2005; Wheatley, 1999). 3. I am able to explain the components that build a comprehensive curriculum (Snowden & Boone, 2007; Thornton et al., 2004; Waters & Grubb, 2004; Zaraza, 1995). 4. I am able to create a job aid or flow chart which explains an effective assessment system (Shipley, 2016; Stave & Hopper, 2007; Waters & Grubb, 2004). 5. I am able to provide a list of characteristics for a structured process

Somewhat confident: I have knowledge of this topic and could develop an outline of a plan for implementation. I would need support in building upon the outline in order to create and implement a comprehensive plan as it relates to this topic. ***Moderately confident***: I have a strong working knowledge of this topic, thus could develop a comprehensive plan with the proper mentor to support effective implementation. ***Very confident***: I have a deep knowledge of this topic, thus could lead as a mentor in developing and implementing a comprehensive plan as it relates to this topic.	of data analysis (Deming, 1994; Shipley, 2016; Vineyard et al., 2018). 6. I am able to describe an inquiry cycle that can be utilized to determine decision making (i.e., PDSA) (Palaima & Skarzauskiene, 2010; Shipley, 2016). 7. I am able to create and help others understand outcome-oriented school improvement goals for the district, building, and teacher level (Deming, 1994). 8. I am able to identify the inputs and outputs of a curriculum system (Cronin & Gonzalez, 2007; Fischer & Gonzalez, 2016; Gonzalez & Wong, 2011; Kainz & Ossimitz, 2002). 9. I am able to identify the inputs and outputs of an assessment system (Cronin & Gonzalez, 2007; Fischer & Gonzalez, 2016; Gonzalez & Wong, 2011; Kainz & Ossimitz, 2002). 10. I am able to explain a feedback cycle and its implications on the system (Ackoff, 1994; Best & Holmes, 2010; Forrester, 2009; Stave & Hopper, 2007). 11. I am able to verbalize the core components of an evidence-based lesson plan design (Waters & Grubb, 2004). 12. I am able to verbalize the core components of an evidence-based lesson plan delivery (Waters & Grubb, 2004). 13. I am able to create a structure in which to hold high quality professional learning collaborations (Shipley, 2015; Shipley, 2016; Waters & Grubb, 2004).

Data-Based Decision Making Understanding that data is dynamic and holds the capability to not only determine outcomes, but also analyze the process by which outcomes derive in order to predict behaviors and manage by fact (Ackoff, 1994; Deming, 1994; Palaima & Skarzauskiene, 2010; Richmond, 1994; Stave & Hopper, 2007; Stroh & Zurcher, 2018; Sweeney & Sterman, 2000; Vineyard et al., 2018). Participants will answer via a 5-point Likert scale of confidence level indicating; (1) Not at all confident, (2) Only slightly confident, (3) Somewhat confident, (4) Moderately confident, or (5) Very confident. Likert Scale Definitions: ***Not at all confident***: I do not have enough knowledge of this topic in order to plan for or lead implementation. ***Only slightly confident***: I have surface level knowledge of this topic, thus would need support in planning for and leading implementation. ***Somewhat confident***: I have knowledge of this topic and could develop an outline of a plan for implementation. I would need support in building upon the outline in order to create and implement a comprehensive plan as it relates to this topic. ***Moderately confident***: I have a strong working knowledge of this topic, thus could develop a comprehensive plan with the proper mentor to support effective implementation. ***Very confident***: I have a deep knowledge of this topic, thus could lead as a mentor in developing and implementing a comprehensive plan as it relates to this topic.	1. I can create a structure to organize a vast amount of data on a common data dashboard (Stave & Hopper, 2007; Stroh & Zurcher, 2018). 2. I can detail the differences between formative, interim, and summative data (Vineyard et al., 2018; Waters & Grubb, 2004). 3. I can identify the current amount of educational data present in my organization (Cronin & Gonzalez, 2007; Fischer & Gonzalez, 2016; Gonzalez & Wong, 2011; Kainz & Ossimitz, 2002). 4. I am able to detail how each data point in my educational organization informs decisions (Cronin & Gonzalez, 2007; Fischer & Gonzalez, 2016; Gonzalez & Wong, 2011; Kainz & Ossimitz, 2002). 5. I can use data in order to predict outcomes (Deming, 1994; Sweeney & Sterman, 2000). 6. I can currently identify and track leading indicator data that correlates to lagging indicator data points and goals (Stroh & Zurcher, 2018; Vineyard et al., 2018). 7. I am able to triangulate data to make fact-based decisions (Deming, 1994). 8. I am able to use data to analyze the process by which numerical outcomes derive (Ackoff, 1994; Deming, 1994; Stroh & Zurcher, 2018). 9. I am able to collect and analyze quantitative and qualitative data when creating continuous improvement goals (Ackoff, 1994; Stave & Hopper, 2007).

