ABSTRACT

JOHNSON, ERIC. Exploring Possible Links between Professional Learning Communities and Complex Adaptive Systems. (Under the direction of Dr. Paul Bitting.)

Implementation of Professional Learning Communities (PLC), as described by DuFour (2006), has depended upon a balance between teacher buy-in and administrative fiat. The tension between the “bottom-up” character of the former and the “top-down” character of the latter presents a leadership challenge: meeting students’ learning needs requires decentralized, shared decision-making on the part of the teachers who work directly with individual students, while those same teachers are subordinates in a hierarchy that centralizes authority at the top of the organization chart. PLC literature lacked a theoretical model that reconciled these seemingly disparate roles. The Literature Review introduced Complex Adaptive Systems (CAS) modeling, and noted some prima facie similarities between Professional Learning Communities and Complex Adaptive Systems. The study’s central purpose was to explore whether those similarities, those links, were strong enough to conclude that Professional Learning Communities are a form of Complex Adaptive Systems. The study systematically analyzed the terms and concepts used to introduce DuFour’s PLC model, and the terms and concepts used to explain Complex Adaptive Systems by Holland (1992), Gell-Mann (1994) and others. The terms from both domains were then systematically compared. The study concluded that Professional Learning Communities are indeed a form of Complex Adaptive Systems, though with a caveat: they are a form of Complex Adaptive Systems when they function as Complex Adaptive Systems. This is to say that a Professional Learning Community, as described by DuFour, is optimally implemented and functioning when it is behaving as a Complex Adaptive System, focusing on simple “rules” (i.e., PLC Essential Questions) on the local level that yield unified behavior on the global level. The
leadership implications of these findings indicated that a focus on the Essential Questions, and not “PLC formation,” would be the most effective practice for PLC leadership, and that teacher buy-in could be enhanced if Professional Learning Communities are viewed as belonging to a larger class of activities that are observed in other fields, some of which are described in the study. Implications for further study include using CAS modeling as a means of determining the degree to which Professional Learning Communities are being implemented, and having CAS modeling serve as the basis for a conceptual framework for PLC implementation.
© Copyright 2013 by Eric Johnson
All Rights Reserved
Exploring Possible Links between Professional Learning Communities and Complex Adaptive Systems

by

Eric Johnson

A dissertation submitted to the Graduate Faculty of North Carolina State University in partial fulfillment of the requirements for the degree of Doctor of Education

Educational Administration and Supervision

Raleigh, North Carolina

2013

APPROVED BY:

Dr. Paul Bitting
Committee Chair

Dr. Peter Hessling

Dr. Kenneth Brinson

Dr. Lisa Bass
DEDICATION

For their patience, and their faith in its completion, this work is dedicated to my wife Maria, and my daughters Isabel and Camille.
BIOGRAPHY

Eric Johnson’s first professional experiences included work as a tennis instructor and serving in a variety of roles within the adolescent units of locked, state-run psychiatric facilities. His public school administrative experiences have taken place in two of North Carolina’s largest school districts, where he has educated elementary and middle school students. His own educational background includes a Bachelor’s degree in Psychology from Guilford College in Greensboro, NC, a Master’s degree in Literature from North Carolina State University, and Master’s and Doctoral degrees from North Carolina State University in Education Leadership.
ACKNOWLEDGMENTS

Over the course of completing this work, I received encouragement from too many people to fairly mention here; however, I would like to acknowledge the particular support provided by my Committee Chair Dr. Paul Bitting. From its inception, this project faced challenges that would have been difficult, if not impossible, to overcome without his invaluable support.

Thank you, Paul.
TABLE OF CONTENTS

LIST OF FIGURES .................................................................................................................. vii

CHAPTER 1: Exploring Possible Links between Professional Learning Communities and Complex Adaptive Systems ................................................................. 1
  Professional Learning Communities and Responding to Students’ Needs .................. 3
  Statement of the Problem ................................................................................................. 6
  Organization of This Study .............................................................................................. 9
  Summary .......................................................................................................................... 10
  Definitions ...................................................................................................................... 11

CHAPTER 2: Methodology .................................................................................................. 12
  Design of Study ............................................................................................................... 12
  Potential Significance ..................................................................................................... 14
  Framework and General Research Questions ................................................................ 16
  Design and Methodology: Overall Approach and Rationale ......................................... 17
  Data gathering ................................................................................................................ 17
  Validity and reliability. ..................................................................................................... 18
  Researcher bias and assumptions .................................................................................. 18
  Personal biography ......................................................................................................... 22
  Ethics and political considerations ............................................................................... 25
  Methodology Summary ................................................................................................. 26

CHAPTER 3: Professional Learning Communities ................................................................ 27
  Historical and Theoretical Context of Professional Learning Communities ............ 31
  The relations of the accountability movement and Professional Learning Communities . 37
  Professional Learning Communities: “bottom-up” vs. “top-down” ......................... 41
  Schools as Organizations ............................................................................................. 43
  Gap in the Literature ...................................................................................................... 49
  Summary of PLC Literature .......................................................................................... 50

CHAPTER 4: Complex Adaptive Systems ........................................................................... 55
  The Edge of Chaos ........................................................................................................... 56
  Implications for Leadership ............................................................................................ 56
  Open Systems .................................................................................................................. 58
  Self-organization .......................................................................................................... 59
  Synergism ....................................................................................................................... 60
  CAS Modeling ............................................................................................................... 61
  Self-organization through self-feedback ....................................................................... 63
  Gap in the Literature ...................................................................................................... 67
  Summary of CAS Literature .......................................................................................... 67
LIST OF FIGURES

Figure 1: Student-teacher interactions in a professional learning community ..................40
Figure 2: Senge’s model of organizational learning .........................................................48
Figure 3: Holland’s model of complex adaptive systems ....................................................52
Figure 4: Gell-Mann schema for complex adaptive systems’ development in nature.........75
Figure 5: Chart comparing basic terms of PLC and CAS ..................................................88
CHAPTER 1: Exploring Possible Links between Professional Learning Communities and Complex Adaptive Systems

The term “Professional Learning Community” (PLC) has become so ubiquitous in North Carolina education that it is no longer capitalized as a proper noun in the statewide teacher evaluation instrument. A central theme of this instrument is the degree to which teachers apply knowledge gleaned from their Professional Learning Communities to guide their instructional practices. Despite the extensive effort that has been invested in the dissemination and implementation of Professional Learning Communities, it has been pointed out that they still suffer from flawed implementation. DuFour (2004), a primary architect of the PLC concept in schools, says that the term is “in vogue, [has come to describe] every imaginable combination of individuals with an interest in education [and has fallen in danger] of losing all meaning” (p. 6).

Given the prominence of Professional Learning Communities in the dialogue surrounding educational leadership, this difficulty in connecting theory to action represents a problem worthy of closer examination. As this study will indicate, part of the problem in making this connection is the lack of an established or identified conceptual framework for the DuFour PLC practices. A wealth of literature describes the reasons Professional Learning Communities are good for schools and the ways in which they may be implemented (Clauset, 2008; DuFour, 2004; Hord & Sommers, 2008; Vescio, 2008); however, it is more difficult to find a body of literature that describes the mechanisms by which Professional Learning Communities actually operate within schools, or how an understanding of those mechanisms
may provide a basis for better understanding Professional Learning Communities overall.

The PLC concept lacks an identified framework to connect it to anything other than itself: the literature (DuFour & Eaker, 1998; Hord & Sommers, 2008; Mullen, 2010; Stoll, 2006) essentially points to instances where PLC implementation was concurrent with increases in school performance with scant specific connection between the PLC behaviors on the part of school personnel and improvements in student performance.

It should be pointed out that there are aspects of PLC practices that have been identified as contributing positively to successful school practices. Teacher satisfaction has been shown to increase with the implementation of Professional Learning Communities (Ackerman, 2011; Martin, 2011), and the information-sharing that is part of PLC best practices also equips teachers with a greater variety of tools for addressing the increasingly complex demands of the modern public school classroom (Benceti, 2009; Bruce, Esmonde, Ross, Dookie, & Beatty, 2010; DiNardo, 2010). Attributing academic success to these factors carries intuitive appeal, and can be borne out by studies showing that increased teacher satisfaction and positive school culture positively affects student achievement.

What is missing from this literature, though, is an identified means for connecting PLC practices to phenomena other than themselves. If Professional Learning Communities in fact follow a theoretical model that also describes other, analogous types of organizational behavior, perhaps that model can be applied to Professional Learning Communities as well.

Complex Adaptive Systems (CAS) modeling has been used to explain unified group behavior in a group that lacks a centralized leader or decision-making agency (DeWolf &
Holvoet, 2004; Holland, 2006). Professional Learning Communities, with their responsiveness to individual students’ needs, represent organizational behavior that is driven by localized, as opposed to centralized, decision-making. For schools, decision-making occurs on a daily basis on the individual teacher level but is driven by the PLC framework for decision-making. As the totality of a school’s teaching staff responds to their localized conditions (their students’ learning needs), those decisions cumulatively comprise the totality of the school’s response to their students. A school’s success is not based upon a single leader’s decisions, but upon the myriad simultaneous, individual decisions made throughout the school.

While other school-based organizational concepts function under the aegis of “Professional Learning Communities” (e.g. Clauset, 2008), the PLC concept in North Carolina is based upon concepts developed by DuFour (2004) and Hord (Hord & Sommers, 2008). Significant training and education has been committed to explaining this means of focusing teachers’ energies upon student learning, a component of which is establishing “buy-in” amongst teachers. Strategies for creating this buy-in have been rooted in testimonials of PLC success and intuitive reasoning, but have not been linked to a specific process that functions outside of the Professional Learning Communities themselves.

Professional Learning Communities and Responding to Students’ Needs

One means by which schools have developed responsiveness to students’ needs is through the Professional Learning Communities model. This model, developed by a team of educators led by Richard DuFour of Chicago, can be summarized by the engagement of
teachers with three main questions: “What do we want students to learn? How do we know if they have learned it? How do we respond if students master/struggle with the material?” (DuFour & Eaker, 1998). These questions seem on their surface to be relatively straightforward. However, within these questions and the format within which they are addressed lie some critical assumptions that align with the changes in the ways in which teachers and schools are held accountable for their students’ performance.

In the Professional Learning Communities model, the teachers first meet in groups, typically organized by grade level, subject area, or any other parameter that logically allows them to compare data and observations about student learning. This is important, for it represents a shift from the teacher culture that was based on individual teachers performing their duties in relative isolation from one another. Under collective accountability frameworks, teachers’ effectiveness levels are equalized across classrooms: in order to be considered part of a successful team or school, each teacher must have a vested interest in their colleagues’ success, for their own success could be negated by a lower performing peer. In the model in which teachers operated in relative isolation from one another, an implicit competition between teachers was established: based on teacher performance, some classes were preferable to others.

The focus of the teacher groups then shifts from teachers’ teaching to students’ learning. The PLC groups function as forums in which teachers exchange ideas and methods that may be effective in expanding their students’ capacity to learn the given material. An underlying assumption of such practices is that two (or more) heads are better than one when
it comes to successfully differentiating instruction to meet the needs of all students, and coordinating a curriculum so that meaningful connections can be made between subjects.

As will be shown in greater detail in the Literature Review of this study, PLC methodologies, and strategies for disseminating them and managing them for school administrators, are plentiful. These methodologies and strategies come with testimonials from various professionals (DuFour & Eaker, 1998; Hord & Sommers, 2008; Mullen, 2010; Stoll, 2006) regarding the effectiveness of Professional Learning Communities when they have been implemented with fidelity to the design put forth by DuFour. However, a component of their literature is lacking. For all of the testimonials regarding PLC effectiveness, and for all of their intuitive appeal, they lack a theoretical framework for explaining what makes them work so well, or for connecting their effectiveness to other effective practices. As will be shown in Chapter 2, PLC leadership contains this gap, and thereby leaves unanswered some fundamental questions regarding the nature and role of educational leadership within such a model.

Shirley Hord (Hord & Sommers, 2008) also formulated PLC practices that have been incorporated into North Carolina teachers’ professional development. Attributes such as supportive and shared leadership, collective creativity, shared vision and values, supportive conditions, and shared personal practice are all identified by Hord and Sommers (2008) as characteristics of Professional Learning Communities.
Statement of the Problem

If this study establishes congruence between Professional Learning Communities and Complex Adaptive Systems, then it can be demonstrated why Professional Learning Communities may work, for they would belong to a larger class of phenomena occurring outside of schools. If Professional Learning Communities indeed belong to such a broader category, their implementation can be justified for reasons that include a pattern of teacher satisfaction and some correlation between PLC implementation and school success. The likelihood of teacher “buy-in” to Professional Learning Communities may be positively affected if the implementation is justified by the inclusion of Professional Learning Communities with other entities that have demonstrated adaptability to changing conditions while maintaining coherence and resilience over time. In short, such an internal framework may enhance the effectiveness of the implementation of Professional Learning Communities, and enhance their sustainability as well. Fusarelli (2002) indicated that the challenges of system reform provide obstacles to creating a coherent conceptualization of policies that adapt to change:

The knowledge of schools as loosely coupled organizations does not equip policymakers with the tools (or theories) necessary to craft coherent education policy. . . . As a result, researchers all too frequently ignore the multitude of coupling, both tight and loose, in organizational analysis – and how the nature of this coupling can change over time. (p. 565)
Exploring the connections between Professional Learning Communities and Complex Adaptive Systems is a potential means by which the apparent theoretical dissonance described by Fusarelli may be resolved through a focus on the microsystems that embody the interactions that take place as part of and as a result of Professional Learning Communities practices.

Without such an internal theoretical model, Professional Learning Communities essentially depend upon top-down, hierarchical decision-making for their implementation. A theoretical model for Professional Learning Communities would therefore not only be useful for developing concepts and strategies for leading PLC organizations, but could provide concepts and strategies for participating in them as well. In developing a theoretical framework that has equal utility on various levels of an organization, the seeming paradox of leading a “leaderless” organization may move a step closer to resolution.

Schools, like many other organizations, function in an environment of constant change, and they cannot depend solely upon formal, centralized organizational structures to provide the basis for their decision-making, as such structures change more slowly than the conditions they are designed to address. An organization’s leadership is reflected in that organization’s capacity to adapt to changing conditions. Jalongo (1991) pointed out that Professional Learning Communities represent a “new strategy” for implementing effective practices for student learning, and that teachers will need to engage in “collegial activities and joint professional efforts that have learning as their purpose” (p. 17). Hord (1997) goes on to say that “this strategy involves investing in teacher preparation and professional
development, as well as permitting greater autonomy and decision-making for teachers” (p. 13).

Teacher autonomy raises the question of the role of the principal in determining how a school responds to students’ needs. Carmichael (1982) questioned whether the role of the principal should be reconceptualized from that of “omnicompetence” to a position in which his or her competence is equivalent to everyone else's within the organization. Kleine-Kracht (1993) suggested that school administrators, along with teachers, be learners, “questioning, investigating, and seeking solutions…[where] there is no longer a hierarchy of who knows more than someone else, but rather a need for everyone to contribute.” (p. 393)

The kind of organization that Kleine-Kracht suggests decentralizes the organizational decision-making of a school, shifting its focus from the authority of the principal to all members of the staff. The question remains, then, of whose role it is to determine such critical features of an organization as its shared vision and values, or other nuts-and-bolts features such as fiscal and human resources decisions. From these ideas and the strategies suggested by Professional Learning Communities, a central question arises: How can the hierarchical, top-down nature of formal organizations be reconciled with the flattened organizational metaphors suggested by Hord, Carmichael, Kleine-Kracht, and DuFour?

The problem being addressed by this study is the basic conflict between the horizontal, non-hierarchical structure of PLC implementation as described in the current research, and the hierarchical nature of formal leadership. The PLC literature acknowledges the need for organizational balancing between hierarchical modes of leadership and less
hierarchical modes, but does not provide a theoretical framework for conceptualizing a reconciliation of those modes.

This study introduces Complex Adaptive Systems as a potential model for creating such a theoretical framework. However, such a framework is only applicable if Professional Learning Communities can be classified as Complex Adaptive Systems. The central question being addressed in this study, then, is, “Are Professional Learning Communities Complex Adaptive Systems?”

**Organization of This Study**

This study provides unique design challenges. Foremost is the placement and role of the Literature Review. In what might be called a “typical” research design, the literature is reviewed to establish a basis for a study: gaps in the literature are defined, previous research designs are examined, and a possible course of data-gathering action can, in part, be discovered within a Literature Review. In this study, however, the literature is the data, so the Literature Review, in part, becomes a review of its own material.

