Winter 2013

System Governance Analysis of Complex Systems

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SYSTEM GOVERNANCE ANALYSIS OF COMPLEX SYSTEMS

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A Dissertation Submitted to the Faculty of
Old Dominion University in Partial Fulfillment of the
Requirements for the Degree of

DOCTOR OF PHILOSOPHY

ENGINEERING MANAGEMENT

OLD DOMINION UNIVERSITY
December 2013

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ABSTRACT

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The purpose of this research was to develop and deploy a systems-based framework for analysis of complex governance systems using a multimethodology research design. Two research gaps motivated this research: : (1) lack of an integrated conceptualization of a system governance construct, (2) an absence of studies that consider both the governed and governing systems as well as the emergent interactions that arise from within complex governance systems.

The research focused on three primary questions: (1) What are the distinctive characteristics of governance?; (2) What system-based framework can be developed for analysis of governance in complex systems?, and (3) What results from deployment of the framework in a field setting? The multimethodology research design that guided the effort included three primary phases. First, the literature was synthesized to derive a set of governance elements. This synthesis was accomplished across an extensive and multidisciplinary literature set by a novel method of content document clustering analysis to reveal important elements of governance. Second, a conceptual framework for analysis of system governance was constructed from the confluence of extant governance literature and systems theory. This governance system analysis framework was informed by Bunge's (2003) system perspective to advance the understanding of governance that will be meaningful in a given practice. Finally, a case based application of the analysis

framework was conducted to examine implications of the framework from a field perspective

The original research provided contributions to theory, methodology, and practice. From a theoretical perspective, the research contributed to the body of knowledge by providing: (1) a literature derived set of generalizable elements of governance, and (2) the development of a systems-based framework to be used to analyze complex governance systems. From a methodological stand-point, the research advanced an integrated multimethodology research design that featured: (1) a novel content analysis approach for synthesis of diverse literature; (2) the development of an integrated systems analysis method; and (3) a rigorous single-case study application within the engineering management discipline. Lastly, from a practical perspective, the systems framework provided a foundation for derivative approaches to enhance practices related to system governance.

This dissertation is dedicated to my family, to whom I am deeply blessed for their love,

patience and support throughout this journey.

ACKNOWLEDGEMENTS

I would like to express my gratitude and thanks to family, friends, mentors, advisors and organizations that provided intellectual, financial and motivational support for this disseration to arrive at its completion.

To my academic family, friends and colleagues who encouraged, advised and challenged me to stay the course, in particular my advisor Dr. Chuck Keating, for sharing with me his wealth of experience acting as my valued advocate and mentor in the scholarly process; my dissertation committee members Dr. Adrian Gheorghe, Dr. Patrick Hester and (the recent addition) of Dr. James Pyne for their questions, contributions, time and for sharing their expertise in engaging my intellectual curiosity throughout this dissertation and in other research activities. To the faculty and staff of the Engineering Management and Systems Engineering department, for the support, encouragement, research collaborations, funding and resource-infrastructure support. To past and future Ph.D. students/fellows, thank you for the laughs, the discussions and the company which truly makes the seemingly lonely research/writing nights more colorful.

To my wife Rachelle and two sons Sean and Andrei, for enduring, nurturing and giving me my strength, inspiration and best hopes for the future. To my parents on the other side of the globe, for breathing me life into this world, their constant prayers and for their sacrifices so I could have the best opportunities growing up. To my siblings Tricia, Ahron and Colai, for the lifelong memories and future experiences I pray we will have an opportunity to share again. To my in-laws and extended family, for their words of encouragement and timely guidance at important junctures of my dissertation journey. My deepest appreciation for their faith and confidence in me is beyond words.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

This chapter presents an introduction to the research focus on development of a system-based approach for analyzing governance in complex systems. The first part of this chapter establishes the background for the research. The primary purpose of this background is to point out the engineering management discipline's present lack of understanding of governance in complex systems and the importance of pursuit of this research in response. Following the first part, the problem overview is described and the research purpose established within that problem space. Then, following the articulation of the purpose of this research, the set of objectives and their related research questions to be answered are developed. Following development of these key research concepts, the chapter concludes with an articulation of the research significance and a high-level summary of the chapter.

1.1 Research Background

Any suggestion leading to ideas involving *governance* pre-supposes a relevant *system of interest* that is the focus of governance. However, our wide ranging experiences suggest that placing such a correspondence between a *system of interest* would also be dependent on a supposedly unique governance context. Are there general approaches for a *system of interest* to govern itself in response to change or challenges in the environment or operational context? Responses to this question settle around one's preferred conceptualization of 'governance'. As this research effort will suggest in the detailed literature review in Chapter 2, governance-relevant research, in particular those

meaningful for engineering management and systems engineering practice, are still evolving, fragmented at best, and do not appear to offer exceptional utility. The fast-evolving governance research is widely debated and figures prominently within social science domains of policy studies, public administration, business economics and international studies. As widely as 'governance' interest is percolating within these disciplines, research on *systems* too has likewise seen an increase in its applicability to a range of disciplines and problem domains. While research interest on *systems* and *governance* are not new, the conceptual union forming *system governance* per se still remains an open exercise for cogent articulation and exploration. Available *system governance* research is reflected in studies within interestingly unrelated fields and appears to have developed along independent paths. Exploration of the intersection between systems and governance appears to be ripe for scholarly inquiry.

Several accounts of certain 'systems' or 'complex systems' become problematic in the context of emergence (Kettl, 2004; Folke, 2005). While ideas about emergence are still widely debated (Pierre, 2000), it is informally understood as the unexpected properties resulting from interactions between systems and their environment. These resultant emergent properties in practice typically manifest in various forms of unforeseen change, dwindling resources, increasing uncertainty, impending complexity, or other innumerable and unexplainable factors. In turn, these emergent conditions are imposed on both the system and on the environment. Emergence in the broadest sense may just be anything that catches the system off guard, in essence the age old notion of unintended consequences. A system may simply not have the ability to recognize, or even if it does - it may find itself simply ill-equipped to identify, process, and effectively deal

with emergent situations. When a system finds itself in such an 'emergent' state – a state which might suggest a focus on governance to provide stability amid emergence, a handful of competing approaches, each one contextually distinct (Aberbach & Christensen, 2003), may be explored to offer plausible paths forward. For these circumstances, one can pose the question as: does the emergence experienced from interactions within the system and between the system and environment have implications for the nature and role of its governance system to provide stability amidst the flux?

There are a range of possible system responses to emergence. First, the system may employ a 'no-action' approach, an option some may argue as not an approach at all. That is, while overly assuming a deterministic stance rooted in Newtonian cause-effect propositions, the system may simply accept the emergent status quo regardless of its implications, accepting the new conditions as compatible within its specific context. Hence, viability might be maintained by simply riding out the turbulence. A second response might include attempting to re-establish the familiar system stability by coming up with timely individual solutions to the complex set of emergent issues. This reflects an individualist/reductionist core argument where one assumes that emergent issues are to a certain degree reducible - that 'emergent' phenomena can be understood and countered in terms of their decomposition and deployment of appropriate responses. In this sense, one may prefer to rely on the totality of piece-meal solutions as a means to resolve emergent problems as long as it is feasible within the current system configuration and resources. Again, this may maintain viability by staying within the confines of the current system. Third, one may introduce a holist/non-reductionist approach based on the notion that the

relevant facts are explainable only in terms of the whole system, rendering analysis by reduction questionable. Based on this alternate holistic view, a resolution approach may attempt to arrive at solutions to solving problems based on direct and immediate grasp of the "whole" while obscuring any potentially relevant subordinate roles emanating from individual components. Again, although viability may be maintained, it is not necessarily maintained in a manner that may provide sustainability of performance or desirable system behavior. In effect, modification of the part-whole relationship in relationship to system performance may be bypassed in this perspective. Fourth and last, a systems-based approach in response to emergent conditions is advocated in this research. Systems-based approaches, in a similar context of 'systemism' as articulated by Bunge (1996), suitably addresses the challenge of emergence based on a combined appreciation of the relationship between parts and the context of wholes. The advocated systems-based approach by Bunge attempts to arrive at a *satisficing* solution where the implemented strategy may best promote the interests of a system. It is this value of systemic thinking that is poised to contribute to addressing societies most vexing problems, centered in dealing with emergence. The particular nature of this environment has been articulated in numerous works (Keating, 2009; Keating & Katina, 2011) suggesting the challenges facing scholars and practitioners in the future.

A system-based approach involves a critical synthesis of different approaches where one may purposefully build a unique approach that is appropriate to the specific nature of the political, technological, cultural, economic, and institutional constrain and enabling forces at play. Systemic appreciation and installation of systems based approaches may offer a path forward in more effectively dealing with increasingly

complex systems and problems endemic in the nature of 21st century society. Whichever system-based approaches are used to address emergence, they will clearly rest within the notional boundaries of governance as a vehicle to support greater understanding, informed decision, and evolution of systems responsive to increasing complexity, ambiguity, and uncertainty. In effect, we might look to governance as an approach to tame complexity to establishing stability essential to weather the turbulence of emergence in ways that will provide sustainable viability of complex systems.

1.2 Problem Overview

Research in governance has been intensively approached to very context-specific problem domains such as in information technology (Marks, 2008), corporate (Bouvaird, 2005; Brown, Steen, & Foreman, 2009), common-pool resources (Ostrom, 2009), risk (Brown, Steen, & Foreman, 2009), and vulnerability (Gheorghe, 2004) among others. Since existing governance related research is diversely investigated within specific disciplines or domains of practice, a comprehensively integrative concept of governance has yet to be produced. There must be caution in pursuing the governance field of research focused on avoiding getting tangled in irresolvable philosophical arguments and debates associated with independently developed perspectives and applications of governance in relationship to systems theories and models. However noble an undertaking, it is not likely that a resolution for longstanding incongruities in discourse across disparate disciplines will be produced anytime soon. The entrenched positional stances may exist from drastically dissimilar sets of base assumptions, precluding the possibility of complementary integration. However interesting the intellectual debates in

governance might appear, they are not likely to effectively engage the current scholarly inquiry being undertaken with respect to system governance. On the contrary, such musings offer background at best and tangential distractions at worst. Therefore, the problem focus for this research must bypass the irresolvable issues related to governance, and more directly focus on issues related to development of the concept in preparation for ultimately deriving scholarly grounding for deployable artifacts, technologies, and guidance for practice necessary to enhance capabilities to better address complex system problems.

So far, the main argument in background for this research focuses on two central points of issue: first, there is a conceptual partiality or incompleteness of current 'governance' initiatives with respect to the objects and practices it governs; second, the incomplete understanding of systems of governance are always focused internally on a known system or externally on systems involved in the process of governing. In other words, sources of appreciation for governance are often seen as driven by an external system on a 'governed' system rather than from 'governance' stemming from within the 'governed' system itself. Therefore, the landscape for governance is problematic. There are issues of internal/external focus and the implications for interactions between internal and external governance perspectives. The internal/external nature of governance is not binary reducible, but the inherent relationship must be considered integral and intrinsic to the inquiry into system governance.

From the systems perspective, some cognizance about the applicability of system theory (Adams, 2012; Adams, et al., 2013) is gaining ground. This will be helpful in providing insight into possible ways to understand and interpret governance literature,

issues, and discoveries as well as possible contribution to design implications to preclude possible governance failure modes. The investigation of empirical and normative questions related to governance will be invaluable for those involved in both the research and practice of governance for complex systems. The topics of governance are in an ongoing tension, being simultaneously overbroad (spanning many different disciplines) and overly narrow (being isolated within independent disciplines) where multiple phenomena related to governance appear to be trespassing of multiple disciplines and practice. A transdisciplinary approach is considered an apt focal lens to advance further the study on governance. The use of the term 'transdisciplinary' follows the meaning implied in Gibbons et al., (1994) referring to a shift in knowledge production that is conducted, along cooperative patterns, by a plurality of scientific and non-scientific partners. A similar distinction amplified in Maasen and Lieven (2006) and in Jacobs & Frickel (2009) that refers to transdisciplinary as "knowledge produced jointly by disciplinary experts and social practitioners" (p. 45). Systems theory, as recently argued by Turke (2008), offers a truly transdisciplinary set of principles and perspective that can serve to integrate concepts across the breadth of disciplines that may be useful to formulate a well-grounded conceptual foundation for governance.

Therefore, systems theory provides an important foundation to identify a transdisciplinary system-logical conceptual framework to transcend an otherwise fragmented mapping of a tangled set of disciplinary specific understandings of governance. In this regard, it is crucial to investigate the different philosophical underpinnings of current understandings of governance, utilize insights from systems-based literature in order to critically examine existing frames of reference for governance,

and finally advance the field through formulation of more sophisticated 'systemic' integration of governance concepts.

1.3 Research Purpose, Objectives Statement and Research Questions

The research purpose was *to develop and deploy a systems-based framework for analyzing governance in complex systems*. Based on extant literature from diverse disciplines and practice, there wasn't one coherent articulation of governance that could be useful as a basis across varying problem context and scale. There certainly was no generalized and widely accepted conceptual grounding or definition of governance that exists in the literature. This was particularly the case in crossing the boundaries of different disciplines. Definitions of governance and their associated real-life deployment were often considered as either too narrow or limited to be transferable to another domain or scale or level of practice. For instance, new trends of financial governance that focuses on regulation, oversight and transparency do not blend well with ongoing trends in IT governance that are focused more on resource management, data security, and enterprise accessibility. In this research, a working concept for "governance", synthesized as a starting point drawn from multiple literatures, attempted to elaborate the underlying worldviews and approaches necessary for maintaining identity, providing order and structuring diverse system/s elements to achieve *collective* goals within the relevant context for a specific system of interest (Duit & Galaz, 2008; Rosenau, 1997). This will be elaborated much further in the detailed literature review to follow in the next chapter. This research bridged the gap between distinct worldviews or accounts of governance

from different disciplines and practice with an analytic systems-based approach articulating the embedded logic of governance in complex systems.

Research purpose

To develop and deploy a systems-based framework for analysis of governance in complex systems

Research Objectives

Identify generalizable elements of governance	Develop a systems-based analytic framework of governance in complex systems	Deploy the systems-based analytic framework in field setting context

Research Questions

What are the distinctive characteristics of governance?	What system based framework can be developed for analysis of governance in complex systems?	What results from deployment of the framework in a field setting?

Figure 1. Integration of research purpose, objective and individual research questions

As shown in Figure 1, an overarching research purpose is supported by three interrelated research objectives. In turn, these research objectives were used to derive the supporting specific research questions. Given the stated research purpose, the specific structure of the inquiry proceeded with the following research objectives:

    i)   To identify generalizable elements of governance systems;

ii)   To develop an advanced systems-based analytic framework, based on identified relevant body of knowledge, that provides analytic utility for performance of "governance" in complex systems;

iii)   To deploy the systems-based analytic framework through a single case study approach to examine the analytic and practical utility in a field setting.

Accordingly, in relation to the research purpose and the associated research objectives, the overarching questions which this research aims to address were served to guide a set of research questions. A summary showing the interrelationships between the research purpose, objectives and research questions appears in Figure 1.

The first research question addressed in this research was: *What are the distinctive characteristics of governance?* There are several frames to understand the nature of governance and its characteristics. Traditional sources of governance-rich literature in the social science disciplines (i.e. political sciences, public administration, and policy studies among others) and including practice-oriented domains (i.e. engineering management, development studies, international relations, economic market studies, industries, etc.) provide sources to examine disparate governance research threads and perspectives. While divergent views were expected as one move from one domain to the other, the research examination for the first question was designed to explore the conceptual commonalities reflected through similar, core ideas, assumptions and propositions which inform the concept of governance, irrespective of the domain of origin. It was these types of distinctive characteristics that are sought to answer the first research question.

The next research question addressed was: *What system-based framework can be developed for analysis of governance in complex systems?* In understanding governance, a systems based approach was sought to reveal coherent governance patterns within a given systemic context. Once these characteristics are taken into account, one may be able to produce a more advanced level of understanding. One's increased understanding that can result from construction of such an analytic framework will provide enhanced knowledge of governance systems.

Last and certainly not the least important, the following research question addressed was: *What results from deployment of the framework in a field setting?* Based on characteristics drawn from the body of knowledge and having structured them using a systems-based analytic framework, a case study research design was appropriate and suitable to answer the last research question. From the single-case study, a holistic research design allowed examination of the framework in an operational field setting.

In its contemporary usage, it would be difficult to reconcile the concept of "governance" based on various dissimilar interpretations/ideas in a variety of different contexts (De Alcantara, 1998; Rhodes, 2000). Despite these conceptual incompatibilities arising from various accounts of governance from different disciplines, it is widely acknowledged that governance continues to be an important term to be conceptualized. This will continue to be the case since in practice, as Ostrom (2008) also suggested, existing systems of governance will continue to find ways to sustain productive system 'states'. A disconcerting reflection on the need for governance is alluded to in scholarly writings concerning "system under stress" (Kettl, 2004) and the suggestion of existing system shortcomings in metaphors of contemporary "dark times" (Stivers, 2008). While

there appears to be general agreement on the need for governance, the same level of agreement is absent when it comes to agreement on a common perspective of governance. While the scope of governance may actually encompass a much larger set of issues within the existing body of knowledge, this research was significant because of its contributions to theory, methodology and implications for practice. The following section amplifies the significance of this research.

1.4 Research Significance

The significance of this research can be succinctly viewed as scholarly contributions in terms of (1) theoretical, (2) methodological and (3) practical implications as summarized in Table 1. The specific areas of significance are elaborated in more detail below.

The theoretical contributions of the research included: (1) articulating and organizing the current state of knowledge for governance, including identification of gaps, and (2) an original systems theoretic based framework inductively developed from multidisciplinary literature for analysis of governance in complex systems. This is significant in that there is not currently such a rigorously developed systems-based framework for analysis of systems governance in the body of knowledge.

From a methodological perspective, given the diverse set of situations where governance may be observed in practice, there was not one available applicable systems-based framework that can be used and be considered as transferable to various systems context. Although there are systems based approaches to deal with different aspects of complex systems (Keating, 2009).The approach developed and deployed to apply the

governance framework (model) provided a significant methodological contribution in this direction. The preparation and application of the framework provides the basis for a corresponding method for application. Additionally, the rigorous application of a case study method to provide a level of "face" validation for research that is largely theoretic-conceptual was in itself a methodological contribution, as the case study method (Yin, 2009) has not reached a significant level of stature as a research design alternative for the engineering management discipline. Finally, the use of a novel method for enhanced literature content analysis represented a significant contribution on the methodological front. With increasing volumes and access to information (research literature), coupled with the expanding multidisciplinary focus of research issues, new methods to support more efficient literature searches across wider information domains offers significance in the research methods realm.

Table 1. Contribution areas and research significance

Contribution Area	Research significance
Theoretical	• Articulation of literature-derived characteristics of governance and their implications in governance systems • Formulation of a systems-based framework to be used to analyze complex systems relevant to governance; • Address gap in the body of knowledge having presented a system-based model of governance systems to link theory to practice
Methodological	• Development of a novel content analysis approach for dispersed knowledge synthesis • Integration of advanced systems-based research strategies in constructing a generalizable system analytic framework • Development of a systems-based framework to be used for analysis and design of governance systems
Practical	• Demonstrated use of a single case study research design that is not extensively employed in the systems research domain • Providing practitioners guidance in understanding the nature of governance systems

Lastly, the research also has important implications for practice. Through a deployment of a single case study, an indicator of the utility for practitioners responsible for conducting or maintaining 'governance' systems was established. The contribution and implications for utility of the analytic framework and its associated methodology to enhance existing or new developments of governance in complex systems represented a significant contribution to practice.

In summary, a thoughtfully crafted "governance" research was significant because 1) it advances the scholarly multidisciplinary discourse on governance in terms of theory and methodology; and 2) it informs the world of practitioners who are responsible for the design and operation of governing systems.

1.5 Chapter Summary

In summary, the governance problem domain painted a research landscape that is still fast evolving and still very much fragmented. This fragmentation was reflected in the diversity of knowledge posited within specific disciplines as well as the conflicting accounts of experience accumulating in certain communities of practice. An integrated account of systems and their governance supported the need for research of phenomena in this area. At a fundamental level, the governance problem was cast in realization of the problem within the context of emergence and complex systems. In the literature reviewed (amplified in Chapter 2), oft employed individualist and holist approaches were criticized for being 'hit-or-miss'. Although holism, the key basis of holist approaches, is one of the philosophical foundations of systems (Ackoff, 1971), Bunge suggested an

emergentist systems view that is distinguishable from the competing individualist and holism alternative paradigms. Individualist approaches assert that the properties of a whole are just hereditary properties of its parts. Whereas holism, on the other hand, asserts that the totality transcends its parts and that the properties of the whole are independent from those of the parts. Instead, a system-based emergentist approach was advocated in this research. A system-based approach implied a combined articulation of the relationships between parts, acting together with the context of the whole, where these insights would result in better understanding of the complexities in operation and enhance the potential responsive decision space based on that understanding. This is based on the emergentist view emphasized by Bunge(1996) as a view that acts as a channel or pathway between the individualist and holism approaches: some system parts is necessary, but not sufficient, condition for understanding the system, and must be supplemented with an examination of the properties of the whole (Bunge, 1996).

Developing a systems-based approach to articulate and make explicit the notional boundaries of governance was suggested as potentially insightful and relevant for dealing with the emergence in complex systems. In response to this challenge, the research purpose was *to develop and deploy a systems-based framework for analyzing governance in complex systems field settings*. Supporting this research purpose, three research objectives were expressed, namely: (i) to identify generalizable elements of governance systems;(ii) to develop an advanced systems-based framework, and (iii) to deploy the systems-based analysis through a single case study approach to demonstrate the analytic utility and implications of framework in context field setting. Accordingly, a corresponding research question was posed for each of the objectives identified. These

questions are: (1) What are the distinctive characteristics of governance? (2) What system-based framework can be developed for analysis of governance in complex systems? And (3) What results from deployment of the framework in a field setting? The significance of this research spans original theoretical, methodological, and practitioner relevant implications.

CHAPTER 2

LITERATURE REVIEW

This present chapter highlights the state-of-the-art research and practice involving both systems and governance concepts. There are three primary objectives of the literature review. First, the synthesis of the literature related to system governance. This synthesis is designed to establish the current state of the field. Particular attention was given to synthesis across the multidisciplinary nature of system governance. The second objective was to provide a scholarly critique of the literature to identify the strengths and limitations of the state of the topic. Third, in conjunction with the critique, relevant gaps in need of further exploration, elaboration, or confirmation were established. The fourth objective was to clearly establish the position and fit of the current research within the larger body of knowledge for which it will become an original contribution. To achieve these objectives, the chapter is organized to first provide an overview of the body of knowledge scope. This provided a boundary for the literature and the scope of the effort to cross multidisciplinary lines. Next, the chapter explores the state of literature for systems philosophy and the systems based approach. This establishes the nature of 'systems' as the basis for establishing the analytic framework for governance. Following the examination of the systems literature, the literature with respect to governance is elaborated. This examination is truly multidisciplinary, as it is expansive across several disciplinary fields and the corresponding sets of literature. The literature review then provides a synthesis of the general themes that have emerged from the review. Care is taken to establish the basis for the themes that run through the literature as well as the

absence of thematic areas that are ripe for research exploration. This is used to position the current research within the body of knowledge as elaborated by the literature review.

2.1 Overview of Body of Knowledge Scope

To begin an informed foray into *system governance* across different disciplinary knowledge domains, the literature review process initiated with a search query through ISI Web of Knowledge Social Science Citation Index (SSCI) and Science Citation Index (SCI) as the database of record since it is the most comprehensive database of peer-reviewed research work for both the social sciences and sciences, respectively. The resulting search records served as a starting point to initiate the literature review process although the entirety of the reviewed literature was extended to sources from outside those initially identified from the primary indexes. Mainly, this preliminary exercise helped to establish a coarse research context (mainly by setting main disciplinary and seminal works sources) which was then used to narrow down previous works that deemed to be relevant to this research. Using a science overlay map (Rafols, Porter & Leydesdorff, 2010), a visual interdisciplinary knowledge domain representation of the resulting search records was visualized as shown in Figure 2 below. This representation provided a "simple and quick" visualization of the disciplinary diversity of governance-related research context without the need for sophisticated combined indices. For instance, as one interpretation from the set of retrieved data, a cognitive knowledge space mapping of mainstream "governance" research is predominantly contextualized from the disciplinary domains of business, management, policy studies, and economics among others. There were also dispersed weak accounts of "governance" research that emerged

in areas of engineering, environmental and ecological sciences, as well as computer sciences. This was indicative of emergent research on associated conceptual ideas and applications of "governance". Also, from the collection of literature sources, it was useful to bear in mind how possibly each conceptual account of governance evolved from the diverse philosophical (axiomatic, epistemological and ontological) orientations and methodological choices that were inherent in the domain under which different strands of governance research were explored.
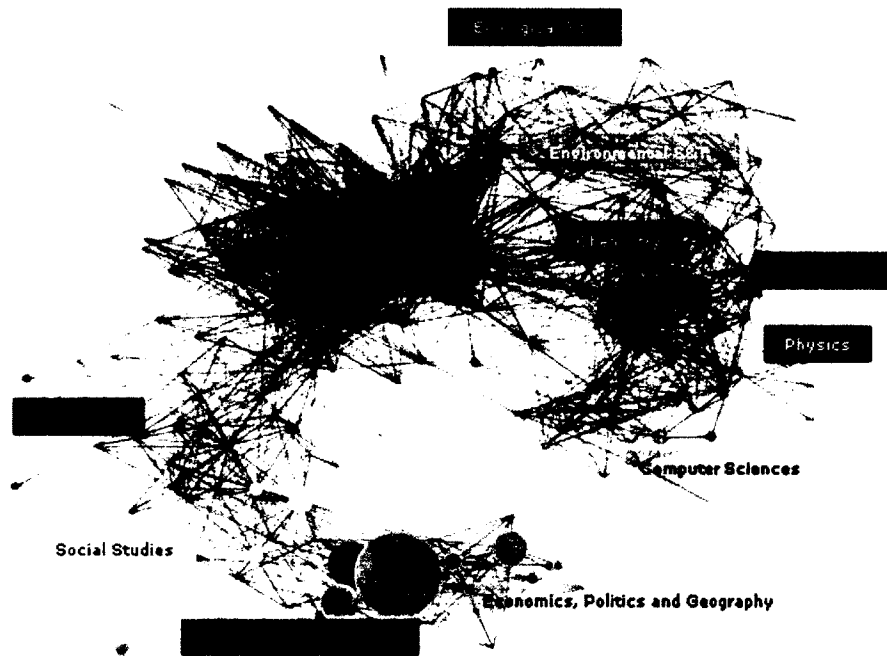
Figure 2. A science overlay map of governance-related research

Furthermore, the above mapping gave a better appreciation of the existing intellectual diversity of governance research. Intellectual diversity as represented by (1) the *variety* of disciplines involved directly or indirectly in governance research, (2) the

balance of how each of the disciplines have contributed to pushing the envelope of "governance" research thus far, and (3) the *disparity* conveyed by how accounts of "governance" from different disciplines are proximally located on a cognitive spatial map. As a first hand high-level assessment of the diversity of research for system governance, it can be elaborated that "system governance" was actively researched in the domains of many disciplines (as high variety), where several of the governance-research treatments were expected to be arguably qualitative in nature coming from subjectivist disciplinary paradigms (one way of interpreting research balance), and being significantly largely framed within economics, politics, business and management (highly dense disciplinary nodes in mentioned areas as an indicator of low disparity). From an engineering management and systems engineering stand-point, quantifiable research on systems governance was practically nonexistent, if not limited in number at best.

To further demonstrate a 'funnel down' mapping of the relevant literature on system governance, the research frame initialized by disciplines and communities of practice familiar with the bodies of knowledge investigating associated phenomena. System governance had for its root components 'systems' and 'governance' which were separately cultivated from specific disciplines or observed from particular application or problem focused communities. The literature review shown in Figure 3 resulted in several informative articles. However, one can easily cast doubt concerning their cross-concept consistencies more specifically on the development of the concepts and theories themselves as opposed to more superficial treatment of the phenomena associated with system governance. While versions of 'systems theories' and 'governance theories' abound, a 'system governance' concept or theory was not available and was not explicitly

articulated. Though studies on 'system' or 'governance' have progressed, a 'system governance' research thread was not determined to have been approached from an integrative perspective - that is appreciative of the purview of disciplines investigating systems or governance, nor from those from practitioner communities engaged in 'governance' application or problem domains.