	10. I understand the Federal accountability model in education enough to explain it to a peer (Deming, 1994; Shipley, 2015). 11. I understand the State accountability model in education enough to explain it to a peer (Deming, 1994; Shipley, 2015). 12. I can forecast needs based on data analysis (Stroh & Zurcher, 2018). 13. When analyzing data, I am able to identify areas of strength and areas in need of improvement (Stave & Hopper, 2007; Stroh & Zurcher, 2018). 14. I can analyze trend data before making decisions (Richmond, 1994; Stroh & Zurcher, 2018). 15. I am able to analyze more than one data point before providing input or feedback to a request or observation (Richmond, 1994; Stroh & Zurcher, 2018).
Strategic Planning The skill and willingness to embrace the ideology that a large portion of the problems in an organization are due to the systems, not the people, with the mental flexibility and agility to analyze and synthesize the systems and course correct in a timely manner (Ackoff, 1994; Deming, 1994; Fullan, 2006; Holzman, 1993; Page & Hale, 2013; Richmond, 1994; Schein, 1996; Shipley, 2015; Shipley, 2016; Stave & Hopper, 2007; Stroh & Zurcher, 2018). Participants will answer via a 5-point Likert scale of confidence level indicating; (1) Not at all confident, (2) Only slightly confident, (3)	1. When a complex problem is evident, I am able to lead a root cause analysis in order to determine a solution (Ackoff, 1994; Stave & Hopper, 2007; Stroh & Zurcher, 2018). 2. I can lead a team through the five-why strategy when determining the root cause of a problem (Page & Hale, 2013). 3. I can lead a team through the cause mapping strategy when determining the root cause of a problem (Stroh & Zurcher, 2018). 4. I can identify members at all levels of the organization who would be impactful when building a strategic

Somewhat confident, (4) Moderately confident, or (5) Very confident. Likert Scale Definitions: ***Not at all confident***: I do not have enough knowledge of this topic in order to plan for or lead implementation. ***Only slightly confident***: I have surface level knowledge of this topic, thus would need support in planning for and leading implementation. ***Somewhat confident***: I have knowledge of this topic and could develop an outline of a plan for implementation. I would need support in building upon the outline in order to create and implement a comprehensive plan as it relates to this topic. ***Moderately confident***: I have a strong working knowledge of this topic, thus could develop a comprehensive plan with the proper mentor to support effective implementation. ***Very confident***: I have a deep knowledge of this topic, thus could lead as a mentor in developing and implementing a comprehensive plan as it relates to this topic.	plan (Shipley, 2015; Shipley, 2016; Stroh & Zurcher, 2018). 5. When problems occur in an organization, I am able to analyze the system for ineffectiveness (Deming, 1994; Richmond, 1994; Shipley, 2015). 6. When building a strategic plan, I am able to deconstruct and analyze the systems as siloes in the organization (Ackoff, 1994; Deming, 1994; Holzman, 1993; Richmond, 1994; Stave & Hopper, 2007). 7. When building a strategic plan, I am able to synthesize the systems in an organization to identify trends between and among systems (Ackoff, 1994). 8. I can speak to the ideology that a strategic plan alone is not enough to improve an organization (Fullan, 2005; Fullan, 2006; Schein, 1996). 9. I can build systems in which two-way communication is present for strategic planning (Shipley, 2015; Shipley, 2016). 10. I am able to lead with actions that demonstrate the belief that a strategic plan is not an event, but a continuous improvement cycle (Shipley, 2015; Shipley, 2016). 11. I have the mental agility to course correct if a strategic plan's data is proving to be unsuccessful (Black & Gregerson, 2008; Fullan, 2005; Fullan, 2006; Schein, 1996). 12. I can identify data to inform a strategic plan that includes both quantitative and qualitative measures (Deming, 1994; Richmond, 1994; Stave &

	Hopper, 2007; Stroh & Zurcher, 2018). 13. I am able to build a succession plan for leaders in an organization in order to avoid "discontinuity in direction" of the organizational goals (Fullan, 2005, p. 31).
Leading by Engaging The commitment to lead by transparent learning in order to foster an intelligent environment continuously seeking to engage in deep thinking in order to institute continuous improvement in the organization (Black & Gregerson, 2008; Forrester, 2009; Fullan, 2005, 2006; Schein, 1996; Shipley, 2016; Stave & Hopper, 2007; Vare et al., 2019). Participants will answer via a 5-point Likert scale of confidence level indicating; (1) Not at all confident, (2) Only slightly confident, (3) Somewhat confident, (4) Moderately confident, or (5) Very confident. Likert Scale Definitions: ***Not at all confident***: I do not have enough knowledge of this topic in order to plan for or lead implementation. ***Only slightly confident***: I have surface level knowledge of this topic, thus would need support in planning for and leading implementation. ***Somewhat confident***: I have knowledge of this topic and could develop an outline of a plan for implementation. I would need support in building upon the outline in order to create and implement a comprehensive plan as it relates to this topic. ***Moderately confident***: I have a strong working knowledge of this topic, thus could	1. As a leader, I am able to learn new content related to continuous improvement in my field (Black & Gregerson, 2008; Schein, 1996; Shipley, 2016). 2. As a leader, I am able to formulate theories to implement into action based on knowledge gained through continuous learning (Fullan, 2005, 2006). 3. I am able to engage in tasks at all levels of the organization in order to learn how the processes are implemented from theory to practice (Shipley, 2016; Vare et al., 2019). 4. I can engage with all levels of stakeholders in continuous learning journeys (Forrester, 2009; Shipley, 2016; Vare et al., 2019). 5. I am able to publicly admit when I need to learn more about a theory or topic (Black & Gregerson, 2008; Fullan, 2005, 2006; Schein, 1996). 6. I can intentionally create structures in the organization in which peers learn from one another, no matter their hierarchical position (Fullan, 2006; Schein, 1996; Shipley, 2016). 7. I can identify indicators to gauge the level of deep-thinking present in a professional collaboration (Fullan, 2005; Fullan, 2006).