To accommodate the logical structure of the study, the order and role of the Literature Review will be modified. The Review will be split into the two domains under consideration, Professional Learning Communities and Complex Adaptive Systems. Those sections will serve as a review of the current literature in the respective areas, but will also serve as the “data” for further analysis in a subsequent chapter. The study will therefore follow this chapter progression: an Introduction, which will introduce the problem being addressed; Chapter 2, which outlines the methodology to be used in the study; Chapter 3, a Literature
Review that focuses on Professional Learning Communities, including their historical context; Chapter 4, a Literature Review that focuses on Complex Adaptive Systems, including descriptions of activities that can be included under their aegis; Chapter 5, which compares terms, concepts, and activities of Professional Learning Communities and Complex Adaptive Systems and draws conclusions regarding whether those terms, concepts, and activities can be considered parts of a continuum of similar phenomena; and Chapter 6, which discusses the implications of this study and its findings, particularly as they relate to PLC implementation and leadership within public schools.

**Summary**

PLC literature does not include a theoretical model for leading an organization that values the concept that all of its members are considered leaders. A traditional leadership model depends upon a hierarchical difference between an organization’s “leaders” and its “led.” A theoretical model for re-conceptualizing that difference would be a useful beginning for implementing a system that negates it. CAS modeling potentially provides a theoretical framework for Professional Learning Communities implementation that could address the conflict between hierarchical and non-hierarchical organizational structures. This study aspires to establish whether or not Professional Learning Communities can be classified as Complex Adaptive Systems. The following chapter will describe the methodology by which such a classification can be established.
Definitions

Professional Learning Community:

A PLC is composed of collaborative teams whose members work *interdependently* to achieve *common goals* linked to the purpose of learning for all . . . *collaboration* represents a systematic process in which teachers work together interdependently in order to *impact* their classroom practice in ways that will lead to better results for their students, for their team, and for their school. (DuFour, 1998)

Essential Questions of Professional Learning Communities:

“What do we want students to learn? How do we know if they have learned it? How do we respond if students master/struggle with the material?” (DuFour, 1998)

Complex Adaptive System:

A whole comprised of a large number of parts, each of which behaves according to some rule or force that relates it interactively to other parts. In responding in parallel to their own local contexts, the parts can, without explicit inter-part co-ordination or any one of them having a global view, cause the system as a whole to display emergent patterns at the global level – the emergence of orderly phenomena and properties of the whole that cannot be predicted from properties of parts. (Maguire, McKelvey, Mirabeau, and Oztas, 2006)
CHAPTER 2: Methodology

Design of Study

This research examines a gap in the literature related to leadership of Professional Learning Communities. Professional Learning Communities provide a significant body of anecdotal and intuitively appealing reasons for incorporating them into a school’s culture and practices and similarly anecdotal and appealing explanations for how such organizations may be led. However, these practices are not connected to a theoretical framework that may explain how PLC leadership “works.” Such a framework, if there were one applicable to PLC leadership, would connect PLC leadership to other organizational behaviors that occur under similar conditions requiring fine-grained, diverse responsiveness to change.

Making such a connection is important to PLC practices and may have wider implications for other educational leadership practices; it may form a basis for connecting PLC practices to other domains of group functioning. PLC leadership focuses on “buy-in” from staff (Fullan, 2000), and provides techniques for enhancing that process. In other words, that “buy-in” is based upon the recognition of Professional Learning Communities’ practices as they have already occurred in other locales and at other times, defining their future success by their past success (e.g., PLC practices will work because they have worked). Such an \textit{a posteriori} approach to establishing a communal commitment to Professional Learning Communities uses only Professional Learning Communities themselves as the basis for believing that they will work in any given location because of their success in other locations.
However, if it can be shown that Professional Learning Communities are similar to other entities that are working to achieve analogous objectives, then it may be possible to establish some more robust *a priori* bases for establishing Professional Learning Communities within a given organization. In such a case, it may be possible for school leadership not to depend solely upon a line of reasoning that implicitly posits that “Professional Learning Communities worked elsewhere, so they should work here,” but to reason more broadly that “Professional Learning Communities belong to a continuum of other social and natural systems that have achieved objectives similar to our own.” It is through such a connection that the “buy-in” aspect of establishing successful Professional Learning Communities may be enhanced, and may become a practice that has implications for other educational leadership practices that fall outside the scope of this study.

Kelle (2005) raised a valid concern for the role of the researcher in such a study, for it is possible that a researcher may impose too great a degree of subjective bias upon such work, “forcing” the categories into artificial relationships. This is a legitimate concern for this study, as it is based upon a set of assumptions that are intuitively appealing. However, it should be noted that for these connections to retain generalizable and research-based legitimacy, one must allow for the emergence of a theory as opposed to a “top-down theorization” (Kelle). By relying upon an “emergent” process as opposed to a “top-down” process, the study itself replicates the “emergent” processes that it describes. Marshall and Rossman (2006) provide a basis for designing a qualitative study using a theoretical lens format, with some additional design input from Creswell (2007).
By necessity, then, developing that underpinning depends upon data- and evidence-gathering that may “induce” a theory. This data will be comprised of primary PLC leadership literature as developed by Richard DuFour and Rebecca DuFour, and primary texts outlining the central tenets of Complex Adaptive Systems, as by Gell-Mann (1994), Holland (1992), Kauffman (1995), Prigogine and Stengers (1997), and others.

Potential Significance

This research is significant on its surface because few studies have used Complex Adaptive Systems as a model for school functioning, and to date none have examined Professional Learning Communities through this framework. The true significance, however, is that making the connection between Professional and CAS lays the groundwork for the creation of a theoretical model that is currently lacking in PLC implementation. Without such a model, Professional Learning Communities are being implemented on a limited theoretical framework of the effects that collaboration has on teacher effectiveness. Such a framework does not fully encompass the function of Professional Learning Communities, nor connect that functioning to the aspect of school climate that is critical to effective PLC implementation. By establishing congruence between Professional Learning Communities and CAS, it can be demonstrated why Professional Learning Communities may work, for they belong to a larger class of phenomena occurring outside of the PLC context, or even the context of schools as a whole.

The element of “buy-in” has become critical to PLC implementation. DuFour, DuFour, Eaker, and Many (2006) describe the importance of building consensus amongst
staff members: “Focusing on changing the culture is one of the most powerful strategies for converting people to the cause of improvement, because most people are powerfully influenced by the culture in which they work” (p. 173). It is recommended that PLC implementation incorporate three major elements: first, presentation of research-based evidence indicating that teachers work more effectively when they collaborate; second, presentation of anecdotal data indicating that Professional Learning Communities increase the effectiveness of districts and schools that adopt them; and third, having school personnel identify their needs, and then showing how the PLC model can help address those needs. These approaches are specifically based upon Gardner’s (2004) strategies for changing people’s thinking regarding PLC implementation, as DuFour et al. note:

1. Reason: Appealing to rational thinking and decision-making.
2. Research: Building shared knowledge of the research base supporting a position.
3. Resonance: Connecting to the person’s intuition so that the proposal “feels right.”
4. Representational Re-descriptions: Changing the way the information is presented (for example, using stories or analogies instead of data).
5. Resources and Reward: Providing people with incentives to embrace an idea.
6. Real-World Events: Presenting the real-world examples of where the idea has been applied successfully. (p. 173)
Of the strategies listed above, this study will be addressing Research, Resonance, Representational Re-descriptions, and Real-World Events in exploring the connections between Professional Learning Communities and CAS.

Another benefit of developing such a framework is that it equalizes the knowledge base across strata of a school’s hierarchy: it is equally and mutually beneficial for the teachers and administration of a school to understand Professional Learning Communities within the CAS framework. As such hierarchies tend to run counter to the “bottom-up” organization of CAS, and as teachers are considered leaders within their organization, it is important that the organization be provided the tools for conceptualizing such forms of distributed leadership. By providing a commonly-held theoretical framework, the unity of purpose inherent in Professional Learning Communities can be supported by a theoretical framework that anchors that unity to a model that is structurally simple yet open-ended in its outcomes. In other words, the model recapitulates the phenomenon it describes.

**Framework and General Research Questions**

The study will analyze PLC literature through the lens of CAS modeling. Analogical connections will be drawn between terms and concepts, and they will be presented within a textual format and with summarizing charts that will make the connections easier to visualize. The general research questions being explored are:

- In what ways are Professional Learning Communities, as explained in the literature, like Complex Adaptive Systems?
• Are those similarities strong enough to include Professional Learning Communities under the term “Complex Adaptive Systems”?

Beyond the actual research questions and the conclusions that can be drawn from them would be a discussion of the implications of the conceptual and practical utility of these findings, especially as they relate to leadership of schools that implement the PLC model.

**Design and Methodology: Overall Approach and Rationale**

The overall approach of this research will be to draw comparisons between PLC implementation and CAS theories. All of the analysis will be textual. The rationale for this approach is based upon the needs that the study addresses. From a textual standpoint, the Literature Review of both Complex Adaptive Systems and Professional Learning Communities demonstrates that a mutual gap exists between the two fields. This gap can be closed if it can be demonstrated that Professional Learning Communities are indeed manifestations of Complex Adaptive Systems.

**Data gathering.** The texts associated with Professional Learning Communities and Complex Adaptive Systems that will be analyzed in Chapters 3 and 4 will serve as the “raw data” for this study. The texts will form the basis for the connections between the theories, and the recommended practices of Professional Learning Communities will be those developed by DuFour (1998) that describe the practices referred to as “Professional Learning Communities.” While these practices may in fact resemble other similar educational or organizational practices referred to as “Professional Learning Communities,” this study will focus specifically upon the work of DuFour for the PLC model under discussion.
Validity and reliability. While the theory-building will take place according to the interrelated phases described in the sections above, other steps need to be taken to establish and maintain qualitative research validity and reliability (Glaser & Strauss, 1967; Strauss & Corbin, 1990): both construct validity, which is enhanced by establishing clearly specified operational procedures, and internal validity, which is enhanced by establishing causal relationships where certain conditions lead to other conditions. The internal validity of the study will depend upon the degree to which the processes of conceptualization, categorization and drawing propositions about the data can be determined to be “true” within this procedural framework.

The external validity of the study will be determined by the extent to which its finding could be generalized to a broader body of theory and professional practice. The reliability of the study will be dependent upon the degree to which the operations of the study, such as the data collection and analysis, can be repeated with the same results. A key component to creating a “formal, retrievable database” will be to follow a process of coding that will be conducive to such repeatability. Strauss and Corbin (1990) refer to it as “the operations by which data are broken down, conceptualized, and put back together in new ways. It is the central process by which theories are built from data.” (p. 57)

Researcher bias and assumptions. This study addresses a conceptual and practical problem: How can centralized leadership be reconciled with decentralized organizational functioning? This research proposes that a conceptual link potentially exists between PLC design and CAS theory. Due to its theoretical and propositional nature, such a proposal
reveals potential assumptions, and therefore biases, on the part of the researcher. Foremost of these is the bias toward finding an answer that is a part of the question. In other words, the reasoning behind the study is potentially circular and its proposal is moot, for it approaches the problem with a solution already formulated --- i.e., the connection already exists, or the study does not need to be pursued. This bias will be averted through a process of self-reflection and self-revelation that would lay bare potential biases, as another “data-source” that would offset the tautological, self-fulfilling prophecy concern that may be raised with such a study, regardless of its findings. Every effort, therefore, will be made to infuse this awareness in the data collection, analysis and findings of the study.

The purpose of the study, and its design, should also be revisited in light of this question. As I noted, I have been implementing Professional Learning Communities for the past five years, and they have been in circulation for longer than that. Similarly, CAS have a history that may be traced further back. This study provides a connection between the two that may serve as a springboard for future conceptualization of PLC implementation specifically, and for more responsive educational leadership generally. The nature of the study, however, is retrospective --- considering what has already been done, and what has already been thought in two heretofore-separate domains. Therefore, the nature of the study is one more of systematic discovery of pre-existing connections than of the demonstration of a hypothesis that is designed to predict collective or individual behavior. It is through this process of discovery that a connection may be established between PLC designs and practices and CAS theories. Through this connection, if it exists, Professional Learning
Communities may be provided a theoretical framework that offers a basis for the leadership approaches associated with them.

While this approach will create an empirical basis for connecting PLC practices to the theoretical framework based in a CAS approach, there is an element of this connection that may be neglected, perhaps for its “non-empirical” nature. English (2008) references John Dewey’s conception of the distinction between leadership as knowledge and leadership as art, stating:

. . . practice is about performance, and practice is not likely to be improved with more the same kind of science (more precise definition) we have historically employed. Improved application begins by placing it within Dewey’s “artistic structures” concept where the integrity, subtlety, and the true forceful impact of leadership reside. (p. 16)

This is to say that, while educational research has a legitimate basis in empirical, “definition-based” frameworks, its practical application may suffer if its basis is entirely within that realm. English goes on to say:

Rather than rigor being defined by exclusion of the art of leadership embedded in a variety of moral discourses, “robust research” must be envisioned as inclusionary.

Then if our brand of science will not enable us to understand this more encompassing perspective of leadership as an art form, we must face up to the fact that our science prohibits us from coming to a more complete understanding of what we want to know. If we cannot permit ourselves to fully comprehend the nature of leadership
because of how we have chosen to define or view it, we should stop using methods and models that leave us perpetually ignorant and unable to adequately grasp what expert practitioners who are supremely artful performers really do. (p. 17)

This perspective may appear to undermine the legitimacy of this study. However, it is a perspective I share in that despite this work encompassing a multi-disciplinary approach to connecting theory and practice, it does not purport to provide the complete explanation of the phenomenon of leadership within a Professional Learning Community or any other school setting.

In that regard, another bias that may pervade this study is the belief on the researcher’s part that the study will be inherently limited in its capacity to explain what “happens” within organizations as they relate to leadership practices. This is not to say, however, that the research or its findings are not believed to be useful; indeed, as the connections are fleshed out, the theoretical framework linking Complex Adaptive Systems and Professional Learning Communities may prove to be very useful.

With these potential biases and assumptions comes some risk that such “research” is not research at all, but a way to prove something that is already a foregone conclusion. Without a research basis in the systematic application of a theoretical lens to the PLC literature, this could well be true. However, if such a system is validly followed, it would provide a method by which the investigation could be repeatable by another researcher, should the need or desire for such repeatability occur. Such a method would furthermore provide a basis for translating and generalizing the findings to PLC leadership practices.
**Personal biography.** Applying a theoretical lens to a body of data inherently reveals characteristics of the researcher. To the end of illuminating potential researcher biases, this brief biography will provide a glimpse of the experiences that have informed my research perspective.

The most basic features of the biography are the facts: I was born in New Jersey in 1966 and lived there until departing for college in 1984. I attended public school until eighth grade, then attended the Delbarton School, a Catholic secondary school for boys. There I played prodigious amounts of tennis with some success. Conversely, I did scant schoolwork with little success. I was accepted to Guilford College with an unofficial understanding that I would play tennis there, but I quickly dropped it upon arrival. I majored in Psychology.

A major turning point in my learning occurred during a class and subsequent self-guided study on Henry James, where I focused on the importance of the relations between James’ characters and how those relations can eventually point to an experience of the void, of nothingness. I also formed a preoccupation with the nature of time as it relates to the void, and how those aspects of existence affect the formation of one’s psyche. These ideas were continued through a master’s degree in Literature, earned from NC State, and my eventual completion of a Master’s thesis entitled, “Lacanian Perspective on Luck and Gambling in Charles Bukowski’s Recent Poetry.” This work was the culmination of my thoughts on the relations between mind, self, and time, as examined through the theoretical lens of the post-Freudian psycholinguistic deconstructionism of Jacques Lacan (1966).
I listen to a broad variety of music. Some aspects of my listening, and my thinking about my listening, will also inform my perspective: the collective improvisation of jazz is an ongoing obsession, especially when the lines of composition and improvisation are blurred; Brian Eno’s early “ambient” recordings depended upon accidents and non-intentionality, yet produced results that sound “composed;” and in Frank Zappa’s “conceptual continuity,” all parts of his multi-faceted musical universe fit with a meta-level work, as if all his works were part of a single work.