Organizational Science

Cybernetics

Complexity theory

Systems Theory

Institutional Studies

Private & Public Affairs

Economics

Systems

Primary Healthcare

Developmental studies

Ecology & study of the commons

Education

Government, Law & State

New Public Management

International Relations

Governance

Policy Sciences

Public Administration

Disciplinary focus

Application/ Problem focus

System governance

Figure 3. Multidisciplinary evolution of 'system governance' concepts

The different highlights from each disciplinary research line are presented in the following sections. In particular, the next section discusses the state of the literature in systems and systems approaches which was closely followed by the state of the literature for governance research mostly from more predominantly 'governance' focused disciplines.

2.2 State of the Literature in Systems Philosophy and Approach

The main highlights to be covered in this section focused on the state-of-the-literature in systems research including an articulation of its philosophy (e.g. systems philosophy) and its approach (e.g. systems approach) as reflected from investigations in recent systems research.

The modern systems movement have grown in prominence over the years since Von Bertalanffy (1950) first posited his theory on open systems that became the basis of the renowned General Systems Theory or simply GST (Boulding, 1956). Resulting from these seminal works, the body of knowledge or BoK has been enriched by several closely woven research threads in complex systems (Bar-Yam, 1997; Kauffman, 1993; Simon, 1962), systems analysis (Hitch, 1955; Digby, 1989), second-order cybernetics (von Foerster, 1979), system dynamics (Forrester, 1961; Senge, 1980), soft systems methodology (Checkland, 1981), critical systems thinking (Jackson, 1985, 1991; Ulrich, 1983), systems architecting (Maier, 1998), systems engineering (Hall, 1965), and systems of systems (Ackoff, 1971; Jackson & Keys, 1984; Keating, 2005; Keating & Katina, 2011). While a complete and exhaustive account was pertinent in understanding the history of the systems movement, it is beyond the scope of this research. One may, however, endeavor a more in-depth look at any of those seminal works mentioned above. What is pertinent to the current research was the articulation of the underlying system philosophy that enabled us to draw a clear understanding of a 'system' that was consistent with the contemporary understanding of the systems approach and directly relevant to this research with respect to system governance.

The main philosophical strands that are brought into focus in this study make a distinction between the traditional reductionist philosophies, which support a traditionally mechanistic view from the natural sciences, versus the emergentist philosophies now being embraced by modern day interdisciplinary science (Pickel, 2007; Wan, 2011). Prior to a conscious awareness of what was meant by systems emerged, the widely adopted philosophical worldview during this time was that of the 'scientific method'. The philosophical precepts of 'scientific method' were initially alluded to by Rene Descartes and then eventually carried over to modern day scientific practice.

> *The first was never to accept anything for true which I did not clearly know to be such; that is to say, carefully to avoid precipitancy and prejudice, and to comprise nothing more in my judgement [sic] than what was presented to my mind so clearly and distinctly as to exclude all ground of doubt. The second, to divide each of the difficulties under examination into as many parts as possible, and as might be necessary for its adequate solution. The third, to conduct my thoughts in such order that, by commencing with objects the simplest and easiest to know, I might ascend by little and little, and, as it were, step by step, to the knowledge of the more complex; assigning in thought a certain order even to those objects which in their own nature do not stand in a relation of antecedence and sequence. And the last, in every case to make enumerations so complete, and reviews so general that I might be assured that nothing was omitted.*

The above passage was by Descartes (reprinted 2009, p. 21) in this classic work entitled "Discourse on the Method of Rightly Conducting the Reason and Seeking Truth in the Sciences". Following Descartes, four primary precepts have been introduced that serve to define the scientific method. Scholars now considered these precepts as the embodiment of skeptical inquiry (the first precept), and the consciously exhaustive analysis (the fourth precept) which partly typifies the dominant approach in modern Western philosophy. Additionally, the precepts of analytic reduction (second precept), and the rule of understanding the simplest objects and phenomena first (third precept)

have become the underlying basis differentiating modern science from philosophy. Together, the precepts two and three became to be known as the antecedents of Cartesian analytic methods that prescribed to the view of scientific explanation through decomposition of problems into simple parts to be considered individually. These parts could then be re-assembled to yield an understanding of the integrated whole. Using these ideas, many of the key developments in traditional disciplines of science promote what is now considered a mechanistic science worldview that promoted mostly mechanical properties of things as primary, in contrast to the derivative and secondary properties divulged in other sciences. Due to the unprecedented success of the scientific method, its philosophy that proved so successful in resolving vexing problems of physical phenomena continued to slowly find its way outside of the natural sciences. However, there was a rejection of the appropriateness of the approach beyond the successes found in the natural sciences. According to Checkland (1981), this paved the way to realizing that Cartesian reductionist philosophy, when applied to the social science domain, is seriously constrained to explain problems of complexity (e.g. emergence), problems of social science (e.g. rational behavioral capacity) and problems of management (e.g. problem uniqueness). Similarly, Casti (1981) also noted the same limitations of scientific modeling when indiscriminately applied to the modeling of processes in the social and behavioral sciences. He contended that fundamental aspects that allow classical scientific modeling to work flawlessly, such as the existence of fundamental 'laws' that are either absent or unknown, are characteristically indeterminable for systems that demonstrate complexity, man-made structures and several possible social interactions. Based on this premise, an alternate philosophy is being argued that would consider the possibility of

taking into account the absence of laws and of operationable forms of key concepts in the social sciences (Pickel, 2007).

Several significant contributions of the science-based philosophy emanating from the natural sciences shaped the present disciplines of physics, chemistry, and biology among many others. Furthermore, several scholarly advances in the sciences and social sciences have pushed for an alternative way of thinking based this time on systems philosophy. This systems philosophy according to Checkland can be attributed to mainly the following two sets of ideas: (i) emergence and hierarchy, originating in organismic biology and generalized in GST; and (ii) communication and control, originating in communication engineering and generalized in cybernetics. As a main distinction that makes it broader than traditional disciplines, these sets of ideas support a systems approach that is fundamentally interdisciplinary.

Separately, Bunge (2000) articulated system philosophy or simply *systemism* as distinct from the reductionist/mechanistic philosophy of *atomism* and *individualism* (or micro-views) but also likewise different from ideas of *holism* (or macro-views) that is often conflated by some to mean one and the same as systems philosophy. He clarifies that while the holistic approach supposes to accept only the idea that a whole is more than a mere aggregation of its parts: it also maintains also that wholes must be taken at prima facie value, understood by them, not through analysis. Below is his reasoning as to why systemism should be considered as different from holism.

> *Because the holistic approach rejects the possibility of analysis, it relies upon the method of intuition, not rational explanation or empirical experiment. While the systems approach recognizes the existence of emergent properties, it nevertheless seeks to explain them in terms of how their constituent parts are organized. Where holism is satisfied with a non-rational apprehension of un-analyzed wholes, systemism aims to demystify emergent properties by*

providing scientific understanding that utilizes analysis as well as synthesis. Therefore, it is equally important that the systems approach be distinguished from holism as from mechanism (Bunge, 2000, p. 149).

Having recognized that both macro- and micro- entities and their processes are at best partial contributors towards complete understanding, systemism requires a full set of linkages for purposes of theorizing. In other words, systems philosophy and the systems approach views systems as a function of its composition, environment and structure, with the appreciation of the necessary linkages or mechanisms that specify its functional form. Bunge posits that the systems philosophy is the adoption of a worldview that is underpinned by the following postulates:

1. *Everything, whether concrete or abstract, is a system or an actual or potential component of a system;*
2. *Systems have systemic (emergent) features that their components lack, whence*
3. *All problems should be approached in a systemic rather than in a sectoral fashion;*
4. *All ideas should be put together into systems (theories); and*
5. *The testing of anything, whether idea or artifact, assumes the validity of other items, which are taken as benchmarks, at least for the time being.*

Based on the above postulates, the system notion adopted in this research is closely following Bunge characterization of systems in terms of its composition, environment, structure and mechanisms or simply called the CESM model (through substitution using each the initials of the key concepts). Composition is the collection of all the parts of the system. The environment is a collection of items, other than those composing the system, that act on or are acted upon by some or all components of the system. Structure is the collection of relations, in particular the linkages, among which components of the system interact with themselves or with their environment. Mechanisms are those collections of processes in the system that explain why the system

behaves the way it does or more specifically, these are the processes or entities that mediate between the observable inputs and outputs of a system.

Following from the earlier discussion, and specifically on Bunge's updated notion of the systemic view, the distinction in different interrelated classes of philosophical considerations are important foundations for the research. As depicted in Figure 4, these may fall under the following several classes: i) epistemological, ii) ontological, iii) methodological, iv) axiological, and v) ethical.

Epistemology
"How we came to know?"

Axiology
What is good or bad?

supports

guides

Ethics
What is right or wrong?

guides

Is based on

Methodology
What approach(es) link knowledge/ ——determines——► concepts with problem/phenomena?

Methods Techniques

supports

for theorizing on

Ontology
"What is said to exist?

applied to

relates to

Research problem
'real world'
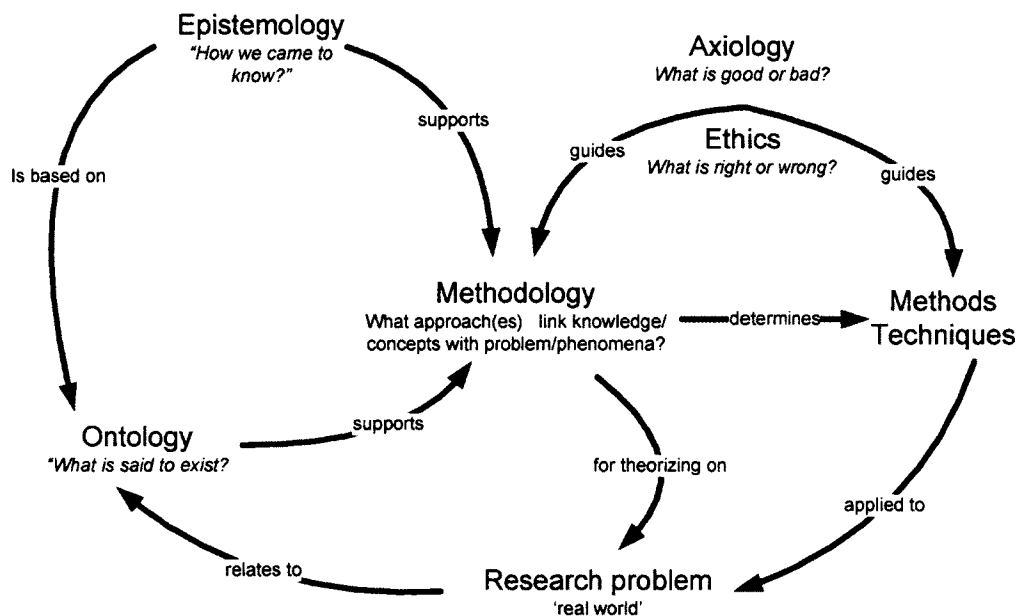
Figure 4. Systemic research paradigm

By epistemological, these refer to the starting assumptions of knowledge, or in this case the manner in which 'system governance' constructs is formed. Epistemology is about how we came to know? According to Bunge, this is an elaboration on the roles of

observation and speculation, intuition and reason, discovery and invention. Johannessen and Olaisen (2005a) add that it also concerns the distinction behind intention and behavior. For instance, the interpretation of meaning becomes an important part of the intention aspect while explanation and predication becomes an important part of the behavior aspect. These provide an important consideration for systemic research where Johannessen and Olaisen (2005) state:

> *In the systemic research model, the mental (emic) does not precede the behavioral (etic), but constitute different knowledge domains to be studied, together or separately. Sometimes the one may be the case of the other, and, at other times, vice versa. Constructs from both domains are used on the condition that workable indicators can be developed. Further, it should be noted that according to the systemic approach, all adequate explanations in social science are pluralistic, i.e. they are related to the model of the human being and the social systems we use, and it is therefore only partial truths...Much of the existing confusion in social science emanates according to systemic thinking, from a lack of distinction between intention and behavior (Johannessen & Olaisen, 2005a, p. 1572).*

Meanwhile, ontological considerations pertain to the nature of reality that is reflected in the constructs. In basic philosophy, ontology is the study of what is said to exist. In the case of system governance, by its adherence to systemic precepts, views the world as a system consisting of subsystems. It would entail an examination of the nature of system governance in society, the kinds of social processes, actions, events, and artifacts involved in governance, as well as the different levels affected by this governance. It would also be concerned with questions like: What precisely are the systems being governed, and who are those responsible for governing? What type of relationships exists with the greater environment? What are the engines of governance: a system of values, norms, laws, culture, politics, economics, or some combination of all these? Do these systems refer to entire social systems, or only aggregate or only

individuals? What are the macro-micro relationships that need to be taken into account? In systems terms, what by-products of system governance may be considered as *emergent*? Emergence takes place as something new emerges which previously did not exist at a lower system level. Emergence, an important systems concept, is crucial in establishing the exact nature of the relation between micro and macro processes. Systemic thinking is based on the premise that society is a concrete system of interrelated individuals, and that some properties are aggregates of individual properties, while others are "global" and emerge as a result of relations between the individuals. The emergent properties must be studied at different levels in a system, and the relations between the levels must also be studied.

Next, there are methodological considerations, or just simply the methodology, which pertains to anything related to general method or technique. From a systemic view, methodology helps to maintain the interconnections, both in terms of concrete things, ideas and knowledge to the problems or phenomenon under study. In general, methodology looks at the nature of this data – its meaning, how it should be interpreted, possible means of validation among others. However, Guba and Lincoln (1994) suggests that methodology is constrained by earlier epistemological and ontological assertions. Take for instance the role of the observer/inquirer, where the observer's conception of social systems would influence their actions regardless of whether their conceptions are justified to be right or wrong. A systemic methodological consideration should therefore start "from individuals embedded in a society that pre-exists them and watch how their actions affect society and alter it" (Bunge, 1996, p. 241). Johannessen and Olaisen (2005b) further added that a systemic approach must reasonably always include actors,

observers, and social systems. The methodology should look into the mental models actors have about their social system. An observer attempts to disclose the system's composition, environment and structure. Social systems themselves have inherently specific processes and mechanisms that need to be disclosed. From all these, the methodology reflects the researcher's decision as to what needs to be analyzed (i.e. unit of analysis like individual, aggregate, organization, enterprise, society). Thinking in terms of systems, this unit of analysis should be viewed in light of its relationships with a larger system where it is a part of, and how it is involved with the lower level system.

Lastly, there is axiology and ethics to enhance the systemic research paradigm. Although each have their specific place in philosophy, both will be discussed together in this section. Axiology is also known as value philosophy that refers to a philosophical school of thought "that examines the common ground for various forms of evaluations" (Johannessen & Olaisen, 2005b, p. 1575). Ethics, on the other hand, established the code of conduct of researchers. Specifically, ethics asks: "What is the role of moral norms in the development of theories, frameworks, and models?" Both axiology and ethics have objective and subjective elements that need to be made explicit given a specific situation or research purpose. Therefore, axiology and ethics as applied to considerations for a systemic research paradigm deals, among other things, with the question of the role of values/ethics in the research. Research based on a presumed value and ethical philosophy, specifically from a systems standpoint, will allow for an assessment of effectiveness in the eventual outcome of the research. Some research situations or purposes call for a concerted effort to address or study social phenomena or problems. These types of problems may be properly addressed if addressed by interdisciplinary/multidisciplinary

teams that have similar axiology and ethical foundations. What is important for a systemic research paradigm is to allow axiology and ethics to achieve their defined goal while reflecting the objective needs and subjective wishes of actors at multiple levels of the system.

These include the key system tenets of system boundary, multiple perspectives, the notion of a system paradigm and emergence. Adams (2011) succinctly summarized these tenets among many others. These systems tenets were discussed below to draw out some underlying system foundation that may be relevant for system governance.

Systems boundary – The notion of system should be understood as a representation of an entity as a complex whole open to exchange or feedback from its environment. Adhering to this tenet is crucial as it dictates a proper framing to problems of complexity (e.g. emergence), problems of social science (e.g. rational behavioral capacity) and problems of management (e.g. problem uniqueness) that are not comprehensively addressed by reductionist thinking.

Multiple perspectives – The existence of macro- and micro- entities and their processes each can only provide at best partial contributions towards complete understanding. Any problem that uses the systems approach requires a full set of linkages for purposes of theorizing. The value of adopting a systems approach is drawn from the critical examination of simplifying assumptions. This helps to make explicit the limits of applicability, such that transformation of the relevant assumptions can possibly extend the application of scientific model-building.

System paradigm – Systems philosophy and the systems approach views systems as a function of its composition, environment and structure, with the appreciation of the

necessary linkages or mechanisms that specify its functional form. When presented with a problem, one must reflect on how to make explicit distinct but different interrelationships of the nature of the problem in terms of epistemological, ontological, methodological, axiological, and ethical considerations.

Emergence – In systems, it is an instantiation of a transformation of something new which previously did not exist at a lower system level. Emergence is crucial in establishing the exact nature of the relation between micro and macro processes. The transformations apply in general to reductionist assumptions that wholes do not have properties apart from the properties of their components, and in particular to linear thinking about causation, composition and control. In general, the premise of emergence is the revelation of interrelations of certain entities that have properties that are not simply aggregates of individual properties, or in others cases may be "global" as a result of relations between themselves. The emergent properties must be studied at different levels in a system, and the relations between the levels must also be studied.

In summary, by enriching our understanding of its history leading to what is now referred to as system philosophy and its approach, we can draw a rich context of important system tenets which will be foundational for the research. Up next is a review of the various research highlights related on the other key concept on governance.

2.3 State of the Art in Governance

Similar to the last on systems, this section highlights the state-of-the-literature in governance research including an enumeration of the different ways 'governance' has been understood in different disciplines and areas of practice, and to make a distinction

between two broad categories namely 1) the rationalist approaches and 2) the empirical school of thought on governance research.

2.3.1 A litany of 'governance' concepts

The meaning of governance is undergoing transformation and is far from offering any semblance of a generally accepted definition, perspective, or related practices. At first glance, studies have noted that there is an ambiguity between the concept and the practice of 'governance' (Walters, 2004). Walters further adds that beyond mere asymmetry of concepts and practice, the problem is actually deeper, going back to the actual presupposition roots and commitments in the implementation of 'governance'. Indeed, uncovering the history of governance over the years reveals the interestingly arbitrary deviations of the concept. There have been accounts that governance as originally first used by Plato himself. Historically, the origin of the word governance can be traced to the Greek verb "kubernân" or its Latin roots "gubernare". As early as a passage in Plato's classical work *Republic*, Plato himself used it metaphorically to indicate the fact of controlling men in the context of *steering* or *piloting* a ship (Kjaer, 2004). Rosenau (1997) emphasizes the value of recognizing governance as distinct but related to the concepts of command and control. He clarifies that governance is more expansive than the concept of command mechanisms which implies hierarchy and government. Governance most certainly isn't limited to hierarchical processes of "framing goals, issuing directives, and the pursuit of policies" (p. 146). Instead, governance is closely related to the mechanisms relevant to control or steering. This highlights the purposeful nature of governance such that it may still evolve without any

involvement of a hierarchy in place. He further promotes an idea of governance that is consistent with the concept of control which consists of relational phenomena that may comprise systems of rule that are used by the system to steer itself. By its relational nature, the dynamics of communication and control are important keys to the overall process of governance that are easily amenable to integration with system-based approaches. These are reflected in several of the definitions including governance purported in various works.

In another work, Eric Voegelin, a German political philosopher (Voegelin, 2003) regarded "governance" as *Herrschaft* (closely related to "governing" as *Herrschen*) and further acknowledged it to be a richly nuanced word and highly context dependent. That is easily interchangeable with ideas like *dominion, domination* and *rule*. A lot has changed in the history of man and his social systems, but the notion of governance persists albeit in different forms and varying levels of articulation. Table 2 below presents a sampling of some recent well-articulated meanings of 'governance'. From what the previous table has suggested, there are innumerable notions of governance.

Table 2. Survey of 'governance' from discipline and practice

Type	Definition/ Description	Source
General Process-centric	*"A governing arrangement where one or more public agencies directly engage non-state stakeholders in a collective decision-making process that is formal, consensus-oriented, and deliberative and that aims to make or implement public policy or manage public programs or assets."*	(Ansell & Gash, 2007, p. 544)
	"social turbulence kept within bounds, and change steered in desired directions... preserves order and continuity, but not necessarily the maintenance of the status quo."	(Dunsire, 1990, p. 18)
Structure-centric	*"...the totality of conceptual ideas about these interactions"* (*these* in relation to the act of governing)	(Kooiman, 2003, p. 79)
	"...the activity of coordinating communications in order to achieve collective goals through collaboration."	(Willke, 2007, p. 10)
Hybrid	*"...the reflexive self-organization of independent actors involved in complex relations of reciprocal interdependence, with such self-organization being based on continuing dialogue and resource-sharing to develop mutually beneficial joint projects and to manage the contradictions and dilemmas inevitably involved in such situations."*	(Jessop, 2003, p. 142)
	"...interdependence between organizations... continuing interactions between network members, caused by the need to exchange resources and negotiate shared purposes, ... game-like interactions, rooted in trust and regulated by rules of the game negotiated and agreed by network participants, ...a significant degree of autonomy; they are self-organizing."	(Rhodes, 2007, p. 1246)

Table 2. (cont.)

Restrictive		
Corporate governance	*"...the system of checks and balances, both internal and external to companies, which ensures that companies discharge their accountability to all their stakeholders and act in a socially responsible way in all areas of their business activity."*	(Brennan & Solomon, 2008, p. 890)
New Public Management	*"...the means for achieving direction, control, and coordination of wholly or partially autonomous individuals or organizations on behalf of interests to which they jointly contribute."*	(Lynn, Heinrich, & Hill, 2000, p. 235)
Public policy	*"...the ways in which stakeholders interact with each other in order to influence the outcomes of public policies."*	(Bovaird, 2005, p. 220)
	"...the processes and institutions, both formal and informal, that guide and restrain the collective activities of a group."	(Keohane & Nye, 2000, p. 12)
International security	*"...the emergence and recognition of principles, norms, rules and behavior that both provide standards of acceptable public behavior and that are followed sufficiently to produce behavioral regularities."*	(Keohane & Nye, 1989)
Social and political	*Governance denotes the structures and processes which enable a set of public and private actors to coordinate their interdependent needs and interests through the making and implementation of binding policy decisions in the absence of a central political authority.*	(Krahmann, 2003, p. 11)
	"...arrangements in which public as well as private actors aim at solving societal problems or create societal opportunities, and aim at the care for the societal institutions within which these governing activities take place."	(Kooiman, 2000, p. 139)

Table 3 and Table 4 below provide many more perspective streams of governance one may encounter when examining the literature. Underlying these notions of governance, one may ponder what ideas or concepts reinforce each particular notion.

2.3.2 Rationalist 'governance'

Rationalist approaches have afforded the formulation of knowledge utilizing base sets of theories, models, and ideas to provide an explanation for 'governance'. These rationalizations provide either a descriptive or prescriptive account of governance constructs. The logical starting points are sets of theories, propositions, and/or principles that aim to provide an explanation for the process of governance (~descriptive) and how governance should be (~prescriptive). For instance, for a descriptive-rationalist overview, Buchinger (2006) relates how the biological concept of 'autopoiesis' and the philosophically-oriented concept of 'meaning' may be adapted to provide an explanation for governance in modern societies. Nicolescu (2010) likewise suggests how different theories (such as agency theory, resource dependency theory, stakeholder theory, and stewardship theory) as well as varying organizational models (corporate, consensual and shared organizational models) should be adopted as a means to make sense of 'governance' irregularities that plague the *system*. Then there are rationalist-prescriptive accounts that characteristically show the use of specific concepts and trace them back to a specific problem domain or discipline practice like those by Brinkerhoff (2005) for

international relations, environmental development (Folke, et. al, 2005; Huitema, et. al., 2009) as well as primary clinical practice (Tait, 2004).

Table 3. Core Usages (Part 1): Governance "IS"

Governance "IS"...	Reference
The act, process, or power of governing; government: The state of being governed.	American Heritage Dictionary, (governance.Dictionary.com, 2004)
The activity of coordinating communications in order to achieve collective goals through collaboration.	(Willke, 2007)
Mainly concerned with creating conditions for ordered rule and collective action.	(Stoker, 1998)
Stewardship of formal and informal political rules. Rule refer to measures that involve setting the rules for the exercise of power and settling conflicts over such rules.	(Hyden, 1999)
Emergence and recognition of principles, norms, rules and behavior that both provide standards of acceptable public behavior and that are followed sufficiently to produce behavioral regularities.	(Keohane & Nye, 2000)
Entirety of interactions instigated to solve societal problems and to create societal opportunities; including the formulation and application of principles guiding those interactions and care for institutions that enable or control them."	(Kooiman & Jentoft, 2009)

While there is a distinct set of literature constructs that mainly report on governance challenges in practice (see for instance Tickel, 1997; Lemos & Agrawal, 2006; Biermann & Pattberg, 2008), a rationalist-prescriptive account posits the alternative use of other concepts such as polycentricity, participation, legitimacy, social capital, effectiveness, leadership, teamwork and communication in relation to governance. The 'rationalist' account, by way of minimizing the effort in scoping the

examination of available literature of this nature, helped to critically examine the general themes of governance as they apply to this research.

2.3.3 Empirical 'governance'

Alternatively, another thrust of accumulated knowledge reflecting 'system governance' may be found in studies that are empirical in nature. Due to the wide range of experience that may be considered as empirical, there is understandably also a number of different configurations for empirical claims about governance. This diversity is expected across different disciplines but surprisingly, empirical evidence may also be divergent even within a single discipline. Consider the discipline of Public Administration, Rhodes (2000) enumerates several diverse usages of governance as shown in Table 4. With the range of 'governance' phenomena, one would assume a level of consistency within a single discipline. However, there is too much variation in the manner empirical evidence is collected and the corresponding interpretations of that evidence. Kersbergen and Waarden (2004) recently suggested that part of the difficulty lies in the problem of empirical identification which touches on the extent one is still able to sensibly describe new empirical phenomena using traditional conceptual tools (p. 164). Therefore, research in governance must take into account that empirical data is a reflection of the phenomena purported as governance may represent a shift in the phenomena itself, a shift in the causes confronting it, or even a shift in consequences or effects of the governance phenomena. Available empirical studies on governance only serve as supporting evidence for a particular account of governance from the perspective of one discipline (Lynn, Heinrich & Hill, 2000).

Table 4. Core Usages (Part 2): Governance "AS"

Governance "AS"...	Usage Context
Corporate governance	How businesses should be directed and controlled. Posit openness (disclosure of information), integrity (straightforward dealing and completeness) and accountability (holding individuals responsible for their actions)
New Public Management	The introduction of corporate management techniques to the public sector (performance measures, managing by results, value for money, etc.) or marketization (introduction of incentive structures into public service); steering as a synonym for governance
Good governance	Government reform that encompasses systemic, political and administrative dimensions (key concepts include distribution of power, promoting legitimacy and authority, accountable and audited public service)
International interdependence	Multilevel governance
A socio-cybernetic system	Interdependence among social-political-administrative actors; shared goals; blurred boundaries between private, public and volunteer sectors; new forms of action, intervention and control
New Political Economy	Interrelationships of the economy to civil society, the state and the market economy
Networks	Self-organizing, autonomous, inter-organizational entities as an alternative to indirectly and imperfectly steer networks.