develop a comprehensive plan with the proper mentor to support effective implementation. ***Very confident***: I have a deep knowledge of this topic, thus could lead as a mentor in developing and implementing a comprehensive plan as it relates to this topic.	8. I can collect targeted data both formally and informally of the effectiveness of processes in the organization from the people who are charged with carrying them out daily (Black & Gregerson, 2008; Schein, 1996; Shipley, 2016). 9. I am able to converse about the ideology that the knowledge of systematic processes in an organization is a prerequisite for systemic thinking (Ackoff, 1994; Arnold & Wade, 2015; Deming, 1994; Holzman, 1993; Palaima & Skarzauskiene, 2010; Shipley, 2016). 10. My mental model of the systems in an organization and their interconnections is able to constantly evolve based on new learning (Deming, 1994; Gruenert & Whitaker, 2015; Richmond, 1994; Vineyard et al., 2018).
Leveraging Interconnections Holding a keen understanding of the linkages between and among the systems in an organization with the ability to leverage those interconnections in order to make high impact decisions for the growth of the organization as a whole. Leaders analyze the organization in a manner that amplifies "seeing both the forest and the trees" (Richmond, 1994, p. 7). (Ackoff, 1994; Deming, 1994; Epejo, 1994; Forrester, 2009; Nguyen & Bocsch, 2014; Palaima & Skarzauskiene, 2010; Parent, Roy, & St-Jacques, 2007; Richmond, 1994; Senge, 1990; Shipley, 2016; Snowden & Boone, 2007; Stave & Hopper, 2007; Stroh & Zurcher, 2018; Vare et al., 2019; Vineyard et al., 2018; Wheatly, 1999).	1. I understand the difference between the whole of the organization and the parts within the organization and can detail their relationship to a colleague (Deming, 1994; Richmond, 1994). 2. I am able to construct a visual which displays the key systems that should be present in an educational organization as silos (Nguyen & Bocsch, 2014; Parent, Roy, & St-Jacques, 2007; Senge, 1990; Shipley, 2016; Stroh & Zurcher, 2018; Wheatley, 1999). 3. I am able to construct a visual which includes key systems that should be present in an educational organization along with the defined, one-on-one linkages that exist between those

Participants will answer via a 5-point Likert scale of confidence level indicating; (1) Not at all confident, (2) Only slightly confident, (3) Somewhat confident, (4) Moderately confident, or (5) Very confident. Likert Scale Definitions: ***Not at all confident***: I do not have enough knowledge of this topic in order to plan for or lead implementation. ***Only slightly confident***: I have surface level knowledge of this topic, thus would need support in planning for and leading implementation. ***Somewhat confident***: I have knowledge of this topic and could develop an outline of a plan for implementation. I would need support in building upon the outline in order to create and implement a comprehensive plan as it relates to this topic. ***Moderately confident***: I have a strong working knowledge of this topic, thus could develop a comprehensive plan with the proper mentor to support effective implementation. ***Very confident***: I have a deep knowledge of this topic, thus could lead as a mentor in developing and implementing a comprehensive plan as it relates to this topic. Definitions for Statements: ***Linkages***: Connections, either direct or abstract	systems (Nguyen & Bocsch, 2014; Parent, Roy, & St-Jacques, 2007; Senge, 1990; Shipley, 2016; Stroh & Zurcher, 2018; Wheatley, 1999). 4. I am able to construct a visual which includes key systems that should be present in an educational organization along with the abstract linkages that exist among those systems (Nguyen & Bocsch, 2014; Parent, Roy, & St-Jacques, 2007; Senge, 1990; Shipley, 2016; Stroh & Zurcher, 2018; Wheatley, 1999). 5. Upon identifying linkages between and among systems, I can define leading and lagging data points deriving from those linkages to gather and analyze trend data (Shipley, 2016; Stroh & Zurcher, 2018; Vineyard et al., 2018). 6. Determining the linkages which would yield the highest impact for continuous improvement would be identifiable for me as an educational leader (Shipley, 2016; Stroh & Zurcher, 2018; Vineyard et al., 2018). 7. I am able to explain the systematic processes that would be impacted by change to the identified linkages between and among systems in the organization (Richmond, 1994; Shipley, 2016; Vineyard et al., 2018; Wheatley, 1999). 8. I am able to create new processes or adapt current processes in order to ensure linkages are effectively serving the organization as a whole (Deming, 1994; Stave & Hopper, 2007; Stroh & Zurcher, 2018; Vare et al., 2019).

	9. I am able to communicate system linkages along with the processes that are impacted by the linkages to educators within the organization (Shipley, 2016; Stroh & Zurcher, 2018; Vineyard et al., 2018). 10. I am able to be a visible leader that serves to constantly support educators in realizing the interconnections between and among the systems of the organization (Fullan, 2005).
Awareness of the Culture Understanding the deep rooted culture of the organization and how that culture has the capacity to accept and change systems over time as it relates to both the systematic processes that live within systems and the linkages that emerge between systems throughout the organizational whole (Black & Gregerson, 2002; Espejo, 1994; Gruenert, 2000; Gruenert & Whitaker, 2015; Fullan, 2005; Schein, 2011; Schein, 1996; Wheatley, 1999). Participants will answer via a 5-point Likert scale of confidence level indicating; (1) Not at all confident, (2) Only slightly confident, (3) Somewhat confident, (4) Moderately confident, or (5) Very confident. Likert Scale Definitions: ***Not at all confident***: I do not have enough knowledge of this topic in order to plan for or lead implementation. ***Only slightly confident***: I have surface level knowledge of this topic, thus would need support in planning for and leading implementation. ***Somewhat confident***: I have knowledge of this topic and could develop an outline of a	1. When taking on a new leadership role, I would be able to observe the culture in order to determine the systems that already exist (Fullan, 2005; Gruenert, 2000; Gruenert & Whitaker, 2015; Schein, 2011; Wheatley, 1999). 2. When taking on a new leadership role, I would be able to observe the culture in order to identify the systematic processes that already exist between and among the systems (Fullan, 2005; Gruenert, 2000; Gruenert & Whitaker, 2015; Schein, 2011). 3. I am able to define characteristics which would indicate a competitive culture vs. characteristics of a collaborative culture (Gruenert & Whitaker, 2015). 4. I am able to analyze the culture of the organization in order to determine my actions as a positioned leader in the organization (Fullan, 2005; Gruenert & Whitaker, 2015; Schein, 2011). 5. I am able to view the culture of the organization as a foundational roadmap for determining actions to implement for continuous improvement (Black & Gregerson, 2002; Espejo, 1994; Fullan, 2005;