There are many, many other performers whom I could mention as influences, but to avoid musician name-dropping excess, I mention those above as holding some more direct relevance to my attraction to Complex Adaptive Systems. Jazz provides a medium of interaction that allows its actors (the musicians) to create a unified statement from their disparate contributions in the (occasional) absence of a centralized decision-making leader. Eno provides a medium in which elements can appear “composed,” even in the absence of a “composition,” where the interactions of the sounds are randomized, yet generate a sense of order and even emotional depth. Zappa showed not only how a body of creative work can appear to be a single piece, but that each smaller piece of that whole is reflective of the whole. Each of these ideas has strong resonance with Complex Adaptive Systems, and should therefore be considered factors that would lead me to have an affinity for Complex Adaptive Systems.

My work life has followed what I believe is an atypical path for a school administrator. After acquiring my undergraduate degree in Psychology, I worked in various
capacities in state-run psychiatric facilities for adolescents. During that time, I earned my
degrees in Literature and Education Leadership. My teaching experience took place at the
Whitaker School in Butner, NC, where I taught all core subjects to 13-17 year olds with
serious emotional and behavioral disorders.

My administrative career began as an assistant principal at a middle school in
Durham, NC. The following years were chaotic, as one principal resigned without notice, and
the school was left in a leadership vacuum for months. When a new principal was hired, she
fought cancer twice, and then fought complications of a bone marrow transplant, all while
attempting to maintain some leadership capacity over the school. After an extended medical
leave, she eventually retired, and I was named principal of the school.

Many destructive factors converged to make that experience a calamity. During the
last part of the former principal’s tenure, and throughout mine, Professional Learning
Communities were being implemented at my school and throughout the district. In the case
of my school, it was clear what happens when change is too abrupt, when it is too drastic,
and when it happens without feedback mechanisms: the result is chaos. Organizational
learning could not occur, and systems for such learning could not be established. Failure was
rampant.

I requested a transfer to an elementary school that was experiencing a higher level of
academic success, where PLC implementation was already underway, and where PLC
leadership was necessary for refinement more than for “building from scratch.” There, I
could observe the positive effects of Professional Learning Communities upon student
learning and upon teacher satisfaction. Last year, after rigorous PLC implementation, the school, which is the largest in the district, was also its top performer, having met all of its federal Adequate Yearly Progress goals as well as local standards for High Proficiency (designated as a North Carolina School of Distinction, with more than 80 percent of students demonstrating proficiency on Reading, Math, and Science), and High Growth (at least 60 percent of students demonstrating a year’s worth of growth within a year) (North Carolina Department of Public Instruction, 2011). To begin this school year, the principal and I made presentations to other district principals about the implementation of Professional Learning Communities at the school. I have since become an Assistant Principal in a different school district.

**Ethics and political considerations.** My professional circumstances could raise some questions regarding my application of a theoretical “lens” to PLC literature. It is possible, for example, that a perception on my part that the disappointment I felt toward the district hierarchy would motivate my affinity for such non-hierarchical theories and processes as Complex Adaptive Systems. In that regard, I believe it is important that the previous biographical section was included, for CAS-like phenomena have been attractive to me since my formative years.

A larger ethical concern that I am finding worth pursuing with this study is the potential alignment that can be established between traditional leadership hierarchy and “bottom-up” structures and processes such as Complex Adaptive Systems. If such an alignment can be established, the PLC idea of “all teachers being leaders” at a school can be
supported from a theoretical standpoint, as can the idea that leading a collaborative culture at a school can enhance that school’s learning environment.

**Methodology Summary**

The methodology described in this chapter supports the research questions posed in this study, for it supports filling the mutual gaps in PLC literature and CAS literature. Applying the theoretical lens of Complex Adaptive Systems fills the gap in the PLC literature. As CAS theory can bring PLC practices into sharper focus, it can become incorporated into those practices, and as a result, the mutual gaps in the literature can move toward closure, and the space between theory and practice can be narrowed. The following chapter will begin this process by presenting the PLC literature, with a particular focus upon DuFour’s conceptualization of Professional Learning Communities.
CHAPTER 3: Professional Learning Communities

Professional Learning Communities “hold considerable promise” (p.1) as a means by which schools may build their capacity for continuous improvement (Stoll, Bolam, McMahon, Wallace, & Thomas, 2006). This promise is based on the assertion that under conditions of change and complexity, the communal approach to enhancing student learning will have a greater likelihood for success than a dependence upon individual teachers’ thoughts and actions.

There is no universal definition of Professional Learning Communities, yet there are consistencies in the concepts used to describe them. Stoll et al. (2006) summarized a variety of definitions as:

. . . a group of people sharing and critically interrogating their practice in an ongoing, reflective, collaborative, inclusive, learning-oriented, growth-promoting way (Mitchell & Sackney, 2000; Toole & Louis, 2002); operating as a collective enterprise (King & Newmann, 2001). (p. 223)

DuFour and Eaker (1998) apply these principles more specifically to the educational environment with the version of Professional Learning Communities that they define:

The very essence of a learning community is a focus and commitment to the learning of each student . . . In order to achieve this purpose, the members of a PLC create and are guided by a clear and compelling vision of what the organization must become in order to help all students learn . . . A corollary assumption is that if the organization is
to become more effective in helping all students learn, the adults in the organization must also be continuously learning. (p. 3)

This PLC definition, which focuses on student learning, embodies two critical and interlocking shifts in thinking. The first demonstrates a shift in perspective from teaching to learning. This shift is critical, as the focus on student learning manifests itself within the performance of each student within a teacher’s classroom, therefore removing the direct control of this domain’s outcomes from the teacher to the students. In other words, the teacher may have control over their own teaching, but that teaching may not have the intended effects over their students’ learning; by shifting the emphasis to students’ learning, the locus of control over the outcomes is dispersed in as many directions as there are students.

The second of DuFour and Eaker’s (1998) statements is also critical, as it includes teachers as learners, not so much as “co-learners” of instructional material, as could sometimes be referenced in a facilitative instructional approach. The “teacher-as-learner,” as referenced in this context, is a necessary posture for teachers to assume if they are indeed to be committed to continuous improvement, and to the learning of all their students, as they would function in a context of continuous flux and adjustment:

A PLC is composed of collaborative teams whose members work interdependently to achieve common goals linked to the purpose of learning for all . . . collaboration represents a systematic process in which teachers work together interdependently in
order to *impact* their classroom practice in ways that will lead to better results for their students, for their team, and for their school. (p.3)

In this definition, focusing on collaborative culture, it is again seen how the locus of a teacher’s control over desired outcomes has been externalized, so that, in this schema, their students’ learning is affected not only by the individual teacher’s ability to evoke learning within their students, but by that teacher’s ability to meaningfully collaborate with his or her colleagues as well. This dispersion differs from that indicated in the first domain, for in this case the teacher has some direct influence over the desired outcome of collaborating with their colleagues. However, it should be noted, as it is by DuFour (2004), that “. . . collaboration does not lead to improved results unless people are focused on the right issues. Collaboration is a means to an end, not the end itself” (p. 3). The outcome, therefore, is not collaboration, but student learning.

Collective inquiry into best practices and current reality also forms a basis for DuFour’s (2004) description of Professional Learning Communities:

Collective inquiry enables team members to develop new skills and capabilities that in turn lead to new experiences and awareness. Gradually, this heightened awareness transforms into fundamental shifts in attitudes, beliefs, and habits which, over time, transform the culture of the school . . . Members of a *professional* learning community are expected to work and learn together. (p. 4)

The authors’ emphasis on “*professional*” reveals a subtext of this study, and the overall approach to Professional Learning Communities in education: educational leadership, in
order to operate in a manner relevant to modern organizations, must take its cues from other organizational structures and cultures. DuFour and Eaker (1998) specifically reference fields such as health care and the legal profession to this end:

Working together to build shared knowledge on the best way to achieve goals and meet the needs of clients is exactly what professionals in any field are expected to do, whether it is curing the patient, winning the lawsuit, or helping all students learn. (p.4)

DuFour and Eaker also identify three other domains of Professional Learning Communities, which do not necessarily embody their definition, but represent essential components of their formation and functioning:

- **Action Orientation: Learning by Doing**: “. . . the most powerful learning occurs in a context of taking action, and [members of Professional Learning Communities] value engagement and experience as the most valuable teachers. In fact, the very reason that teachers work together in teams and engage in collective inquiry is to serve as catalysts for action.” (p.4)

- **A Commitment to Continuous Improvement**: “Inherent to a PLC are a persistent disquiet with the status quo and a constant search for a better way to achieve goals and accomplish the purpose of the organization . . . The goal is not simply to learn a new strategy, but instead to create conditions for perpetual learning -- an environment in which innovation and experimentation
are viewed not as tasks to be accomplished or projects to be completed but as ways of conducting day-to-day business.” (p.5)

- **Results Orientation**: “. . . members of a PLC realize that all of their efforts in these areas . . . must be assessed on the basis of results rather than intentions.” (p.5)

The combined impetus of these three quotations solidifies the design and intention of Professional Learning Communities to manifest themselves in action rather than collaboration for collaboration’s sake. While that stance may seem self-evidently important, it is critical to recognize that Professional Learning Communities interact with their milieu, and constantly assess their effects upon their students’ learning. This is achieved through the use of common assessments that measure whether or to what degree students have mastered their material.

**Historical and Theoretical Context of Professional Learning Communities**

Stoll (2006) observes that the concept of Professional Learning Communities is “not new” because they are connected with notions of enquiry, reflection, and self-evaluating tools. They embody certain key features that were evident in the work of education writers in the early part of the last century. For example, John Dewey (1938) was committed to the view that “educational practices provide the data, the subject matter, which forms the problems of inquiry” (p. 223). These concepts continued to be developed by Schon (1983), who introduced the concept of teachers being “reflective practitioners.” McLaughlin and
Talbert (1993) brought forth the notion of teachers working within “professional communities:”

…teachers’ responses to today’s students and notions of good teaching practice are heavily mediated by the character of the professional communities in which they work…schools differed strikingly from one another in the strength of their professional communities – reporting clear differences, even within the same districts, in levels of collegiality, faculty innovativeness, and learning opportunities as perceived by teachers. (p. 8)

Hord (1997) used the term “PLC” to describe these concepts, though conceptually they were not as fully formed as later iterations:

In a PLC, the unifying principle asserts that we have not fulfilled our purpose until *all* students have learned at high levels. Once the principle is truly embraced, the need for significant change becomes evident. (p. 29)

Seashore, Anderson, and Reidel (2003) further expanded the concept by connecting it with a formalized process by which such a culture is established by systematic means:

By using the term *professional learning community* we signify our interest not only in discrete acts of teacher sharing, but in the establishment of a school-wide culture that makes collaboration expected, inclusive, genuine, ongoing, and focused on critically examining practice to improve student outcomes…The hypothesis is that what teachers do together outside of the classroom can be as important as what they do
inside in affecting school restructuring, teacher’s professional development, and student learning. (p. 3)

The systematic means by which such a culture may be established has been characterized by the framework which followed (DuFour, 2004), with four Essential Questions being posed by teachers and administrators forming the basis for this process:

- What is it we want all students to learn?
- How will we know if each student has mastered the essential learning?
- How will we respond when a student experiences initial difficulty in learning?
- How will we deepen the learning for students who have already mastered the essential knowledge and skills?

While not necessarily new, the concept, and particularly the implementation, of Professional Learning Communities were systematized by the works of DuFour (2004). This implementation will be discussed in the next section.

PLC Implementation

Fullan and St. Germain (2006) observed that “terms travel easily . . . but the meaning of the underlying concepts does not” (p.67). One of the obstacles to PLC implementation is an inadequate internalization of the concepts described above, and an inadequate belief in the need to embrace these concepts. This difficulty arises not only at the individual level, but also at the collective level:

All schools have cultures: the assumptions, beliefs, expectations, and habits that constitute the norm for a school and guide the work of the educators within it.
Perhaps it is more accurate to say that educators do not have school cultures, but rather that school cultures have them. Teachers and administrators are typically so immersed in their traditional ways of doing things that they find it difficult to step outside of those traditions to examine conventional practices from a fresh, critical perspective. (p.8)

Anecdotaly, my own experience as a school administrator introducing and implementing professional learning communities to a school for the first time very closely followed this characterization. Teachers and administrators in that particular situation believed that the culture of the school was eternally imposed, rather than self-created. With such thinking, the school was stuck in a cycle of self-defeat that initially made PLC implementation impossible. The Essential Questions were met with answers such as, “It’s the parents’ fault,” “These kids don’t care,” and “We already have too many meetings.”

Through a gradual wearing-down of such assumptions, the school began to embrace PLC concepts. In focusing on student learning, the staff began to express a certain dread that they would be accountable for students’ academic performance in a way that forced self-reflection. The school data painted a stark picture that led to a recognition of the need for deep cultural change within the school. The process was slow, more so because the staff had developed an ethos that distrusted initiatives from district administration the staff resisted against changing their relationship with their district, and with their students. These difficulties were generated from within, yet, they perceived them as external threats.
In response to Fullan’s sentiment regarding the difficulty that meanings of concepts have in “traveling”, then, DuFour and Eaker (1998) identify a school’s culture as the medium in which the necessary self-examination may occur. A school’s culture, in this schema, is therefore critical to establishing the need or desire for school change, as well as maintaining that change, as DuFour says, “forever” (DuFour & Eaker, 1998, p. 5).

The schema that DuFour and Eaker (1998) propose asserts that change is not only necessary, but necessarily permanent: participating in Professional Learning Communities requires an acceptance of the assumptions underlying the maxim that change is the only constant. Embracing such a long-term commitment to constant change and perpetual learning requires a compelling argument that implementing Professional Learning Communities will benefit students and teachers, i.e., that both students’ academic performance and teachers’ professional satisfaction will improve, with these factors reinforcing one another. DuFour et al. (2006) present such an argument, framed by a 2001 statement by Jim Collins: “‘Good is the enemy of great.’ ‘Good’ organizational performance can cause complacency and inertia instead of inspiring the pursuit of continuous improvement essential to greatness” (p. 7). At the heart of PLC values is the sentiment that “good” is simply not “good enough.”

DuFour (2004) identifies two strategies used to motivate schools to leave behind the attitudes described in the quotation: sanctions and punishment for schools that fail to make improvement, and “initiat[ing] new practices and procedures . . . to present a persuasive case that there is a better, more effective, more gratifying way to approach the work” (p.7). Professional Learning Communities, naturally, are the means by which the authors propose
to achieve such a state for schools: “The model offers a tangible, realistic, compelling vision of what schools might become. We hope to bring the PLC concept to life in ways that resonate with educators because, after all, ‘It just makes sense.’ [italics added]” (p. 7). The final line of that quotation reveals a key assumption of PLC implementation, one that provides the basic gap in understanding that drives this study. The authors do not expand their rationalization, “It just makes sense,” beyond an assumption that it is self-evidently true. Indeed, it may very well be true that many educators will find sense in PLC theories and practices. However, the question remains regarding what about the implementation “makes sense.” Part of the sense-making objective of this study is to determine whether there is a systematic way to “make sense” of the PLC practice, and by doing so provide a theoretical framework for what is otherwise a practice that is untethered to any such framework.

The authors provide some means by which schools may assess the need for change, and those assessments are quite naturally (given their design to help schools implement Professional Learning Communities) structured to demonstrate to schools the ways in which they could benefit from Professional Learning Communities, more than whether they could benefit from PLC implementation. Without a means of identifying what “makes sense” about Professional Learning Communities, it would appear that the “culture of continuous improvement” that Professional Learning Communities depend upon for their implementation is lacking a basic theoretical framework that can serve as a basis for sustaining that culture.
The relations of the accountability movement and Professional Learning Communities. By being held accountable for results that they only vicariously produce, school officials are placed in a predicament, for they are held publicly accountable for circumstances over which they ultimately have very little direct control. They may influence these outcomes, but determining them is beyond their purview. Control over the results resides with the students. This asymmetry provides the basis for developing an approach to education that values influencing the behavior of its constituents as much as delivering a curriculum.

Schools’ formal accountability has more to do with systemic standards, which are set by centralized decisions at the federal level, as with NCLB, or the state level, as with North Carolina’s ABC’s. In the formal accountability model, the principal is responsible for the school’s performance as a whole; the principal may persuade teachers, through basic supervisory methods, that their job security is dependent upon meeting the principal’s expectations, which may include having their students perform well on tests, but the principal is not equipped to formally hold a teacher accountable to their students’ standardized test performance as the sole measure of their job performance. The principal is relegated to using abstract tools such as persuasion, establishing positive school climate and culture, and what is generally termed “leadership” to ensure that curriculum delivery can be favorably reflected in students’ test performance.