In many of the above use cases, governance, as traditionally defined, is something related to government. Clearly over the years, it is now referred to as something broader than government as some of the above definitions imply. Where can we attribute the diversity of evidence constituting 'system governance'? Part of the reason for such diverse accounts is because the identified 'governance' concept is instantiated in particular from a specific level with the involvement of users, approving bodies, sponsors, etc. (Gideonse, 1993; Hill & Lynn, 2005; Slowther, et. al, 2006; Whitehead,

2003), mode – in terms of economic firms or assets, public or private markets (Driver, 2008; Fligstein & Choo, 2005; Kooiman & Jentoft, 2009; Hawley & Williams, 2003), or order of governance - in terms of day-today affairs, institutional arrangements, or the general incorporation to practice of basic sets of values, norms and principles (Kooiman & Jentoft, 2009). Similar to Kooiman and Jentoft (2009), who provided a conceptual framework to form the empirical logic of governance systems, there were also integrative governance studies that lie somewhere within the rationalist and empirical spectrum such as those by Brown, et. al (2009) and Garcia-Meca & Sanchez-Ballesta (2009). In these studies new developments from other disciplines not traditionally associated with the practice of governance, such as risk management and earnings management, were incorporated. These types of research revealed some form of empirical coupling evident across different conceptual levels, modes, or order.

2.4 Synthesis of General Themes for Governance

It will not be surprising that the scope of governance literature just about covers any problem as a problem of governance. For instance, one account of the problem of governance in modern society suggests that it is a problem of adaptation, capacity and scale (Kettl, 2000). Under the paradoxical reality of globalization and devolution, terms used to refer the simultaneous *internationalization* and in parallel *localization* of traditionally government-centered decision processes, the agenda for modern governance must find ways to address these problems. The problem of adaptation, specifically in government, refers the need for non-traditional structured and staffed bureaucracies to support newer strategies and tactics, suggesting the role as "fitting traditional vertical

systems to the new challenges of globalization and devolution, and integrating new horizontal systems to the traditional vertical ones" (p. 495) The problem of capacity is a call for effective management and accountability as enhancing government's ability to govern and manage effectively in this transformed environment. This is uncharted territory not accounted for in traditional intellectual foundations supporting hierarchical authority, bureaucratic exchange mechanisms and delegation of power practices.

Closely related to the problems of adaptation and capacity, there is also the problem of scale that makes issues harder to address, as it remains unclear as to which levels of governance are best suited or best fit to address it. In other words, the problem of scale implies sorting out the functions of different levels of governance and finding better alternatives of channeling available capabilities rather than relying on ad hoc mechanisms most of the time.

Though examples were found in very distinctly different disciplines and problem domains, the rhetoric sounds all too familiar and almost resounding very similar themes. The next few sections in this chapter will espouse the general themes that these researches have highlighted.

2.4.1 Need for a Systems Perspective on Governance

Theorizing system governance would imply an attempt at formulating an acceptable multilevel abstraction of the system. This allows for the accommodation of underlying worldviews to be made explicit and perceived *governance* situations to be accurately depicted. To help confront this issue, a systems based approach is the primary study lens where perceived systems of interests will provide the focus to study generalizable aspects of governance situations. The process of governance and the system

of interest themselves exist as independent societal entities and are embedded within the society at large. As such, they are easily captured conceptually as complex systems, as system-of-systems (SoS), or just simply, as systems. Motivated by several system-based principles, certain anticipated paradoxical divergences of perspectives helps in resolving the practical difficulties in theorizing about governance. Keating (2005), similar to Baldwin, et. al. (2010), promoted the use of system-based articulations of context and its associated boundaries as the key tools in resolving such paradoxical perspectives. Whereas several definitions were available, Lycan (2010) suggests a definition of paradox as "an inconsistent set of propositions, each of which is very plausible" where its resolution is a matter of deciding, on principled ground, which of the propositions are to be abandoned. This is the usual case and the domain of complex system governance. Paradoxes can be traced to propositional inconsistencies arising from philosophical, methodological, axiological, axiomatic and even application logical levels of divergence (Keating, 2005). Without a way to study these paradoxes, it would be impossible to even begin to understand how to design or embark on development of a *system governance* platform that would make sense with the vast array of other relevant theories and/or frameworks. Any resemblance to replicable governance phenomena, though interesting and novel, is coincidental and, at best, existential in the context of time, place and prevailing logic of someone else's decisions and actions. In other words, while there are examples of the utility in examining particular accounts of governance, the main argument in this dissertation is towards an attempt for a well-articulated universal governance concept. It is a grand and complicated effort but it should be attempted

nonetheless because of its greater relevance to resolving paradoxical dead ends that confound day-to-day practice related to governance.

Hence, moving forward it would be convenient to explore the notion of the concept of governance in greater depth. Current understanding of governance is either conceived too broadly or too narrowly, limiting the recognition of the paradoxical phenomena that carries over to conflicting approaches of implementation.

2.4.2 Diverse understanding on Governance

The literature is replete with studies that are about governance but are totally standing on very dissimilar conceptual bases. To date, there is still no comprehensive conceptual account of "governance" (Kjaer, 2004; Jose, 2009). This does not imply a shortage of well-thought rigorous scholarly studies at all. In fact, several works on the usual "what" question have been articulated quite sufficiently and extensively (Kooiman, 2003; Pierre, 2000; Stoker, 1998). Multidisciplinary literature would reveal two prevailing perspectives in the practice of "governance". Either governance is deployed supposedly for a *system of interest* for purposes of i) maintaining its operation despite any recurring problem, and/or ii) adapting its capabilities in anticipation of future challenges. While it is the contention in this study that existing governance systems were predominantly designed towards either one of the previously mentioned perspectives, new and existing governance systems will benefit from analysis that reaches back to basic concepts and approaches supporting such perspectives. In reality, most governance systems will have to merge both perspectives given their underlying purposes. Such an appreciation is starting to emerge as evidenced by many studies about governance within the specific topical contexts of the internet (Mathiason, 2009), urban culture (Ostrom,

2008), knowledge (Stehr, 2004), enterprise information systems (Marks, 2008), networks (Provan & Kenis, 2008), resilience and vulnerability (Gheorghe, 2004) to name a few.

In some general sense, all these initiatives seem to converge on governance as either the last resort solution or as the ultimate cause of failure. There are several successful realizations where resulting outcomes can be evaluated against some theoretical backdrop of "governance". In each of those instantiations, however, the claims will not allow for enough comparison to suggest similar conceptualizations of 'governance'. In some instances, one implicitly assumes that "governance" is viewed not as the problem but the solution. Conversely, the problem perspective is stated in terms of the "lack of" where new efforts towards correct "governance" will progress towards improvement. There is also the difficulty to clearly draw out what is being governed and to what end. Presumably, a system is assumed at the receiving end where governance reflects the effort to realize a system's purpose. Each unique system state often invariably requires its own unique kind of governance which was also identified as a gap in the literature. The current state is described by an internal differentiation of dynamics and complexity residing within the system in relation to its environment (Luhmann, 1977). There are of course several available ways to reveal the state of a system by way of systematic classifications or typologies (Ackoff, 1971; Boulding, 1956, 1985; Simon, 1962; Weaver, 1948). These have been instrumental in advancing understanding that are useful for application in real-life complex systems. Therefore, the rich diversity of interpretations for governance brings to light a key systems concept, specifically the notion of multiple perspectives. This consideration has implications for anyone responsible for the design, development or transformation of governance systems. They

will have to utilize these perspectives in order to comprehensively allow the system to accomplish their underlying purpose.

2.4.3 Irresolvable conflicts of perspectives

Several reasons for conflicts in perspectives on governance are traceable to the multiple "levels" and roles of different actors and their associated interests in implementing governance. Because each perspective held by every actor are important in the actual implementation of governance, blurring of traditional "functional" boundaries (i.e. political, administrative, public, private, etc.) is inevitable. Having no clear delineation presiding over practice, the active 'governance' concept is a tenuous implementation of overlapping and often conflicting hierarchical and network/collaborative paradigms. We can draw perspectives based on both assumptions from a single very recent real-life example - the US financial market collapse that triggered damaging effects throughout the global economy. Depending on how an individual's epistemological stance or knowledge boundaries are drawn, one can make a good case either way that some form governance already exists or was in fact absent. Before the financial collapse, the financial market is a good case example of sophisticated layers of governance. Governance in the financial market can be described as a dizzying array of regulations, policies, laws, standards through a complex interaction between public, private and government sectors (Willke, 2007). Shortly after the collapse, everyone was insisting on better governance as a pressing concern since taxpayers' money was used for bailout or stimulus money. However, if one is a keen fan of Adam Smith's genius, the financial market as it was conceived was one that can function without any individual's awareness of obvious governance, whether minimal or if any at

all. Hence since then, free markets are famous for the "Invisible Hand" metaphor (Williamson, 1994). This shows that no matter which assumption is held, governance is perceived sometimes as a solution and sometimes as the problem.

2.4.4 Uncovering underlying philosophical debates

Undoubtedly, there are much larger philosophical roots underlying the debates that feature these differing perspectives. This goes back to the great debates between philosophers like Plato, Aristotle and much more recently Kant regarding the very nature of existence, of reality, of knowledge and of truth, of wholes and of entities (Santas, 2001). It is not the intent of this dissertation to offer a resolution to these debates as they are expected to persist irrespective of any ongoing scholarly deliberation of governance. Instead, it is supposed that to have a good foundational understanding of governance, an integrative philosophy should be adopted that is appreciative of the different ontological, epistemological and axiological perspectives found in the literature. While governance can mean very different things based on which philosophical strand dominantly persists, it will be helpful to establish the preliminary conceptual boundaries before going any further in this study.

2.5 Critique of the Literature

The main focus of this critique revolved around i) the conceptual ambiguities underlying theories of 'systems' and 'governance' and ii) the absence of a specific set of criteria to be able to compare and assess existing and new theories related to governance of complex systems.

2.5.1 Need to address conceptual ambiguities

Jessop (1998) notes that 'governance' according to its usage in the social sciences may often be considered as still "'pre-theoretical' and eclectic; and lay usages are just as diverse and contrary." Further, Jessop observed that the conceptual interest in governance clearly have "precursors of the current interest in governance in various disciplines" (p. 31). In reality, these precursors call out a distinct set of assumptions, models, theories that bring about a concept of governance characterized by *heterarchy*, understood as 'self-organization across different levels'. Walters (2004) likewise observed that despite the growing prominence of governance and its use in policy circles, that "(T)here is still a striking imbalance between the exponential growth of literature applying governance to particular cases and areas, and research that critically examines the foundation assumptions and political implications of governance (p. 27)." He also noted that "there are also continuities, certain core ideas, assumptions, propositions which attach to the term as it moves from one locale to the next." These comments, however, are still made within the purview of a single discipline – political science. There is yet a reconceptualization that marries insights from different disciplines although there are already applications across different problem domains. Therefore, there is a need to formulate a theory of 'governance' that adequately analyzes the various conceptual underpinnings or presuppositions. Hence, as alluded to by joining the term 'systems', what should be attempted here is a reconceptualization that synthesizes 'governance' in terms of more general 'systems'.

2.5.2 Lack of a Criteria Set for Theorizing and Practice

Meanwhile, due to the diversity of theorizing practices, there is also a need to establish an agreed set of criteria as a basis for theorizing and practicing normative

concepts of governance. Four different categories of criteria will be presented. These different criteria cover ontological, theoretical, pragmatic and axiological grounds. These different area categories are summarized in Table 5 and will be discussed in turn below.

Table 5. A criteria set for 'theorizing' on system governance

Area	Application to theorizing
Ontological	Concerns with the scope and simplicity (e.g. parsimony) in addressing the principal question of "What can be said to exist?"
Theoretical	Embody a degree of testability given presented evidence and conservatism when compared with other related theories
Pragmatic	The judgment of a posited theory by its usefulness
Axiological	Suggested theory tracks the "truth" based on some measure of value, worth, and quality

An *ontological* criteria, in the case of system governance, should consider treatment of ontological issues concerning the "levels of analysis" and the "status of entities" that are posited in the theories. The scope of the suggested theory should be able to arrive to the same level of resolution as to the type of questions we expect governance to answer. Simplicity refers to the use of a generic set of forces and entities for as broad a scope of "governance" phenomena. A *theoretical* criterion implies that any scientific explanatory theory on governance should be responsive to evidence, in the sense that it is able to accommodate a wide range of evidence (does not mean insulate itself from possible counterexamples). Another theoretical criterion is that the posited theory should fit with nearby theories (conservatism or principle of theoretical unification). *Pragmatic* criteria have two routes to applying this either through i) its theoretical merit and/or ii) its methodological merit. Theoretical merit asks a predetermined set of relevant "why"

questions. The methodological aspect refers to how a good theory often also offers indications of the right level of resolution (unit of analysis) and techniques to manipulate the phenomena under investigation. Lastly, an *axiological* criterion is mostly important to be able to drive the other earlier suggested criteria. This is what sets apart normative theories from descriptive theories. A good theory tracks the "truth" if it makes good predictions and generally fits the data, as a basis for setting a baseline to pursue action/intervention.

Having understood how these different criteria can be applied; suggested theories related to "governance" can be assessed, clarified, dismissed from consideration, or to be used in support of development of a better conceptual definition for governance. Any indication of a good theory on governance or for any theory on any phenomena for that matter should be assessed based on some acceptable criteria set. In the case of governance, any theory posed is reviewed against ontological, theoretical, pragmatic and axiomatic grounds.

2.6 Chapter Summary

In summary, the literature review showed that several disciplines advanced certain versions of systems and governance without regard for a wider multidisciplinary perspective of system governance. Adopting a multidisciplinary purview as the primary impetus, the challenge was to investigate the ambiguous nature of relevant ideas for a more precise articulation of system governance. These entailed a thorough investigation at the conceptual and empirical level of governance-related situations that reflect the mental images, memories, concepts, propositions, theories, inferences, problems and

many more. This resulted from a deep investigation of the state-of-the-art in diverse research in systems theory and in governance practice.

As such, the body of knowledge introduced here highlights the multidisciplinary lens to investigate system governance. Having implemented a thorough literature review process, an overview of the body of knowledge (BoK) was produced to help narrow down the key literature boundary themes on system governance. Both systems and governance are well studied terms with each having undergone advanced conceptual development and a long history from the purview of multiple independent disciplines and practice domains (Bevir, 2004; Bovaird, 2005). System governance, however, is not an easy transition from both key ideas (e.g. systems and governance), although there were already a few recent studies which used the compound notion of 'system governance' (Bevir, 2006). The difficulty was in the heterogeneous paradigms and plurality of conceptions expected when associated *ideas* were cultivated from the diverse world of traditional disciplines and practice (Dixon & Dogan, 2003; Kersbergen & Waarden, 2004). These were evidenced by a set of systemic themes emerging from the literature.

Finally, the chapter concluded by presenting a critique of the literature. The main focus of the given critique revolved around i) the conceptual ambiguities underlying theories of 'systems' and 'governance' and ii) the absence of specific criteria set to be able to compare and assess existing and new theories.

CHAPTER 3

METHODOLOGICAL FRAMEWORK

In this chapter, the basis and details of the multimethodology approach used for the research design are presented. First, a discussion on how traditional models of the research process may be impacted by the notion of a paradigm is provided (Sec. 3.1). Then, the idea that every research endeavor must subscribe him or herself to a specific research paradigm in the course of the conduct or duration of the research process is explored (Sec. 3.2). Next, a dissection of an evolved understanding of 'paradigm' is presented as a basis for a systemic research design framework that consists of a set of philosophical considerations spanning epistemological, ontological, axiological and ethical concerns (Sec. 3.3). Due to the combinatory nature of different philosophical stances, a systemic research design was necessarily calling for a multimethodology approach (Sec. 3.4). Finally, the specific details of the multimethodology research design are discussed (Sec. 3.5).

3.1 Paradigm and the Research Process

Many phenomenological aspects of 'systems' and 'governance' fall under what was broadly categorized as the social sciences domain. As with the social sciences that debated the research implications of various paradigms, this study likewise recognized the need to be grounded in an underlying philosophy that would inform how the research would proceed.

Deduction

Observation

Hypothesis or
Theory

Induction
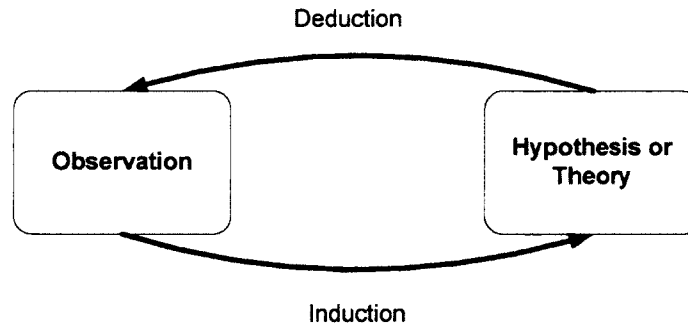
Figure 5. Traditional model of scientific research

The typical end result according to traditional models of a science-based research was the generation of a knowledge claim (Gilbert, 1976; Sousa-Poza, et. al., 2008). This by no means resolves debates as to the "truth" value of the corresponding knowledge claims. How this knowledge gets transformed into accepted, rejected or invalidated knowledge is the deductive process that is beyond the scope of this study. The focus of this research effort instead is focused on research take-off points; advancing knowledge through research (posited as a research question) that proceeds from either i) observed data, or from ii) established knowledge claims (i.e. existing hypothesis or theory) (Bunge, 1996). Above, in Figure 5, the research proceeded using an inductive (from data to theory) process where the research goal was to build new theory. Conversely, research may also proceed using a deductive (from existing theory to confirmed data) process where the research goal was to test or confirm existing theory. Due to its close interaction with actual data; the deductive process became closely associated with wholly quantitative/empirical approaches that were rooted in observations established by precise measurement of particular experienced data. On the other hand, inductive processes, having been predisposed for tendencies to draw out generalizations or higher level

abstractions embodied in statements of theory, were embraced by qualitative/constructivist approaches. Over time, research communities or disciplines have flourished and built their knowledge base on accumulated deductive and inductive research. However, as simple as this distinction may sound, there thrived strongly contested debates as entire disciplines with their associated groups of scientists, researchers, and practitioners have developed strong allegiances towards a particular set of philosophical assumptions – or as described earlier as a *paradigm*.

Fast forward to contemporary times, evidence of crisis points in research practice and the philosophy of science, in general, can easily be found centering on paradigmatic debates between polarized stances like quantitative versus qualitative (Smith, 1983; see also Shadish, 1995), nomological versus idiographic (Hermans, 1988), and realist versus constructivists (Niiniluoto, 1991) to name a few. These philosophical debates are usually centered on certain opposing ontological (what is said to exist) as well as epistemological (how we came to know) assumptions. While it is beyond this research to either provide a complete assessment or a resolution of these debates, one can refer to several other recent summative studies to gain a better sense of the state of these debates (Johnson & Onwuegbuzie, 2004; Johnson, Onwuegbuzie & Turner, 2007).
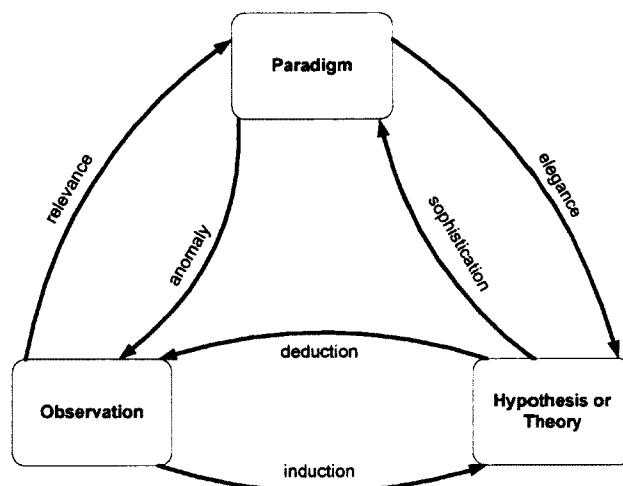
Figure 6. Expanded version of the scientific research process

For the purposes of this discussion, it should at least be acknowledged that the conduct of any piece of research (including this work) must take into account such paradigms held by the researcher as they will have profound implications concerning how knowledge claims are produced, which methodological framework to use, and even the choice of specific methods/techniques to consider. Following Royce (1978) and as illustrated by Voorhees (1987), the previous figure may be redrawn as shown in Figure 6 to reflect on how a paradigm is said to impact the research process. From this representation, Royce suggests that an individual researcher's preponderance for a certain paradigm continuously influences i) one's deductive and inductive reasoning propensities (through purely rational means) and eventually ii) as to how research merit is evaluated (through either empirical or metaphorical means). For instance, a deductive research process is contingent on how a paradigm views reality – whether a set of observed data present itself as either a relevant or an anomalous pattern with respect to practice. The American philosopher, C.S. Peirce (Buchler, 1955), in explaining his theory of signs,

alluded to this when he criticized the limitations of deduction as merely offering recycled knowledge about the world based on knowledge consequences of what one already accepts. In other words, any supposed knowledge is tainted or constrained by the framing conditions of earlier sets of knowledge percolating in the researchers mind. Alternatively, from an inductive research standpoint, any posited theory may be judged by a particular paradigm as to its elegance or its explanatory sophistication with respect to other available theory. The inductive process, like its deductive counterpart, is beset with its own set of criticisms. One such criticism is from Popper (1968) who indicated that induction cannot fully claim credit for any significant knowledge advances. Instead, Popper suggests that advances in knowledge primarily occurred due to the researcher having gone beyond the data; performing a conceptual leap with the aid of creativity and imagination as a way to make sense of the data; considering analogies, metaphors, models, etc. to make such leaps he called "imagination conjectures" that gain scientific stature when subjected to a series of falsifiability tests.

To this end, there were two important considerations for the researcher and implications for the research design of this effort. First, a researcher's particular paradigm establishes how one considers them with regards the research process itself. Is the researcher going to be fully detached or actively engaged as part of the research design? Depending on the researcher's position with respect to the paradigm, a next level of understanding allows for values that guide the selection of different means and ends for problem solving and the commitment to developing a particular solution. Next, a researcher also must decide on their view of reality and the role a researcher's actions may take to affect this reality. A model of reality that is structured logically, as some

paradigms suggest, would allow a researcher to make flawless predictions where all the possible consequences of taking an action have been worked out without ever having to implement the action at all. Alternatively, some paradigms place a premium on knowledge gained by acting on the real situation, no matter how trivial the consequences of the researcher's actions may seem, as the situation in itself is a simultaneous by-product of the existing states of knowledge. In the context of system governance, this discussion establishes the implications of particular paradigms held by the researcher and their influence in the research process and on how the results are interpreted. A research paradigm and leveraging on usefulness will be critical in resolving perspective conflicts and eventually in providing satisfactory justification towards conducting the research in the first place.

3.2 Justification for "Paradigm" in Research

There is a long standing history of the word 'paradigm' as discussed in the context of larger philosophical debates in the natural and social sciences. They were introduced here to provide a generally acceptable underpinning for a system-based research philosophy that was used to investigate 'system governance.' Contemporary understanding of a paradigm was summarized by Guba and Lincoln (1994) where they provide a definition of paradigm as "a set of basic beliefs…that deals with ultimates *[sic]* or first principles…" (p. 107). They further add that a paradigm represented "a worldview that defines, for its holder, the nature of the world, the 'individuals' place in it, and the range of possible relationships to that world and its parts…" (p. 107). This prevailing notion of a paradigm was itself not historically consistent as some suggest but instead reflected a series of *philosophical turns* throughout recorded history (Klein, 2004; and

also in Johannessen & Olaisen & Olaisen, 2005a,b). As suggested in Table 6, the contemporary idea leading to today's understanding of *paradigm* followed important research streams in the history and knowledge discourse for the philosophy of science.

Table 6. Genealogy of important ideas shaping understanding of 'paradigms'

'Paradigm' shifts	Characteristics	Principal influence
Mind turn Pre-1900s	All knowledge that may be acquired is mind-dependent. Outside of the mind, reality may exist independent of one's experience but may remain unknowable unless access by experiential reasoning abilities.	Immanuel Kant (1966, as cited in Klein, 2004)
Logical turn (1920-)	Acquiring knowledge should follow a logical flow for orderly constitution of scientific theories. Still supportive of idea that theorizing is only possible through experiment and field experience	Hempel (1965), Popper (1959)
Linguistic turn (1950-)	Language as the only 'reality' that matters. Not necessary to account for facts, problems, theories, experiments, methods, designs and plans	Wittgenstein (1953)
Kuhn's view - Historical turn (1960-)	Preference for historical understanding of social processes that explain practices of disciplines. Logic, semantics, epistemology, ontology and ethics possibly seen as an historical outcome	Kuhn (1976)
Sociological turn (1970-)	Researchers, in response to social stimuli or inhibitors, are responsible for creating facts; Premium on 'meaning' rather than norms or the objective truth	Berger & Luckmann (1967)
Reflective turn (1980-)	Integrative effort to investigate ontological, epistemological, axiological and ethical issues raised by science.	Bunge (1996)

First, Immanuel Kant (1966, as cited in Klein, 2004) offered a revolutionary insight that "…anything we can come to know at all was determined by the faculties of our mind…(p. 128)" and that "there may very well be a reality independent of (ones) experiences and investigations, but it remains unknowable without our a priori or innate

reasoning capacities (p. 128)" During this period, a paradigm was simply the result of our senses forming the mind's descriptive representation of reality. Next, a further development of this thinking that puts more emphasis on the proper logic of acquiring knowledge resulted from Hempel (1965) and Popper's work (1959) that became the de facto basis of the modern day scientific method. Third, following the implications of linguistic studies pioneered by Wittgenstein (1953; also cited in Johannessen & Olaisen, 2005a, p. 1263) came the understanding that reality was contingent on language for "language may be the only reality that we have." Insights from this period depicted how a paradigm may in fact be a function of 'subjective' meaning systems that were embedded within language. Fourth, a significant notion attributed to Kuhn (1976) reshaped understanding about what a paradigm is - as the important social processes and interactions of disciplines that eventually becomes the generally accepted science. If this was the case, combined with the prevailing deeper notions of paradigms carried over from earlier reflection, support for the ultimate 'truth' of an objective reality was further weakened. So far, each individual knowledge perspective of reality was depicted as highly subjective reflecting in turn the subjectivity either of i) the researcher's mind, ii) the variable meanings embedded in language, or iii) the social processes attributed to a discipline. This becomes an important logic behind differentiation across different disciplines where stylized research practices were cultivated and promoted. Fifth, a recent development of new philosophies of consciousness (Berger & Luckmann, 1967) again added a different take on paradigms as possibly the inter-subjective middle ground providing the means to analyze social meanings based on "life world" accounts of everyday experience. Here, the subjective nature of a paradigm took center stage as a

result of the inherent reflective nature of an individual as an additional factor that can impact scientific investigations. Specifically, Tsoukas (1996) described this paradigmatic subjectivity as "the system of mental patterns of perception, appreciation and action which has been acquired by an individual via past socializations and is brought to bear on a particular situation of action" (p. 17). Lastly, perhaps to establish a high level synthesis that can take into account all these different shifts, an integrative philosophical turn can be observed of late (Johannessen & Olaisen, 2005a) which mostly was reflected in the works of Bunge (1985, as cited in Johannessen & Olaisen, 2005b) that attempts to articulate the ontological, epistemological, axiological and ethical concerns that support the science paradigm. Johannessen and Olaisen (2005a) used Bunge articulation of 'paradigm' as the basis of the systemic view that mirrored several systems thinking approaches. In a nutshell, the main idea in the systemic approach to a research problem was that no idea can be fully understood until it is incorporated into an organized field of knowledge. System ideas can be interwoven with other knowledge, and gain support from the latter.

This explains why this research advocated a systemic paradigm reiterating how the highly social phenomena inherent in 'system governance' may be understood. Research from a systemic paradigm implied understanding based on an individual's dispositions and conceptions of a governance situation, while other more social governance phenomena must be approached on the basis of the system of relations of which the entire system of interest is part. How do we decide if we should use the individual's dispositions and conceptions as a medium of understanding, or use the system of relations instead? For a more abstracted case, understanding by means of a

system of relations should be used on social phenomena that are emergent. On the other hand, researcher's dispositions and notions should be used when social phenomena were considered to not be emergent, but were instead a resulting property. Bunge's (1996) observation and contention in favor of a systemic paradigm position this research with an integrated phenomenon/problem perspective as "only the starting point of factual inquiry" (p. 42). Such a research position allowed powerful resolution of the confusion between reality and the representation of reality, a confusion that was pervasive in domains associated with system governance. A systemic paradigm was a reflexive research process that delineates facts (that are not considered constructions) from social facts (which are possibly social constructs). The truth encompasses mere simple facts, data, or an aggregate of social constructs. Truth in a scientific context was a relation between facts and the construct/constructs, and it becomes reasonable to expect that more constructs may be true about the same fact, hence the systemic application of multiple perspectives denoting partial truths. The systemic paradigm used as the foundation for this research was based on the realistic view of knowledge, but also regards the distinction between the description and the described as central, as well as specifically the consideration of the key distinctions between ontological and epistemological positioning.