plan for implementation. I would need support in building upon the outline in order to create and implement a comprehensive plan as it relates to this topic. ***Moderately confident***: I have a strong working knowledge of this topic, thus could develop a comprehensive plan with the proper mentor to support effective implementation. ***Very confident***: I have a deep knowledge of this topic, thus could lead as a mentor in developing and implementing a comprehensive plan as it relates to this topic.	Gruenert, 2000; Gruenert & Whitaker, 2015; Schein, 2011; Wheatley, 1999). 6. Before instituting change in the organization, I can discuss the extent to which the people within the organization will accept the change with various stakeholders (Espejo, 1994; Gruenert, 2000; Gruenert & Whitaker, 2015; Schein, 2011; Schein, 1996). 7. I am able to converse about the ideology that school improvement action plans cannot be implemented in the same manner from one organization to the next organization (Black & Gregerson, 2002; Fullan, 2005; Schein, 2011; Wheatley, 1999). 8. I can forecast and plan for the reality that the systematic processes that I institute as a positional leader in the organization may look different when implemented due to the culture (Espejo, 1994; Fullan, 2005; Gruenert, 2000; Gruenert & Whitaker, 2015). 9. I am able to plan for the reality that the culture of the organization has the capacity to determine if system changes will be sustainable (Fullan, 2005; Wheatley, 1999). 10. In order to implement change in an organization, I am able to visually engage in the processes of change with every level of the organization (Black & Gregerson, 2008). 11. I am able to view culture as a system of its own with systematic processes that keep the current culture in place (Gruenert, personal communication, 2020).

	12. I am able to converse with peers about the ideology that changes to a system impacts the culture of an organization (Fullan, 2005; Fullan, 2006; Schein, 1996; Wheatley, 1999). 13. I can rationalize with peers that the appearance of disorder in an organization is not always an indicator of ineffectiveness (Schein, 1996; Wheatley, 1999).
Systemic Thinking The ability to view both the systematic processes inside of systems, along with the linkages between systems in an organization, in order to make high impact decisions that will be sustainable through the knowledge of the organizational culture (Ackoff, 1994; Arnold & Wade, 2015; Deming, 1994; Forrester, 2009; Fullan, 2005; Fullan, 2006; Gruenert, 2000; Gruenert & Whitaker, 2015; Holzman, 1993; Palaima & Skarzauskiene, 2010; Richmond, 1994; Shipley, 2016; Stave & Hopper, 2007; Stroh & Zurcher, 2018; Vineyard et al., 2018; Wheatley, 1999). Participants will answer via a 5-point Likert scale of confidence level indicating; (1) Not at all confident, (2) Only slightly confident, (3) Somewhat confident, (4) Moderately confident, or (5) Very confident. Likert Scale Definitions: ***Not at all confident***: I do not have enough knowledge of this topic in order to plan for or lead implementation. ***Only slightly confident***: I have surface level knowledge of this topic, thus would need support in planning for and leading implementation.	1. I am able to identify people within the organization that would best lead and drive actions that require changes to multiple parts of the larger system (Fullan, 2006; Gruenert & Whitaker, 2015; Stave & Hopper, 2007). 2. I know when to push the organization forward into new initiatives and when to allow the organization to maintain function in its current state (Deming, 1994; Forrester, 2009; Gruenert, 2000; Gruenert & Whitaker, 2015; Richmond, 1994). 3. I am able to engage in an inquiry cycle with multiple stakeholder groups to ensure the organization's strategic plan is dynamic and relevant to the culture's readiness level to accept changes (Fullan, 2006; Gruenert & Whitaker, 2015; Richmond, 1994; Stave & Hopper, 2007; Stroh & Zurcher, 2018). 4. I am able to categorize which problems are in need of systematic solutions and which problems are in need of systemic solutions in the organization (Ackoff, 1994; Richmond, 1994; Shipley, 2016; Stroh & Zurcher, 2018).

Somewhat confident: I have knowledge of this topic and could develop an outline of a plan for implementation. I would need support in building upon the outline in order to create and implement a comprehensive plan as it relates to this topic. ***Moderately confident***: I have a strong working knowledge of this topic, thus could develop a comprehensive plan with the proper mentor to support effective implementation. ***Very confident***: I have a deep knowledge of this topic, thus could lead as a mentor in developing and implementing a comprehensive plan as it relates to this topic. Definitions for Statements ***Capacity***: "Any strategy that increases collective effectiveness of a group to raise the bar and close the gap of student learning" (Fullan, 2006, p. 9).	5. I am able to transfer theory to action in a manner that builds the collective capacity of the organization (Deming, 1994; Fullan, 2006; Richmond, 1994; Stave & Hopper, 2007). 6. I am able to intentionally build individual's capacity of systems thinking in an organization (Forrester, 2009; Fullan, 2006; Richmond, 1994; Stroh & Zurcher, 2018). 7. I am able to intentionally build the capacity of other leaders to think and act systemically (Fullan, 2006; Richmond, 1994; Stroh & Zurcher, 2018). 8. I am able to find value in collaborating with other educational organizations in my geographical location for a common goal (Fullan, 2006; Vineyard et al., 2018). 9. I am able to identify the factors inside and outside of the organization for consideration when change is needed (Ackoff, 1994; Fullan, 2006; Gruenert & Whitaker, 2015; Richmond, 1994; Wheatley, 1999).