This kind of asymmetry between formal leadership and its constituents may seem like a natural part of any organization, where, for example, supervisors do not have direct and
immediate control over their subordinates’ actions, or where production outcomes may be influenced by forces or events that are beyond the control of an organization. Public schools’ accountability, however, differs from other organizations’ accountability in several important ways. First, the participation of their stakeholders is compulsory. Schools do not have the option of not educating those students, or not measuring their performance. Second, outside of not achieving the intrinsic rewards of academic or personal success, the consequences for the students and their families for not meeting academic standards are minimal. Grade retention is a possible consequence, but this practice is falling out of favor due to the effects that retaining a student has upon the rest of their academic career. In its most basic and perhaps cynical interpretation, parents’ and students’ only obligation to schools is to be physically present until their compulsory attendance age passes.

The third component of this difference in accountability is the inherent nature of the product for which schools are being held accountable: performance on standardized test measures. The tests are designed to measure student learning. The North Carolina assessments contain a relatively small fraction of pure knowledge questions, with the majority being questions that reflect students’ abilities to perform “higher-order” thinking tasks with the information that is presented. By demonstrating an ability to use information in this way, the presumption is that students are demonstrating that they have learned the necessary skills and content to be considered to have “learned the material.” Hence, schools are ultimately being held accountable for student learning, both on the individual micro-level and on the collective macro-level. The difficulty with being held accountable for both levels
of student learning is that educators are contending with forces outside their control: social and individual differences account for broad variations in students’ capacity for learning and willingness to perform to high academic standards.

This accountability seems simple: schools exist in order for learning to occur; public schools are funded by public dollars; the public should have some evidence that schools are doing what they are designed to do, and standardized testing of all eligible students is a means by which educational processes are translated into performance numbers that can be understood and evaluated by policy-makers. The seeming simplicity of this accountability model, however, is corrupted by its interaction with some of the elements mentioned earlier, i.e., that the schools, and especially the principals, are only indirectly responsible for that for which they are being held accountable.

This tension played out at the school I led, where, with the shift to becoming accountable for student learning, the teachers faced a dissonance between two conceptual streams: the necessity for internal change and the changelessness of the external circumstances (poverty and generational academic failure) affecting the school. For many, the dissonance proved overwhelming. The emotional climate of the school was toxic: during that first year, two teachers were fired in separate incidents of choking students with their bare hands. Attrition was high, though in the end it may have been a useful factor in shifting the staff’s otherwise immovable perspective.

While the scenario of otherwise knowledgeable students deliberately (or even inadvertently) producing test results that do not reflect their learning is somewhat unlikely,
its disastrous potential is indicative of the disconnection between what is being measured and who is held accountable for those measurements. Naturally, the reason the majority of students engage in the process to the best of their abilities is that they have their own systems of accountability: parental and peer approval, further academic ambitions, intrinsic reinforcement for success. The point, however, is not whether students choose to engage in the process appropriately or not. The issue at hand is the position into which schools are placed by the accountability model, and the response a school formulates to it. That response occurs in the interactions amongst the individuals involved in the educational organization: the students, the teachers, and the administration. These interactions are the “micro” level of the organizational functioning, the “bottom” of the hierarchy of decision-making, furthest removed from the “top” of that hierarchy, yet the domain in which the most decisions take place.

Figure 1 below can schematically represent these relations:

Figure 1: Student-teacher interactions in a professional learning community.
In the figure above, it can be seen that while the student may be interacting with any individual teacher (represented by the broken lines), that student will also be interacting with the network of relations that occur within a well-functioning Professional Learning Community. This model of interaction is an example of the “bottom-up” metaphor that characterizes Professional Learning Communities, where the “top” of an organizational structure is represented in a pyramidal formation. In such a formation, the “top” interactions are fewer in number, though they may have wide-ranging effects through a larger number of interactions further “down” in the organization. In this example, the interaction of a teacher and student involves the agency of two parties, but that interaction is reflective of the interaction of three parties.

The student, while interacting directly with a teacher, could also be affected by that teacher’s interactions with the other teachers; embedded within that student’s interaction with the teacher are the effects of the teacher’s interaction with the other two teachers, so that, in essence, the student is interacting with three teachers. In a Professional Learning Community, these interactions are distinguished from typical social interactions in that they are structured around the Essential Questions regarding the curriculum and the student’s mastery of it.

**Professional Learning Communities: “bottom-up” vs. “top-down.”** DuFour (2004) acknowledges a central internal conflict with leading a PLC effort: that, despite what may be the appearance of a Professional Learning Community being a “bottom-up” phenomenon (one in which individual elements of a system interact in a way that supports
the larger, meta-systemic goals), it is inevitably presented as a “top-down” (centralized, hierarchical decision-making) initiative:

The idea of bottom-up reform is great, but it is unrealistic to assume that one day a group of educators gathered together in the faculty lounge will suddenly re-examine the basic assumptions, beliefs, and practices that constitute the culture of their school. Major change almost never happens from the bottom (Evans, 1996) . . . School leaders cannot passively wait for substantive change to “bubble up.” (p. 191)

The role of the administrator or other centralized educational decision maker is clear: consistently support their organization through the adoption of PLC initiatives, and provide the appropriate pressures to ensure that the organization is indeed implementing Professional Learning Communities with the proper fidelity. This conflict between the “inherently positive” aspect of centralized “support” and “intrinsically negative” aspect of administrative “pressure” is reconciled through an approach that is guided by necessity:

We have heard from educators who oppose an improvement initiative, regardless of its merits, for one reason: It came from the administration. They expect us to be appalled at the disclosure of a top-down initiative. But top-down leadership has its place. It is far more productive to recognize that effective change processes demand both pressure and support. Effective leaders at both the district and building level must be willing to exert top-down pressure when needed. They will embrace the advice of Robert Evans (1996), “Bottom-up as possible, top-down as necessary.” (p.245)
In this passage, it can be seen that all members of a Professional Learning Community of any size will be operating in a domain of countervailing conceptual frameworks: “top-down vs. bottom-up,” and “pressure vs. support.” DuFour (2004) presented a means of conceptualizing the basic currents that run through a PLC implementation. However, what is lacking in their explanation is a means of reconciling these frameworks for PLC members with a theoretical basis more persuasive than “It just makes sense.”

**Schools as Organizations**

Another countervailing conceptual system within Professional Learning Communities is the divide between individual and organizational learning. As Leithwood, Aitken, and Jantzi (2006) propose, the qualitative difference between the two can be explained:

Whereas organizational learning always includes individual learning, considerable amounts of individual learning can take place without any organizational learning; organizational learning is not simply the sum of each member’s learning. Unlike individuals, organizations do not have brains. They do, however, have “cognitive systems” that permit perception, understanding, storage, and retrieval of information.

(p.12)

Somewhere between individuals and organizations, a qualitative shift occurs, wherein the organization acquires the characteristics of an “individual” through the collective interactions of its constituent individuals.

Such collective changes result from feedback that occurs between the development of constituents’ understanding and the changes in their behavior. Fiol and Lyles (1985) point
out that such processes are not necessarily interdependent, as changes in understanding do not necessarily result in changes in behavior, and changes in behavior do not necessarily result in changes in understanding. However, if the changes in understanding, or especially the changes in behavior, are extreme and the environment is turbulent, “the organization lose[s] its sense of direction and stimulates such complex feedback that it becomes impossible to learn from the experience” (Leithwood et al., 2006).

If organizational learning is to take place, one of the roles of leadership, then, is to calibrate the amount and kind of change that the organization is to absorb. Too many simultaneous changes can overload an organization’s capacity to process such change. Such overload would obviously overwhelm its capacity to engage in the “continuous improvement” prescribed by PLC practices. Leadership’s calibration of change, in both initial and ongoing PLC implementation, must strike a balance between change and inertia. As was discussed above, this balance is achieved through a carefully modulated balance between bottom-up support and top-down pressure.

Leithwood et al. (2006) describe a third characteristic of organizational learning, concerning *levels of learning*. The authors cite multiple theorizations (Fiol & Lyles, 1985; Hedberg, 1981; Argyris & Schon, 1978) that discuss the ways in which small, incremental changes within an organization may result in “substantial and irreversible” (p.17) changes in understanding and behavior, ultimately creating changes in the organization’s “worldview” to a degree that the organization’s culture, its previously-held assumptions, may be
challenged. In such an environment of “challenged” culture, continuous improvement may occur as organizational assumptions are destabilized.

Leithwood et al. (2006) further cite Argyris and Schon’s (1978) assertion of yet another level of learning, in which “organizational members, together, reflect on the processes by which they become informed and how these processes might be improved -- a form of collective metacognition” (p. 28). This “collective metacognition” recapitulates the idea that, despite not having a centralized brain characteristic of an individual, an organization may still exhibit the characteristics of an individual with a centralized brain. In the constructivist view, an individual’s capacity for learning depends upon “a process of sense-making in which information from the environment is first perceived, then encoded, interpreted, stored, and/or retrieved for application to some problem” (p. 28). Leithwood et al. point out that analogous “cognitive” structures exist within organizations to support their organizational learning:

Individuals’ perceptions of their environment are guided by their personal needs, goals, aspirations, and values. Aspects of the experienced environment that appear relevant to such goals are attended to; those considered irrelevant are not. Such perceptual screening and attention allocation is a function of a hypothetical structure in the mind sometimes referred to as the “executive.” The organizational equivalents of the mind’s executive include explicit mission statements, organizational goals, aspects of strategic plans, and formal statements of organizational values, ethics, and
beliefs. Stories and those implicit norms, values, beliefs, and assumptions making up the organization's culture may also serve this executive function. (p.29)

This passage draws parallels between personal functions (needs, goals, aspirations, and values) and collective functions (mission statements, organizational goals, plans, value statements, etc.). These aspects are coordinated by a centralized “executive function.” The choice of term “function” is significant, for it implies a process rather than a specific location in time or space. Hence, the source of the executive function is dispersed: its constancy is a construct shared by the functions mentioned earlier. This construct takes the form of formal organizational patterns, as demonstrated by hierarchical organization charts, or it may be embedded in the more fluid forms of interaction amongst its constituents.

In a context with such fluidity, the organization would cease to exist as such if it did not have structures that maintained some constancy of its functions over time. Such structures are a critical form and function of organizational learning; they will provide some insights into how organizations may engage in constant improvement, and ultimately into the functions of Professional Learning Communities and how they are led. Leithwood et al. (2006) cite Levitt and March’s (1988) assertion that:

Organizational learning centers on organizational routines based primarily on interpretations of past events. These routines, adapted incrementally in response to feedback about how well they accomplish outcomes, include the norms, rules, procedures, conventions, and strategies around which organizations are built. Some of these routines serve, for organizations, the same function as short-term memory does
for individuals: that is to search through the contents of long-term memory for previously stored knowledge capable of making sense of perceived information from the environment. (Leithwood et al., 2006, p. 29)

In this passage it can be seen how analogous structures function on both the individual and collective levels. Yet it should be remembered that the structures on the collective level are comprised of the structures on the individual level; that is to say, an organization does not exist without its constituent parts, comprised of individuals. For this reason, it may not be accurate to refer to the structures as analogous, as they are interdependent: the individual and the organization interpenetrate and define one another.

Senge (2000) developed a schematic representation of organizational learning that is represented by three corners of a triangle, which, much like a three-legged stool, would collapse if all three corners were not fully represented. The corner elements are Guiding Ideas, or the “explicit statements of the principles and values that the organization should stand for, and its purpose and direction” (p. 328); Methods and Tools, or “the means by which organizational member can be led to the broad imperatives of new ways to think and behave within their organization”; and Organizational Arrangements, or “the means by which a school system makes resources available” (p.330). In explaining the importance of the coordinated and simultaneous presence of these elements, Senge also highlights the central importance of organizational cultural change in eliciting behavioral change within the organization: “A professional community does not develop by itself. The three corners of the organizational architecture must come together to reinforce one another and generate a
climate that draws forth new attitudes, beliefs, skills, capabilities, awareness and values” (p.331). According to Senge, the underlying structure of an organization’s interactions with itself is the basis for its change, as illustrated in Figure 2 below (Senge, 2000, p. 334):

As can be seen from the diagram, this dynamic exists in a state of constant feedback between the two domains, where a change in one domain will create changes in the other, and vice versa. Each domain informs the other: conceptually, both domains coexist, distinct and parallel from one another, but in reality they interpenetrate one another, existing simultaneously but separately observable depending on the level from which they are being observed.
**Gap in the Literature**

This Literature Review has shown that while PLC literature contains some elements of what it characterizes as a conceptual framework, this framework does not offer a theory for why Professional Learning Communities work. While the conceptual framework provides a means by which teachers and administrators can think about how to implement Professional Learning Communities, it misses a valuable component in not explaining the mechanisms that govern Professional Learning Communities’ effects upon school culture, organizational learning, and the congruence between teaching within a PLC framework and the context of accountability under which schools currently operate.

**Summary of PLC Literature**

PLC literature contains a gap in its conceptual framework. Through the image of the three-legged stool, the literature provides a basic metaphoric means for thinking about the important elements of PLC implementation. DuFour also provides anecdotal evidence of the successes experienced by schools and districts that have implemented Professional Learning Communities (“See Proof,” 2012). However, the literature does not contain a theory for the basis of PLC functioning and success. Questions remain regarding whether there is a theoretical framework that could be applied to Professional Learning Communities. If there is, then Professional Learning Communities can be determined to be part of a larger set of analogous phenomena, and their value can be generalized in a way that would support their implementation, and bolster its legitimacy. The following chapter will provide a Literature Review of Complex Adaptive Systems.
CHAPTER 4: Complex Adaptive Systems

Complex Adaptive Systems (CAS) have a broad and varied body of literature that is represented in a comparably broad variety of fields of academics and practice. As will be seen in this chapter, a central concept associated with Complex Adaptive Systems is that of “emergence,” or observed properties or behaviors of a collective entity that cannot be explained by the behaviors or properties of its parts (Bar-Yam, 2004, p. 15). The definition of Complex Adaptive Systems is being developed as its theoretical base is growing; however, this study will use a definition provided by Maguire, McKelvey, Mirabeau, and Oztas (2006) as a working definition:

A complex [adaptive] system is a whole comprised of a large number of parts, each of which behaves according to some rule or force that relates it interactively to other parts. In responding in parallel to their own local contexts, the parts can, without explicit inter-part co-ordination or any one of them having a global view, cause the system as a whole to display emergent patterns at the global level – the emergence of orderly phenomena and properties of the whole that cannot be predicted from properties of parts. (p. 167)

As will be seen, any given conglomeration of elements or subjects cannot be predicted to behave as or function as a Complex Adaptive System; indeed, a feature of Complex Adaptive Systems is that the observed behavior of the system cannot be explained by the properties of its constituent elements, i.e., it cannot be explained in reverse. For the same reasons, then, it cannot be predicted to come about given a particular combination of elements.
The definition of a Complex Adaptive System is itself “emergent,” for it is not simply a mechanistic, clearly defined phenomenon so much as a combination of phenomena that interact and are observed in a particular manner. Complexity is itself “a very slippery word. It can mean many things” (Lewin, 1992). As a Complex Adaptive System is emergent in the sense that it is dependent upon the parameters within which it is being observed, it can be said that the concept of Complex Adaptive Systems itself possesses some of the same properties and qualities as the phenomenon it describes: it depends not simply upon a combination of certain elements, but upon the synergistic interaction of those elements.

A survey of CAS literature reveals that these properties fall into certain categories. This Literature Review is presented according to these properties, and will examine how these properties are manifested in various fields. John Holland, in developing the conceptual and technical basis for genetic algorithms, provides a beginning working technical definition of CAS as “systems that involve many components that adapt or learn as they interact” (Holland, 2006, p.1).

The term “Complex Adaptive System” emerged as the working label for the phenomena described above through the collaborative work by Holland and others at the Santa Fe Institute, an interdisciplinary research community established in 1984 to study and define complexity science. Given Holland’s ongoing primacy in the development and dissemination of CAS research, his definition of Complex Adaptive Systems will serve as the basis for this study, though others will be examined. While the concept of CAS begins with
the word “complex” in its name, the basis of the phenomena it describes is relatively straightforward:

Figure 3: Holland’s model of complex adaptive systems.