In summary, the systemic paradigm has important implications to science and research. The main idea captured in the systemic approach with respect to a certain research problem was that no idea can be fully understood until it is incorporated into an organized field of knowledge. Any research claiming to provide a strong basis for social research has to take into account how social phenomenon (i.e. socially perceived patterns

and regularities) were in fact resulting from the influence and positioning within the underlying philosophical paradigms in play. These philosophical paradigms reinforce specific interpretations of values, norms and meanings that may or may not necessarily be shared by those who are stakeholders to the research being conducted.

3.3 Rationale for Multimethodology

In this section, a rationale in support of the use of a multimethodology research design is presented. The concerns of system governance spans different facets and different levels and offer the strongest rationale in support of incorporating a multimethodology research design to guide exploration of the research questions. This rationale may take one of two forms. These two forms of rationale were represented in Figure 7 below.

Specifically within the systems community, the former position saw several important attempts to articulate a critical systems paradigm (Jackson, 1997) that reflected the comprehensive complementarity of different conventional research paradigm traditions (Burrel and Morgan, 1979), where each paradigm (functionalist, interpretative, emancipatory and postmodern) were said to be equally valid, having no hierarchy among them, and no one paradigm legitimately imposing limitations on another paradigm. Also, a new *metaparadigm* stance is taking the form that suggests a comprehensive research practice should not exclusively proceed under the auspices of a single paradigm (Lewis & Grimes, 1999). Instead, systemic research should benefit from shared research perspectives that take place across permeable paradigmatic boundaries which Gioia & Pitre (1990), and more recently Goles and Hirscheim (2000), refer to as paradigmatic

research *transition zones*. In this new development, while each paradigm may still be incommensurable with another paradigm, bridging of research findings were made possible since there was a uniquely valid cause to investigate the phenomena within these paradigmatic transition zones (Figure 7).
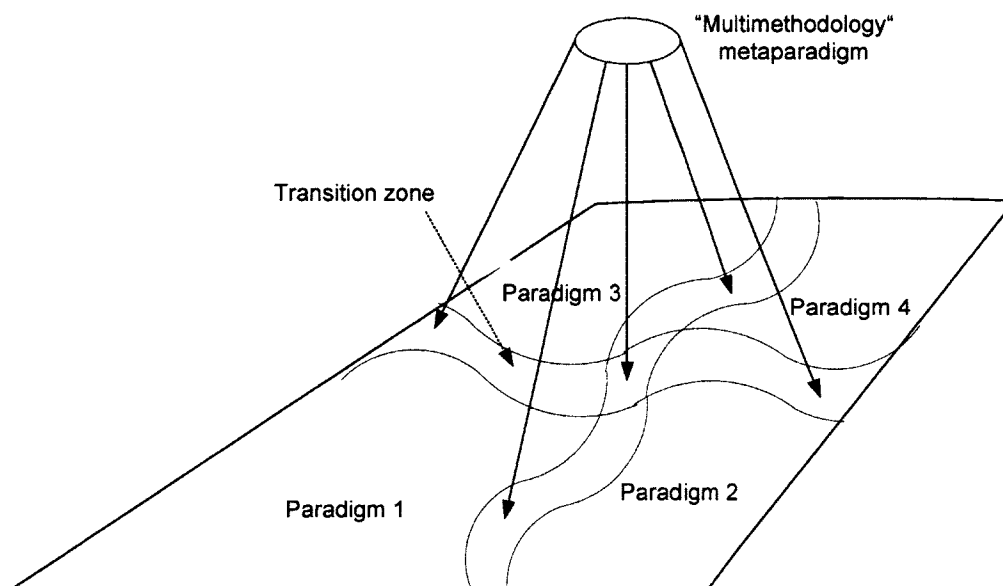
Figure 7. Paradigmatic positioning for a multimethodology rationale

Emergent pluralist and paradoxical research perspectives suggested that there are multiple possible paradigms available for any research undertaken (Lewis & Kelemen, 2002). A review of these different sets of systemic research paradigms have already been discussed elsewhere and are beyond the scope of this discussion. One may refer to Burrel and Morgan's (1979) foundational sociological paradigm work, or Deetz (1996) where the widely debated framework was updated to take into account post-modernist paradigmatic stances. While each of these paradigms were believed to have different sets

of ontological and epistemological assumptions spurring paradigm incommensurability debates, each one offers a fresh take of possibly the same phenomena (Gioia & Pitre, 1990), specifically in this case the form for exploring governance phenomena. In the first form, a rationale for multimethodology research design was subsumed or co-opted as already compatible with a specific philosophical position. In the second form, there was the possibility of introducing a new philosophical framework that might itself be considered a *metaparadigm*, carefully articulating its distinct difference from already existing paradigms, and thus reasonably establishing itself as warranting the need to stand independently.

3.5 Chapter Summary

In summary, multimethodology implied the use of more than one methodology from more than one paradigm to investigate the same problem or phenomena, in this case pertaining to issues related to the conceptualization of system governance. While there were several contentious problems of 'incommensurability' leading to nuanced interdisciplinary vis a vis philosophical-methodological debates, the research adopted a stratified ontology with pluralist epistemological assumptions. Phenomena investigated in relation to system governance were viewed as consisting of multiple realities across "stratified" system dimensions where epistemological representations and their "truth" claims may be diversely varied across these "stratified" levels. Key methodological considerations described above were consistent with system-based pluralist, complementarity and reflexivity principles.

Specifically, a systemic consideration has to take into account the nature of a paradigm and its implication in the research process, the effect of different possible classes of philosophical assumptions, and the development of a 'multimethodology' rationale, as well as a detailed 'operationalization' of this multimethodology. Each of these areas was discussed in turn in the chapter sections.

The multimethodology approach used in the research of 'system governance' was argued as crucial in the implementation of a system-based research paradigm. This multimethodology integrated different methods and was considered appropriate to investigate research questions posed. Data collection and analysis from each of the employed methods supporting the multimethodology provided feedback and proper context to the results obtained in the other methods in a way that mutually reinforced one another (triangulation). Furthermore, such a multimethodology approach was adopted as a genuine effort to be reflexive and more critical of 'system governance' practice and, ideally, more useful and accountable to broader audiences.

CHAPTER 4

RESEARCH DESIGN

In this section, the overarching research design is articulated. First, a high level perspective of the research design is presented as it expresses how the 'multimethodology' aspect is integrated into the conduct of the research process. Next, the three subsequent sections each discuss the detailed research design as well as additional research considerations in content analysis, system framework development and single-case study research.

4.1 High-Level "Multimethodology" Research Design

For purposes of this research on 'governance' and 'systems of governance', a multimethodology approach was used. There are quantitative and qualitative empirical studies on governance that were conducted recently (Lynn, Heinrich, & Hill, 2000). Though in these types of studies, regression-discontinuity was strong in internal validity and can parallel other non-equivalent designs in terms of validity threats, interpretation of results might be difficult. This is especially so for a topic as widely interpreted as governance, outcomes might be the result of combined factors that were not exactly explicitly related or initially identified up front. No matter what numerical regression indicators may elucidate, it might still also be difficult to assess the efficacy of a governance effort. Adding some qualitative complement to the quantitative basis for research was a good strategy to overcoming some of these difficulties. Going back to the research purpose which is to develop an integrated philosophy-theory for complex system

governance, the 'multimethodology' outlined in Figure 8 best depicted the research

sequence that was followed.
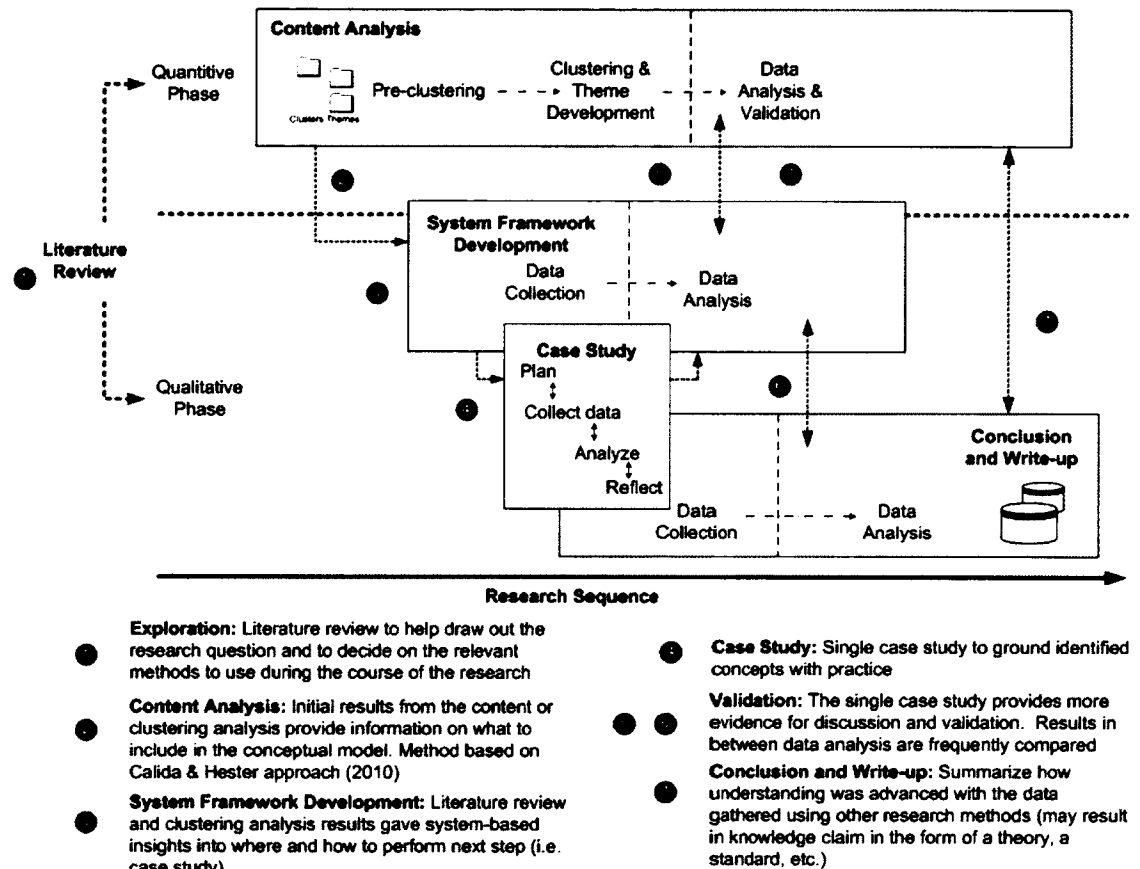
Figure 8. Detailed 'multimethodology' research design

From Figure 8, a multi-domain investigation of the topics relevant to the research

question was approached through the literature review. This was the pre-research design

exploration step where a literature review covers both a review of available

methods/techniques as well as help to reveal some number of issues, controversies and

themes related to 'system governance'. During the exploration phase, the overriding

assumption that guided the literature review was that 'system governance' was not yet

explicitly articulated in any actual system. Another related assumption was that any possible 'serendipitous' adoption of 'system governance' has not translated into concrete positive values, except perhaps having benefited the 'system' in intangible ways.

Any data that resulted from this exploration were used as the datasets feeding into the subsequent research activities, specifically the 'content analysis' (as the quantitative phase), the system framework development, and the 'case study' (as the qualitative phase). Broadly, these become the three sequential phases of the research design. Each of the major research phases are addressed separately in turn in the following sections.

4.2 Quantitative Phase using Content Analysis

Content analysis is "a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use" (Krippendorff, 2004, p. 18). It has several advantages, chiefly, its objectivity. Governance and systems related research, in possessing strong grounding in values and attitudes, and having social science derivatives, must employ repeat methodologies which avoid subjective biases (Duriau, Reger, & Pfarrer, 2007). Specifically, properly use of content analysis tends to avoid recall biases (Barr, Stimpert, & Huff, 1992). Furthermore, it can be performed utilizing unstructured input data, a feature which was very useful given the diverse nature of scientific input likely to be employed in a given literature review process. Dealing with diverse input was one promising feature of content analysis as it is often highly utilized to obtain otherwise unavailable information (Kabanoff, Waldersee, & Cohen, 1995).

There are four main approaches to content analysis (Neuendorff, 2002), descriptive, inferential, psychometric, and predictive. The first two, as stressed by Neuendorff, were not empirically founded; descriptive approaches limit conclusions to that which is under study, while inferential content analysis is subject to bias and therefore, less scientifically rigorous and desirable. Psychometric content analysis extends "beyond simple inference in that the measures were validated against external standards" (Neuendorff, 2002, p. 54) and experienced increasing popularity, while predictive content analysis was used to forecast particular outcomes for the analyzed material.

Together with the advances in computing technologies, current content analysis methods incorporated the processing and analysis with computers (Duriau, Reger & Pfarrer, 2007). Previous approaches to content analysis used the frequency with which words occur or co-occur within texts. The general idea was to simply take a list of concepts (which may be regarded as single words or a set of words) and then simply count the number of times each concept occurs in the text sample. Today more sophisticated approaches incorporated algorithms that go beyond simple word frequency counts. Andrews and Fox (2007) noted that advances in algorithms like Suffix Tree Clustering (STC) or Document Index Graph (DIG) techniques were now available to differentiate cases previously indistinguishable using frequency-based approaches. As a specific example, the statement "the cat chases the mouse" may now be distinctly differentiated from another similar statement "the mouse chases the cat". Whereas, frequency based approaches only count the instances of the main keywords or terms {cat,

mouse, chase} resulting to an equal count between the two sample statements without regard for word order information at all.

While there was recognition as to the approaches of content analysis in use today, there still exist debates as to whether these approaches are qualitative or quantitative. Duriau, et al. (2007) considered content analysis as a method that exists at the intersection of the quantitative and qualitative realms. For the purposes of this research the initial software-based data analysis and collection was taken to be quantitative analysis, whereas the latter stages of subjective data interpretation were taken to be qualitative and envisioned as later inputs to the system framework development and the case study qualitative phase.

4.2.1 Validation approaches

In conducting content analysis, there were several validation concerns for consideration. These considerations as discussed below affected the results achieved, the interpretation of the results, and whether it is wise to employ a manual or computer-assisted process for content analysis. Furthermore, when content analysis methods are used, researchers should be mindful of the possibility that validation of some of the choices require semantic, cultural or expert interpretations of the data.

Also, specifically for computer-assisted processes, researchers must be mindful that the choice of software or any automated procedure in conducting content analysis may actually have already made interpretative research choices by default (Carley, 1993). These choices are summarized briefly in Table 7. While these choices are essential, several of these choices were already addressed by virtue of the method/technique utilized. The more important choices that have implications for validation were discussed

in turn in the following subsections. These were addressing namely the following: (i) the level of analysis, (ii) irrelevant information, and (iii) the level of generalization and its implication of concepts.

Table 7. Coding Choices (from Carley, 1993) and Implications to Method Design

Coding choices	Implication to 'content analysis' method used for research
Level of analysis	What constitutes a concept? Results vary if single words, as opposed to phrases, are used in the coding. Single words are useful if one wants to contrast the results in a specific text or type of text with general usage. Phrases are useful when the research is interested in capturing broad-based concepts or terms defining a given community.
Irrelevant information	What needs to be excluded from the data? Typically, a protocol needs to be adopted how irrelevant information is detected, deleted, or used to dynamically modify the coding scheme. Depending on the actual degree of elimination methods used may determine if the content analysis may be conducted automatically.
Use of Predefined or Interactive Concepts	The research may have prepared a priori a ready set of categories of concepts (supervised) or may continue to develop the listing dynamically during the coding process (unsupervised).
Level of generalization	Coding concepts as they appear facilitates automation but usually at the expense of cross-text comparability. Choosing the right level of generalization is in many ways dictated both by theoretical concerns and by the type of analysis.
Creation of translation rules	Depending on the level of generalization required, sometimes it is necessary to use a set of 'rules' or a thesaurus that translates less general concepts into more general ones.
Level of Implication for concepts	Does the coding account for direct, implicit (or both) meaning? The coding based on words or phrases may or may not have a direct relationship on the actual concept that one needs to study. Locating implicit knowledge goes beyond generalization as it often involves transitioning from one concept to the other.
Existing or frequency	Should text be compared on the basis of the merely the existence of those concepts or in terms of how frequently the concepts occur?
Number of concepts	How many concepts should be used in the analysis? For considerations for saliency and emphasis, what is the number of concepts that can allow a 'satisficing' level of generalization to sufficiently capture the span of discourse within a given research topic.

The various coding choices above have correspondingly specific validation concerns. In general, validation in content analysis was a demonstration of the worth of the analysis (Romesburg, 1984). This should show how the results produced are informative and useful in reconfirming the research goal and in answering the research question. How well the analysis achieved its research goal and in generating interesting and useful conclusions is a measure of its *primary validity*. Additionally, there were certain features (such as the technical coding choices listed above) that every content analysis technique should have, and these are measures of its *secondary validity*. The specific technique employed itself has been demonstrated to satisfy different checks for primary and secondary validity including face validity, representational validity and internal validity (Corman, Kuhn, McPhee, & Dooley, 2002). In the meantime, a supplementary discussion is provided below to show how validation aspects were taken into account in the over-all content analysis process central to the research design..

4.2.1 Level of analysis

The method employed in this research featured the state-of-the-art in content analysis where the level of analysis goes beyond analysis of words or phrases. Centering resonance analysis (CRA) was a relatively recent development designed to enhance any content analysis methodology (Corman, et. al., 2002). It goes beyond traditional content analysis through the identification of the most crucial words in a text document and linking these words in a network. These linkages help to organize the words holistically by looking at the influences of these words in the larger document based on the word location within the document. With each specific linkage identified, useful meaning can

be designated where the CRA technique relies on foundational linguistics and network theories to posit accurate representation of the textual concept. Unlike other content text analysis methodologies that rely on frequency counts of words or phrases, CRA considers a word to have more influence within a text, depicting the prominence of its relationship to other words, if it links other words together in the network text and assists in assembling meaningful groups of text.

4.2.2 Irrelevant information

There were three approaches adopted with respect to how irrelevant information was addressed. One was in the literature search strategy used. The literature search restricts the choice as well as the quality of data to be sampled. As such, scholarly research text data that focused on recent developments in the system governance topical domain was used. Another approach was in the implementation of the CRA technique itself where irrelevant information was automatically eliminated by virtue of linguistic and network computations integrated within the Crawdad Desktop 2.0 software package implementing the CRA algorithm (Corman & Dooley, 2006). CRA involved sequential step processes of selection, linking, and indexing (Corman, et al.). First, selection categorized text in terms of patterns connecting them. Compilation of these words and their underlying connections across all utterances in the text yielded a CRA network depiction of the text. Next, the linking step converted word sequences into networks of relationships between words. Each article found as a result of a scientific literature review containing the target topic area was analyzed with CRA by grouping the words into noun phrases and combining these phrases to form utterances. Accumulating links over a set of utterances comprising a text (or series of texts that were the result of a

literature review) yields a symmetric, valued, undirected network whose nodes represent the center-related words. Then, indexing analyzed the network to determine relative node (word) influence. The final approach incorporated a human-based assessment as an external validation of the clustering results. The over-all content methodology ensured higher quality clustering results by employing previously mentioned approaches to minimize irrelevant information. As discussed, the content analysis method combines a manual pre-processing and post-processing step in conjunction with automatic computational packages in between.

4.2.3 Level of generalization and implications to concepts

CRA results can be interpreted in a number of different ways. These may include: i) investigation of a particular author in a field to determine how the author's works are related to other existing research; ii) identification of clusters of research to determine the underlying themes of a particular field about which you little or no knowledge, perhaps in an effort to speak the language of a particular field or familiarize yourself with the important literature; iii) examining a seminal study in a field in order to determine how other research in the field relates and has furthered this early work, iv) comparing and contrasting existing research in an effort to gain insight; iv) observation of gaps in research, thereby identifying opportunities for future innovation, v) assessment of the prevalence of a particular method or theme in research; and vi) understanding existing research to leverage findings to enhance efficacy of new research initiatives within an enterprise.

Furthermore, word resonance was important to consider when analyzing CRA network structures. It provides a general measure of the mutual relevance of two texts.

The more frequently two texts use the same words, especially in similarly influential positions, the higher the underlying resonance of those words and thus, the more prominent are those words in the underlying text's structure and message. Computer software helped to make this process repeatable and objective, as individual biases influence the reliability and repeatability of the process. CRA processed the raw information present in text, determining how literature sources were interrelated and grouping them into clusters based on topical similarities. All assessment of relationships between literature sources were not predetermined by the user or the software, thereby ensuring that the software mimics the natural process undertaken by researchers, scientists and program managers in subjectively identifying relationships between multiple sources of information. Relationships may exist based on the analyst's perspective or experience, the underlying method in the work, historical context of the work, results, or language used.

4.2.4 Procedure in conducting content analysis

To begin with the quantitative phase of this research, the textual data sets were made ready for use in the modified content analysis procedure, which employed a novel clustering text analysis method. The novel method employed a clustering technique that helped to extensively discover any important concepts and interrelationships that are reflected in frequently recurring themes. The methodology, shown in Figure 9 first proposed in Calida and Hester (2010) and employed in this research study utilized a modified three-stage approach.