APPENDIX C: CONSENT FOR RESEARCH STUDY LETTER TO PARTICIPANTS

December 2020

Dear Organizational Leader,

You are invited to participate in a research study addressing systems thinking in organizational leaders serving in the education sector. This study is being conducted by Erin Stalbaum as a part of a doctoral dissertation with Dr. Steve Gruenert serving as a faculty sponsor from the Department of Educational Leadership at Indiana State University. Current educational leaders are invited to participate in completing the survey. By participating in this survey, I will be afforded the opportunity to determine the domains of systemic leadership that should be considered for the development of an instrument to measure systems thinking.

The study will not require your name or personal identification, and your answers will be kept in a secure, password-protected file that is only accessible to the researcher and the faculty sponsor. Due to the nature of an Internet survey, we cannot guarantee anonymity; thus, all responses received will be reported only as group data for this study.

Your participation in this research is voluntary. There is no penalty for not participating in the survey, and your risk of involvement is not greater than minimal risk. If you proceed with the research study, you will not be able to withdrawal your submission from the data collected as data is non-identifiable by name. The survey will take approximately 10-15 minutes to complete.

If you have any questions about this research study, please contact me at estalbaum@sycamores.indstate.edu or Dissertation Chairperson, Dr. Steve Gruenert, by email at Steve.Gruenert@indstate.edu. If you have any questions about your rights as a research subject, you may contact the Indiana State University Institutional Review Board (IRB) by mail at 114 Erickson Hall, Terre Haute, IN 47809, or by phone at 812-237-3088, or by email at irb@indstate.edu.

Thank you for agreeing to participate in this research study by clicking on the link to complete the survey.
The Continuum of Systems Thinking Survey

Respectfully,
Erin Elizabeth Stalbaum
Doctoral Candidate
Bayh College of Education
Indiana State University

APPENDIX D: EMAIL FOR PARTICIPANT CONTACT INFORMATION

December 11, 2020

Dear (Dr. J.T. Coopman, Dr. Bess, IDOE Public Records Request),

As a Doctoral Candidate from the Educational Leadership Department at Indiana State University under the faculty sponsorship of Dr. Steve Gruenert, I am inviting participants via email to engage in a research study addressing the ability to identify the level of systems thinking in organizational leaders serving in the education sector. As such, I am contacting your organization to gather the email addresses of superintendents, assistant superintendents, organizational directors, and principals currently serving in Indiana districts. I appreciate your support for this dissertation study and look forward to sharing the results at the conclusion of the study. If you have any questions or wish to converse further about the study's intent, please contact either Dr. Steve Gruenert at Steve.Gruenert@indstate.edu or Erin Stalbaum at estalbaum@sycamores.indstate.edu.

Respectfully,
Erin Elizabeth Stalbaum
Doctoral Candidate
Bayh College of Education
Indiana State University

APPENDIX E: DESCRIPTIVE STATISTICS FOR EXPLORATORY FACTOR ANALYSIS

Coded Item	Mean	Standard Deviation	N
CIAE	11.18	.816	184
CAS	10.99	.884	184
CCS	10/90	.888	184
SOC	11.10	.863	184
COMCUR	11.08	.838	183
JAFC	10.96	.931	183
DATA	10.67	.988	183
SPDA	10.68	.988	183
QQD	4.07	.819	183
ICDM	10.78	.994	183
IDEO	10.95	.915	182
OOSI	11.09	.836	182
SIP	11.05	.953	183
FISD	11.51	.700	185
IOCS	10.98	.899	183
IOAS	11.02	.941	185
FC	11.01	.978	185
EDDA	11.25	.748	185
DPD	10.88	.851	185
DNO	10.77	.964	182
LPDE	10.90	.927	185
LPDL	3.90	.953	185
PLC	11.05	.905	185
COLL	11.21	.885	185
FED	10.37	1.081	185
STATE	10.70	1.034	185
LELA	10.37	1.078	178
DPO	10.93	.855	179
SI	11.38	.712	179
5Y	9.98	1.380	178
CMS	9.94	1.289	177
RCA	10.43	1.158	178
TRI	10.89	1.084	179
ANA	10.96	.879	179

Coded Item	Mean	Standard Deviation	N
SYS	10.61	1.031	176
FORE	10.86	.881	178
TRE	11.16	.770	177
SPDQ	10.96	.885	178
MORG	11.23	.835	178
DASS	10.65	1.014	171
SSOT	10.64	1.014	172
DYNA	10.73	1.049	172
2WAY	10.99	1.032	172
SUCC	10.62	1.093	172
MACC	11.11	.921	172
STRA	11.16	.947	172
CICA	11.27	.851	172
CLS	11.64	.638	171
NEWC	11.55	.751	172
T2P	11.35	.815	171
T2A	11.22	.793	171
DPFR	11.40	.706	173
P2P	11/06	.833	173
CURO	11.04	.806	164
PRO	10.95	.851	166
CLJ	11.33	.742	166
SYST	10.78	.981	166
MMO	11.10	.843	165
FOR	11.05	.912	165
CU2A	11.16	.838	166
DTPC	10.85	.905	166
VIS	10.46	1.019	166
VIS1	10.28	1.031	166
VISA	10.18	1.117	165
WPO	11.01	.940	165
FAC	11.07	.798	166
CSBA	11.27	.801	164
LINK	10.91	.868	165
LELAL	10.66	1.000	164
CHA	10.64	1.000	165
POLE	10.87	.880	165
STAK	11.10	.746	165
EFF	10.87	.894	164