From this illustration, several points in Holland’s CAS definition become clear. The adaptive agents are seen as behaving in a parallel, decentralized fashion that is represented by the two-way arrows within the larger circle. That network of adaptive agents, as a whole, generates the aggregate agent. The most salient feature of this model, though, is the highlighted box describing the conditional interactions of the aggregate: the behavior of the aggregate is not simply the sum of the agent actions. This explanation may at first seem counterintuitive, as the aggregate agent is produced by the actions of the adaptive agents;
however, the process is nonlinear (Plsek, 2001), so that the effects of individuals are amplified and transformed as they manifest themselves in the aggregate behavior.

Using this definition and model as a means of identifying Complex Adaptive Systems, this Literature Review will survey areas in which these types of interactions (between networked adaptive agents) produce these types of aggregate behaviors. These properties have been identified in a variety of fields, but are succinctly identified by Plsek (2001) in his application of Complex Adaptive Systems to redesigning health care systems. They include adaptable elements, or the capacity for the elements of a system to change itself; simple rules, where complex outcomes can emerge from simple, localized rule sets; nonlinearity, where small changes can have asymmetrically large effects; emergent behavior/novelty, where the system is in a constant state of creative change and flux; non-predictability, where on a detailed level forecasting the system’s behavior is inexact; inherent order, in which the system can operate despite its absence of a centralized control; context-embedding which describes how the system is actually a “system of systems,” wherein subsystems and multiple systems function as a Complex Adaptive System; and co-evolution, which describes how the system can move forward through a process that balances chaos and order.

A system that is merely complex, complicated, or chaotic does not constitute a Complex Adaptive System, despite some aspects of those descriptions being elements of Complex Adaptive Systems. One question related to this inquiry is whether a system must be functioning at an optimal level of efficiency or effectiveness in order to be considered a
Complex Adaptive System. The answer lies in the nature of the interactions of the system. If a system is exhibiting the interacting characteristics described earlier, then it is functioning as a Complex Adaptive System.

Osborn and Hunt (2007) provide an expanded definition of Complex Adaptive Systems that helps clarify the distinction between Complex Adaptive Systems and other systems: “…it is an identifiable collection of interacting elements characterized by dynamic and non-linear interaction (non-proportional interaction, where small changes in one element can have large results and vice versa” (p. 320). The important aspect of this updated definition is its emphasis upon nonlinear interaction amongst the elements of the system, for without such nonlinearity, with properties of cause-and-effect and predictability, the system would lose its dynamism and in the process lose its adaptive ability, functioning more as a machine that is unable to respond to any changes within its environment without first being “reprogrammed” or rebuilt by a centralized creator or operator. Levy (1992) described a Complex Adaptive System as

one whose component parts interact with sufficient intricacy that they cannot be predicted by standard linear equations; so many variables are at work in the system that its over-all behavior can only be understood as an emergent consequence of the holistic sum of the myriad behaviors embedded within. Reductionism does not work with complex systems, and it is now clear that a purely reductionist approach cannot be applied; . . . in living systems the whole is more than the sum of its parts. The
result of . . . complexity, which allows certain behaviors and characteristics to emerge unbidden. (pp. 7-8)

In other words, collections of actors that engage in simple behaviors can, under the right circumstances, produce complex behaviors that appear coordinated to adapt to changing environmental circumstances (Anderson, 1999; Holland, 1995).

The Edge of Chaos

Stacey (1996) describes Complex Adaptive Systems as operating within one of three zones: “stable,” “unstable,” and the “edge of chaos,” which is the transitional phase between stability and instability. McMillan (2004) further refers to this “edge of chaos” as “a place that harbors both the capacity to perform the most complex tasks and the capacity to evolve adequately in a changing world” (p.93). McMillan further describes it as a zone, “not an exact spot or an edge like the edge of a cliff” (p. 94). Stacey (1996) identifies five factors that move systems into that zone: increase in flow of information, increase in diversity, increased connectivity between elements of the system, managed anxiety amongst participating individuals, and differentiated power amongst the members of the organization. McMillan further clarifies that at the edge of chaos, an organization is neither too tightly nor too loosely coupled:

[It has] sufficient freedom for creativity, entrepreneurship, experimentation and risk-taking to emerge. There is ongoing change, but there is a dynamic balance so that the organization does not tip over into massive confusion and uncertainty. (p. 95)
This kind of observance is only possible in the presence of an intertwined relationship between the Complex Adaptive System and its environment. In many senses, as seen in Figure 4, the Complex Adaptive System reacts to itself as much as to its environment: it is on one hand distinguished from the aspects of the environment over which it does not have control, while on the other, its collective responsiveness to the environment becomes part of that environment. This simultaneity of responsiveness between internal and external dynamics characterizes a Complex Adaptive System, and is crucial to its sustained adaptability.

**Implications for Leadership**

An organization functioning as a Complex Adaptive System places different requirements upon the nature of leadership within that system. This shift in requirements is succinctly stated by Mainzer (1994), who notes that “linear thinking may be dangerous in a nonlinear complex reality” (p. 225). In her dissertation, Blandin (2008) distills ten key themes from her research about leadership in a Complex Adaptive System:

1. Leadership must view organizations as living systems
2. Leadership is dynamic and interactive
3. Leadership focuses on core values
4. Leadership is generative and future-oriented
5. Leadership is committed to continuous learning
6. Leadership must foster variety and diversity
7. Leadership is enabling and controlling
8. Leadership needs to leverage critical dynamic tensions

9. Leadership must create context for addressing key adaptive challenges

10. Leadership requires new combinations of mental models, qualities and properties

The combined effect of these themes is an optimization of the systemic functionality. In describing leadership in such a system, Loehr and Schwartz (2003) explain that “managing energy, not time, is the fundamental currency of high performance” (p.17). Hawkins (2005) similarly identifies systemic energy management as a primary function of strategic leadership in a complex system. Gratton (2007) further refined the concept of an organization as a dynamic energy system, with “hotspots of innovation and improvement” (p.136). A central question, asked by Gratton, is, “If hot spots are emergent rather than controlled and directed, what can the role of the leader be?” (p. 137). She answers her own question by positing that leaders “guide the conversational agenda in their organizations” (p 138); they “create friendships” (p. 141) that lend depth and commitment to the organization; and they implement “signature processes” (p. 141), which provide procedural structures for the identification of individuals with the organization, and provide a means of governing the energy within the organization. Maguire et al. (2006) also identify organizational structures termed as “energizing devices” that function as sources of adaptation and innovation within a system through “adaptive tensions” (p. 199).

Complex Adaptive Systems are categorized under General Systems Theory (GST), which has been identified as a cross-disciplinary phenomenon since as early as 1956 (Boulding, 1956). Early studies included the interdependence and interaction of populations,
and of those populations’ interactions with their environments. Boulding theorized that the interactions of those populations were governed by energy flows that were regulated by self-maintaining mechanisms that tended toward states of homeostasis.

Blandin’s (2008) key findings support this view of organizations functioning as dynamic systems that can be described as Complex Adaptive Systems:

- The idea that leadership in a complex adaptive system differs substantially from leadership based on conventional leadership models.
- The view of leadership as a mindset, process and practice -- not as role-based -- with the corollary that leadership can exist anywhere in an organization.
- The context of leadership is one characterized by constant change, uncertainty, and complexity.
- The view that the role of leadership is not to direct or control, but to engage in a more indirect (though no less powerful) series of practices involving calibrating energy, noticing tensions, fostering dialogue and constructive conflict, generating learning, and fostering a collective organizational identity. (p.166)

Key to understanding Blandin’s findings is the recognition that while organizations function as Complex Adaptive Systems, they do not depend upon hierarchical, top-down structures for their functioning; rather, they depend upon the structure underlying the collective interactions of the organization, where its behavior is observed as a whole.

**Open Systems**
Katz and Khan (1978) applied General Systems Theory (Boulding, 1956) to organizational theory in what they described as “Open Systems” (Katz & Khan, 1978) that were dependent upon relationships, structure, and interdependence. The implications for leadership theory become evident, as these systems’ structures and relationships maintain their constancy through some regulatory mechanisms that could be observable through leaders’ or leadership behavior. Some of these implications were identified and explored by Osborn, Hunt, and Jauch (2002). An emphasis should be placed, however, on the observed tendency of such “open” systems to retain a sense of order and stable relationships within their boundaries. As will be discussed in a future section of this review, the scale at which a system is being observed defines the limits of such boundaries, as such a system is a macrocosm of its own subsystems.

**Self-organization**

Chiles, Meyer, and Hench (2004) termed self-organization and emergence as the anchor points of complexity science. Plowman and Duchon (2008) combine the terms into “emergent self-organization.” Self-organization as an independent concept was developed by Ilya Prigogine (Prigogine & Stengers, 1997) in his work on “dissipative structures,” related to his Nobel Prize-winning work in chemistry. Based on Prigogine’s work, Boal and Schultz (2007) describe dissipative structures as “systems that respond to increasingly complex environments by importing greater resources from outside and exchanging more resources within their boundaries to achieve greater degrees of fitness” (p. 415).
Goldstein (1999) initially defined emergence as "the arising of novel and coherent structures, patterns and properties during the process of self-organization in complex systems." Corning (2002) identified five factors contributing to emergence:

1. Radical novelty (features not previously observed in systems);
2. Coherence or correlation (meaning integrated wholes that maintain themselves over some period of time);
3. A global or macro "level" (i.e., there is some property of "wholeness");
4. It is the product of a dynamical process (it evolves);
5. It is "ostensive" (it can be perceived). (p. 49)

These properties are critical to the formation of Complex Adaptive Systems (Stacey, 1996), as the agents in Complex Adaptive Systems dynamically interact with each other and their environment; through those interactions, they self-organize with the emergent properties of adaptation and increasing fitness over time. As Kauffman (1995) points out, Complex Adaptive Systems are operating at the edge of chaos, and are able to rapidly adapt to change. Complex Adaptive Systems, according to Olson and Eoyang (2001), “allow for creativity and efficiency [to] emerge naturally. Some basic rules, positive contacts and relationships among members of the organization allow solutions to emerge from the bottom up.” (p. 5)

**Synergism**

The combination of such systems reveals a distinctive characteristic of open systems: synergism, or the phenomenon of a system being explainable as a totality rather than as a sum of its parts. Such is the nature of complex systems, as they are distinguished from
“complicated” systems: as was illustrated by Cilliers (1998), “a jumbo jet is complicated, but mayonnaise is complex” (p.21). This colorful example of the difference between the two concepts shows two systems: the jet, with its thousands of parts, could, for the most part, retain its functional identity as a jet if one of those parts were removed, while the mayonnaise could not retain its functional identity (its “mayonnaise-ness”) if, say, the oil were removed from it. When isolating the ingredients of mayonnaise, another aspect of complex systems emerges: the unpredictability of outcomes based on the properties of those ingredients. In other words, the properties of eggs, oil, and seasonings individually do not account for the properties of mayonnaise. If the ingredients are combined in a certain way, if they interact in a certain way, the ingredients assume properties that are irreducible to any of their individual characteristics.

These characteristics of irreducibility of totality into parts, and the unpredictable nature of the outcomes of the interactions of those parts, are essential aspects of Complex Adaptive Systems (Ashby, 2004; Holland, 1995; Kauffman, 1995; Prigogine & Stengers, 1997). These characteristics of systems are abundantly found in natural systems, where change and novelty are constant, yet systems are sustained over time. Prigogine and Stengers (1997) observed that the necessity for a CAS modeling of nature comes about because linear models of nature are inadequate due to the “fluctuations, bifurcations, and instabilities at all levels [of nature]” (p. 55) In short, the modeling of natural phenomena through linear, cause-and-effect relationships proved inadequate.

**CAS Modeling**
Bar-Yam (2004) described the shortcoming of such modeling as a basic shortcoming of the assumption of the power of calculus to explain all of the universe. All phenomena can be broken into smaller and smaller straight lines, such that curves are not curves at all, but series of almost infinite series of connected straight lines. Such straight lines are analogous to the cause-and-effect relationships that “traditional” science attempted to establish, in both temporal and spatial relationships. In the temporal sense, science attempted to establish how one event could lead to another in the course of manifesting its “equal and opposite reaction,” while in the spatial sense, when phenomena occur within some measurable proximity to one another, “lines” are drawn between them to indicate how one influenced the action of the other in a way that could be replicated, given the same initial conditions.

While some attempts were made to reconcile classical scientific theories, such as described by Daft (1992), where systems were broken into smaller and smaller subsystems within a larger organization, where the subsystems operate in hierarchical levels similar to corporate organizations, such theories still do not capture the essence of the interactions of those subsystems, where the systems’ elements interact in a nonlinear fashion. Prigogine (Prigogine & Stengers, 1997) advanced the knowledge of nonlinear dynamics, or in his terms, “dissipative” structures in thermodynamics, or systems that operate under conditions of extreme instability. These systems are characterized by boundaries with their surrounding environments that allow for heightened states of energy exchange with those environments. These structures’ instability leads them through multiple transitions, rather than toward a point of equilibrium. As Mathews, White, and Long (1999) later observe, dissipative
structures develop into increasingly higher levels of qualitative and quantitative complexity. The key difference between relatively stable, relatively linear structures and dissipative structures is that dissipative structures have characteristics that are emergent properties resulting from the interaction of their elements with each other as opposed to the system’s interaction with its environment (Morel & Ramanujam, 1999).

The environment may not, therefore, impose properties upon a dissipative system (Holland, 1995), as those properties represent the results of the interaction of the elements of that system. Such a relationship with its environment may cause a system to react unpredictably and disproportionately to changes in its environment, such as with the “Butterfly Effect.” The Butterfly Effect was a theory proposed by Edward Lorenz (1963) during his study of weather systems, and was named after the theory that the flap of the wings of a butterfly in Chicago may cause wind waves that ultimately escalate and form a hurricane in Rio de Janeiro. Studying such a phenomenon as weather in this way reveals and aptly illustrates a nonlinear system where all parts are interrelated in such a way that any change that occurs within any part of the system will change the relationships of all the other elements of the system in a way that affects the behavior of the entire system.

**Self-organization through self-feedback.** This ability to adapt is an emergent characteristic of CAS self-organization, or the interdependence of the individual subsystems or “agents”, as they are sometimes called. Not all systems have the capacity to evolve, as systems that are disproportionately chaotic cannot maintain behaviors and are easily disrupted by external forces. On the other hand, highly orderly systems are likewise unable to
absorb or tolerate external changes, and will fail to adapt to environmental changes as well (Kauffmann, 1995).

Systems that are “poised” on the edge of chaos are optimized for evolution (Kauffmann, 1995): as they develop a range of responses to environmental changes, they can develop patterns around responses that produce desirable results, thus “self-organizing” themselves through feedback loops with the changing environment. Kauffman identifies the capacity of a system’s ability to create and sustain these feedback patterns as affected by the system’s size ($N$, the number of subunits within the system) and the degree of interrelatedness or interaction between the subunits ($K$, which is measured by the number of inputs to each $N$). Kauffman further identified $P$ as the common schemata that the subunits share. The element of $K$, of subunit interrelatedness, is the structural feature that allows for nonlinearity within the system and in how the system interacts with its environment (Morel & Ramanujam, 1999).

With each of the subunits within an organization having the capacity to interact, directly or indirectly, with each of the other members of the organization, the central question of this study comes to the fore: What function does leadership hold in a system that apparently “guides itself” on a macro level through the micro-decisions of its subunits? In what might be considered a “traditional” or “classical” Systems Theory model of organizations? Katz and Khan (1978) suggest that leadership exerts an incremental influence over the routine functioning of an organization, eliciting change through small changes that are repeated throughout the organization. Marion and Uhl-Bien (2001) characterize
leadership in such organizations as functioning without authority and in a temporary
capacity, meaning that the leadership within an organization may function outside of formal
structures while serving the formal needs of the organization. These needs may also be
addressed from a formalized standpoint, in that the leadership may be manifested by a
consciously defined leadership role. Marion and Uhl-Bien distinguish between the
“leadership” of an organization and its “leaders,” where the former is more wide-ranging in
who may fall under that category and is not bound to formal structures and definitions, while
the latter depends upon externally defined titles and a formal, objective organizational
structure.

This perspective on group functioning operates outside of the parameters of
complexity theory. Gell-Mann (1994) indicates that a system is complex when the
relationships within it are not clearly defined in either mathematical or verbal forms. The
formal structures of an organizational chart, especially those that depend upon clear role
definition and job descriptions, therefore do not comprise “complex” organizations. This is
not to say, however, that informal, complex elements do not manifest themselves with the
formal frameworks, particularly as part of their real-time implementation.