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┌─────────────┐╲  ┌─────────────┐╲  ┌─────────────┐╲
│ Pre-processing:│╲ │  Cluster    │╲ │Post-processing:│╲
│ Data generation│ ╲│  Processing  │ ╲│  Validation    │ ╲
│             │╱  │             │╱  │             │╱
└─────────────┘╱  └─────────────┘╱  └─────────────┘╱
```
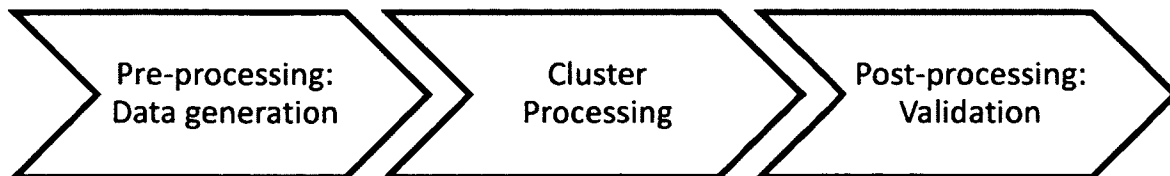
Figure 9. Simplified 3-stage Method Overview

Stage 1 consisted of data generation and pre-processing. A literature review

process was typically undertaken by performing a search in a library database using

research relevant keywords, thereby identifying a set of potentially relevant articles from

only peer-reviewed journal sources. In depth process and other details of the content

analysis as part of the literature review is further discussed in Appendix 1. Peer-reviewed

journal articles feature the intellectual hallmarks for validated forms of knowledge

(Bedeian, 2004; Mahoney, 1985) that may eventually impact and shape the research field.

In this regard, the ISI Web of Knowledge Social Science Citation Index (SSCI) and

Science Citation Index (SCI) was the selected database since it was the most

comprehensive database of peer-reviewed research work for both the social sciences and

sciences. All material available in the database for years available up to the time of the

research: from 1992 through 2011 was used. Other archived material earlier than 1992

were not yet digitized to the now standard optical character recognition technology

(OCR), hence were not available to be used as part of the study. Another key

consideration was the determination of the relevant keywords to be used for the search.

Given the plurality of meanings attached to the word 'governance' and 'systems', the

search query employed was intentionally crafted to be as broad as possible, as a general

selection requirement, to maximize the inclusion of all the relevant studies. The initial search of the SSCI and SCI database was performed using the basic keywords: 'governance' and limiting to descriptive 'systems' and its derivatives of systems-related research work (i.e. Title=(governance) AND Topic=(systems OR system OR systemic)); document type 'article' and 'review' (not including book reviews); language as 'English'. The search was further delimited to include only articles that also mention 'systems' (and its derivatives) in the relevant topic search fields. This was an important reduction step that significantly narrowed the search field and yet still remained inclusive to relevant works that write about governance within the context of a system. The system delimitation was an important distinction to other research available on governance that often specifically talks on a rather narrow view of the concept.

A digital copy of each identified full text of each article was then retrieved, excluding those that were identified as irrelevant (e.g. a book review or editorial). This pool of articles was considered the text for proceeding to the literature review process. All baseline articles were then converted to ASCII text files. This pre-formats the articles in order to enable the next step in the clustering process.

In Stage 2, each ASCII text file was subjected to cluster analysis. Cluster text analysis was performed through the use of *Crawdad* computer software (Corman & Dooley, 2006). Articles were automatically processed using computer software in a textual analysis program. Stage 3 ensured the subsequent proper validation of the identified common thematic elements present in the articles. All these stages are described in more detail in the next paragraph.

The textual network clustering established conceptual linkages between different literature sources using textual frequency, location and relevance within the text. Clustering results were verified and validated by comparing the two modes of clustering undertaken in Stage 2. In Stage 3, clustering results were compared in terms of the themes identified and membership of the themes. In line with the earlier discussions, validation at this point was achieved in terms (i) obtaining well-structured clusters, (ii) agreement with existing literature results and expert intuition, and (iii) demonstrated stability robustness of the clusters found. Not involving any expert inputs in the validation steps, this enabled the advantages described earlier in the study to be fully realized, namely, the analysis and synthesis of large amounts of information, unable to be analyzed by a human-only system.

4.3 System Framework Development

Two established system models provided the basis for the systems framework development described in this section. One system model, based on Bunge's CESM system model, provided an approach to make explicit the ontological aspects of governance as found in practice. Considering how governance itself may be composed by several levels of activities, there were issues that need to be resolved at a conceptual level. One means for addressing these issues was to introduce Cabrera and Colosi's (2008) systems thinking approach. Bunge's CESM model has already been introduced earlier (see Sec. 2.2). The remainder of this section will discuss the rest of the proposed approach.

With this as a starting point, a system-based conceptual analysis framework called DSRP (Distinction, Systems, Relationships, Perspective) by Cabrera and Colosi (2008) is used to inform the framework development. The DSRP is an analytic tool which can be utilized to extract relevant conceptual patterns, to clearly delineate between a given concept's content and context. In order to assist in threshing out conceptual inconsistencies, the DSRP framework was utilized to provide a system/critical thinking approach. The DSRP refers to four patterns of thinking that are universal to how all people build, change, and understand ideas, mental models, and even mindsets and worldviews. Using this framework, a rich conceptual descriptive representation of "governance" is outlined. In the following section, descriptive information on "governance" will be utilized to provide a better framing for development of a normative understanding on "governance". Table 8 is an overview of the DSRP framework used for this research.

Table 8. Conceptual analysis using Cabrera & Colosi's (2008) DSRP Framework

Distinction – Making a distinction is the process of determining what something is (identity) and what something is not (other).	Systems – Every whole is made up of parts, while also serving as a part of a larger whole.
Relationships – When two ideas relate to each other, they have a mutual effect on each other that changes them both.	Perspective – Every idea is a perspective comprised of a point and a view. The point is the subject, or the position from which the idea is viewed; the view is the object, or what is viewed.

4.4 Qualitative Phase: Single Within-Case Study

In this phase of the proposed research, a qualitative structured within-case study design was pursued to evaluate and provide partial validation of the concepts resulting from the system framework development in the previous phase of the research. Through the use of a case study, dynamics and interplay arising from the scholarly themes, drawn from the content analysis including the application of conceptual systems framework, supported advancement of the qualitative discovery and limited validation of 'system governance' constructs.

The purpose in this section is to describe details of the qualitative phase in the research, specifically for the design of the case study. The case study design was primarily drawn from a synthesis of the state-of-the-art in the case study research from numerous seminal works (Bennett & Elman, 2006; Carroll & Swatman, 2000; Yin, 2009;). As such, these discussions focused on the key developments and suitability of the specific case study research design taken in this research. Lastly, the proposed step-by-step process details of the case study design are presented and are also shown in detail in Appendix 3. In particular, the single case study research protocol on of a university-based start-up entity is detailed in Appendix 5.

4.4.1 Overview of Case Study Research

Case studies have generally been considered to be qualitative research, among a number of possible qualitative research choices (Creswell, 2003) that "focuses on understanding the dynamics present within single settings" (Eisenhardt, 1989, p.534). They can be used to 'illuminate a decision or set of decisions, why they were taken, how they were implemented, and with what result" (Schramm, 1971, as cited in Yin, 2009, p.

17). However, from Schramm's definition, a 'case' was not always a 'decision' or a set of decisions where a 'case' was regarded in a much broader sense that may imply a person, a group of people, an organization, a process, or sometimes an 'event'. With this in mind and considering other developments in the field, Yin (2009) presented an updated more complete definition of case studies as follows:

> *"A case study is an empirical inquiry that*
> - *Investigates a contemporary phenomenon in depth and within its real-life context, especially when*
> - *The boundaries between phenomenon and context are not clearly evident.*
> *The case study inquiry*
> - *Copes with the technically distinctive situation in which there will be many more variable of interest than data points, and as one result*
> - *Relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result*
> - *Benefits from the prior development of theoretical propositions to guide data collection and analysis."(p. 18)*

Using this definition, the essence of a case study encompasses both the scope and technical nature of the approach, including the basis of design, data collection techniques, and specific approaches to the data analysis.

Within the operating definition above, there can be several implementation variations possible in considering case study as a research method. According to Yin (2009), these variations were typically determined by three factors: (i) the form of the research question, (ii) whether there is a contemporary event focus; and (iii) the degree of control available to the researcher. Specific to the use of a case study, the basic category of questions answered by a case study was of the form "how" and "why". Posing the research questions in these forms suggested a more explanatory substantive approach. This was because these types of questions specifically deal with operational links needing to be traced over time, rather than the focus on the culmination of repeat or random

events. After duly considering that 'how' and 'why' questions were indeed the present research focus, another consideration was "the extent of control over and access to actual behavioral events" (p. 11). Closely related to this, another consideration was that the research interest can be narrowed down to the provision of explanation of timely and contemporary events. Among the tools available for case study researchers are the use of direct observation of the events and interviews of the persons involved in the event. Because of the contemporary nature of the approach, historical data may be complemented by a full variety of additional recent evidence in the form of documents, artifacts, interviews, and observations.

A case study research design consisted of (i) the study questions, (ii) any propositions, (iii) its unit(s) of analysis, (iv) its logic linking data to the propositions, and (v) the criteria for interpreting the findings. These were also discussed in more detail in Yin (2009). Elements of the research design listed here prompt the researcher that a preliminary theoretical construct related to the topic of study is necessary. That is, part of the consideration in the use of the case study research design is the role of theorizing and addressing it as a central component of the research design phase (Eisenhardt, 1989). In other words, a further requirement for case study research design was the inclusion of a theoretical development component whether the research was going to be explanatory, descriptive or exploratory.
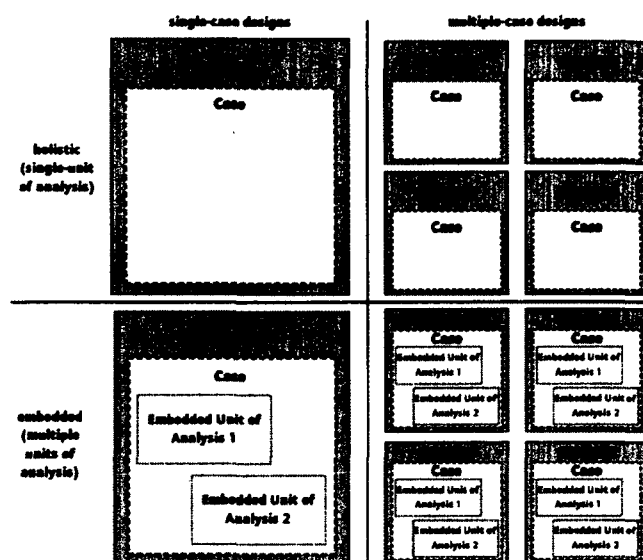
**Figure 10. Basic Types of Designs for Case Studies
(adapted from Yin, 2009, p. 46)**

Having discussed the main elements and considerations for case study research design, another decision, based on the previous characteristics mentioned, was the overarching specific design to be followed. In Figure 10, Yin (2009) mentioned the types of case study research designs. Single cases were a common design and usually two variations are possible namely: (i) those employing a holistic design, and (ii) those using embedded units of analysis. The rest of this section focuses on this particular variation as it is going to be the primary overarching case study design used in this research. A discussion on the potential of multiple-case designs was beyond the scope of this review and can be studied further in Yin (2009). The point of selecting a single case study was to explain 'how' and 'why' something happens by taking a closer look at the interdependencies involved and the embedded dynamics of the case to be studied. Yin (2009) suggested five main reasons that help to justify the use of a single case design namely:

- The *critical* case (that may be a test of theory or a way of comparing theories or ideas);

- The *extreme* or *unique* case (to highlight a glaringly obvious but under-explored causal mechanism);

- The *representative* or *typical* case (to capture the circumstances and conditions of common situations);

- The *revelatory* case (where the research gains access to a previously unavailable situation), and;

- The *longitudinal* case (a progressive study of the same case at two or more different points in time). (pp. 47-50)

The proposed case study aptly takes the form of a *critical* case where the case study will be used to evaluate the systems development framework. Setting up such a single case study may proceed in three ways: (i) as a quasi experiment – to challenge the theory or ideas in order to explain how the cases work; (ii) an analysis of "best practice" – deliberately challenging the reputation of cases of "best" or "good" practice from instances where "success" has been claimed; or (iii) as a comparison of competing sets of ideas – contrasting which possible approach may give a more complete explanation of the problem. Since research on system governance was often subject to a wide variety of approaches coming from different individual perspectives, the proposed case study will primarily focus on comparing the ideas that have been used to develop the system governance framework against competing sets of ideas. For instance, in a given situation presented in a case, the system governance framework provided an overarching logic

while an exclusively management-based framework is solely limited to executing specific tasks or activities.

Finally, another dimension of case studies was the consideration as to whether the unit of analysis was considered as *holistic* or *embedded* with respect to the context of the case study. A given single case study was considered *holistic* whenever no logical subunits can be identified or when the nature of the relevant theoretical underpinning is holistic itself. Otherwise, when several subunits are distinctively identifiable then such a single case study has an embedded unit of analysis. In the context of this research, a possible holistic unit of analysis entailed the study of initiatives directed towards an entire governance system in a university, a healthcare service, or a business network. Alternatively, an embedded unit of analysis may also be selected if it presents itself as a more logical way to understand the situation. For instance, an embedded unit of analysis within the single case study context of this research could have possibly looked at the functional processes, structures, technology, people, culture that comprise the initiatives underlying or supporting the existing governance system.

4.4.2 Drawing Causal Inferences from Within-case Study: Large-n versus Small-n

A main concern when using single case study research was a problem related to the determination of the best way to draw causal inferences (Bennett & Elman, 2006). Historically, several assumptions of causality that determine distinct affinities to different methodologies have been mentioned in Bennet and Elman. Some of these approaches lend themselves to large-*n* statistical regression analysis. This results by virtue of the underlying presuppositions that were consistent with neo-Humean regularity theory, counterfactual and manipulation theories that characterize most experimental research

designs. Alternatively, a small-*n* proved to be useful in establishing a causation process in search for mechanisms and capacities. Having committed to the proper framing of 'mechanisms' and 'capacities', a coherent and distinguishable set of methodological choices were made available. Whereas most large-n and exclusively quantitative views adopt what was described as an 'effects-of-causes' paradigm, a 'cause-of-effects' paradigm differs in terms of its explanation of an outcome based on just a particular case or a few cases. A causal explanation of this form does not find for the net effect of a cause over a large number of cases, but instead investigates how causes interact in the context of a particular or a few cases in order for an outcome to emerge. This can be strictly established as long as ontological and epistemological commitments were being mutually reinforced. While large-*n* quantitative research strategies still have significant research merit, an in-depth small-*n* qualitative case study suggested in this research offered a complementary inferential advantage based in the uniqueness of circumstances that do not necessarily allow the use of quantitative methods. In summary, a qualitative small-n case study was supported to respond to the application research question, particularly with distinct justifications for allowing its use in ways "that are capable of producing verifiable, and in some instances, generalizable scientific explanations of the social world" (p. 458).

4.4.3 Case-selection Criteria

Unlike most 'effects-of-causes' approaches that aim to establish causation through comparison of large-*n* case studies, the small-n within case methods were primarily focused on discovery and validation of causal mechanisms. As such, there were methods (such as either *process tracing* or *causal process observations*) that were now

used to uncover "traces of a hypothesized causal mechanism within the context of a historical case or cases" (Bennet & Elman, p. 459). Single within-case methods bear on multiple testable implications of a theory where the research provides solid singular evidence that allows the elimination of alternative explanations. That is, a within-case study may be able to provide a "smoking gun" piece of evidence that strongly validates one explanation and ruling out several competing ones. The argument for using a single within-case study was further bolstered when the following elements are present: (i) a suitably selected start and end point of the story, (ii) accounts that have fewer or no notable "logical chain" breaks in the causal story, (iii) suggestions of verifiable evidence at each step of the process for an account posited to be true, (iv) appearance of observable evidence that make alternative explanations inconsistent, boosting confidence on the one theory that remains true up until this point, and (v) through the rigor of the process tracing involved, confirmation bias was minimized as evidence was being reviewed against every step as a means to elevate one explanation over others. Each of the above arguments when reviewed against available research in system governance justifies support in using a single within-case study approach. As it shall be articulated in a system governance framework development, a suitable start and end point was the governance system itself. While there were already attempts to introduce competing concepts such as management, planning, administration among others, the state of the research in system governance was beyond the scope of these concepts. As a result, evidence and explanation using these alternative ideas may either be limited or entirely misinformed. When explanations based on loose constructs other than governance results in a paradox,

understanding must yield to a new formulation of ideas in order to arrive to better explanations and theories.

Some guidelines, however, need to be considered in the use of small-n case study methods, specifically on the concern for 'selection bias.' A 'selection bias' was a concern since researchers may be vulnerable to selecting to investigate cases where an outcome was known to have occurred or almost occurred. Detractors, mostly from large-n and quantitative case study methodologists predicts that selection of cases "on the basis of values of the dependent variable leads to an underestimation of the effects of the independent variable (Bennet & Elman, p. 461) leading to a flatter regression line as a result of the truncating effect of case selection. These were valid arguments; however, these do not necessarily apply for small-n within case studies. By virtue of the process tracing or causal process observations, small-n within case studies fundamentally do not rely on co-variation that intuitively implies regression. Causal inferences instead arise from actual evidence that a process connects the cause and the outcome. Hence, critique for selection bias does not apply, even allowing comparison without bias for situations where distinct sets of causal process observations derived from cases that were not initially identified by their dependent variable values. Moreover, such critique may be said to be misplaced for research that were selected on the basis of the dependent variable in order to test claims of necessity or sufficiency. That is, when the purpose of the research was to determine whether a suggested cause was operating, then it was logically appropriate to study a case in which the outcome was known to align the research purpose.

Some implications for this research need to be kept in mind in the use of small-n case study methods. First and foremost, there should be careful restraint when drawing straight out generalizations and not to claim unsupported generalizability from the study. This was because, while a clear cause can be identified, providing strong inferences to establish the validity of a theory, it may not give sufficient reason that the findings can be generalized for a broader population. While certain aspects of governance suggested from within the system governance framework may be suggested to be transferable across different context, ascertaining and claiming absolute generalizability in the face of the unknown future and different contexts is a tall order. Secondly, it was impossible for any researcher to have insight in advance as to whether or not any new explanations or variables being uncovered would be relevant for only a given case or for a wider population. In other words, one cannot ascertain if a hypothesized causal mechanism was generalizable in advance. These considerations must not be construed as limiting the conduct of research. Instead, they must be viewed as an encouragement to pursue knowledge further and advance better understanding of system governance.

4.4.4 Data Collection Strategies

As shown in Figure 11 , Yin (2009) mentioned several different possible sources of case study evidence. While each of these different sources of evidence were potentially useful for these research, three of these were significant to achieve the purposes of this research, (i) interviews, (ii) existing documentation, and (iii) direct or participant observations. However, it must be noted that before engaging in a detailed data collection phase, it was preceded with some preliminary research involving background literature, open-ended interviews and an assessment of research data access.

Before coming into the case study stage of the research, preliminary background research in the literature and informal interviews honed relevant ideas about the 'How?' and the 'Why?' research questions before embarking on a much more detailed investigation. If a case study is about an organization or group of organizations, what is particularly useful is to collect and analyze available literature about the entity, such as annual reports, news coverage/marketing material, publicly-available newsletters and other pertinent ones available from their website. This preliminary research can be complemented with open-ended interviews with 'involved experts'. Prior to selection of the case, these experts must be identified as individuals that are knowledgeable, accessible and available for discussion. Based on this exploratory phase, an assessment must be made to determine to what degree the level of access is consistent with that required to pursue the research case.
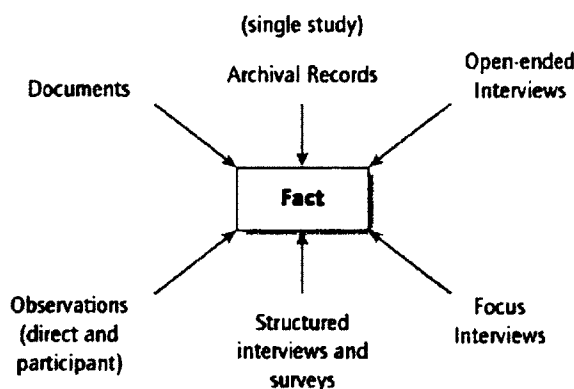
Figure 11. Multiple Sources of Evidence for Case Study (Adapted from Yin, 2009)

The first data collection method to support the case was a semi-structured interview. A semi-structured interview technique collected data from individuals who

were involved in the 'governance' process within each organization. The role or involvement from a prospective interviewee may vary from someone who was charged with the governance of the partnership arrangement, or to someone who was the recipient of the 'governance' efforts, while others may have a hybrid of both roles. The people interviewed included the governance champions or initiators, managers, and staff involved in various governance activities.

As shown in Appendix 5, the interviews for this case covered the following topics:

- Organization overview and role of governance

- Historical developments within the governance system

- Existing governance arrangements

- Understanding of the data and data sharing processes

- Operational and resource aspects of the partnership

- Organizational and institutional arrangements

- Barriers and issues (legal, technical, economic, institutional).

The next key source of evidence for this particular single-case study research consisted of historical documentation which had been in existence since the design, development, and even deployment of the governance effort. The documentation varied from organization to organization (or from department to department) but included forms of the following:

- Initial planning documents for the governance effort

- Descriptive documentation such as that available on Web sites

- Examples of individual governance agreements

- Internal review documents of the arrangements

• External consultancy reports

• Conference and journal papers describing the arrangements.

In the evaluation of each of the documents, care was taken to recognize the strengths and weaknesses of the various forms of documentation, particularly with respect to any bias. To achieve this, one of the most important uses for documentation was to corroborate and augment evidence from other sources to minimize possible bias (triangulation). This has been made easier with the aid of qualitative data analysis research software. Among the more integrated software in use today are software like MaxQDA (www.maxqda.com/products), Dedoose (www.dedoose.com), and NVivo 10 (www.qsrinternational.com/products_nvivo.aspx),.

Finally, observations (either direct or participant) were another key source of evidence for this research. Yin (2009, p. 109) noted that these observations "can range from formal to causal data collection activities." In this study, the observation component was going to be a piece of observation collected that overlaps with data analysis. To aid in later data analysis and support the theory building phase. This was very similar to what Eisenhardt (1989) envisioned for 'field notes' taking, a running commentary to oneself and or the research team. This form of observation suggests that data analysis frequently overlaps with data collection. Field notes were, as Van Maanen was describing it and cited in Eisenhardt (1989), "an ongoing stream-of-consciousness commentary about what was happening in the research, involving both analysis – preferably separated from one another." What then were useful field notes impressions to take down? As a guideline, field notes for this research gave impressions of what may seem important, or as a 'thinking piece' that pushes thinking about possible implications to the original research

questions. These were in the form of emergent ideas, "as cross-cutting comparisons, hunches about relationships, anecdotes, informal observations from team meetings" that were taking place in the field. In this research, the field notes will be housed together with the rest of the data evidence as part of the single-case study data analysis database.

4.4.5 Structured Within-Case Study Process Design

The actual case study research cycle to be used in this research overlaps significantly with elements from the Carroll and Swatman (2000) structured-case methodological framework.
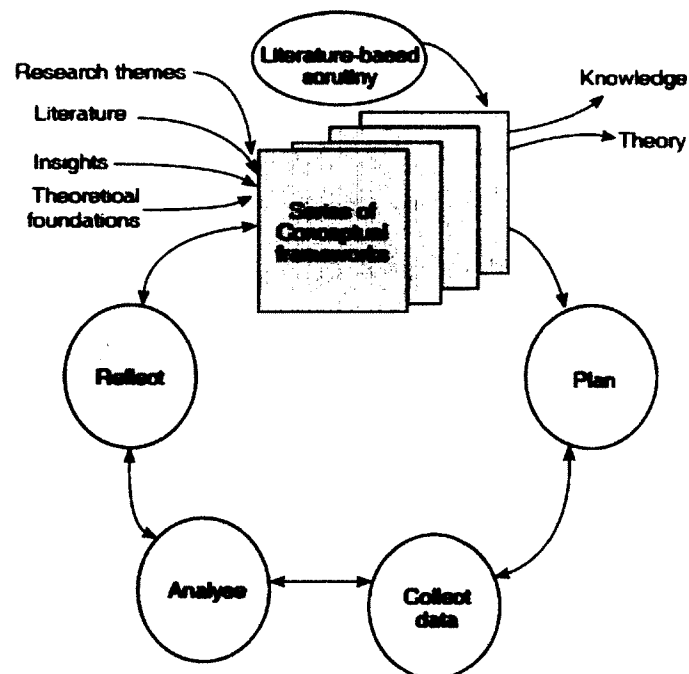
Figure 12. The Structured-Case Research Method Adapted from Carroll and Swatman, 2000)

As shown in Figure 12, and in conjunction with Figure 8, where the systems development framework output served as an input to the four-stage 'case study' research cycle conceptualization. This was showing the 'case study' proceeding in an iterative, fluid and ill-defined non-sequentially set adjacent research stages involving (i) planning, (ii) collecting data, (iii) analyzing, and finally, (iv) reflecting.

In planning, the research themes, key concepts produced in the systems development framework and its place in the research paradigm is reviewed. A critical assessment between the research paradigm used and the concepts and relationships emerging from systems development framework were used to narrow down to a specific research design. What was revealed in the planning step provided insight concerning the appropriate types of cases and organizations for the research design as well as an identification of the ways of gaining access to organizations and informants. The techniques for collecting, recording, processing and analyzing data (and related criteria for rigor and validity) were planned, as was the method for reporting the outcomes. The research design remained as a guide rather than a hard rulebook that merely prescribes the research activities, as qualitative research must be responsive to emergent conditions in the field.

From the previous planning step, a rigorous process of collecting data and recording them follows. Whereas collecting and analyzing the data were likely seen as separate stages, in practice they are closely interrelated. During actual collecting of data, an investigator continually examines and analyses the data; field notes record the researcher's interpretations, which may reveal new areas for exploration. As a result, the present research adopted a flexible approach to data collection in order to respond to

opportunities, unexpected outcomes and emergent themes, for instance, by formulating new questions to an interview protocol in order to integrate new themes that have emerged. Such flexibility is encouraged because small-n qualitative case study theory building was based on deep understanding, rather than large-*n* statistical comparisons between data collected through standardized protocols.

Next was the analyzing step, which as previously noted, may significantly overlap between data collection and analysis activities. Analysis ensued during and following completion of data collection activities. Qualitative research typically involves vast amounts of raw data; analysis was the process of organizing and reducing these data so that the researcher can bring meaning to them. This was facilitated by the use of coding procedures. Coding is one of the most common approaches to qualitative data analysis. Codes should have some sort of conceptual or structural order, rather than being a random collection of categories (Miles & Huberman, 1999). To ascertain that the findings were linked to the original research purpose and questions, the data analysis was related to the research themes primarily through the aid of the structuring offered by the systems development framework described earlier in the multimethodology outline. The systems development framework reflected the researcher's evolving understanding of the research themes at the start of the research cycle. The concepts suggested in the systems development framework were used as initial codes to guide the analysis, along with 'any other' codes to incorporate new themes. This also provided a good avenue to identify existing as well as new links between the data, the data analysis and the research themes. Analysis is not a single-step activity but rather an ongoing, iterative task in order to gain deep understanding of the data and the underlying themes and patterns contained in it.

The researcher's preliminary understanding helped to frame the data and leads to new understanding, which then guided further reading of the data. However, as Merton (1948) has noted, throughout the analyzing process it is vital that the researcher is receptive to serendipity or 'the discovery through chance by a prepared mind of new findings that were not looked for' (p. 506). Therefore, while the systems development framework helped to structure the data collection and analysis, it should not be seen as overly constraining. As analysis continued, new concepts and themes emerged, and were accommodated in the research.

Finally, the case study went through a reflecting process where previous steps were reviewed in a process of deliberate reflection and critical analysis most particularly focused on any of the interpretations emerging from the data collection and data analysis steps that help to enhance the rigor of research. A formal stage of reflection, involving deliberate and critical thought, was performed after the data were analyzed. This involved: (i) reviewing the research process, such as methods to collect and analyze data; (ii) evaluating the outcomes of analysis, including assessing emergent themes, challenging current interpretations and seeking disconfirming evidence for tentative findings, (iii) reviewing the structures of structured-case; (iv) looking beyond the data for implications to theory building; and if necessary, (v) updating the systems development framework to incorporate the revised knowledge accumulated and preliminary theory built. Based on these reflections, the inputs to the systems development framework were reexamined, and the research themes refined. The emergent themes lead to clarification either from the literature or through practitioners or experts. The research required a revisit with "involved experts" to discuss whether the tentative interpretations were valid.

The data were collected and analyzed up until this point do not used to build theory themselves. Instead, the investigator considered any wider implications of the findings for the research themes; including a rigorous iteration back and forward between the data, and the tentative findings and the inputs to the framework used. Any ensuing rationale for changing the framework recorded as this provided for *internal* justification of the research findings. *External* justification may also be accomplished if a panel of 'governance' practitioners, who review the updated framework and the related rationale. This stage ended when the existing or working framework was challenged and confirmed, or revised and updated to include the learning gained in this research cycle. The revised systems development framework was then prepared to become the new basis for any new research cycle of inductive development to extend the framework, confirm in different context, or to begin the process of deductive theory testing.

4.5 Final Step: Validation, Conclusion and Write-up

The next steps are considered as a form of validation as some of the steps here actually overlap with the reflection steps in preceding methods used. Operationalization was through a 'single-case study' to relate the identified concepts in practice. In the final part, a meta-synthesis step took into consideration all of the findings acquired from implementing the various research methods supporting case data collection and analysis. This last step helped advance understanding of the 'system governance' problem domain by rearticulating 'multimethodology' implications in the form of a metamodel, theory, standard, or hypothesis.