Coded Item	Mean	Standard Deviation	N
IMP	10.76	.966	164
REAL	11.02	.841	165
SUPP	11.21	.839	165
COCU	11.12	.882	165
DRIV	11.36	.757	165
DISO	11.01	.887	165
ICEL	11.02	.853	163
CAP	10.94	.819	164
T2AC	10.91	.896	164
TASY	11.04	.850	164

APPENDIX F: STATEMENT ITEMS AS CODES FOR EFA

Factor	Item as Statement	Item as Code
1	When building a strategic plan, I am able to deconstruct and analyze the systems as silos in the organization.	DASS
1	I am able to build a succession plan for leaders in an organization in order to avoid "discontinuity in direction" of the organizational goals.	SUCC
1	I am able to view the culture of the organization as a foundational roadmap for determining action to implement for continuous improvement.	CURO
1	I can collect targeted data both formally and informally of the effectiveness of processes in the organization from the people who are charged with carrying them out daily.	PRO
1	I can engage with all levels of stakeholders in continuous learning journeys.	CLJ
1	I am able to converse about the ideology that the knowledge of systematic processes in an organization is a prerequisite for systemic thinking.	SYST
1	My mental model of the systems in an organization and their interconnections is able to constantly evolve based on new learning.	MMO
1	I know when to push the organization forward into new initiatives and when to allow the organization to maintain function in its current state.	FOR
1	I am able to analyze the culture of the organization in order to determine my actions as a positioned leader in the organization.	CU2A
1	I can identify indicators to gauge the level of deep thinking present in a professional collaboration.	DTPC
1	I am able to construct a visual which displays the key systems that should be present in an educational organization as silos.	VIS

Factor	Item as Statement	Item as Code
1	I understand the difference between the whole of the organization and the parts within the organization and can detail their relationship to a colleague.	WPO
1	I am able to identify the factors inside and outside of the organization for consideration when change is needed.	FAC
1	When taking on a new leadership role, I would be able to observe the culture in order to determine the systematic processes that exist between and among systems.	CSBA
1	Determining the linkages which would yield the highest impact for continuous improvement would be identifiable for me as an educational leader.	LINK
1	Upon identifying linkages between and among systems, I can define leading and lagging data points deriving from those linkages to gather and analyze trend data.	LELAL
1	I am able to explain the systematic processes that would be impacted by change to the identified linkages between and among systems in the organization.	CHA
1	I can forecast and plan for the reality that the systematic processes that I institute as a positional leader in the organization may look different when implemented due to the culture.	POLE
1	Before instituting change in the organization, I can discuss the extent to which the people within the organization will accept the change with various stakeholders.	STAK
1	I am able to create new processes or adapt current processes in order to ensure linkages are effectively serving the organization as a whole.	EFF
1	I am able to communicate system linkages along with the processes that are impacted by the linkages to educators within the organization.	IMP
1	I am able to plan for the reality that the culture of the organization has the ability to determine if system changes will be sustainable.	REAL
1	I am able to be a visible leader that serves to constantly support educators in realizing the interconnections between and among the systems of the organization.	SUPP

Factor	Item as Statement	Item as Code
1	I am able to define characteristics which would indicate a competitive culture vs. characteristics of a collaborative culture.	COCU
1	I am able to identify people within the organization who would best lead and drive actions that require changes to multiple parts of the larger system.	DRIV
1	I can rationalize with peers that the appearance of disorder in an organization is not always an indicator of ineffectiveness.	DISO
1	In order to implement change in an organization, I am able to visually engage in the processes of change with every level of the organization.	ICEL
1	I am able to intentionally build individual's capacity of systems thinking in an organization.	CAP
1	I am able to transfer theory to action in a manner that builds the collective capacity of the organization.	T2AC
1	I am able to intentionally build the capacity of other leaders to think and act systemically.	TASY
2	I am able to create a job aid or flow chart which explains an effective assessment system.	JAFC
2	I can create a structure to organize a vast amount of data on a common data dashboard.	DATA
2	I am able to provide a list of characteristics for a structured process of data analysis.	SPDA
2	I am able to collect and analyze quantitative and qualitative data when creating continuous improvement goals.	QQD
2	I can identify the current amount of educational data present in my organization.	EDDA
2	I can use data in order to predict outcomes.	DPO
2	When analyzing data, I am able to identify areas of strength and areas in need of improvement.	SI
2	I am able to triangulate data to make fact-based decisions.	TRI
2	I can forecast needs based on data analysis.	FORE
2	I can analyze trend data before making decisions.	TRE

Factor	Item as Statement	Item as Code
3	I am able to publicly admit when I need to learn more about a theory or topic.	CLS
3	As a leader, I am able to learn new content related to continuous improvement in my field.	NEWC
3	I am able to engage in tasks at all levels of the organization in order to learn how the processes are implemented from theory to practice.	T2P
3	I am able to analyze more than one data point before providing input or feedback to a request or observation.	DPFR
4	I am able to list the current systems for curriculum, instruction, assessment, and environment present in my educational environment.	CIAE
4	I am able to view culture as a system of its own with systematic processes that keep the current culture in place.	CAS
4	I am able to identify the core characteristics that make up the structure of a system.	CCS
4	When taking on a new leadership role, I would be able to observe the culture in order to determine the systems that already exist.	SOC
4	I am able to converse with peers about the ideology that changes to a system impacts the culture of an organization.	IDEO
5	I can detail the differences between formative, interim, and summative data.	FISD
5	I am able to identify the inputs and outputs of a curriculum system.	IOCS
5	I am able to identify the inputs and outputs of an assessment system.	IOAS
5	I am able to explain a feedback cycle and its implications on the system.	FC
N/A	I can lead a team through the five-why strategy when determining the root cause of a problem.	5Y
N/A	I can lead a team through the cause mapping strategy when determining the root cause of a problem.	CMS
N/A	When a complex problem is evident, I am able to lead a root cause analysis in order to determine a solution.	RCA
N/A	I am able to verbalize the core components of an evidence-based lesson plan design.	LPDE