Gell-Mann’s theories suggest that the “effective complexity” of a system -- its ability
to adapt from “crude complexity” to more fine-grained responsiveness -- is dependent upon
the degree to which the system can simplify its own self-definition: systems with more
concise self-descriptions can yield a greater range of responsiveness to external variables
than those with less concise selfdefinitions. Organizations that depend upon organization
charts and detailed role definitions are limited by their own structures, and while they may be complicated, they are not complex, for they do not allow for interactions between their subunits that are not previously established. Such a dependence upon an a priori definition of behavior does not, in this scheme, allow for adaptation to changing conditions.

Through an organization’s “effective complexity,” it establishes its organizational identity, as defined by Wheatley (1994): “Self-organization succeeds when the system supports the independent activity of its members by giving them a strong frame of reference” (p. 78). It is this “frame of reference” that provides the guidance for action without the limitations of over-literal role and relational definitions. Pratt (1998) defined such an identification by an individual with an organization as “organizational identification,” when one’s beliefs about an organization become self-referential. When members of an organization collectively engage in organizational identification, the enduring concepts of that organization are reflective of the shared beliefs amongst its members (Dutton, Dukerich, & Harquail, 1994).

This aspect of organizational identity, of reflecting the collective identities of the organization’s constituent subunits, relate to the $K$ variable mentioned earlier. $K$, the number of interrelated inputs into each subunit within a system, is reflective of the interactions amongst those subunits. This directly affects the shared beliefs and organizational identity formation, for it is through the inputs and outputs of each subunit to other subunits that the enduring concept of an organization is maintained amongst its constituent subunits. Chiles, Meyer, and Hench (2004) describe this phenomenon of organizational identity, of self-
organization, as the “anchor point phenomenon” of complexity theory. They identify the emergent system-level order resulting from the lower-level interactions between the individuals, and their individual schemas and identifications.

This is not to say, however, that the systems in question are achieving the objectives set forth for that organization. Much like Mitchell’s (2001) description of Hofstadter’s “Copycat” analogy-simulating computer program, an organization may not have passed through an adequate number of iterations of localized rule-sets to achieve stable global functioning. While not desirable, it is entirely possible that a Complex Adaptive System does not adapt in a manner that is sustainable within its context. In other words, the “adaptive” aspect of the equation was inadequate or inappropriate.

**Gap in the Literature**

CAS literature provides a basic framework for Complex Adaptive Systems, and provides examples of its appearance in other, extra-educational contexts, with some mention of educational contexts in the dissertation work of Conrad (2006) and of Blandin (2008). The literature does not specifically link CAS theory and PLC practices, specifically as DuFour et al. (2006) describe them as referenced in the Literature Review. Therefore, the gap being addressed in this study is not a single gap, but a mutual gap between the bodies of literature related to Professional Learning Communities and CAS theory.

**Summary of CAS Literature**

This Literature Review surveyed works from two disparate fields: Professional Learning Communities and Complex Adaptive Systems. Professional Learning Communities
developed from ideas related to organizational learning posited by Senge (2000) and others. Senge and the PLC literature describe the importance of a school’s culture in engaging in continuous improvement, providing tools for leaders of such organizations to bring about such changes. However, one aspect of organizational learning that neither Senge nor the PLC literature addresses is the mechanisms that govern organizational behavior --- i.e., the cultural and informal networks within an organization.

This gap in the literature, the “missing link” of Professional Learning Communities to a theoretical framework, may be filled by CAS theories. This gap is further reinforced by the relative paucity of mention of educational leadership theories in CAS literature, and the virtual absence of mention of Complex Adaptive Systems in education leadership literature, especially as it relates to PLC leadership. This study will build from this review of the current literature, and endeavor to fill this gap.

Complex Adaptive Systems are described in a variety of fields, ranging from human to animal to artificial systems. In such systems, organizations of individuals, or agents, make individual decisions without being cognizant of how their decisions affect the group. Despite functioning within such a decentralized decision-making context, however, the organization demonstrates unified and goal-directed behavior. In other words, organizations behave as though they are under the direction of a centralized decision-making leader when in fact the decision-making is dispersed equally throughout the organization. It has been shown that such emergent behavioral results can be achieved if the agents within a group follow some
simple rule-sets that govern their interactions with others following the same rule-sets, or other organizations that are following complementary rule-sets.

Professional Learning Communities in schools function in a similar manner, in that they frame teachers’ decision-making according to four questions, which, if followed, enhance the development of a culture of continuous improvement. This culture is instrumental in creating a workplace environment for teachers that may be more conducive to job satisfaction and retention, but more importantly, it is conducive to students’ learning and to favorable school accountability results. School performance accountability is structured in a manner that is analogous to their functioning: as each individual student’s learning represents the result of the totality of their interactions with the school environment, the school’s accountability represents the totality of individual performances within that environment. No single interaction can define a student’s performance; no single student performance can define the performance of the whole.

The structures and process illustrated by Figures 3 and 4 provide a conceptual basis for this study. Complex Adaptive Systems modeling shows how aggregate behaviors interact with an “aggregate agent,” or the collective behavior of an organization observed as it interacts with itself. The term “itself” is key, for the organization is defined as a matter of scale: it is comprised of individuals, or in CAS parlance, “agents.” The collection of agents is framed by a formal but abstract entity called the “organization.” While the organization may be defined by this abstraction of this collective state, no single member of the organization defines it. Each “adaptive agent” interacts with others. The totality of these interactions not
only comprises the “aggregate agent,” but interacts with it. Hence, the Complex Adaptive System is simultaneously creating and interacting with itself in a self-sustaining feedback loop.

Senge’s (2000) “Deep Learning Cycle” of organizations also contains a similarly self-sustaining feedback loop. In his schema, the actors, the individuals comprising an organization, fall under the “Domain of Action,” the aspect in which the “three pillars” (Guiding Ideas, Organizational Arrangements, and Methods and Tools) play out. That domain creates and interacts with the “Domain of Enduring Change,” whose three pillars (Attitudes and Beliefs, Skills and Capabilities, and Awareness and Values) interact to create a domain that is also only observable as a totality.

Both of these schemas operate within a realm of apparent paradox: the organizations they represent sustain themselves through a process of constant self-creation, with the interactions amongst individuals synchronized with the interactions of the collective and individual interactions with the abstracted domains of “aggregate agents” and “Domains of Enduring Change.” In other words, the interactions of one “level” generate another “level” which sustains the previous level --- a feedback loop of synchronous self-generation.

These concepts provide linkages to practice through Professional Learning Communities, in that they provide a structure through which such cultural self-generation can occur. While PLC literature focuses on the anecdotal and research-based reasons for adopting it, the literature likewise does not connect Professional Learning Communities to anything other than themselves. Stated another way, PLC adoption makes sense based on the a
posteriori evidence that it had worked in various locales, and under various circumstances; however, it lacks a conceptual, a priori argument which posits that the design of PLC implementation holds a congruence with other organizational systems in such a way that it provides a model for the conditions necessary for a culture of continuous learning.

Likewise, the CAS literature does not make mention of the Professional Learning Communities model as a manifestation of CAS modeling. These mutual gaps -- Professional Learning Communities’ absence of Complex Adaptive Systems and Complex Adaptive Systems’ absence of Professional Learning Communities -- forms the basis of this study, with the central question being, “Are Professional Learning Communities Complex Adaptive Systems?” The following chapter will provide an analysis of these bodies of literature to approach an answer to that question.
CHAPTER 5: Comparing Complex Adaptive Systems and Professional Learning Communities

This chapter will make a comparative analysis of Professional Learning Communities and Complex Adaptive Systems. The analysis will be accomplished through a staged process of detailed unpacking of the terms and concepts used to define those phenomena.

Defining Professional Learning Communities

DuFour (2006) provides the following definitions of a Professional Learning Community:

An ongoing process in which educators work collaboratively in recurring cycles of collective inquiry and action research to achieve better results for the students they serve. (p. 2)

“An ongoing process.” A Professional Learning Community is focused on the learning of each student (DuFour, 2006, p. 6). As can be seen from the language of the definition, learning is taking place in two parallel yet interdependent streams: that of the student(s) and that of the teacher(s). This is a recursive process in which changes on one side of the equation will elicit changes on the other side. The phrase “ongoing process” also indicates that there is not necessarily an “end point” that is achieved, as the context of and relations between the elements are constantly shifting, or, as DuFour terms it, are “nonlinear” (p. 39).

“Work collaboratively in recurring cycles of collective inquiry and action research.” DuFour outlines what he sees as important structures (“recurring cycles”) that
support the collective learning: curricular for the students, “inquiry and action research” for
the teachers. Developing such structures communicates organizational priorities and
systematically addresses them (DuFour 2006, p. 20). DuFour does not see best practices as
being completely open-ended, with the hope that the system will self-organize based upon
identification of need, but prefers to work within structures that not only provide a format
within which communication can occur, but that limit the degree to which the organization
can stray from its original commitment to student learning.

“To achieve better results for the students they serve.” DuFour (2006) describes
processes by which teachers monitor goals as part of a Professional Learning Community:
A critical step in moving an organization from rhetoric to reality is to establish the
indicators of progress to be monitored, the processes for monitoring them, and the
means of sharing results with people throughout the organization. For example, if the
staff agreed student learning were the priority in their school, procedures to monitor
each student’s learning on a timely and systematic basis would be imperative. (p. 20)
This explanation provides insight into what constitutes “better,” for it is tied to the first
priority of the Professional Learning Community: student learning. As the Essential
Questions indicate, part of the role of the Professional Learning Community is to determine
what students should learn, and how it is known whether those things have been learned. An
important aspect of the information that DuFour describes is that the information is shared
“throughout the organization.” The information would be the data gathered that constitutes
the indicators of student learning agreed upon by the organization.
Hence, two systems of communication serve Professional Learning Communities: the data that is generated through assessments, and the “recurring structures” that facilitate their being shared “throughout the organization.” These systems operate in service of the learning of two sets of learners: students and teachers. These four components—data, systematic sharing, student learners and teacher learners—interact in ways unique to the participants and their circumstances. From those interactions, a Professional Learning Community emerges.

**Defining Complex Adaptive Systems**

As was pointed out in Chapter 4, the definition of Complex Adaptive Systems is evolving, and is itself emergent (Bar-Yam, 2004). To restate the working definition of Complex Adaptive Systems for this study:

A complex [adaptive] system is a whole comprised of a large number of parts, each of which behaves according to some rule or force that relates it interactively to other parts. In responding in parallel to their own local contexts, the parts can, without explicit inter-part co-ordination or any one of them having a global view, cause the system as a whole to display emergent patterns at the global level – the emergence of orderly phenomena and properties of the whole that cannot be predicted from properties of parts. (Maguire et al., 2006, p. 167)

In other words, a Complex Adaptive System can be summarized as a large number of active participants that, following simple rules, can behave in an organized manner absent a rule that states, “Behave in an organized manner.”
Examples of Complex Adaptive Systems. Gell-Mann (1994) provides an introductory model for the ways in which Complex Adaptive Systems manifest themselves in the world. This adapted model (Figure 5) demonstrates how the complexity evolves not simply in a linear fashion, but in a manner that complexifies complexity itself:

Prebiotic chemical evolution

<table>
<thead>
<tr>
<th>Biological evolution (organisms)</th>
<th>Biological evolution (ecosystems)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mammalian immune systems</td>
<td>Individual learning and thinking</td>
</tr>
<tr>
<td>Cultural evolution in other species</td>
<td>Human cultural evolution</td>
</tr>
<tr>
<td>Evolution of organizations and societies</td>
<td>Evolution of economies</td>
</tr>
<tr>
<td></td>
<td>Evolution of strategies by computers</td>
</tr>
</tbody>
</table>

Figure 4: Gell-Mann schema for complex adaptive systems’ development in nature.

Through such a schema, Gell-Mann (1994) clarifies that “Although [Complex Adaptive Systems] differ widely in their physical attributes, they resemble one another in the way they handle information” (p. 21). He describes that process:

In studying any Complex Adaptive System, we follow what happens to the information. We examine how it reaches the system in the form of a stream of
data....We notice how the Complex Adaptive System perceives regularities in the data stream, sorting them out from features treated as incidental or arbitrary and condensing them into a schema, which is subject to variation....We observe how each of the resulting schemata is then combined with additional information, of the same kind as the incidental information that was put aside in abstracting regularities from the data stream, to generate a result with applications to the real world: a description of an observed system, a prediction of events, or a prescription for behavior of the Complex Adaptive System itself. (p. 23)

Gell-Mann is describing a system that abstracts information and applies it to experience, which in turn generates information that can be further abstracted. Through this hierarchical series of abstractions, simple rules emerge that have long streams of data embedded within them, but that are not expressed by the direct statement of those streams of data. (pp. 31-34).

Complex Adaptive Systems are exhibited in such phenomena as flocking birds, which demonstrate unified group or “global” behavior but do not have a specified “leader” (Weiss, 1990). Each bird follows a simple rule set (i.e., maintain distance, proximity and speed similar to others nearby, and move in relation to a perceived center of the group) that it compares with its perceptions, as when avoiding a predator or selecting a perch. By doing so, the flock emerges, as does the unified global behavior, without a “supervisor bird” leading it (Weiss, 1990). Similar phenomena occur within schools of fish, ant colonies, and termite mounds.
Examples of Complex Adaptive Systems have been studied and documented in many areas of human endeavor: organization change in business (Dooley, 1997), supply networks (Choi, Dooley, & Rungtusanatham, 2001), technology and innovation rates (Fleming & Sorenson, 2001) economic modeling (Tesfatsion, 2003), electric power grid control (Wildberger, 1997), anthropology (Abel, 1998), artificial society modeling (Lansing, 2003), language evolution (Steels, 2000), and health care systems (Holden, 2005; Anderson, Issel, & McDaniel Jr., 2003).

**Potential Links between Professional Learning Communities and Complex Adaptive Systems**

Based upon this definition, what, if any, aspects of Complex Adaptive Systems can be linked to Professional Learning Communities? The Literature Review of Chapter 2 and an ongoing review of CAS and PLC literature have demonstrated that the link between these concepts and practices has not been explored or established. The subsequent sections will relate various components of the CAS definition posited earlier to aspects of PLC concepts and practices. Following the discrete analyses, a summary of the findings will discuss patterns found within these linkages.

“Community” and “A whole comprised of a large number of parts.” Perhaps it is obvious that the typical school (and, by extension, Professional Learning Community) is comprised of a large number of parts: students, teachers, support personnel, and the requisite materials collectively comprise a “school.” This definition could be extended to include parents and communities connected with the school. These parts have specific roles --- and
within these roles, identities --- which contribute to the functioning of the whole. In some cases, the whole is not significantly affected by the removal of an individual part, as in the case of a relatively quiet student leaving a school. In other cases, the departure of a single individual can have enormous effects upon a school, as in the case of a principal joining the school with an agenda for radical change (Supovitz & Riggan, 2012).

“Recurring cycles of collective inquiry and action research” and “Each [part] behaves according to some rule or force that relates it interactively to other parts.” The most immediately identifiable parts of a school are those one would see when walking into the building: students, teachers, and the like. Aside from being directly observable as parts of the school, they are verifiably so, as they are enrolled or hired through formal processes. Additional “parts” such as parents and community can be included as belonging to the school, though their inclusion becomes more tenuous with each step of removal from the “core” group of teachers and students.

The “rule or force” that relates the parts to one another is multi-dimensional. The over-arching force driving a public school is student learning. It could be argued that without serving that purpose, the school, as such, would cease to exist. Within that force, manifested as interactions among educators and students, particular rules govern those interactions, including the interactions not only between educators and students, but amongst educators as well.

“A focus on learning” and “In responding in parallel to their own local contexts, the parts can, without explicit inter-part co-ordination or any one of them having a
global view, cause the system as a whole to display emergent patterns at the global level.” Professional Learning Communities serve as means by which to respond to the Essential Questions, given that the Questions’ answers will vary throughout a school – grade levels and subject areas have different learning objectives, and students respond differently to them. While an entire school could be considered a “Professional Learning Community,” it is comprised of multiple parallel Professional Learning Communities that can be disaggregated across grade and subject lines.

This parallel functionality is, on one level, coordinated by a central decision-making authority, i.e., an administrative fiat related to Professional Learning Communities; however, that authority is limited to school-wide functions that address generic, collective needs of a school’s students, but not necessarily the specific, individual needs of each student. Taken from the standpoint of the daily meeting of specific students’ learning needs, schools lack an explicit inter-part co-ordination: even with a global perspective, it would not be possible for any form of hierarchically-oriented administration to meaningfully direct teachers as to how to meet their students’ individual, unique learning needs.