As a guideline to proper validation involving multimethodology approaches, Green et al. (1989) highlighted five major contributions such an approach may have to enhance the study on 'system governance.' These were triangulation, complementarity, development, initiation, and expansion. *Triangulation* tests the consistency of findings obtained through different instruments. In any typical case study on 'governance', triangulation increased chances to control, or at least assess, some of the threats or multiple causes influencing our results. *Complementarity* clarifies and illustrates results from one method with the use of another method. As envisioned for this research study, in-class observation added information about the learning process and qualify the scores and statistics. *Development* results from allowance of one method to shape subsequent methods or steps in the research process. In this case, partial results from the other related research on governance outcome measures were used to examine that the degree to which other assessments should be incorporated. *Initiation* stimulates new research questions or challenges to results obtained through one method. In this case, focus group interviews with 'governance' scholars and practitioners provided new insights on how any 'system of governance' has been articulated, operationalized, perceived and valued across sites. *Expansion* provides richness and detail to the study exploring specific features of each method. Integration of procedures mentioned above expanded the breadth of the study and likely enlighten the more general debate on crucial discussion points about governance in general.

4.6 Chapter Summary

In summary, the crucial elements of the research design were presented in this chapter. The definition of *research design* itself and the decision to use a multimethodology approach as described in the earlier sections are supported by fully describing the process and considerations in each research phase. The three major research phases included in the research design include a quantitative content analysis, system framework development and finally, a single-case study approach to provide first-level face validity to the system framework development. As with any research, the research design refers to the strategy to integrate the different components of the research study in a cohesive and coherent manner. This led in defining the path taken to address the research questions. The research design presented in this chapter served as a detailed and rigorous guide to conduct research systematically and provide a replicable approach, capable of withstanding scholarly scrutiny.

CHAPTER 5

RESULTS AND DISCUSSION

In this chapter, results for each of the major phases of the research design are presented. First, the findings of the content analysis are presented. This is followed by the system framework development phase and then the results of the single-case study phase. Finally, a brief summary integrating the highlights in each of the major research phase are discussed in turn before closing this section.

5.1 Content Analysis: Detecting Key Governance Themes

Despite the broad reach of the concept, governance is not necessarily articulated consistently in theory and much less so in practice. The content analysis method realizes the added value in determining the common coherent linkages of disparate concepts. Derived common conceptual threads were useful in articulating the thematic basis needed to produce a rigorous conceptual understanding of a meaningful "system governance" theory, framework and application development. This section present the results of the content analysis phase of the research.

5.1.1 Systematic Literature Down-select Process Results

The content analysis was cast wide to fully encompass all conceptual nuances, associated constructs, and related models or theories. Considering the far-reaching anticipated search for conceptual usages, a systematic scheme was necessary in order to make an analytic assessment of the contributions of a given body of literature. A systematic literature review scheme utilized here refers to a specific explicit methodology to enhance the rigor, relevance and over-all quality of the review process and outcome by

employing a transparent and repeatable sequence of steps (Tranfield, Denyer, & Smart, 2003). There were inherent challenges in implementing such a methodology because of the difficulty of merging data from divergent disciplines not to mention the expansive literature topics to include.

Because of the aforementioned reasons, it was necessary to have a consistent content analysis methodology that was able to deal with the range of ideas or concepts associated with the 'system governance' research domain. Broadly, the review process employs three distinct parts: data collection, analysis plus synthesis, and gap critique. Each distinct part adhered to highly systematized steps shown in Figure 13 (is represented in detail in Appendix 1). In the first part, the data collection starts by reviewing the purpose and objectives for the research. Also, this step also decides on the appropriate data source. Recall that the research purpose was for an integrated articulation of relevant and current themes for system governance. These resulted with the alignment to a related research objective which allows for a comprehensive inclusion of relevant literature. Hence, the review process was decided to be intentionally broad and multidisciplinary in order to take into account the wide range of definitional, conceptual, operational and theoretical similarities (and/or differences) pervasive in the *governance* research domain. Next, as previously mentioned, the sources were limited to include only peer-reviewed journals that feature the recognized intellectual pedigree for validated forms of knowledge (Bedeian, 2004; Mahoney, 1985). The ISI Web of Knowledge Social Science Citation Index (SSCI) and Science Citation Index (SCI) was the selected database since it covered the most comprehensive database of peer-reviewed research work for both the social sciences and sciences. Its citation count tracking

functionality allows for extensive characterizations of the large pool of articles. The time period for the material available in the database for years available during the time of the research was from 1992 through 2011, periods where article databases have started to implement optical character recognition (OCR) technology.

Data collection

Analysis plus Synthesis

Find themes and critique for gaps
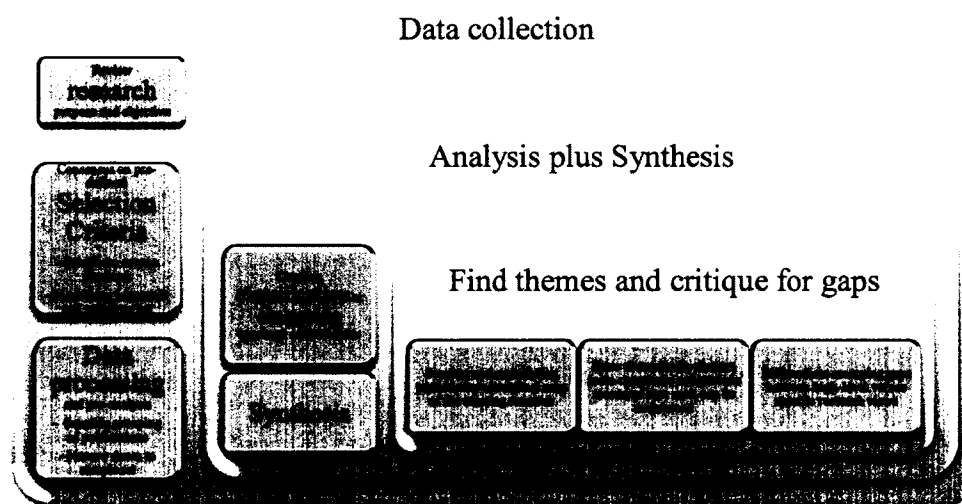
Figure 13. Outline of systematic literature critique filtering process

Given the plurality of meanings to the word *governance* and *systems*, the search query employed was crafted to be as broad as possible in order to maximize the inclusion of relevant studies. The initial search of the SSCI and SCI database was performed using the basic keywords: *governance* and limiting to descriptive *systems* and its derivatives of systems-related research work (i.e. Title= (governance NOT government) AND Topic= (systems OR system OR systemic)); document type *article* and *review* (not including book reviews); language as 'English'. The search was further delimited to include only

articles that also mention *systems* (and its derivatives) in the relevant topic search fields. This was an important reduction step that significantly narrowed the search field and yet still inclusive to relevant works that write about governance together within the context of a system. Another set of delimiters to aid in scoping and filtering the amount of relevant literature to be reviewed was to include in the Topic field the terms *engineering*, *analytic*, and *framework*. Using the earlier specified selection criterion, the resulting search yielded an initial sample of 1,516 documents, which at this point were further narrowed down into more manageable base sets of articles. To do that, a secondary search exercise was performed using the same basic keywords: *governance* and limiting to descriptive *systems* and its derivatives of systems-related research work (i.e. Title= (governance NOT government) AND Title= (systems OR system OR systemic)); document type *article* and *review* (not including book reviews); language as 'English'. Note that by delimiting the search using the identified keyword only from within the database 'title' fields, the resulting search yielded a much more manageable sample of two hundred ten (210) documents. The selected peer-reviewed articles were not indicative of a coherent body of literature on *governance* but representative of relevant writings across different domains where governance was considered invaluable. An unrestricted search of articles from the same database targeting only articles that mention *governance* either in its title, keywords or abstract resulted in more than 38,000 plus articles. This was a voluminous amount of literature and was not necessarily amenable to any level of conceptual homogenization or grand synthesis. The system delimitation is an important distinction to other research available on governance that often specifically talks on a rather narrow view of the concept. Additional search delimitation to further

narrow the search field was to specify only articles that advanced how to analyze existing forms of governance systems through an analytic framework or assessment instrument. As such, in the database search query, the terms *analysis* or *framework* or *assessment* (and their lemmatized word derivatives) were added. By specifying this additional search delimitation, the resulting searches were narrowed significantly to a few hundred articles and were considered as the starting set of articles that will be used in the later stages of the content analysis.

In the next step, the narrowed samples of peer-reviewed articles were assigned to different groupings. The rationale for the grouping was based on subject treatment differences between specific types of peer-review articles retrieved. Since part of the objective of the literature review was to identify and understand broad theoretical foundations of the area, the first group (Group 1) consisted of reviews and meta-type studies. The second group (Group 2) was obtained by employing citation-based selection criteria to the initial pool of articles. Furthermore, in light of possible citation lags and biases, a separate group (Group 3) included the most recent publications (from 2009-2011) subject to an additional selection criteria that will be explained in later discussions. All three groups were verified for any duplicates already assigned with a group. The main assignment rule was that the entry will be retained in the first group under consideration, while duplicate entries were removed from subsequent groups. All other articles that did not belong to either of the previously mentioned groups were excluded although they were recorded as they may have held relevance for later validating stages of the literature review process. Essentially, the three groups acted as the main source to draw the eventual literature map for system governance. Once the process reached this stage, the

original pool of 210 articles was further reduced to a smaller set. This smaller set served as the input for later stages in the literature review process.

The above series of activities described the data collection portion of the content analysis and subsequent generation of conceptual themes. The next phase involved data processing and analysis. The specific details of the analysis activities as well as results are discussed in the next section.

5.1.2 Navigating the "System Governance" Literature

Following up from the previous section, the next part of the content analysis process was the analysis of the narrowed set of peer-reviewed articles (final tally for analysis was 210 articles). In this section, the different resulting groupings and additional reduction/selection criteria will be discussed. Also, a descriptive analysis of the initial sample and the different prominent governance dimensions captured in highly cited papers are presented. The literature that resulted thus far will be complemented with a preliminary conceptual map as a way to visualize the research domain. Finally, this section concludes by presenting a tentative theoretical boundary scope for the research based on peer-reviewed published material.

To identify articles that fall under Group 1 (Perspectives, Reviews and Meta-analysis type studies), the filtered set is further restricted to include only papers with *governance* in their title with the additional restriction of *review* or *meta** in the relevant topic fields of the search input. This search yielded twenty-four (24) papers. After manually reviewing the abstract and the full papers further, only fifteen (15) may be considered as either a review or meta-analyses in its actual use context. While no distinction between methodological approaches was used in this set of articles, it was

observed that there were more reviews of empirical cases while a few were notably conceptual reviews. The rest of the articles that were not selected for analysis were either purely descriptive or just too narrowly focused articles and were subjected to follow-on grouping selection criteria steps. To continue with identifying Group 2 articles, a highly-cited selection criteria process was applied to the original pool of articles (numbering around 210). Citation-based analysis roughly served as a proxy measure of article quality, with the widely held assumption that a citation serves as a merit vote for its contribution towards knowledge accumulation and research progress. Applying this process, around thirty-eight (38) high impact papers were identified, which had at least two (2) average citations per year (having 2011 as the base cut-off year). Reading through the abstracts and full content of each of these articles and eliminating duplicate articles already assigned to Group 1, the Group 2 listing was further narrowed to thirty-one (31) articles. These articles were specially cited because of their contribution towards either theory development or theory testing related to *governance*. The criteria excluded book reviews; purely descriptive, narrow-focused, and difficult to generalize articles. Lastly, Group 3 encompassed articles that were published very recently within the period of 2009 until 2011. It was important to have a separate group for recent articles in recognition that the highly-cited selection criteria may discriminate against recent publication. It can be safely assumed that newer articles do not have enough exposure time to be able to significantly accumulate citations. Out of the original pool of articles, eighty-five (85) were identified this way but eventually only sixty-six (66) remained due to duplication from the previous two groups. Approximating this to be approximately one quarter of the base pool, an additional alternative quality criterion was utilized for further data reduction purposes.

Based on the premise that high quality journals equate to high quality articles, the source journals for the remaining set of articles identified to this point were reviewed taking a closer look at the journal's impact factor (IF) rating metric. Impact factor is a widely accepted indicator of a specific journals indirect measure of quality (Bordons, Fernández, & Gómez, 2002). A higher impact factor is considered a very good indicator of the average times cited count of a specific article over a five year period. As shown in Table 9, the recent papers from top journal titles with a 2010 IF higher than 1.75 categorized and sorted according to the number of recent articles.

Table 9. High impact factor journal titles

Journal Source Titles for recent article sources for systems governance research, Group 3	Included Articles
Ecological Economics	4
Ecology and Society	3
Global Environmental change – Human and Policy Dimensions	3
Marine Policy	3
Current Opinions in Environmental Sustainability	2
Energy Policy	2
Environmental Science Policy	2
Expert Systems with Applications	2
Quality Safety in Health Care	2
Review of Research in Education	2
Annual Review of Environment and Resources	1
Environment and Planning C Government and Policy	1
Environmental Management	1
Geoforum	1
Global Environmental Politics	1
Information Systems Frontiers	1
Journal of European Public Policy	1
Journal of Public Administration Research and Theory	1
Policy Science	1
Research Policy	1
Transportation	1

In applying this additional selection criterion, there were now twenty-five (25) recent articles under Group 3 of the eighty-five (85) earlier numbers of recent articles being considered. To recap, Table 10 shows the breakdown for each category grouping of the journal articles being used in this content analysis.

Table 10. Breakdown of papers in each group

Group	Initial pool	Filtered	Abstracts reviewed	Less duplicates
Group 1 – Perspectives, Reviews and Meta-analysis type studies	210	24	24	15
Group 2 – Highly-cited articles	210	38	36	31
Group 3 – Recent articles from high impact factor journals	210	85	85	25
			Total	71

5.1.3 A Boundary Mapping of System Governance Literature

The preliminary stage of the content analysis methodology consisted of generating noun-phrase information networks for the entire set of literature as a whole and their subsequent aggregation into categorized groups (Groups 1 through 3). The results for the entire data set and those at the group level are captured in Table 11 (the table is limited to the top 25 words for clarity).

The combined articles appearing in multidisciplinary publications within the 1992-2011 timeframe revealed a number of interesting features. First and foremost, the number of nodes – herein referring to the number of noun or noun phrases in the network - was 27,912. The density score was ~0.001 (the density score was determined by

calculating the ratio of the number of network connections that directly links the nodes compared to how many linkages were possible within the network). The group influence score, which signifies the level of coherency of the entire network of noun phrases, was 0.069. Note that the density and group influence scores were standardized measures with minimum-maximum score ranging between [0,1].

When segregating the results according to different article categories (Groups 1, 2 and 3), the specific noun phrase network similarly demonstrated loosely connected networks. Moreover, it also demonstrated having a slightly higher level of group influence or focus for all groups with the exception of Group 2. In particular, the density of the texts segregated by group was similar to those for the "All Groups Combined" dataset (Table 11). For Group 1 articles, the number of nodes was 11,170 (see Table 11). The density score and group influence score were 0.0014 and 0.074, respectively. In comparison, Group 2 has 16,007 nodes, 0.0013 density score and 0.05 group influence score. Rounding out the category, Group 3 has 13,500 nodes, 0.001 density score and 0.078 group influence score. The density scores range from a high of .00143 for Group 1 to a low of .0013 for both Groups 2 and 3. The Group influence values range from a high of 0.07789 for Group 3 and a low of 0.05102 for Group 2 (M = .0947, SD = .014179). These density and group influence scores suggest that the article texts selected are composed of fairly diverse representations of the system governance field.

Table 11. Noun phrase network summary information

All Groups combined		Group 1 - Perspectives, Reviews and Meta-analysis		Group 2 - Highly Cited		Group 3 - Recent articles from High IF Journals	
Nodes	27,912	**Nodes**	11,170	**Nodes**	16,007	**Nodes**	13,500
Density	0.00086	**Density**	0.00143	**Density**	0.00131	**Density**	0.00133
Influence	0.06873	**Influence**	0.07483	**Influence**	0.05102	**Influence**	0.07789
Word	**Influence**	**Word**	**Influence**	**Word**	**Influence**	**Word**	**Influence**
system	0.04806	system	0.07503	system	0.05115	system	0.0549
governance	0.03332	governance	0.04446	governance	0.04314	governance	0.04619
policy	0.0239	management	0.0416	policy	0.02553	policy	0.02891
management	0.02371	fishery	0.03463	management	0.0221	management	0.02531
change	0.01411	policy	0.03222	state	0.0203	food	0.01946
state	0.01275	health	0.02465	corporate	0.01832	public	0.0178
public	0.01211	change	0.02309	change	0.01742	forest	0.01747
social	0.01156	social	0.0193	firm	0.01709	research	0.01636
new	0.01057	ecosystem	0.01794	industry	0.01341	state	0.01538
research	0.01003	process	0.01422	company	0.01323	social	0.01534
process	0.01003	environmental	0.01312	director	0.01322	change	0.01345
resource	0.01002	public	0.01295	university	0.01282	resource	0.01312
firm	0.00946	new	0.01206	process	0.01197	development	0.01184
fishery	0.00897	resource	0.01171	environmental	0.01176	model	0.01132
environmental	0.00896	development	0.01167	economic	0.01174	university	0.01132
forest	0.00885	information	0.0116	market	0.01174	local	0.01094
university	0.00873	climate	0.01148	public	0.01166	information	0.01043
food	0.00859	political	0.0112	social	0.01163	global	0.01023
corporate	0.00847	level	0.01084	global	0.01122	analysis	0.01005
global	0.00836	science	0.01071	research	0.01102	government	0.00966

In addition to the descriptive node, density and group influence calculations of the selected dataset, the top influential words for all the groups of text were produced. As previously mentioned, the influence score is normalized and ranges from [0,1]. The higher the influence score, the more influential the word is. Specifically, influence score of 0.10 or higher imply that the words are *significantly influential* which further implies its tendency to become the center point tying together thoughts and meanings of the diverse text sampled. The more influential words across all the dataset and within each group include *system, governance, policy, management, change, social,* and *process.*

Other influential words appearing denote specific domains or context of governance including *economy, market, fishery, health, ecosystem, environmental, corporate, food, forest, research,* and *water* to name a few. Still in others, influential words like *public, organization, government, director, organization, industry, firm,* and *university* highlight the diversity of entities involved in the process of governance. The influence of these words was interesting, particularly because of the fact that it comes from multidisciplinary sources reflecting on separately distinct issues and problems. Although it should be expected that *system* and *governance* to be the most influential words from the sampled dataset, it is still interesting to note that there were unanimous even though the context or perspective may be different. In particular, the results highlight *policy* and *management* as jointly important perspectives when it comes to the topic of system governance. While the top influential words may present some interesting narratives and insights of themes characterizing the system governance literature, further thematic analysis was pursued to derive a refined perspective of the field.

5.1.4. Emergent Themes

All literature identified and categorized in the previous section where further analyzed deeper for much more refined themes. Themes were identified based on state-of-the-art computer-assisted clustering Crawdad software (Corman & Dooley, 2006). Given the large-sized clusters detected across the scholarly literature sampled, several relevant system governance themes emerged and were discussed accordingly in this section.

A software built-in exploratory factor analysis (EFA) using the 250 most influential words appearing across three (3) or more articles within the sampled dataset of articles and publications was performed. Having computed the influence values as score values for each of the variables, EFA used principal components analysis (PCA) with varimax rotation to assess the underlying thematic structure of the body of abstract texts. Having designated an eigenvalue cutoff of two (2), those factors having values greater than the cut-off were extracted. As a result, it was determined that there are forty-eight (48) factors to extract from the resulting factor solution. Using the top factor components identified, the EFA process provided a first look at emerging themes and provided a good basis to develop system governance themes. The eigenvalue cut-off resulting in 48 factors represents a combined explained variance of 82.63%. As shown in Table 12 after rotation, the top 15 resulting factors accounted for 30.66% of the dataset variance. The remaining component factors (Factors 16 thru 48) accounts to a combined explained variance of 51.96% that brings the cumulative variance to 82.63%.

Table 12. Breaking down EFA % explained variance per factor component

Component	% of Variance Explained	Cumulative %
Factor 1	3.33	1.33
Factor 2	7.10	4.17
Factor 3	5.52	6.38
Factor 4	7.98	9.58
Factor 5	5.37	11.73
Factor 6	7.25	14.63
Factor 7	3.63	16.08
Factor 8	5.03	18.09
Factor 9	4.39	19.85
Factor 10	5.28	21.96
Factor 11	3.59	23.40
Factor 12	4.45	25.19
Factor 13	4.97	27.17
Factor 14	3.67	28.64
Factor 15	5.05	30.66

*Note 1: Remaining Factors 16 through 48 accounts for 51.96% of explained variance.

Recall, from the first study objective which was to identify generalizable elements of governance. In relation to this, recall too the research question posed as "*What are the distinctive characteristics of governance?*" The preceding objective and research question provide the basis for further elaboration of themes as suggested from the sample of articles collected. The theme analysis continued by using the rotated factor loading method. This provided a preliminary basis for evaluating the emergent themes for the first 20 factors, where only the highest loading components were included for clarity. As shown in Table 13, the first factor reflected strong factor loadings on influential words *performance, shareholder, investor, finance, firm, control,* and *market* (0.715, 0.714, 0.559, 0.539, 0.469, 0.400, and 0.390, respectively). For comparison purposes,

Table 14 shows the same factors but omits the most influential list of words that appear in previous noun phrase information (as shown in Table 11). The comparison allows for thoroughness by also increasing the possibility of identifying useful terms other than the most influential ones. For instance, omitting the most influential words for the first factor introduced more descriptive terms into the analysis such as *corporate* (0.356) and *executive* (0.335). Moving to the second factor, the results show strong loading on the words *press, large, university, change, new, problem, international,* and *system* (in Table 13); add to that *human, institution, stakeholder,* and *theory* (in Table 14). The same process was performed for all the different factors thereby producing the rest of the tabular data presented in Tables 13 and 14. Together with the examination of the factor loadings, the texts from the dataset were reviewed. Additionally, a secondary latent coding analysis was performed to "logically connect words to themes and strengthen the face validity of the theme" (Tate, et. al, 2010, p.25). These two data considerations were synthesized to express the dataset themes. Starting with the rotated factor solution, descriptive labels in each factor were generated. The labels identified the themes that were logically inherent in the texts (or components) associated with each of the factors. The emergent final themes were then presented in Table 15.

Table 13. Factor loadings for the rotated factors (see note below)

Factor	Component	Loading	Factor	Component	Loading	Factor	Component	Loading	Factor	Component	Loading
1	performance	0.715	6	nsmd	0.992	11	fishing	0.946	16	stockholder	0.988
	shareholder	0.714		audience	0.984		commission	0.941		director	0.947
	investor	0.559		pragmatic	0.959		stakeholder	0.489		reform	0.784
	finance	0.539		legitimacy	0.512		stock	0.435		investor	0.714
	firm	0.469		environmental	0.445		reform	0.397		corporate	0.449
	control	0.400		certification	0.426		process	0.252		board	0.350
	market	0.390		forestry	0.318		community	0.248		law	0.267
2	press	0.166	7	transnational	0.964	12	coordination	0.600	17	product	0.961
	large	0.157		accountability	0.946		assessment	0.406		safety	0.434
	university	0.154		global	0.621		organizational	0.401		information	0.418
	change	0.145		network	0.469		learning	0.315		data	0.239
	new	0.137		international	0.292		commission	0.262		good	0.236
	problem	0.134		actor	0.284		cost	0.236		environmental	0.129
	international	0.122		governance	0.279		pragmatic	0.213		shareholder	0.125
	system	0.117		national	0.253		level	0.155		carbon	0.119
3	adaptive	0.847	8	press	0.135	13	theory	0.110	18	governance	0.132
	socio-ecological	0.733		approach	0.130		human	0.098		control	0.105
	resilience	0.681		management	0.107		governance	0.098		data	0.104
	management	0.630		different	0.105		business	0.078		approach	0.100
	change	0.577		problem	0.102		new	0.078		international	0.097
	social	0.457		governance	0.099		institutional	0.077		market	0.095
	ecosystem	0.413		institution	0.095		change	0.077		state	0.093
4	emission	0.941	9	executive	0.842	14	urban	0.987	19	incident	0.989
	policy	0.612		performance	0.506		city	0.986		case	0.687
	federal	0.585		company	0.425		energy	0.456		network	0.605
	carbon	0.543		innovation	0.412		local	0.440		federal	0.495
	energy	0.507		board	0.368		scale	0.349		control	0.202
	government	0.422		international	0.332		new	0.263		theory	0.163
	state	0.382		business	0.311		change	0.239		research	0.151
5	approach	0.136	10	large	0.113	15	system	0.142	20	press	0.139
	public	0.126		problem	0.104		governance	0.126		university	0.119
	group	0.106		stakeholder	0.100		press	0.125		level	0.111
	business	0.102		financial	0.094		control	0.100		governance	0.106
	information	0.100		stock	0.093		change	0.095		institutional	0.106
	bank	0.097		market	0.090		national	0.095		process	0.105
	board	0.089		action	0.086		large	0.094		social	0.100

Note: INCLUDING words from influential list (first 20 factors only for clarity)

Table 14. Factor loadings for the rotated factors (see note below)

Factor	Component	Loading	Factor	Component	Loading	Factor	Component	Loading	Factor	Component	Loading
1	performance	0.715	6	nsmd	0.992	11	commission	0.941	16	stockholder	0.988
	shareholder	0.714		audience	0.984		stakeholder	0.489		reform	0.784
	investor	0.559		pragmatic	0.959		stock	0.435		investor	0.714
	finance	0.539		legitimacy	0.512		reform	0.397		board	0.350
	control	0.469		certification	0.426		community	0.248		law	0.267
	corporate	0.356		case	0.196		rule	0.202		executive	0.247
	executive	0.335		organization	0.193		control	0.162		rule	0.239
2	press	0.166	7	transnational	0.964	12	coordination	0.600	17	product	0.961
	large	0.157		accountability	0.946		assessment	0.406		safety	0.434
	problem	0.134		network	0.469		organizational	0.401		data	0.239
	international	0.122		international	0.292		learning	0.315		good	0.236
	human	0.112		actor	0.284		commission	0.262		shareholder	0.125
	institution	0.102		national	0.253		cost	0.236		carbon	0.119
	stakeholder	0.098		legitimacy	0.245		pragmatic	0.213		law	0.078
	theory	0.097		approach	0.105		agency	0.112		standard	0.049
3	adaptive	0.847	8	press	0.135	13	theory	0.110	18	data	0.104
	socio-ecological	0.733		approach	0.130		human	0.098		approach	0.100
	resilience	0.681		different	0.105		business	0.078		international	0.097
	human	0.297		problem	0.102		institutional	0.077		stakeholder	0.061
	group	0.248		institution	0.095		control	0.072		institution	0.061
	learning	0.243		society	0.095		data	0.072		performance	0.058
	society	0.207		study	0.093		stakeholder	0.068		value	0.056
	agency	0.196		data	0.090		model	0.068		service	0.054
4	emission	0.941	9	executive	0.842	14	urban	0.987	19	incident	0.989
	federal	0.585		performance	0.506		city	0.986		case	0.687
	carbon	0.543		innovation	0.412		energy	0.456		network	0.605
	energy	0.507		board	0.368		scale	0.349		federal	0.495
	government	0.422		international	0.332		institutional	0.190		control	0.202
	national	0.151		business	0.311		emission	0.165		theory	0.163
	international	0.124		ownership	0.196		problem	0.150		actor	0.126
5	approach	0.136	10	large	0.113	15	press	0.125	20	press	0.139
	group	0.106		problem	0.104		control	0.100		institutional	0.106
	business	0.102		stakeholder	0.100		national	0.095		control	0.080
	bank	0.097		financial	0.094		large	0.094		area	0.076
	board	0.089		stock	0.093		group	0.089		society	0.075
	human	0.088		action	0.086		action	0.074		executive	0.073
	organization	0.081		scale	0.073		theory	0.071		theory	0.070

Note: EXCLUDING words from influential list (first 20 factors only for clarity)

Table 15. Emerging themes on system governance

Emergent Themes	Descriptive Components	Factors
Theme 1. Extending boundaries beyond the organization	legitimacy, accountability, deliberative, discourse, public	2,7
Theme 2. Operational quality standards	quality, service, improvement, standards, safety, assessment, external certification	6, 12
Theme 3. New regulatory tools	standards and policy, traceability, certification	17, 18
Theme 4. Recognizing multiple perspectives	adaptive, management, governance, policy, local, global, scale	3, 10, 14
Theme 5. Enhanced performance monitoring	financial, value, incentive, corporation, control, ownership, board	1, 9, 16
Theme 6. Evolving governance structures and organization	new, change, network, industry, corporate, school, company, organization, market	10, 13, 19,20
Theme 7. Advancing analytic tools		11,13,14
Subtheme 7a. Institutional analysis	Ostrom, rules, economic, game, theory, institution, analysis, common, resource	
Subtheme 7b. Group policy development	change, management, information, research, process, social, public	4, 5,8,15, 20
Theme 8. Implementation modeling		
Subtheme 8a. Conceptual approaches	complex, adaptive, systems, levels, resilience	3, 13
Subtheme 8b. Action learning-based approaches	action, coordination, learning, organizational, pragmatic	6, 11,12

The first theme emerging from the dataset concerned open-system issues and combined factors 2 and 7. Although the texts were reflected from different contexts

(international development and global environment), some of the consistent key terms referenced to this theme (and as reinforced by its associated factors) were *legitimacy*, *accountability*, *deliberative*, *discourse*, and *public*. An implication would be that the assumed boundaries need to be enlarged to include those beyond the traditional notions of an organization or a system in general. Unlike closed-systems where boundaries are more definite, decision making in this new context need to be deliberated in discourse (with the public as an additional stakeholder) and also with enlarged new concerns for legitimacy and accountability of authorities as it applies to their decision making processes.

The next theme, *Operational quality standards*, is another resonant topic area reflected by Factors 6 and 12. Strong loading on the following components represent this theme including: *quality*, *service*, *improvement*, *standards*, *safety*, *assessment*, and, *external certification*. The related articles that strongly emphasize these themes reveal a deeper context of large complex systems, specifically in pertinent areas of healthcare, clinical practice, and hospital systems among others. In closer review, the needs for quality and safety system practices highlight current challenges related to service-intensive and publicly-scrutinized aspects of the health care system. This is consistent with the domain of contemporary governance systems where the larger involvement of external stakeholders (e.g. the public) in a healthcare practice would require certain incorporation of quality and service standards to appease the plurality of interests that are entangled within the operation-level decision-making processes.

Closely related to the previous theme, the next theme *New regulatory tools* highlight a different set of themes as reflected by strong loadings (Factors 17 and 18) on

the components as follows: *standards, policy, traceability,* and *certification.* Whereas the previous theme reflects the clamor for solutions to problems at the operational level, the new regulatory tools theme reflects the needs for enhanced regulation at the higher levels of policy, which does not necessarily exist within the influence or control of an organization or system. It is also a reflection of the interconnectedness of multiple systems. Articles reflecting this theme affirm the importance of recognizing higher level systems in addition to the current level system at issue. External standards, traceability and third-party certification were meant to regulate processes and interactions between disparate large systems involved in food or agricultural supply value chains, for instance between the global food markets, the consumer, the private and public enterprises, and the state.

Recognizing multiple perspectives is the next dominant theme emerging from the dataset. It shows strong loading on components like *adaptive, management, governance, policy, local, global,* and *scale* (Factors 3, 10, and 14). The specific context of articles that reflect the theme focuses on bridging the gap between diverging views of governance like policy versus management, social and ecological, local versus global, and scalability from human to institutional resource levels. A frequent term associated with this theme is the need for adaptive measures –to enhance resilience and to improve the learning capacities with regards the relevant changes. This is another theme closely related to systemic thinking which also considers incorporating multiple perspectives to large, complex problem situations.