Factor	Item as Statement	Item as Code
N/A	I am able to verbalize the core components of an evidence-based lesson plan delivery.	LPDL
N/A	I understand the Federal accountability model in education enough to explain it to a peer.	FED
N/A	I understand the State accountability model in education enough to explain it to a peer.	STATE
N/A	I am able to find value in collaborating with other educational organizations in my geographical location for a common goal.	COLL
N/A	I am able to explain the components that build a comprehensive curriculum.	COMCUR
N/A	I am able to create and help others understand outcome-oriented school improvement goals for the district, building, and teacher level.	OOSI
N/A	I am able to detail how each data point in my educational organization informs decisions.	DPD
N/A	I am able to use data to analyze the process by which numerical outcomes derive.	DNO
N/A	I am able to create a structure in which to hold high quality professional learning collaborations.	PLC
N/A	When problems occur in an organization, I am able to analyze the system for ineffectiveness.	ANA
N/A	I am able to categorize which problems are in need of systematic solutions and which problems are in need of systemic solutions in the organization.	SYS
N/A	I can identify data to inform a strategic plan that includes both quantitative and qualitative measures.	SPDQ
N/A	I can identify members at all levels of the organization who would be impactful when building a strategic plan.	MORG
N/A	I can build systems in which two-way communication is present for strategic planning.	2WAY
N/A	I have the mental agility to course correct if a strategic plan's data is proving to be unsuccessful.	MACC
N/A	I can speak to the ideology that a strategic plan alone is not enough to improve an organization.	STRA
N/A	As a leader, I am able to formulate theories to implement into action based on knowledge gained through continuous learning.	T2A

Factor	Item as Statement	Item as Code
N/A	I am able to construct a visual which includes key systems that should be present in an educational organization along with the defined one-on-one linkages that exist between those systems.	VIS1
N/A	I am able to construct a visual which includes key systems that should be present in an educational organization along with the abstract linkages that exist between those systems.	VISA
N/A	When building a strategic plan, I am able to synthesize the systems in an organization to identify trends between and among systems.	SSOT
N/A	I am able to engage in an inquiry cycle with multiple stakeholder groups to ensure the organization's strategic plan is dynamic and relevant to the culture's readiness level to accept changes.	DYNA
N/A	I can intentionally create structures in the organization in which peers learn from one another, no matter their hierarchical position.	P2P
N/A	I can currently identify and track leading indicator data that correlates to lagging indicator data points and goals.	LELA
N/A	I am able to describe an inquiry cycle that can be utilized to determine decision making.	ICDM
N/A	I am able to converse about the ideology that school improvement action plans cannot be implemented in the same manner from one organization to the next organization.	SIP
N/A	I am able to lead with actions that demonstrate the belief that a strategic plan is not an event, but a continuous improvement cycle.	CICA

APPENDIX G: CONTINUUM OF SYSTEMS THINKING (COST) SURVEY

Participants will indicate a confidence level of each statement utilizing the following definitions:
NC: Not at all confident: I do not have enough knowledge of this topic in order to plan for or lead implementation.
OSC: Only slightly confident: I have surface level knowledge of this topic, thus would need support in planning for and leading implementation.
SC: Somewhat confident: I have knowledge of this topic and could develop an outline of a plan for implementation. I would need support in building upon the outline in order to create and implement a comprehensive plan as it relates to this topic.
MC: Moderately confident: I have a strong working knowledge of this topic, thus could develop a comprehensive plan with the proper mentor to support effective implementation.
VC: Very confident: I have a deep knowledge of this topic, thus could lead as a mentor in developing and implementing a comprehensive plan as it relates to this topic.

Operational definitions for terms utilized in the COST survey are as follow:
Linkages: Connections, either direct or abstract
Capacity: An increase in the collective effectiveness of a group

Statement	Not at all Confident	Only Slightly Confident	Somewhat Confident	Moderately Confident	Very Confident
I am able to identify the core characteristics that make up the structure of a system.	NC	OSC	SC	MC	VC
I can use data in order to predict outcomes.	NC	OSC	SC	MC	VC

Statement	Not at all Confident	Only Slightly Confident	Somewhat Confident	Moderately Confident	Very Confident
When building a strategic plan, I am able to deconstruct and analyze the systems as silos in the organization.	NC	OSC	SC	MC	VC
I am able to engage in tasks at all levels of the organization in order to learn how the processes are implemented from theory to practice.	NC	OSC	SC	MC	VC
I am able to intentionally build individual's capacity of systems thinking in an organization.	NC	OSC	SC	MC	VC
I am able to publicly admit when I need to learn more about a theory or topic.	NC	OSC	SC	MC	VC
I am able to create new processes or adapt current processes in order to ensure linkages are effectively serving the organization as a whole.	NC	OSC	SC	MC	VC
I can rationalize with peers that the appearance of disorder in an organization is not always an indicator of ineffectiveness.	NC	OSC	SC	MC	VC
I understand the difference between the whole of the organization and the parts within the organization and can detail their relationship to a colleague.	NC	OSC	SC	MC	VC
I am able to identify the inputs and outputs of a curriculum system.	NC	OSC	SC	MC	VC