In that regard, on the “global” level, a school exhibits “emergent” behavior: without a centralized means of dictating how to enact the “force” of student learning, a school must respond to each student’s needs on a localized level. The collective quality of these localized responses will make up the emergent behavior of the school. As was pointed out in an earlier chapter, this aggregate, collective behavior is recognized in the measures to which schools are held accountable. In North Carolina, schools’ yearly success is boiled down to a single
score that reflects students’ combined performances on the subjects that were tested at the end of the year or end of the course: the emergent “behavior” of the school is illustrated by an aggregation of all of the separate interactions of all of the “parts” of the school over the course of the year.

“Collective inquiry into best practices” and “The emergence of orderly phenomena and properties of the whole that cannot be predicted from properties of parts.” Disaggregated Professional Learning Communities, such as those of grade levels and subject areas, operate in a roughly parallel fashion. The results of their behavior in relation to the force and rules of student learning can be aggregated to exhibit a degree of orderly behavior on the global, school-wide level. For example, in an elementary school, the percentage of students reading on grade-level in first grade will not affect the percentage of students concurrently reading on grade-level in fifth grade; however, the percentage of students reading on grade-level across those grades will provide a composite picture of how well that school “teaches reading.” For each student who is on grade-level, the “school” is apparently effective. Within each student, strengths and weaknesses emerge; within each grade level, strengths and weaknesses emerge; within a school, strengths and weaknesses emerge. While the aggregate can be explained by its parts, no single part can predict how the aggregate will behave.

Within each of those levels, a sample of any of the individual parts may not yield a strength and weakness profile that matches that of the larger unit. However, the whole is reflective of the sum of its parts: strengths and weaknesses that emerge when aggregating
their performance are reflective of exactly the performance of the group. This is problematic, for on the one hand, it is true that individual samples of student performance would not necessarily yield a profile that is reflective of the whole; on the other hand, the behavior of the whole is reflective of an average of the performance of the whole.

The issue, however, is not the numbers that are produced at the end of the interactions that comprise a Professional Learning Community. Student learning is the force that drives the interactions of the various parts of the Professional Learning Community, but it is not the Professional Learning Community itself. The actions that are produced by a Professional Learning Community result from the school’s responses to the Essential Questions and the actions that follow. By using the Questions as the basis for their interactions, members of a Professional Learning Community can produce a myriad of responses to a myriad of circumstances.

It is conceivable that those responses can vary across groups, so that one Professional Learning Community could respond to a given set of circumstances in one way, and another respond in another way. It is equally conceivable that the effects of those actions could produce differing results. Each of these scenarios could be produced by the same set of Essential Questions. Hence, in determining “the emergence of orderly phenomena and properties of the whole that cannot be predicted from properties of parts,” it can be said that from a Professional Learning Community driven by the Essential Questions emerge orderly phenomena (student learning) and properties that cannot be predicted from the properties of its parts.
In analyzing this definition of Complex Adaptive Systems through the lens of Professional Learning Communities, as described by DuFour, it becomes clear that Professional Learning Communities share some basic elements of Complex Adaptive Systems: they involve the interaction of many parts that are part of a whole; their interactions are not dictated by a centralized decision-making process or entity, yet the whole demonstrates unified behavior; and this unified behavior cannot be predicted from the properties of the parts.

**Other CAS Definitions and Their Relation to PLC Practices**

Other CAS definitions contain some components that are not explicitly addressed in the aforementioned definition, and that should be included in the analysis of the compatibility of Professional Learning Communities and Complex Adaptive Systems. Holland’s (2006) definition of Complex Adaptive Systems as “systems that involve many components that adapt or learn as they interact” (p. 1) introduces the concept of systemic learning. While it may be obvious that “learning” is a component of any school environment, the practice of “organizational learning” is the phenomenon that is being addressed in this usage; i.e. it is addressing not the students’ learning, but the teachers’. As was described by Senge (2000), the underlying structure of an organization’s interactions with itself is the basis for its change. In schools, this change is centered upon and dictated by student learning: it can be said that it is a form of organizational “learning about learning,” much in the same way that students learn about their own learning through metacognition.
This organizational learning function serves as a collective “mind” for the Professional Learning Community. To restate an earlier quotation from Leithwood et al. (2006), organizations support their learning though a variety of mechanisms:

The organizational equivalents of the mind’s executive function include explicit mission statements, organizational goals, aspects of strategic plans, and formal statements of organizational values, ethics, and beliefs. Stories and those implicit norms, values, beliefs, and assumptions making up the organization's culture may also serve this executive function. (p. 29)

While these mechanisms are the outward signs that organizational learning is taking place, a process that supports that learning in schools is Professional Learning Communities. Hence, in addressing Holland’s CAS definition that includes collective learning, it can be said that Professional Learning Communities provide a framework for that learning.

Plsek (2001) applied CAS theory to redesigning health care systems. Some aspects of his descriptions of Complex Adaptive Systems also do not coincide with or overlap the definitions previously set forth. Those aspects include: simple rules, where complex outcomes can emerge from simple, localized rule sets; inherent order, in which the system can operate despite its absence of a centralized control; context-embedding that describes how the system is actually a “system of systems,” wherein subsystems and multiple systems function as a Complex Adaptive System; and co-evolution, which describes how the system can move forward through a process that balances chaos and order.
“The Essential Questions” and “Simple rules.” The “simple rules” of Professional Learning Communities can be reduced to the four Essential Questions. From the Questions, a Professional Learning Community can generate any collective or individual response to students’ collective or individual needs as they relate to the Standard Course of Study. With Professional Learning Communities, the “complex outcomes” would be the responsiveness to students’ learning needs, as described in the previous section.

“Recurring cycles” and “Inherent order.”” While Professional Learning Communities operate within the normal governing structures of public schools, their primary purpose and driving mission is to meet the needs of students. Given the multifaceted, dynamic nature of students’ learning needs, the order that is maintained by a Professional Learning Community is maintained by each member’s interest in serving student learning. It should be noted, however, that administrative fiat is likely an element of even the most well-intentioned and motivated Professional Learning Communities.

“A collaborative culture” and “A system of systems.” To borrow from Cilliers’ (1998) dictum, “a jumbo jet is complicated, but mayonnaise is complex”, it can be said that “schools are complicated, but Professional Learning Communities are complex.” Schools have many interdependent parts that work together: instructional resources, student support resources, physical plant resources, and the like. While each of these parts serves important functions, if any one of them were removed from the organization, it could continue to function, albeit in a modified manner. However, a Professional Learning Community represents a dynamic set of interdependent parts in which if one part were removed, the
others could not survive as a Professional Learning Community. A Professional Learning Community depends upon common determination by teachers of students’ learning goals; it depends upon the relation of those goals to student performance; and it depends upon the response by teachers to students’ demonstrated learning needs.

Those three elements are in constant dialogue with one another. If one aspect is removed, the dialogue ceases, and the dynamics of the system are destroyed: each aspect interpenetrates the other. Absent of any of these elements, the Professional Learning Community ceases to exist. The difference between “complicated” and “complex” in this case is the dependence of each of the elements, exemplified by the Essential Questions, upon one another for maintaining their aggregate status as a Professional Learning Community.

Returning to Cilliers’ example, mayonnaise would cease to exist as mayonnaise if, for example, it no longer had oil. It would also never become mayonnaise if the oil, eggs, and other ingredients were not combined using the particular method that produces mayonnaise. Using mayonnaise as a metaphor for Complex Adaptive Systems, it is important to note this quality. Mayonnaise is an example of a whole that is greater than, or at least qualitatively different from, the sum of its parts. Through a particular combination of ingredients and technique, mayonnaise is created by ingredients that individually do not possess its characteristics. By becoming mayonnaise, those ingredients are irrevocably changed: once combined into the creamy spread, none of the ingredients can be removed – they have become “something else.”
This inseparability of ingredients is similar to the inseparability of the “ingredients” of a Professional Learning Community: learning targets, student performance, and teacher responsiveness to students’ needs are inseparable from one another in the PLC context. The particular combination of elements, and the particular way they are combined, will produce results that cannot be predicted on the basis of the individual parts.

The question, then, of whether Professional Learning Communities are comprised of “systems of systems” becomes one of whether a Professional Learning Community is a “complicated” system of systems or whether it is a “complex” system of systems. If a Professional Learning Community is indeed combining its “ingredients” in a manner that irreversibly alters their qualities, then one could conclude that it is a complex system of systems.

“A commitment to continuous improvement” and “Co-evolution that balances order and chaos.” These processes are similar to the one described in the foregoing section. However, they describe a balancing boundary between two phenomena that are typically mutually exclusive. This boundary is not so much a dividing line as a meeting zone, where both of these characteristics are balanced in a way that can become indistinguishable from one another, much in the same way that the oil and eggs of mayonnaise are indistinguishable once they are whipped together.

The “co-evolution” that takes place involves the particular characteristics that emerge from the combination of order and chaos, for within those two categories there are subcategories of order and subcategories of chaos that will produce different emergent
characteristics, different “mayonnaise,” as they interact. As the order emerges, it interacts with the chaos and becomes more chaotic; as the chaos interacts with the orderliness, it will become more orderly. The “chaos” in this model is the dynamism of changing students’ needs and teacher fulfillment of those needs; the “order” is the Standard Course of Study, the regularity of instructional pacing, and the rhythms and routines of Professional Learning Communities that produce teachers’ instructional behaviors.

**Summary of Findings**

As discussed in the previous sections, the chart below summarizes the characteristics of Complex Adaptive Systems and how they are manifested in Professional Learning Communities:
The preceding discussion and the above chart demonstrate linkages between Professional Learning Communities and Complex Adaptive Systems. The central linkage between those phenomena lies in what each does with information --- specifically, in how new information interfaces with established information, and how new information affects the global behavior of a Professional Learning Community. A Complex Adaptive System processes information (and subsequently makes behavioral decisions) in a manner that is specific to descriptions provided earlier. If a Professional Learning Community is

<table>
<thead>
<tr>
<th>Complex Adaptive Systems</th>
<th>Professional Learning Communities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole comprised of large number of parts (Maguire et al., 2006; Holland, 1995)</td>
<td>Teachers/multiple parts of school organization</td>
</tr>
<tr>
<td>Parts interact according to rules (Maguire et al., 2006; Plsek, 2001)</td>
<td>Leadership hierarchy, the Essential Questions</td>
</tr>
<tr>
<td>System displays emergent patterns without any parts having a global view (Holland, 1995)</td>
<td>“Buy-In;” a particular school’s response to student needs</td>
</tr>
<tr>
<td>Behavior of the whole cannot be predicted from its parts (Holland, 1995)</td>
<td>No single part’s performance necessarily predicts the performance of the whole</td>
</tr>
<tr>
<td>Co-evolution balances order and chaos (Van den Berg, 2012)</td>
<td>Organization change in accordance with changing conditions</td>
</tr>
<tr>
<td>Order over time, even while experiencing internal changes (Van den Berg, 2012; Bar-Yam, 2004)</td>
<td>Personnel changes, internal and external political changes do not change the essential character of the organization</td>
</tr>
</tbody>
</table>

Figure 5: Chart comparing basic terms of PLC and CAS.
functioning as DuFour et al. (2006) describe, then it is functioning as a Complex Adaptive System. As was pointed out earlier, schools are entities that have many parts; they are complicated. The practices associated with Professional Learning Communities provide schools a means for processing information that shifts the schools’ functioning from being “complicated” to being “complex.”

**Limitations of the Findings**

While the connection between Complex Adaptive Systems and Professional Learning Communities is demonstrable, it comes with caveats that themselves lend complexity to the findings.

*“Schools” vs. “Professional Learning Communities.”* Many of the contexts within which schools operate comprise the connections between Complex Adaptive Systems and Professional Learning Communities. In other words, some characteristics that lend Professional Learning Communities their connections to Complex Adaptive Systems (such as changing contexts, numerous parts, formal and informal leadership structures) are simply parts of *schools*, not necessarily of Professional Learning Communities. Other aspects (such as application of simple rules that produce co-evolutionary balance of order and chaos) fall within the domain of Professional Learning Communities and may not be part of “non-PLC” schools, or may be such without the application of PLC principles and practices.

This complexity reverts back to the mayonnaise metaphor: a school may be complicated, but it may not be complex unless it meets certain criteria that address its functioning and its responsiveness to its internal and external contexts. If a school functions as
a complex, adaptive entity, one whose adaptation is not centrally guided, then the school is
functioning as a Complex Adaptive System. It is possible that a school could accomplish this
kind of functionality in the absence of the DuFour model of organizational interactions.
However, if the school is indeed functioning in this manner, and it has done so as a result of
PLC implementation, then it can be said that the Professional Learning Community is
functioning as a Complex Adaptive System. So in order for a Professional Learning
Community to be a Complex Adaptive System, it has to become the means by which the
school becomes a Complex Adaptive System: in such cases, the Professional Learning
Community and the Complex Adaptive System are as inseparable as the eggs and oil in
mayonnaise. The connection between Professional Learning Communities and Complex
Adaptive Systems, therefore, only exists when the Professional Learning Community
exhibits the emergent, self-sustaining characteristics of a Complex Adaptive System.

“Collective intentionality” vs. “Open-endedness.” The second caveat relates to
intentionality. Many of the Complex Adaptive Systems that have been discussed in this study
are systems that develop relatively open-ended outcomes, even as they operate with tightly
limited rule-sets. This can be seen in the example of termite mounds: without centralized
directives, each termite participates in a collectively-built structure that is similar to others
built by similar termites, but is not an exact replica due to local variations. Each structure will
develop within a certain range of outcomes, recognizable as “termite mounds,” yet begin
without a pre-established design.
The kind of open-endedness that produces these structural variations is distinguished from the nature of schools. A distinction must be drawn between what would be an entirely open-ended, though limited, system and one that has a particular outcome built into its intention. Schools fit the latter description, as their outcomes are reverse-engineered, beginning with the end in mind: delivery of the Standard Course of Study. The specific outcomes and the means by which they are generated will differ from school to school, but their goal is mastery by their students of a specific curriculum within a given timeframe, i.e., a school year. Hence, together with the material limitations within which each school develops toward a complete delivery of the Standard Course of Study, each school is also bound by a cyclic timeframe, where a school year begins and ends, followed by another that repeats the cycle the next year.

This cyclic structure, and the curricular context within which it takes place, would be distinguished from a completely open-ended Complex Adaptive System, which could be described as having no pre-established curriculum -- that is, one that is developed as it is being delivered -- and that is not bound by calendar cycles but continuously moves forward in time without regard for a “beginning” or “end” of a school year. It should be noted that the provision of a time mechanism and a Standard Course of Study are both functions of the system communicating with itself: both facilitate evaluation of the effectiveness of instruction in a way that would not be possible in their absence. If, for example, there were no Standard Course of Study, only each student following their own interests, the system would devolve into chaos, as there would not be a way to develop a simple rule set to govern
the behavior of the group: with change happening in so many directions, the organization could not learn from itself, and the Professional Learning Community would quickly collapse.

**Summary of Conclusions**

A connection has been established between Professional Learning Communities and Complex Adaptive Systems. The connection is specific to Complex Adaptive Systems that exhibit behaviors specific to schools’ behaviors: they are limited by pre-established structures such as decision-making hierarchies and the Standard Course of Study, and they are reverse-engineered, rather than forward-emergent. These limitations do not preclude the aforementioned characteristics that are shared between Professional Learning Communities and Complex Adaptive Systems; rather, they refine the specificity with which Complex Adaptive Systems are manifested within the school context. Understanding this relationship can help clarify how Professional Learning Communities develop and are maintained, and can therefore provide useful background understanding for leading them. The following chapter will examine the leadership implications for understanding Professional Learning Communities through the lens of Complex Adaptive Systems.
CHAPTER 6: Implications of Findings

Approaching Professional Learning Communities as Complex Adaptive Systems carries implications for PLC leadership. As was stated in the Introduction, the lack of a theoretical framework for Professional Learning Communities has an impact upon elements such as buy-in, climate, and fidelity of PLC implementation. By providing the initial steps to developing a theoretical framework for Professional Learning Communities based on CAS theories, this study offers PLC leadership practices an expanded means by which to reflect upon effective and meaningful engagement with student learning.