The fifth theme, *Enhanced performance monitoring,* is one theme that emerged within the context of system governance. Although most of the articles that capture this

theme emanate from the wider context of financial markets and related industries, the strong loading on the components: *financial*, *value*, *incentive*, *corporation*, *control*, *ownership*, and *board* (Factors 1, 9 and 16) signify the much more general need for specific governance performance mechanisms (e.g. incentives, board structure, and ownership influence, etc.) to ensure greater value is promoted. Performance monitoring is indeed a very important governance theme related to embedding control in the design of any system of interest.

Another emerging theme is *Evolving governance structures and organization*, which, at its core, reflects the need for better governance structures within and beyond any system or initiative. It recognizes that whereas existing structures are acknowledged to exist, new or better changes to its governance structure have to take place. This theme highlights strong loadings on the factor components: *new*, *change*, *network*, *industry*, *corporate*, *school*, *company*, *organization*, and *market* (Factors 10, 13, 19 and 20). In particular, the component *network* strongly implies a structural dimension to system governance and is in itself an increasingly strong topic in governance, having its own body of multidisciplinary literature (e.g. network governance) that broadens the scope of any system of governance across traditional governance disciplines and areas of practice.

Several factors combined to create the major theme of *Advancing analytic tools* which was comprised of factors 4, 5, 8, 11, 13, 14, 15, and 20. After reviewing several of the texts associated with the influential words from this theme, the sub-theme *Institutional analysis* became apparent within the major theme of *Advancing analytic tools*. Another sub-theme that seemed to reveal itself from the *Advancing analytic tools* was *Group policy development*. For the *Institutional analysis* sub-theme, the texts

highlighting the sub-theme include: *Ostrom, rules, economic, game, theory, institution, analysis, common,* and *resource* (Factors 11, 13 and 14) which appear to index Nobel-prize winning work by Elinor Ostrom and her colleagues on an integrated framework to analyze institutional rules at work in common-pool resource governance problems (Ostrom, 2009). This theme highlights the importance of incorporating advanced analytical frameworks into governance practice focused on the latest in game theory and economic modeling approaches. *Group policy development* is the second sub-theme of the *Advancing analytic tools* theme and the words found in factors 4, 5, 8, 15, and 20 which suggested ways to engage and manage group initiatives through collective, collaboration, and coordination in the texts. The components *change, management, information, research, process, social,* and *public* all provided perspectives about this theme; some of the articles were directly related to various complex system issues pertaining to forestry governance, climate change, emergence of nanotechnologies, energy and innovation policy to name a few. All of these discussions highlight the need for new analytic approaches to collectively analyze and inform the mobilization of group-based multilevel efforts to address the complex issues involved. All together these two sub-themes comprise the larger theme of developing or introducing new enhanced analytic approaches to analyze and guide a governance system.

Lastly, the final theme (e.g. *Implementation modeling*) that emerged from the dataset is again comprised of two subthemes. The words associated with rotated factors 3 and 13 all reference a major subtheme, *Conceptual approaches,* and the texts that the influential words (*complex, adaptive, systems, levels, resilience*) of each factor point to support it. Breaking down the *Implementation modeling* theme further, the texts

associated with the influential words of factors 6, 11, 12 supports a sub-theme of *Action learning-based approaches*. In this sub-theme, the specific component indicate strong loading on the terms *action, coordination, learning, organizational,* and *pragmatic*. Although the theme, *Implementation modeling: Conceptual approaches*, addresses articles discussing the trend of adopting new concepts terms not traditionally associated with the practice of governance and outside its own disciplines, the sub-theme *Implementation modeling: Action learning-based approaches* recognizes articles discussing result-driven approaches that need to be adopted within involved organization or components of governance systems. Altogether, both subthemes comprise an emergent complementary schema to model and implement governance systems. It entails the necessity to engineer a pragmatic approach that encompasses new conceptual theoretical advances but still remaining firmly implanted on delivering results through action and collective engagement.

To summarize this section, the content analysis phase of the research yielded several interesting themes relevant to system governance. In relation to the first study objective, the earlier discussed themes offer an identification of the different generalizable elements of governance which was in response to the research question posed as *"What are the distinctive characteristics of governance?"* The preceding discussions support the first objective and have offered a rigorously developed response to the research question. Since the research purpose was for an integrated articulation of the philosophical, theoretical, axiomatic and methodological basis for system governance, and the research objectives attempts for a comprehensive theoretical formulation, the content analysis results have responded with a set of closely interrelated themes (eight

major themes with four sub-themes in two of the major thematic categories). These themes are broad and multidisciplinary and take into account the wide range of definitional, conceptual, operational and theoretical similarities and differences pervasive in this "governance" research domain across multiple disciplines. Each of these themes serve to inform and properly contextualize the system framework development phase that follows next in the research design.

5.2 System Governance Analytic Framework Development

In this section, the focus is on the development of a system-based system governance analytic framework, grounded in the earlier research effort. Governance plays a key role in complex systems. From a system governance perspective, the system-of-interest must account for the following: i) enlarging its planning boundaries (Theme 1), ii) recognizing involvement of multiple perspectives or interests (Theme 4), and iii) accommodate the evolution of new or existing governance structures and organization (Theme 6). All these can be used as the starting assumptions as outlined in the contextualization phase of the system governance application framework. At a gestalt level, the literature suggests that, to a large degree, success in any system depends on the kinds of behavior and structure of the governance system as it adapts to the environmental settings. The development of a system governance analytic framework is motivated towards addressing a number of problems such as: i) understanding the structure and dynamics of the governance in complex systems, ii) diagnosing problems and detecting avenues for improvement, and iii) producing a common understanding and formulating requirements needed for achieving desired complex system outcomes.

Taking a systemic approach recognizes the importance of framing the conceptual understanding of *governance* as it is incorporated within an actual organized field of knowledge, discipline or application context. A more detailed review of different approaches to governance is elaborated in the next chapter. In the meantime, it is crucial to highlight the two common distinct views of governance as it is conceptualized in theory and in practice. The available literature determining the critical boundaries for a *system of interest* has been extensively reviewed from the purview of organizational philosophy, institutional theory and systems thinking. These frameworks produced classifications or typologies of general *system of interest* properties such as structure, purpose, actors and processes in order to specify system boundaries (Ackoff, 1971; Boulding, 1956, 1985; Simon, 1962; Weaver, 1948). These in turn show how governance analysis has been scaled in such a way that the unit of analysis and study approach remains consistent with the specific governance context per se.

There were, first however, underlying assumptions about governance being designed into or perceived within the system of interest construct. Figure 14 shows two possible conceptualizations of the actual context of governance, how exactly governance may be embedded within a system of interest. The conceptualization of *Limited governance* suggested a well-structured and highly formalized notion of governance. As long as the current *system of interest* state behaves predictably within its structure and well-defined formalisms (core value premises, organization, processes, procedures and outcome expectations), a common basis for planning, implementing and extracting empirical evidence of limited governance to that specific aspect of the system of interest is adopted. On the other hand, *emergent governance* is an alternate conceptualization

where the environmental context, the internal structure and behavior of the *system of interest* are hardly predictable, hence the notion of emergence being the dominant theme.

The current set of challenges in design (or redesign) of governance systems is mostly initiated by difficulties dealing with emergence. Emergence, a pivotal higher-level systems concept famously described by John Holland (1998) in the sentence 'the whole is more than the sum of the parts', is often the prescribed way of making sense of the novelty, individuality, peculiar, unexplained behavior of the *system of interest* in some given instantiation. Via the inherent nature of emergence, specifically its novelty and unpredictability, any attempt at analyzing, developing or transforming governance systems invokes a significant challenge. Tempered by heated philosophical debates regarding the historical, ontological and epistemological basis of emergence, interesting progress has been made in incorporating ideas of emergence, particularly in pragmatic areas of complex adaptive systems (Braha, Minai & Bar-yam, 2006) and system of systems research (Keating, 2009). The concept or idea behind any existing governance system within a *system of interest* could be quickly grasped in terms of these limited and emergence formulations. Under any prevailing system context, the actual governance being deployed may be situated or transitioned within these two system formulations. There are then various sets of questions, implications and approaches that will be readily revealed depending on which of the conceptual formulations are currently in place. The characteristics and relationship between limited and emergent governance is further summarized in Table 16.
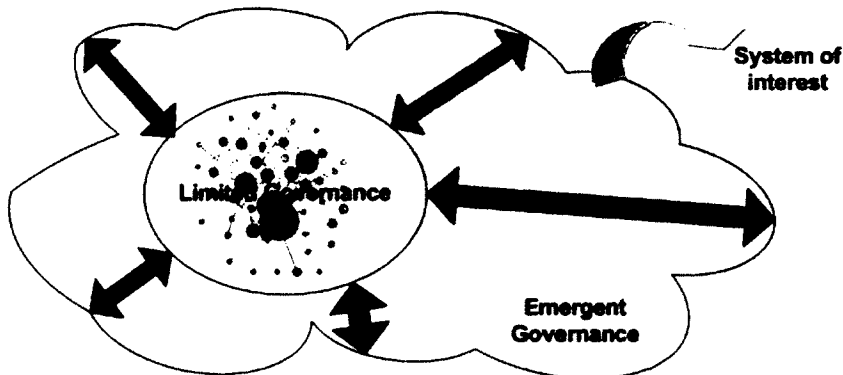
Figure 14. Typical conceptualizations of 'governance' in theory and practice

To contrast these two dominant governance perspectives, the nature of limited and emergent governance is contrast with the research derived initial set of governance attributes. This set of attributes give rise to two particular conceptualizations of governance. One conceptualization speaks to *limited governance* in the sense that associated processes, structures and procedures are existentially formalized; system boundary are well defined and explicitly acknowledged; relevant actors and their roles are identified in advance; there is a singularly cohesive identity presupposed by a purposefully determined values; this results in a pre-defined and distinct set of interaction modes that are reinforced by a unitary or shared perspective on relevant issues; power and authority is centralized and legitimately recognized; and interactive exchange with the environment is primarily "closed" with a primary focus on getting things done right here and right now.

Table 16. Characteristics between limited and emergent governance

Governance system attributes	Dominant Governance Perspective	
	Limited governance	Emergent governance
Existence of defined process, structure and procedures	Formal	Informal
System boundary judgment	Well-defined and explicit	Ill-defined
Relevant Actors or players	Identified	Arbitrary
Identity	Singular	Diverse
Purpose and value determination	Purposeful by design	Ad hoc, transitioning or temporary
Mode of Interaction	Pre-defined and distinct	Innovative and creative
Typical perspective	Unitary or Shared	Pluralist or Distributed
Authority and Power distribution	Centralized or hierarchical, Recognized legitimacy	Decentralized or distributed, Legitimacy-contested
Exchange with Environment	Closed	Open
Time-Action Horizon	Primary focus on the 'Here-and-Now' and ONLY for short OR medium- range considerations	Integrative focus on ALL of short, medium, and long-range considerations;

In contrast, a conceptualization on *emergent governance* would reveal that its processes, structure, procedures are informal at best; likely as a result of a system boundaries that are ill-defined with only an partial cognizance of some of its actors; there is a diverse often conflicting set of identities where purpose and held values are either ad hoc, transitioning or temporary; the likely mode of interaction possible would require innovation and creativity to counteract expectation gaps brought about by pluralist and distributed perspective views; which also likely has to work within a decentralized authority and power base; characterized by a more fluidic open exchange with its immediate environment, taking into account an integrative focus of time-action horizon expectations. While there is a need to recognize the distinct view between the two broad notions of governance, when it comes to philosophizing, or conceptualizing or theorizing, it would be useful to realize that both perspectives should not be dismissed because

perhaps the "truth" shared by both perspectives may hold the explanatory utility as to how governance systems actually work in operational settings.

5.2.1 Emerging Background Context

In a general emergent situation, how can governance help systems overcome challenges? What role does governance play given such situations? Where should governance be situated within that system? The underlying notions of emergence, governance and systems, and how one comes to understand each related concept, greatly influences the response one may offer in response to such questions. The articulated *system governance* construct addressed how an individual (or an organization) should think (e.g. 'to conceptualize') and engage (e.g. 'to act') in relationship to challenges arising from within and beyond a system. 'To conceptualize' and 'to act' are two different, albeit still interrelated, levels of activities that are integrally co-dependent on one another in the sense that one is incomplete without the other. A systems approach helps mediate the gap between a 'mental model' and the known situation where the problem is being experienced. A framework based on the systems approach was introduced here to piece together an otherwise disjointed conceptual-experiential mapping of a tangled set of relations that has been proven problematic in dealing with governance challenges.

Applying the DSRP rule set (Cabrera, et al., 2008), a set of questions about 'governance' were put forth. Firstly, what was distinct about governance? While there were several usages and definitions available, among the special properties that can be argued as consistently unique about governance include the inherent treatment of exogenous/endogenous variables. In the previous section, several important common

themes have been drawn appeared across disparate instantiations of *system governance.* When speaking about governance, identified themes (Theme 4) encompass multiple levels or domains. There was an apparent blurring of boundaries across operational, tactical and strategic levels of decision made feasible by interactions of relevant governance actors that operate across these different levels (Theme 1). While oftentimes used interchangeably with management, governance was clearly not limited to just management (Hoogervoost, 2009). The distinction between governance and management were tackled in various areas such as in constitutional law (Post, 1987), new public management (Lynn, Heinrich, Hill, 2000), and even in application-focused areas of information technology (IT) enterprise systems (Hoogervorst, 2009), R&D system governance (Keating, Hester, Meyers & Calida, 2010) and corporate governance (Huse, 2003). From a constitutional law perspective, Post (1987) determined that the exercise of authority was a matter of management if a said resource is "within" an organization while it is a matter of governance if a resource is "outside". This distinction that bases itself as merely a matter of institutional boundaries, however, does not generally hold true since organizations were generally understood to be fixed by consent (Simon, 1957). In a much more recent articulation, the domain of new public management placed management within a wider scope of a logical governance framework. For Lynn, et al. (p. 239), governance encompasses both the formal and informal structures that predispose action while management is much more concerned with the action itself (Theme 6). Hoogervorst (p. 12) traced back the Latin roots of these words of governance from 'gubernáre' which meant 'to control' and management from 'manus' that is literal for 'hand'. In this sense, management was to executing activities while governance was to

guiding those activities to proper execution. Both governance and management each have important roles in shaping the resulting outcome but governance was more indirect and often implicit. This lies in contrast to management. In reflecting on these interrelated concepts, Keating, et al. (2010) presented (in Table 17) how a governance perspective contrasts from a management perspective. This was part of their work to addressing one of the pressing challenges for governance, which was to develop frameworks and indicators for performance.

Table 17. Perspectives of Management and Governance Interests

Interest	Governance Perspective	Management Perspective
Consequence	*Outcomes*	*Outputs*
Relevant Questions	*Why?*	*How? What?*
Stakeholders	*Relevant Stakeholders*	*Relevant Shareholders*
Role	*Strategic Direction*	*Day-to-Day Operations*
Focus	*Future Projection*	*Near-Term Results*
Success	*Difficult to Define*	*Clear*
Design Properties	*Emergent*	*Designed*

Note: As adapted from Keating, et al., 2010

Because it is indirect and implicit, the contribution of management appears distant from any initial assessment of outcomes. Also, unlike in governance systems, management systems are focused on indicators or performance measures on results that occurred immediately if not almost simultaneously or real-time. Governance has a longer

time horizon window, rendering it more likely that its short term impact was not likely to be directly observable. Therefore, a key distinction for this research was to make the conceptual separation and distinction of governance in relationship to management.

Next, what were the relevant systems related to governance? More specifically, what was a convenient way to conceptualize governance or a governance system? Three systems defining conceptual boundaries for "system governance" include what Kooiman & Jentoff (2009) refer to as concentric rings as "orders of governance". As described, they were merely developed as constructs of convenience that provided means to be able to better study the governance process. These three systems included i) a metagovernance system, ii) a 'governing' system, and iii) a 'governed' system. In some particular instantiations, any governance system may be used to describe any one of these different 'orders of governance'. A metagovernance system, as central or core, was typically referring to how a governing process takes place. In other words, this was the main basis as it articulated "governing how to govern". This included the overarching value systems, or dominant paradigms that dictate rules of the game. An exploration of the set of overarching rules was a major part of the theoretical framework development. More explicitly, the determination of the relevant system entities in relation to the governance process, including establishing the manner "how to govern", would require conceptually resolution in order to have an effective system of governance.

Closely related to the distinct conceptual properties and systems associated with governance, which other ideas have a conceptual relationship to "governance"? How were they related? In many of recent studies on governance, it was often discussed in conjunction with other resonating terms such as authority, leadership, oversight, control,

accountability, guidance, and steering to name a few. In many of these instances, the relationship of each of these terms to governance was well argued. The relationship can be understood in terms of the specific point of analysis, the perspective taken, or the underlying governance. With respect to points of analysis, the nature of the "governance" discourse can either be one or both of the following as i) as interactions (Kooiman, 1999), ii) as artifacts (Simon, 1996), instruments (Turke, 2008), or communication (Luhman, 1982; Willke, 2007). Furthermore, the relationship can be better understood if a view or the role of the 'governance system' analyst was explicitly expressed as either i) exclusively an observer, or ii) exclusively a participant. In practice, however, an individual may transition between either of these two views. It was also important to note if the context that governance is used referred to specific or broad processes or structures.

Finally, how do we account the differing perspectives of "governance"? As previously discussed, a perspective of 'governance' can either be specific or broad. We refer to specific (substantive or normative) governance (institutional frameworks) to include those specific, purposive governance interventions that were developed and delivered by multiple actors at multiple scales in pursuit of a broad goal. On the other hand, broad governance ('governance regimes') encompasses the whole range of customs, norms, rules that shape governance and interactions within its associated entities. Different perspectives can be easily categorized between these two. There was definitely some ubiquitous interplay between different perspectives that are co-influencing one another, leading to eventual determination of governance outputs, impacts and outcomes. Although the governance construct may be considered from the extremes of the different perspectives suggested, in reality there exists the spectrum

between the polar perspectives presented. The challenging role for governance analysts is rooted in realizing the good fit and healthy interplay possible from the different perspectives.

Having articulated governance in terms of the DSRP framework, posited 'governance' hypotheses, principles or theories may now be differentiated or evaluated comprehensively in contrast to one another. More specifically, by identifying the distinctness, the relevant systems, associated relationships and the appropriate perspective inherent in each governance perspective, it is feasible to normatively describe and differentiate between competing governance theories in terms of their underlying ontological, theoretical, pragmatic and axiological inclinations.

5.2.2 Overview of the Systems Approach

The modern systems movement has grown in prominence over the years since Von Bertalanffy (1950) first posited his theory of open systems that became the basis of the renowned General Systems Theory or simply GST (Boulding, 1956). Resulting from these, the body of knowledge has been enriched by several interrelated research threads in complex systems (Bar-Yam, 1997; Kauffman, 1993; Simon, 1962), systems analysis (Digby, 1989; Hitch, 1955), second-order cybernetics (von Foerster, 1979), system dynamics (Forrester, 1961; Senge, 1980), soft systems methodology (Checkland, 1981), critical systems thinking (Jackson, 1985, 1991; Ulrich, 1983), systems architecting (Maier, 1998), systems engineering (Hall, 1965), and systems of systems (Ackoff, 1971; Jackson & Keys, 1984; Keating, 2005). Although there is a rich history of systems, for the present research the focus is on articulation of the underlying system philosophy that enabled us to draw a clear understanding of a 'system' that was consistent with the

modern understanding of the systems approach and directly relevant to contemporary 'governance', the focus of the present research.

Systems philosophy, and the systems approach, viewed systems as a function of their composition, environment, and structure, with the appreciation of the necessary linkages or mechanisms that specify its functional form. Whereas several proposed system approaches espouses a methodological orientation for application in the social sciences, According to Mattesich (1990), the Bunge system philosophy offered a detailed and thoroughly elaborated axiomatic formulation of the systems framework for ontological purposes. Mattessich lauds Bunge's contribution as impressive producing a formalistic framework for tying all kinds of systems together in logically and meaningful ways. For this same reason, the system framework development made use of Bunge philosophic approach to systems that can easily relate concrete as well as conceptual aspects of notional governance practice. Bunge (2003) posits that the systems philosophy is the adoption of a worldview that is underpinned by the following postulates:

1. *Everything, whether concrete or abstract, is a system or an actual or potential component of a system;*

2. *Systems have systemic (emergent) features that their components lack, whence*

3. *All problems should be approached in a systemic rather than in a sectoral fashion;*

4. *All ideas should be put together into systems (theories); and*

5. *The testing of anything, whether idea or artifact, assumes the validity of other items, which are taken as benchmarks, at least for the time being.*

The system notion adopted in this research was closely based on Bunge's characterization of systems in terms of their composition, environment, structure and mechanisms or simply called the CESM model (using only the initials). The next section will outline these formal definitions derived from among Bunge's body of work. It should be noted that these definitions belong to an expansive series of postulates, definitions, theories, and concepts that Bunge presented as his formal (e.g. mathematic-logical) justification of his system philosophy.

In addition to other primitive notions such as thing, property, and time among others that Bunge has elaborated in both books *The Furniture of the World* (1977) and *A World of Systems* (1979), the characterization of system as a a complex object (1979) that may apply to either conceptual or concrete things provides an important scholarly launching point for our formulation of the systems view for exploration of governance. Since this research aims to capture notions of governance that are reflective of contemporary life, the use of system as it applies to this research implies those whose components are made up of concrete or material things.

Hence, one can assume X to be a concrete system that exists over a nonempty class of things U. Following Bunge (1979, pp.5-12), the following formal definitions hold namely:

Definition 1. The Composition $C(X)$ of X is the collection of all parts of the system given by :

$$C(X) = \{ x \in U \mid x \subseteq X \}, \qquad [1]$$

where '$x \subseteq X$' symbolizes *"x is a part of X."*

Definition 2. The Environment, *E(X)* of the concrete system *X* are the set of all things other than those in *C(X)*, that are acted on or are acted upon by the *C(X)* formalized as:

$$E(X)= \{ x \in U \mid x \notin C(X) \text{ and } (\exists y)(y \in C(X) \ \& \ (x \triangleright y \ \lor \ y \triangleright x)) \} \qquad [2]$$

where '*x* ▷ *y*' indicating if a thing "*x acts upon another thing y.*"

Definition 3. The Structure, *S(X)* is an existing set of relations *R(r)* (e.g. couplings, links or bonds signifying connections) and non-relations *R̃(r)*, among members of *X*, and among them and the things from the environment *E(X)* formalized as:

$$S(X)= \{ r_i \in R(r) \cup \tilde{R}(r) \mid R(r) \neq 0 \ \& \ 1 \leq i \leq n \} \qquad [3]$$

that are defined on C(X) ∪E(X).

Lastly, Bunge (2003) defines a *mechanism* as a set of processes that bring about or prevent some change resulting either in the emergence of a property or another process in the system as a whole. However, he later refined this definition to specify only essential mechanisms in clear distinction from nonessential ones (Bunge, 2004). For our practical purposes, following this refinement from Bunge we have *essential mechanisms* "*of a system is its peculiar functioning or activity*" or simply "*the process that it and only its kind can undergo*" (Bunge, 2003).

Definition 4. Given a concrete system *X* of its kind *U*, then

(1) the totality of processes (or functions) in *X* over the period *T* is *P(T)* = the ordered sequence of states of *X* over *T*;

(2) the essential Mechanism *M_e(X)* (or specific function) of *X* over the period *T*, denoted by;

$$M_e(X) = \{ p_i \in P(T) \mid (\exists p_i) \text{ and } (p_i \subseteq P(T) \ \& \ t \leq i \leq T) \} \qquad [4]$$

From these generalized definitions, each can be restated simply as: i) Composition is the collection of all the parts of the system, ii) environment is a collection of items, other than those composing the system, that act on or are acted upon by some or all components of the system. iii) structure is the collection of relations, in particular the linkages, among which components of the system interact with themselves or with their environment, and iv) mechanisms are those collections of processes in the system that explains why the system behaves the way it does or more specifically, these are the processes or entities that mediate between the observable inputs and outputs of a system.

Bunge's (2003) CESM model, however, requires "the knowledge of all the parts of the system and of all their interactions, as well as their links with the rest of the world (Bunge, 2003, p. 37)." It is more practical to use the notions of composition, environment, structure and mechanisms at a given *level*. Hence, in order to make practical use of the CESM model, its reduced form must take into account the notion of levels which Bunge (1979, p.13) defines as follows:

Definition 5. Levels L in a system is a family of non-empty sets depicting a partition $L=\{L_i \mid i=1,...n\}$, with $1 \leq i \leq n$. Then:

$$L_i < L_j = {}_{df}\forall x \ (x \in L_j \ \& \ C(x) \subset L_i) \tag{5}$$

In words, if L_i and L_j are members of L, then L_i precedes L_j if and only if each member of L_j is composed exclusively of things in L_i.

Furthermore, by enriching our understanding of what is now referred to as system philosophy and its approach, these definitions are helpful to articulate i) systems boundary, ii) multiple perspectives and iii) emergence as it relates to derived themes reflected from the design and analysis of governance systems.

- Systems boundary - The notion of system should be understood as a representation of an entity as a complex whole open to exchange or feedback from its environment (Theme 1).

- Multiple perspectives – The existence of macro- and micro- entities and their processes each can only provide at best partial contributions towards complete understanding (Theme 4).

- Emergence – In systems, it is an instantiation of a transformation of something new which previously did not exist at a lower system level. Emergence is crucial in establishing the exact nature of the relation between micro and macro processes. In general, the premise of emergence is the revelation of interrelations of certain entities that have properties that are not simply aggregates of individual properties, or in others cases may be "global" as a result of relations between themselves. The emergent properties must be studied at different levels in a system, and the relations between the levels must also be studied (Theme 6).

In summary, this section presents Bunge's (2003) notion of a system in terms of its components, environment, structure and mechanisms referred to as the CESM lens. Together with the more important system principles such us system boundary, multiple perspectives and emergence, the following section will proceed with the articulation of the System Governance Framework.

5.2.3 The System Governance Framework: Applying the CESM Lens

As with any system, a governance system can be described in terms of the CESM lens. Subscribing to that notion of a system, a governance system likewise consists of

components, an environment, a structure, and some mechanisms. This section is an elaboration of the CESM lens as the primary basis for the system governance framework. Utilizing key definitions and postulates from Bunge's (2003) axiomatic formulation of the systems approach, the system analytic framework elaborates on governance in a complex system. Briefly, the system analytic framework proposes to proceed with the analysis of governance in complex systems by reviewing the composition, environment, structure and mechanisms of the system-of-interest. Figure 15 presents a simplified model of the system governance framework. This framework suggest 'governance' as the totality of activities involving interrelated governance levels composed of metagovernance, the governing system and the governed system, facilitated by the use of a predefined structure of relations across different levels, and that is openly interacting with an external environment thru a range of mechanisms or processes. These structural relations may be one of two forms: as either: i) a control or influence structure, and as ii) an information or feedback structure. Control linkages are represented as solid lines where each level of governance has a specific capacity to influence change within itself and with other related systems. Information linkages, on the other hand, are represented as dashed lines and they emanate upwards providing feedback to higher level systems. Another set of linkages which we distinctly refer to as mechanisms or processes was utilized in the exchange that occurs between each of the systems with their environment. The purpose of the governance activity or more specifically the questions "why" governance is needed, the manner of "how to govern" as the act of 'governing' and being 'governed' signified very different roles in the realization of effective system governance. Metagovernance refers to the "why" a governing process takes place. In other words, this

explicitly establishes the purpose of governance and therefore influences the manner of governing. These may include the overarching value systems, or the determination of interests that help set the 'rules of the game'.
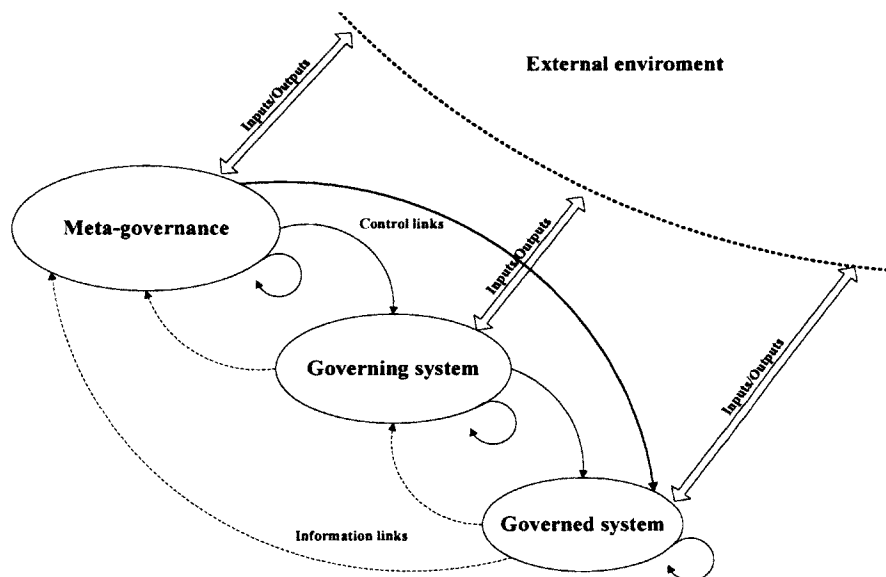
Figure 15. A system governance framework

Once the interests in the prior level were articulated, these sets of overarching rules are imposed through what we may refer to as the 'governing system'. The governing system addresses the "how" part of governance and includes the underlying collection of procedures, roles, identities, processes, etc. that help ensure the realization of the articulated interests or purpose of governance. And on the receiving end of the governing system, it was helpful to distinguish a governed system - or the 'system of interest', where all these rules are enacted and will also be the level where results, whether desired or unintended, will be experienced and observed. Among the features that are unique to

the approach to governance suggested here are included the endogenous/exogenous interactions. We refer to an endogenous interaction as the direct or indirect activities occurring through pre-existing structures - as the collection of explicit or implicit events, processes, entities, rules or procedures available between the different levels of governance. In contrast, an exogenous interaction refers to the input and output activities enacted through pre-existing mechanisms or processes available between each level of governance to its wider environmental context.