Statement	Not at all Confident	Only Slightly Confident	Somewhat Confident	Moderately Confident	Very Confident
I am able to build a succession plan for leaders in an organization in order to avoid "discontinuity in direction" of the organizational goals.	NC	OSC	SC	MC	VC
I can forecast needs based on data analysis.	NC	OSC	SC	MC	VC
My mental model of the systems in an organization and their interconnections is able to constantly evolve based on new learning.	NC	OSC	SC	MC	VC
I am able to explain a feedback cycle and its implications on the system.	NC	OSC	SC	MC	VC
Determining the linkages which would yield the highest impact for continuous improvement would be identifiable for me as an educational leader.	NC	OSC	SC	MC	VC
I am able to create a job aid or flow chart which explains an effective assessment system.	NC	OSC	SC	MC	VC
I am able to identify people within the organization who would best lead and drive actions that require changes to multiple parts of the larger system.	NC	OSC	SC	MC	VC
I am able to converse with peers about the ideology that changes to a system impacts the culture of an organization.	NC	OSC	SC	MC	VC

Statement	Not at all Confident	Only Slightly Confident	Somewhat Confident	Moderately Confident	Very Confident
I am able to view the culture of the organization as a foundational roadmap for determining action to implement for continuous improvement.	NC	OSC	SC	MC	VC
I am able to collect and analyze quantitative and qualitative data when creating continuous improvement goals.	NC	OSC	SC	MC	VC
I am able to identify the inputs and outputs of an assessment system.	NC	OSC	SC	MC	VC
I am able to explain the systematic processes that would be impacted by change to the identified linkages between and among systems in the organization.	NC	OSC	SC	MC	VC
I can identify the current amount of educational data present in my organization.	NC	OSC	SC	MC	VC
I can collect targeted data both formally and informally of the effectiveness of processes in the organization from the people who are charged with carrying them out daily.	NC	OSC	SC	MC	VC
I can detail the differences between formative, interim, and summative data.	NC	OSC	SC	MC	VC
I am able to analyze the culture of the organization in order to determine my actions as a positioned leader in the organization.	NC	OSC	SC	MC	VC

Statement	Not at all Confident	Only Slightly Confident	Somewhat Confident	Moderately Confident	Very Confident
I am able to list the current systems for curriculum, instruction, assessment, and environment present in my educational environment.	NC	OSC	SC	MC	VC
I can create a structure to organize a vast amount of data on a common data dashboard.	NC	OSC	SC	MC	VC
When taking on a new leadership role, I would be able to observe the culture in order to determine the systems that already exist.	NC	OSC	SC	MC	VC
I can engage with all levels of stakeholders in continuous learning journeys.	NC	OSC	SC	MC	VC
In order to implement change in an organization, I am able to visually engage in the processes of change with every level of the organization.	NC	OSC	SC	MC	VC
I can identify indicators to gauge the level of deep thinking present in a professional collaboration.	NC	OSC	SC	MC	VC
I am able to view culture as a system of its own with systematic processes that keep the current culture in place.	NC	OSC	SC	MC	VC
I am able to converse about the ideology that the knowledge of systematic processes in an organization is a prerequisite for systemic thinking.	NC	OSC	SC	MC	VC
I am able to triangulate data to make fact-based decisions.	NC	OSC	SC	MC	VC

Statement	Not at all Confident	Only Slightly Confident	Somewhat Confident	Moderately Confident	Very Confident
When taking on a new leadership role, I would be able to observe the culture in order to determine the systematic processes that exist between and among systems.	NC	OSC	SC	MC	VC
When analyzing data, I am able to identify areas of strength and areas in need of improvement.	NC	OSC	SC	MC	VC
I can forecast and plan for the reality that the systematic processes that I institute as a positional leader in the organization may look different when implemented due to the culture.	NC	OSC	SC	MC	VC
As a leader, I am able to learn new content related to continuous improvement in my field.	NC	OSC	SC	MC	VC
I am able to construct a visual which displays the key systems that should be present in an educational organization as silos.	NC	OSC	SC	MC	VC
I am able to identify the factors inside and outside of the organization for consideration when change is needed.	NC	OSC	SC	MC	VC
I am able to analyze more than one data point before providing input or feedback to a request or observation.	NC	OSC	SC	MC	VC

Statement	Not at all Confident	Only Slightly Confident	Somewhat Confident	Moderately Confident	Very Confident
I know when to push the organization forward into new initiatives and when to allow the organization to maintain function in its current state.	NC	OSC	SC	MC	VC
I can analyze trend data before making decisions.	NC	OSC	SC	MC	VC
I am able to define characteristics which would indicate a competitive culture vs. characteristics of a collaborative culture.	NC	OSC	SC	MC	VC
Upon identifying linkages between and among systems, I can define leading and lagging data points deriving from those linkages to gather and analyze trend data.	NC	OSC	SC	MC	VC
I am able to provide a list of characteristics for a structured process of data analysis.	NC	OSC	SC	MC	VC
I am able to communicate system linkages along with the processes that are impacted by the linkages to educators within the organization.	NC	OSC	SC	MC	VC
I am able to intentionally build the capacity of other leaders to think and act systemically.	NC	OSC	SC	MC	VC
I am able to plan for the reality that the culture of the organization has the ability to determine if system changes will be sustainable.	NC	OSC	SC	MC	VC

Statement	Not at all Confident	Only Slightly Confident	Somewhat Confident	Moderately Confident	Very Confident
I am able to transfer theory to action in a manner that builds the collective capacity of the organization.	NC	OSC	SC	MC	VC
I am able to be a visible leader that serves to constantly support educators in realizing the interconnections between and among the systems of the organization.	NC	OSC	SC	MC	VC
Before instituting change in the organization, I can discuss the extent to which the people within the organization will accept the change with various stakeholders.	NC	OSC	SC	MC	VC