Teacher Buy-In

As was noted in Chapter 1, “buy-in” plays an important role in any organizational change. It is particularly important in PLC implementation because of a Professional Learning Community’s dependence upon, and intention to maintain, positive affect amongst its participants. As was stated previously, PLC implementation should incorporate three major elements: first, presentation of research-based evidence indicating that teachers work more effectively when they collaborate; second, presentation of anecdotal data indicating that Professional Learning Communities increase the effectiveness of districts and schools that adopt them; and third, having school personnel identify their needs, and then showing how the PLC model can help address those needs.

Each of these three elements depends upon PLC-related data to encourage the implementation of Professional Learning Communities at a school. While this approach is an important component of PLC implementation, it depends upon an ex post facto argument that
is lacking a theoretical component. If a theoretical framework can be established for Professional Learning Communities, the justification for their implementation can be supported with a predictive reasoning that is connected to data-supported practice. In doing so, it can be pointed out that Professional Learning Communities are a means of connecting theory to practice within an educational context.

While the links between Professional Learning Communities and Complex Adaptive Systems approach PLC buy-in from a more theoretical perspective, perhaps not addressing the specific needs of a school or of its teachers, this approach supports Gardner’s (2004) strategies for changing people’s thinking. To review:

1. Reason: Appealing to rational thinking and decision-making.
2. Research: Building shared knowledge of the research base supporting a position.
3. Resonance: Connecting to the person’s intuition so that the proposal “feels right.”
4. Representational Re-descriptions: Changing the way the information is presented (for example, using stories or analogies instead of data).
5. Resources and Reward: Providing people with incentives to embrace an idea.
6. Real-World Events: Presenting the real-world examples of where the idea has been applied successfully. (p. 173)

As they relate to the Three Elements cited earlier, the connections to Complex Adaptive Systems serve as a means of connecting theory to practice. The strategies suggested by Gardner above are also supported by the connections between Complex Adaptive Systems and Professional Learning Communities:
**Reason:** In conceptualizing Professional Learning Communities as Complex Adaptive Systems, it has been demonstrated that they share similar theoretical territories with regard to group behavior and information sharing. Also, if organizations that function as Complex Adaptive Systems are effective in achieving their objectives, it is reasonable to conclude that Professional Learning Communities, functioning as Complex Adaptive Systems, will be effective in achieving their objectives as well.

**Research:** This study represents a beginning of research that supports the connections between Complex Adaptive Systems and Professional Learning Communities. There is research that indicates a correlation between PLC implementation and increased student performance; however, if research can conclude that Professional Learning Communities represent a melding of a theoretical model with effective practice, the justification for implementing them could be strengthened.

**Resonance:** While it may be difficult to quantify beyond subjective experience, the basis of this study lies within a relatively intuitive domain, where the inherent “rightness” of viewing Professional Learning Communities within the same continuum as “extra-educational” natural systems can have an appeal. It is also possible that the opposite could be true, where individuals may have difficulty viewing Professional Learning Communities as functioning on the same intellectual level as, say, a school of fish or a swarm of termites. However, since the concept applies to human endeavors as well as animal behavior, that objection may be assuaged.
Representational Re-descriptions: connecting Professional Learning Communities with Complex Adaptive Systems falls squarely within the domain of representational re-description; indeed, it is the basis of this study. As has been demonstrated through the various connections existing within the literature and terminologies, these concepts have already been co-existing; their connection is merely being brought to light. The applicability of this study is based in its reconceptualization of Professional Learning Communities, and the ways in which their practices can be made more effective and meaningful by thinking of them as Complex Adaptive Systems.

In a parenthetical statement, Gardner’s strategy points out an approach that “[uses] stories or analogies instead of data.” Connecting Complex Adaptive Systems and Professional Learning Communities provides a fertile basis for such an approach, for it supports idiosyncratic interpretations and reasoning behind PLC implementation. It also provides a means by which to approach buy-in from an a priori rather than an a posteriori direction: rather than relying solely upon the logic of correlations between PLC implementation and schools’ success, the persuasive strategy depends upon the analogical consistency between the activities of other Complex Adaptive Systems and Professional Learning Communities. As has been pointed out before, that consistency can provide a theoretical basis for the implementation that is supported by the data collected after the implementation.

Resources and Reward: It may be difficult to identify extrinsic resources and reward for embracing a concept; however, the motivating force that drives Professional Learning
Communities is student learning. If embracing such a conceptual framework indeed improves student learning, achieving that goal becomes its own reward as an intrinsically motivated task.

*Real-World Events:* The compelling case for PLC implementation appears to be rooted in anecdotal data related to correlations between academic achievement and the presence of Professional Learning Communities. Complex Adaptive Systems manifest themselves in real-world phenomena outside of the educational context. If those phenomena can be viewed as being applicable to Professional Learning Communities in a way that connects them, then those phenomena can be considered part of a larger continuum of phenomena. If, together with this inclusion into the larger context, supporting data can bolster Professional Learning Communities, their meaning and effectiveness may be deepened. It is through these personal connections, in whatever forms they take for individuals, that Gardner’s strategies for changing people’s thinking can take place if Professional Learning Communities are viewed through the lens of Complex Adaptive Systems.

**The Role of Leadership**

Viewing Professional Learning Communities in this manner is a means of enhancing participants’ buy-in to the PLC concept. Once the buy-in is established, however, viewing Professional Learning Communities as Complex Adaptive Systems also carries implications for the role of leadership. A central implication for this role in the CAS perspective centers on the equalizing nature of Complex Adaptive Systems, in which the dichotomy between
“leaders” and “followers” is removed. As has been indicated before, a Complex Adaptive System is a “leaderless” organization, which, by corollary, makes it a “follower-less” organization as well.

While it is certainly an oversimplification to characterize a hierarchical organization in purified terms such as leader/follower, doing so provides a contrasting perspective of the basis for an organization and the processes by which its behavior is decided. In the hierarchical organization, decisions follow pre-determined pathways; those decisions are sequential and bound to the authority of the person or people making the decisions, as well as to the compliance of the person or people enacting the decisions. In a Complex Adaptive System, the decision-making flows with necessity, and no single viewpoint or decision defines the behavior of the group: the collective behavior is emergent, rather than dictated.

While it may appear that a Complex Adaptive System presents an idealized form of organizational behavior, its characteristics make it an impractical model for the context in which public schools operate. Accountability and resource allocation require structures that support those functions; hierarchical organization provides an efficient means of connecting and distributing those properties. Yet for schools, hierarchical organization creates an intrinsic conflict, for the student-teacher relationship -- the space in which learning takes place -- occurs at the end of a long chain of decisions that were only remotely related to the needs existing within that space.

The CAS organizational model brings the decision-making closer to the activities of teaching and learning. The problem, however, is that that teaching and learning space, that
relationship, does not exist in a vacuum: it is dependent upon the chain of decisions and resources that made it possible. Hence, the teacher-student relationship depends upon hierarchical structures to facilitate its existence, yet it is those very structures that can also present obstacles to the effectiveness of the relationship. Professional Learning Communities present a means by which students’ needs can be identified and addressed, and though they operate within a conceptual model that does not depend upon hierarchical decision-making, they in fact also operate within a hierarchical organizational context. Complex Adaptive Systems provide a means by which to conceptually reconcile the non-hierarchical function of Professional Learning Communities with the hierarchical context of public school organization.

**Implications for Leadership**

The intrinsic organizational conflict presented by Professional Learning Communities stems from the conflict between centralized, hierarchical organization and decentralized, emergent organization: the “org. chart” vs. dynamic responsiveness to students’ needs. Viewing Professional Learning Communities through the lens of Complex Adaptive Systems provides a means of reconciling the relative “order” of hierarchical organization with the relative “chaos” of changing students’ needs. Complex Adaptive Systems provide a conceptual model for structured and directed interactions that are responsive to localized conditions: order and chaos do not co-exist so much as meld into a “third” entity which possesses properties that are separate from both, despite being comprised of both.
In a hierarchical organization, roles and pathways of decision-making power are clearly defined: agents on one level of the organization generally have greater decision-making power than their subordinates. However, in an emergent organization such as a Professional Learning Community, particularly when viewed as a complex adaptive system, the roles and decision-making pathways can be less clearly defined. In such a system, leadership and decision-making is more equally distributed, as it is taking place in closer organizational proximity to the events that are affected by those decisions, absent the longer chain of decision-making steps that would take place in a hierarchical decision-making structure.

Without clearly-defined roles, particularly as they relate to leadership, questions can quickly arise regarding the role of the school principal or any other formal leadership position within a school. If the decision-making within a Professional Learning Community takes place at a localized level, how do those localized decision-making structures and processes interact with formalized, hierarchical structures and processes?

As was pointed out earlier, schools, and the Professional Learning Communities within them, do not function in a vacuum. They depend upon structures and processes of resource allocation that are highly formalized and follow hierarchical decision-making pathways. Professional Learning Communities aside, schools’ resources (such as materials, human resources, and information) are similarly managed in a context of formalized, hierarchical decision-making structures and processes. On the strictly formal level,
formalized positions such as school administration populate these agencies as a matter of necessity.

Beyond that necessity, though, is the role that leadership plays within the CAS model of Professional Learning Communities. As has been stated previously, the DuFour model of Professional Learning Communities centers on the four Essential Questions. It has also been pointed out that a Professional Learning Community cannot be expected to spontaneously arise or be maintained through the simultaneous realization by teachers that the Professional Learning Community needs to exist for the sake of their students. School leadership and management are essential factors in the establishment and maintenance of Professional Learning Communities. If Professional Learning Communities function as Complex Adaptive Systems, they likewise do not spontaneously arise.

If Professional Learning Communities function as Complex Adaptive Systems, the role of school leadership in establishing and maintaining Professional Learning Communities is the same as in establishing and maintaining other Complex Adaptive Systems. Van den Berg (2012) formulated “five basic CAS elements” that are useful to serve as a basis for framing these comparisons. In many cases, the role of leadership in such a model is to maintain a balance between PLC/CAS requirements and the requirements of hierarchical organization.

**Autonomous agents.** If teachers are guided and limited by their respective curricula and pacing guides, the question of the degree of teacher autonomy answers itself with regard to curriculum. However, the question of the means and methods by which the curriculum is
delivered remains relatively open-ended. The leadership challenge in this context is to balance autonomy, or “open-endedness,” with the determinism of the curriculum. While autonomy is a prerequisite for CAS functionality, it cannot be maintained or limited for its own sake: it needs to be shaped by the guiding principle of the organization. In the case of schools, that principle is student learning and achievement.

**Communication mechanism.** The most elemental aspects of Professional Learning Communities are the communications between teachers, administrators, and any other PLC stakeholders. If a school is functioning properly as a Professional Learning Community, its teachers will be communicating; however, the leadership can influence the quality and utility of those communications. This influence is tied to the degree of autonomy afforded to teachers, and to the pathways of communications that are supported and reinforced.

Teachers who feel a sense of autonomy tend to have a higher degree of self-efficacy and job satisfaction; however, as is the case with teacher autonomy, teacher communications can become counter-productive if they are not tempered by a sense of purpose, or, in the parlance of CAS determination, by a driving principle. In this regard, the communications are limited insofar as their subject matter. However, the role of administration is to establish and maintain pathways of and procedures for communication. Again, a balance needs to be struck between systemic processes and emergent processes, so that the interests of changing student needs can be addressed within the structure of pre-established communication pathways.

**Driving principle.** It is becoming apparent that it is important not only for a Complex Adaptive System to possess the five basic elements identified by Van den Berg (2012), but
for those elements to interact with and support one another in their functioning as well. When this is the case, autonomy and communication mechanisms have been mutually supportive. Together, those elements are supported by a driving principle. In most cases, that driving principle can be summarized by a variant of “meeting student needs” or “preparing students for future success,” ideas that are frequently found in schools’ vision and mission statements.

The importance of these statements, and the concepts they represent, is that they provide a focusing prioritization for agents -- teachers and administrators -- when they must decide actions in the absence of an external decision-making authority. This function speaks to the heart of the connection between Complex Adaptive Systems and Professional Learning Communities, for it places decision-making within the domain of individuals responding to localized conditions, rather than within formalized, hierarchical decision-making mechanisms. The difficulty remains, however, within the implications for leadership: the reconciliation of formal, hierarchical decision-making and localized, emergent decision-making.

That reconciliation takes the form of formalized power interacting with localized decision-making. With reliance solely upon hierarchical decision-making, a Professional Learning Community will be limited by the formalism of the hierarchy rather than by the interaction between students’ needs and a school’s capacity to meet them. By disseminating and reinforcing the driving principle, PLC leadership is providing means by which to guide communication and autonomy in a way that does not become overly reliant upon the order of hierarchy or overly tolerant of the destructive effects of chaos.
Balance between order and chaos. As the driving principle pervades and guides communication mechanisms and teacher autonomy, the concept of the Learning Organization comes into play: on the one hand, an organization cannot learn if it is entrenched in hierarchy and procedure as ends unto themselves; on the other hand, an organization likewise cannot learn if it is functioning in a modality that is marked by change that occurs so rapidly and frequently that generative patterns cannot form. Leadership in this context involves balancing those two modalities in a way that preserves organizational order through consistency and predictability while developing a collective tolerance for change and contingency. This balance is played out through a focus upon a school’s guiding principles as teachers manifest them through communication mechanisms and autonomous decision-making.

Changing context. For schools, there are two major domains of change that must be addressed: internal and external. As the various levels of autonomy, communication, guiding principles, and balancing order and chaos play out within a Professional Learning Community, the final analysis of its status as a Complex Adaptive System is its capacity to respond to these changing contexts. The leadership of a Professional Learning Community is the center of these concentric, interdependent, and interacting features of Complex Adaptive Systems. The internal context can change in the form of changing student needs, changing curricular demands or changing personnel. The external context can change through changes in laws and policies, or changes in the community. While there are many portals through which the information related to these changing contexts can reach the Professional Learning Community within a school, the leadership is the governing mechanism that determines the
rate at which that information is processed by the Professional Learning Community as a Complex Adaptive System.

For this reason, understanding the functioning of Professional Learning Communities as Complex Adaptive Systems is useful for PLC leadership, for it provides a frame of reference for how leadership decisions flow through the Professional Learning Community while maintaining the responsiveness of the Professional Learning Community to changing contexts. Effective PLC leadership balances all of the aforementioned characteristics, both within and amongst one another; the balance is struck in real time, as each characteristic interacts with the others.

**Conclusion**

Viewing Professional Learning Communities through the lens of Complex Adaptive Systems does not necessarily change the core best practices of PLC implementation. It does, however, have the potential to enhance those best practices by providing a theoretical basis from which to implement them. By approaching Professional Learning Communities as Complex Adaptive Systems, PLC practices can be linked to best practices in fields other than education. Since education is a preparatory activity, one that provides a linkage to fields other than itself, this would be an appropriate mindset, and an appropriate theoretical framework, from which to deliver instruction.

On its face, teacher buy-in to Professional Learning Communities supports their implementation. As was demonstrated earlier, viewing Professional Learning Communities as Complex Adaptive Systems is an effective means by which to change people’s minds or
influence their thinking. Using the same understanding and the same mechanisms, it can therefore also be an effective means by which to influence the thinking of those who comprise the entire school community, for all such members can be viewed as “agents” in a Complex Adaptive System, mostly by conceptualizing and utilizing the same mechanisms that create and maintain Professional Learning Communities.

**Implications for Further Study**

Establishing that Professional Learning Communities function as Complex Adaptive Systems is useful for creating a formalized PLC conceptual framework, which can serve as the next logical step in that evolution of our understanding of Professional Learning Communities. Further, more specific case studies can be performed to deepen the body of literature that supports the connections between Professional Learning Communities and Complex Adaptive Systems. As the implications for CAS understanding of Professional Learning Communities become stabilized, that understanding can be used for studies regarding the effectiveness of Professional Learning Communities that were implemented from a CAS standpoint and those that were not.

A CAS framework for Professional Learning Communities may establish a means of evaluating PLC effectiveness that is not limited to their fidelity to a prescribed model such as DuFour's, but extends to their fidelity to a set of conditions that will enhance schools’ capacity to be responsive to the student needs to which they are accountable.
REFERENCES


Ackerman, D. V. (2011). *The impact of teacher collaboration in a professional learning community on teacher job satisfaction*. Available from ProQuest Dissertations and Theses database. (UMI No. 3482819)


Becenti, C. J. (2009). *Is there a relationship between the level of professional learning community attainment, teacher effectiveness, and student achievement.* Available from ProQuest Dissertations and Theses database. (UMI No. 3357253)