In order to demonstrate that the system governance framework does not operate only in the abstract, the system governance framework was modeled as an interactive ontology domain capture process. One smaller contribution of this study was to describe the development of a limited ontology using the conceptual framework described here for explicitly representing and communicating knowledge about the relevant governance processes guided by a systemic perspective. The concept of *ontology* used here does not refer to its philosophical sense, as a study of being and the kinds of things that exist, but instead as a term now greatly used in various information science (IS) domains. In IS, an ontology refers to the manner in which domain knowledge (a domain being a field of interest) is represented in the form of concepts and relationships between concepts. The ontological capture process provides flexibility for representing and reasoning about the implications of concepts as they interact relative to one another. To facilitate the ease in capturing the operational descriptions above, the systems governance framework was implemented as an ontology web language (OWL) representation using Protégé Ver. 4.2 (Build 256, downloaded from http://protege.stanford.edu/), which is a free and publicly available open-source ontology editing tool.

The rationale for borrowing ontology-based capture methods was to draw on appropriate and accessible tools to support framework application. Application of the system governance framework is greatly boosted by the suitability of using existing tools in the IS domain or other domains. Consistent with the analytic purposes of the system governance framework, several existing ontology tools support capturing the intricate multilevel relationships as well as the tedious visualization mappings that behooves the analytic process itself. In this research, the Protégé editor provides a software based environment for implementing the system governance framework. It helps to provide an intuitive and powerful mechanism of modeling concepts and interrelationships between concepts. To support this rationale, we are drawing on earlier work in computer science fields suggesting the use of ontology as part of the conceptualization process (Gruber, 1993; Guarino, 1995; McCarthy, 1980;). McCarthy noted that an environment's ontology goes beyond a simple list of concepts involved in a problem environment but also an elaboration of possible meanings in a given context. He provides several examples of how to apply ontology for establishing an order of concepts in a given domain. This later paved the way for using ontologies with the representation of concepts. Later works by Gruber (1993) and Guarino (1995) further reinforced this notion of using ontology as a means of representing concepts.

Figure 16 is an OWL class diagram implementation of the proposed system governance framework. The corresponding first-level relationship map shows the any entity as the focal point of the visualization together with the other related entities that form its relevant context as well.
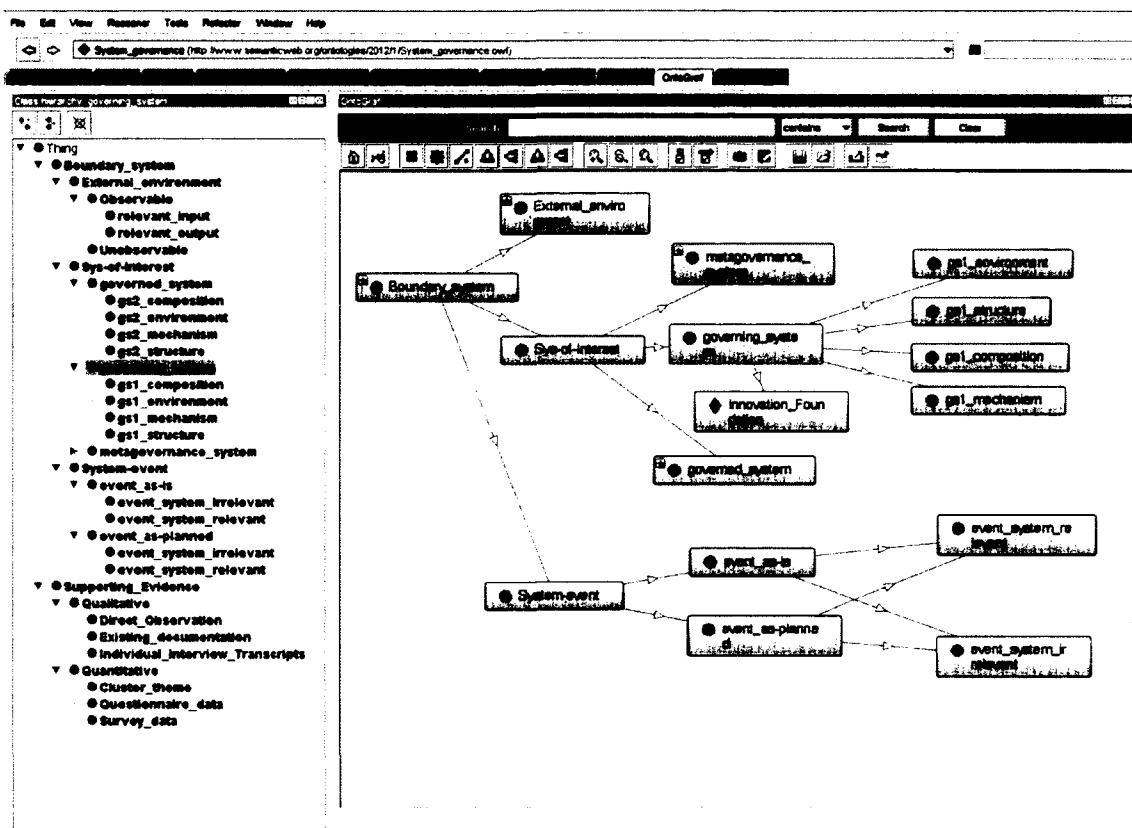
Figure 16. Domain Ontology-Capture Based on System Governance Framework

A detailed discussion is provided in the following section where the framework was used to populate the case study evidence related to the case study subject (or hereafter referred to as the system-of-interest. Furthermore, the system governance framework populated with the complete evidence pertaining to selected system-of-interest is espoused as a "blueprint" representational diagram reported in Appendix 7.

5.3 Single Case Study: Governance Profile of Case Subject

This section reports the application of the system governance framework in a field context. A new university-based venture designed to be a key component to promote innovation activity in behalf of the university was used as the single-case study context. This new university-based venture will then be referred to as the system-of-interest. The discussion in this section follows the main outline of the system governance framework. Initially, the governance boundary of the new university-based venture was described. Next, the focus shifts to the system-of-interest itself as the system governance framework exposed the various perspectives that make up the governance system of the system-of-interest. Third, the discussion followed the different interrelationships between the different components of the emerging governance system of the system of interest. And last, the chapter concluded with the implications and outputs of the system governance framework as application notes for the governance aspects of the system of interest.

The starting point for the single case study was elaborating the application of the system governance framework to the relevant context of the system-of-interest. Based on characteristics drawn from the body of knowledge and having articulated the system governance analytic framework, the findings presented were in response to the final research question: *What results from deployment of the framework in a field setting?* In the actual single case study, the system governance analytic framework was populated using the relevant context of the university-based venture designed to facilitate and promote governance of innovation-related activities.

5.3.1   System Governance Boundary – External Environment & the System-of-Interest

Based on the system governance framework, a distinction must be made between the system-of-interest and its external environment. This section describes this boundary distinction as supported by case study evidence.

As the framework suggests, the system-of-interest is acted upon (or is acting on) by an external environment. However, the boundary consists of mainly of social interactions that are so diffused throughout the social context of the system-of-interest. For purposes of explicitly narrowing down the supposed external environment of the system-of-interest, the boundary drawn, similar to the general character about systems, are products of analytic selection – as limited by the practical interests on the part of an observer. For governance-related interactions, the test whether these social interactions are directly related to the governance of the system-of-interest is whether they influence in the outcomes of the system (e.g. in maintaining identity, providing order, structuring diverse elements in achieving a collective goal, etc.). An intentional additional analytic selection is made to only choose those that are observable and were relevant to purposes of governance within the system-of-interest.

To gathedo we have a target?r evidence of the external environment of the system-of-interest, interviews were conducted. In this interview, several individual interviewees were asked key questions to help discern the external environment. The questions were i) "How would you describe the current environment that the 'system-of-interest' is expected to function in?" and ii) "Any perspective on possible political, technological, cultural and economical factors?" as key questions to draw out the interviewees initial perspective.

A couple of representative leaders and practitioners gave discerning answers as to the broad outline of the external environment. In one interview, the interview subject mentioned about getting the philanthropic community involvement to set up a revolving endowment fund set-up to provide grants to entrepreneurs, This is with the expectation that they will be part of some "economic gardening" for the region that will reduce the dependence of the local economy to military and defense contractor funding. This view was reinforced by other interviewees, one representing regional business interests groups and another individual tasked with city-level economic planning.

From the interviews and documentation gathered, the external entities that make up the part of the system environment and expected to engage with the system-of-interest include business individuals (e.g. private entrepreneurs), private companies, and the local public or government sector interests. Moreover, the system-of-interest operates as a support function in a regional university environment where a vast network of universities are all competing for talent, and for grant money from similar fund sources. Existing publicly available innovation database like the *CometsBETA* database (Zucker and Darby, 2011), as well as the in-depth interviews conducted with key authorities representing each of these identified entities revealed a set of perspectives, expectations and diversified interests. These in turn help to discern the extent of the governance boundaries of the system-of-interest.

5.3.2 System-of-Interest – Different Governance Perspectives

Having articulated the external environment, the focus now shifts to the internal boundary of the system-of-interest itself. Using the developed framework, system

governance of the system-of-interest was described in terms of three distinct perspectives namely: (i) metagovernance, (ii) governing system, and (iii) governed system. Likewise, additional perspectives on the system of interest as given by interview subject in response to general-purpose question, specifically about describing the impetus behind creating the system of interest and what role they envision the system interest plays with already existing strategies.

The metagovernance is composed of higher level institutional authorities within the university where the system-of-interest resides. The offices responsible for metagovernance are also the leaders that set forth the strategic vision, the values, culture and long-term goals for the university. For instance, the organizational strategic plan was formulated under the guidance of these decision makers. They give support to the system-of-interest by providing the institutional support, and financial resources to make the system-of-interest operational at the shortest time possible. At the same time, the system-of-interest is held accountable for the implementation of this vision. The metagovernance proponents have looked forward to seeing this system-of-interest succeed where other endeavors have failed before, to take advantage of lost opportunities. While throughout its history, innovation has existed sporadically in various forms, the system-of-interest is viewed as a big step forward to finally broadening the university's reach with a more business-orientation, as a go to place for innovative research and its eventual implementation.

Next, the governing system of the system-of-interest was established to become an intermediate and complementary entity relating internal university assets with external entities in relation to three central university activities in: i) commercialization,

ii) collaboration, and iii)revenue or value realization. Specifically, one internal briefing

outlined its mission statement as follows:

> *The (system-of-interest) will compliment and extend the university's relationships (through the (university business incubators, university enterprise centers, and the colleges) with companies and organizations by providing a structure and process for:*
> - *Enhancing the university's role as a partner with industry in the commercialization of value driven technology*
> - *Providing flexibility and alacrity in creating collaborations, including joint ventures, partnerships with third-parties, and faculty and student business creation activities*
> - *Creating an entity for the potential aggregation (while still managing the resulting risks) of university revenue generating activities, such as business-related professional development, student and faculty business endeavors, and material or infrastructure usage*

It described how the system-of-interest's primary function was addressing a legal

and operational services gap that did not exist within the wider university's current

structure prior to the installation of the new structure. University stakeholders recognized

the need to adapt with industry/business standard practices. University leadership for

their part has been responsive putting together an overarching vision framework as

articulated in the forward-looking the university's mission and strategic plan. In turn, a

much wider set of stakeholders were tapped to validate the need to have the system-of-

interest operational.

Lastly, the governed system of the system-of-interest refers to a group of people

who are interested in entrepreneurship and innovation. This may be external and internal

to the university. External to the university, the governed system include local

entrepreneurs, business-owners, and people from industry who need some

complementary expertise to push forward their innovation activities. Internally, the

governed system include individual faculty, research centers, colleges and their students (undergraduate and graduate levels) who in the same way would require support in successfully transitioning a research idea into the market.

5.3.3 System Interrelationships

Up next in the application of the system governance framework, the various governance interrelationships of the system-of-interest were examined. These interrelationships were elaborated and supported by case study evidence via the selected interviewee answers to questions describing the specific nature of their office linkage with the system of interest, the process involved during such an interaction, and the resources and mechanisms that have been put in place as leverage for the system-interest. Presumably, the relevant players at the wider context external to the system-of-interest have themselves their own processes of collaboration for input/output linkages between private-sector and the public-sector. However, this section only covered in detail the various input/output linkages of the system-of-interest.

The system-of-interest's main task is the establishment of needed mechanisms to equip the university with the right mix of *"policies, approaches, culture, skill sets, or systemic priorities required for meaningful business interaction"*, that currently was observed as either lacking or deficient within the university's current structure.

A detailed visualization of the specific roles of individuals interviewed with respect to the internal governance structure as well as external environment of the system-of-interest was developed. The application of the system governance framework helped show an explicit representation of an invisible network of governance-relevant

entities that would otherwise be under recognized. This finding was one of the answers to one of the original research questions "What results from the deployment of framework on an actual field setting?" The analytic artifact or visualization was a very important planning tool: i) to visualize the complexity and intricateness of the system-of-interests span of influence and ii) to be used as a baseline for periodic learning and improvement initiatives.

The university environment of the system-of-interest spanned several multiple levels of the governance system. The metagovernance level structures provide the institutional leadership at the top-most level. For instance, the metagovernance entities give the strategic direction for the governing system and governed system. The metagovernance for the system-of-interest include several of the university's top administrative and finance officers. The governing system is made up of the system-of-interest which works hand and hand with the university's business outreach centers. Meanwhile, the governed system include all the university enterprise centers, the faculty and student body. And as earlier mentioned, the external entities that make up the external system environment and was expected to engage with the system-of-interest include business individuals (e.g. private entrepreneurs), private companies and the public or government sector interests.

A higher level governance system, which was previously discussed as metagovernance, included entities that influenced how and why governance is necessary in the first place. Recall that at this level, an explicit articulation of the purpose of governance is explored. More specifically, the wider interests of entities at this level make explicit certain overarching value and rule systems. Within the current case context,

the Innovation Foundation as the system-of-interest was contextualized at the governing system level. Representing the metagovernance higher level system, the case study included insights from key representatives of the highest decision making and leadership positions in the university, particularly those in administrative and finance control units which ultimately influenced the administrative mandate and the operational scope of the system-of-interest.

5.3.4 Mechanisms and Processes to Enhance Innovation

The previous discussion described in great detail the multilevel nature of governance processes relevant to the system-of-interest. From a system governance vantage point, the focus in the earlier section was mostly on the system boundaries comprising the external environment and internal composition as well as interrelationships of the system-of-interest. In this section, we present case study evidence to substantiate the structural relations and mechanisms identified as supporting governance-related activities of the system-of-interest. The discussion was divided between mechanisms identified at the higher-level and those that were designed only at the system-of-interest level.

5.3.4a Wider Economy and University Level

The innovation profile of university where the system-of-interest is a sub-unit of has steadfastly increased over the years. University research has reported FY 2011 R&D expenditures at around $102.2 million which gives credibility to its modest estimates of annually contributing over $1 billion to the regional economy taking into account spillover effects like job creation and boosting investment in business start-ups. Empirical

data meanwhile is hard to independently substantiate at the regional level. This is particularly challenging especially in the general area of innovation assessment because of attribution problems, time lag between R&D, innovation and economic effects, and finally the quantification constraints of qualitative attributes of the regional research enterprise infrastructure. Part of the case study evidence is to understand the big picture pertaining to innovation activities in the region, and more specifically the innovation relevant activities using actual historical data. Hence, the analysis utilized the Connecting Outcome Measures in Entrepreneurship, Technology, and Science (COMETS) database (Zucker and Darby, 2011) which is an integrated database that traces government investment in R&D through the path of knowledge creation. The COMETS database integrates data on government grants, dissertations, patents, and publicly available firm data. A subset of this dataset (in particular the federal grants awarded by NSF and NIH, excluding patent activities) was retrieved. As shown in more detail from the Appendix 6, the university has managed to acquire grants and funding support consistently over the years but more work is needed to translate these into commercializable ideas.

In the meantime, the in-depth interviews with various representatives from private companies and the public or government sector have revealed interesting insights with regards the wider environment that may have important governance-implications and expectations for the system of interest. The main insight highlights the push for better integration in the regions innovation capacity. Several integration problems arise for a variety of different reasons ranging from sporadic and even absent well-planned efforts to the lack of visible mechanisms necessary to encourage commercialization of existing and future intellectual property generated in universities or those initiated by individual

entrepreneurs. To better address all those perceived missed opportunities, a number of collaborative initiatives have recently emerged from regional stakeholders that include local players like interest-bodies from the industry and the economic development team of the city government unit. Representatives from these organizations recognized the contributions of university to date but also maintain that more work needs to be done.

Key mechanisms that are being cultivated outside (and in conjunction with the university in some instances) include i) developing a stronger philanthropic community that is willing to invest in innovation for the region; ii) setting up an "angel-type" funding mechanism for purposes of encouraging research commercialization; and iii) strengthen the regional push to provide access to talent pools in key growth areas which will in turn likely produce future-focused commercially-viable ideas. The university that the system-of-interest supports has been cognizant of its role in the last mechanism thereby taking laudable strides in realigning its university-level strategy with the current economic challenges and global realities.

5.3.4b Mechanisms within the System-of-Interest

Whereas the previous section discussed the various higher-level mechanisms, this section now focuses on highlighting the mechanisms within the system of interest.

Several university faculty and/or different recipients in the college departments, with administrative help by its research support units have actively been the recipient of numerous federal grants from grant-awarding bodies like the National Science Foundation (NSF) and the National Institutes of Health (NIH). There is however, a perceived mismatch with its current structure with regards new challenges more aptly defined by regional economic development driven objectives. Institutional research

infrastructure in the university which the system-of-interest operates is reflective of practices in other universities as well. Like in most universities, the university was required to ensure that its recipients in their faculty are performance-bound to the terms and conditions of the accompanying research grant contract vehicle (Colyvas, 2007). These tasks are in keeping with contemporary trends for more oversight and accountability of publicly-funded research (Etzkowitz, et al., 2000).

While a separate research administrative unit services bulk of regulatory compliance of its internal assets with research fund/grant guidelines, the synergistic representative function embodied by the business outreach centers and the system-of-interest aims to complement by focusing more on economic and commercial-focused externalization activities. While relatively new additions to university infrastructure, the business outreach centers and the system-of-interest is working hard to be recognized as a "one-stop" shop linking university research and innovation capacity with the wider local, regional and national economy. This synergistic approach has been envisioned to accommodate both of the university's internal (e.g. faculty, students, etc.) as well as external assets (e.g. individual entrepreneurs, local business communities and/or industries). Among the complexities of economic commercialization activities revolve around the very complex nature of its multi-stage technical process and interplay of various legal considerations (Kempf, 1990). Hence, the tandem contribution can be understood as a confluence of promotion, facilitation and protection arm in behalf of the university and its stakeholder partners as a whole. The university's business outreach centers was now widely regarded in the community in helping to develop and bring together the wanted expertise from the university as needed by the business community

or the external industries. The system-of-interest when fully-functional envisions addressing a current gap by providing the necessary collaborative innovation infrastructure specifically the risk-managed legal expertise and venture fund facilitation components of university-research commercialization.

5.3.5   System-of-Interest Contributions to Practice

Although the presented framework does not yet suggest a new theory, it does address critical gaps in the literature of system governance. One such gap is the introduction of a systemic perspective on governance that in turn helped to reduce the ambiguity of interrelated governance concepts that were by-products of disparate sets of assumptions, models, and application contexts. The system governance framework served as a tool to enrich one's understanding and giving an exhaustive contextualization of the current and future directions of the system-of-interest. Also, with regards the research question posited above, the analytics phase of the deployment of the systems governance analytic framework also resulted in a series of useful engineering artifacts in the form of a Protégé OWL ontology model database whose detailed representations served as a baseline planning 'blueprint' documenting an actual organization or initiative. The system governance framework itself spans two sequential phases namely: contextualization and the usual process of generating analytics artifacts in order to draw insights or implications.

The formation of the system-of-interest was in cognizance to the opportunity for a wider involvement and contribution to an increasingly very competitive economic market landscape. The in-depth interviews with key stakeholders revealed a preferred set of long-term outcomes expected from the system-of-interest. The system-of-interest as

stated explicitly in the latest briefing document presented to the university's leadership committee outlined the realization of several long-term outcomes based on the following gaps identified. Firstly, it was presented that there is a current gap in application know-how in terms of having a standard approach to facilitate idea exchange and/or related services. For instance, it is difficult to identify much less to suggest existing services available in the university's research environment with the means for individuals to pursue their own intellectual property or in collaboration with others leading to potential joint-venture (JV) partnership opportunity in exchange for equity.

Secondly, the university needs to utilize more its current internal assets in terms of promulgating a business-oriented mindset when it comes to innovation. The university has yet to fully realize unlocking the benefits of its undertapped department faculty and student entrepreneurship network. When interviewed as part of this research, a university leader in concert with his vision for the university to emerge as the "go-to-place" to do research innovation and commercialization, he further sees these as an "opportunity with an upside" to establish something that goes beyond the traditional university-industry relationship. He envisions the system-of-interest as one of the mechanisms to increase visibility to not only external environment but also its internal faculty as well. The system-of-interest served as a key enabling entity to be able to open several "doors" for purposes of enhancing the university's role in driving commercialization, leverage shifting funding focus to economically viable venture developments, flexibility to actively engage in such JV creation and partnerships with third parties.

Lastly, a main long-term expected outcome for the system-of-interest is to establish an entity that helps to manage risk and also the aggregation of revenue in behalf

of the university. While the system-of-interest has been envisioned as a means to push the envelope of opportunity realization for the university, it also has a risk-mitigation component to it. If the university were to become successful and fully-engaged in the business of economic commercialization, it has to be fully-equipped not only to "monetize" or generate revenue from its research but also to provide legal remedies or expertise to any potential ramifications or risks involving technology competition, intellectual property protection-related and/or contractual disputes.

5.4. Chapter Summary

The framework based on the system governance construct is useful in mainly structuring and developing a set of diagnostic and as well as analytic tools that will help to provide novel insights into (1) the realities of overlapping interests associated with each perspectives reflected in the different levels of governance, and (2) how various component of governance relate to a variety of endogenous as well as exogenous interactions between themselves and their environment, respectively.

Several diagnostic methods/techniques may be identified and deployed. The goal was to use the framework to be able to do some analysis. And in this regard, the system governance framework helped identify through analyses and by obtaining a sufficient picture of governance. It was beyond the scope of this application to solve problems that were identified. Through the appropriate analyses, we determine the specific conditions that exist in order to produce guidelines of the actual governance situation in terms of what has been discovered about the system-of-interest and its relationship to its environment. These guidelines can then be used as a basis to proceed with the analysis stage. The analysis stage was the active process of identifying the range of approaches

that might be more suited to deliver a desired governance outcome. This stage was primarily a participative one, so each situation may have to articulate each of the broad steps differently.

In summary, using a single case study research design, the system governance framework was populated using the relevant context of a university-based the system-of-interest. The system governance framework was helpful in visualizing a sufficient picture of governance processes in the institutions. Note that the system governance framework aided the analysis in identification of gaps and pitfalls but it does not promise to necessarily solve problems that were identified. Through the appropriate analyses, we determine the specific conditions that exist in order to provide insights and implementation guidelines of the actual governance situation in terms of what has been discovered about the system-of-interest and its relationship to its environment.

Although the presented framework does not yet suggest a new theory, it does address critical gaps in the literature of system governance. One such gap is the introduction of a systemic perspective on governance that in turn helped to reduce the ambiguity of interrelated governance concepts that were by-products of disparate sets of assumptions, models, and application contexts. The system governance framework served as a tool to enrich one's understanding and giving a comprehensive contextualization of the current and future directions of the system-of-interest.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

In this chapter, the conclusion and recommendations are presented. First, the summary of the main findings of this research are reviewed in relationship to the stated research purpose, study objective and research questions. Next, the implications of the research are provided. These implications include both theoretical as well as practice implications stemming from the research effort. Finally, some ideas and suggestions for future research in line with the research recommendations were identified.

6.1 High-level Summary of findings

It is now that stage of the research where we look back on what has been accomplished with respect to the over-all research purpose and objectives that guided the effort.. Motivated by the need for better ways to conduct governance, recall the research purpose was *to develop and deploy a systems-based framework for analyzing governance in complex systems field settings.* In conjunction with this research purpose, supporting research objectives included: (i) to identify generalizable elements of governance systems;(ii) to develop an advanced systems-based framework, and (iii) to deploy the systems-based framework for analysis through a single case study approach to demonstrate the analytic utility and implications of framework in a field setting. At different times during the implementation of the research design, each of the research objectives has been met. High-level findings at each juncture of the research design are reiterated in this section.

To help address the first research objective, a corresponding research question was posed as (i) what are the distinctive characteristics of governance? Related research

has shown that purported claims for general approaches of governance in various domains of practice differ with respect to the pre-existing notions of governance. While some efforts have investigated governance very thoroughly within the confines of their discipline, the assumptions and extensions of their conceptual framework have not been established as applicable across different contexts. To overcome this lack of generalizability and to further take stock in the lessons learned by various disciplines in implementing their governance frameworks, a scalable and powerful content analysis methodology was devised to initiate the research design to discover the distinctive characteristics of governance. Specifically, the content analysis was conducted to generate interdisciplinary themes rather than focus on application-specific governance formulations. As discussed in Chapter 5, the content analysis yielded a set of interrelated themes (eight major themes with four sub-themes in two of the major thematic categories). These themes are broad and multidisciplinary and take into account the wide range of definitional, conceptual, operational and theoretical similarities and differences pervasive in this "governance" research domain. Each theme helped contextualize the system framework development phase that followed next in the research design.

Moving on with the next research objective, a corresponding research question was also posed: (ii) what system-based framework can be developed for analysis of governance in complex systems? Bearing in mind the themes generated in the content analysis step, several foundational systems principles and the underlying systems philosophy were used to guide the development of the system governance framework. In particular, the system-based concepts based on the systemic philosophical ontology by Mario Bunge were utilized to form the basis for framework development. From Bunge's

(2003) work, a purposeful system governance framework was developed, taking into account the system-of interest's components, environment, structures and mechanisms that interact across a multilevel governance domain. The system governance framework was developed in two phases, specifically, (i) the contextualization phase, and (ii) the analysis phase. The contextualization phase focused how the understanding at each level of governance operates and interacts with the other levels. The levels of consideration for system governance included the *meta-governance, governing,* and *governed* system levels. These included also taking into account the nature of interactions with their relevant environment. The system governance framework allowed the capability to capture the extent to which each element within those levels of governance was realized in practice. Next, the composition of activities necessary to accomplish the analysis phase was developed based on the prior contextualization. For purposes of making evolving the framework, readily available tools or techniques were utilized to enhance the contextualization process.

Lastly, the final research objective was met in response to the following research question: (iii) what results from deployment of the framework in a field setting? Formulating this research question in support of the last research objective provided partial 'face' validation regarding the system governance framework's utility for application in a field setting. Specifically using a single case study design approach, the system governance framework was applied as a conceptual tool to understand governance related application in start-up efforts to establish a university-based foundation focused on fostering innovation and supporting exploitation of university based research and capabilities. Although the application of the system governance framework can possibly

produce different types of analyses, the single case study illustrated its use in the context of a start-up organization operating at the interface of university research innovation and eventual commercialization-relevant activities. The main purpose of the case study target is to deliver support services that were not available for different types of users within the universities current structure. The start-up organization was in the tentative stages of development but expected future engagement to involve a multi-level structure that would be comprised of several disparate governance foci. Several findings, insights and mapping artifacts were generated as a result of structuring the analysis using the system governance framework. Through the single case study implementation, the system governance framework was demonstrated during the structuring and developing process of a set of diagnostic (e.g. feedback and implications) as well as analytic tools (e.g. relationship map or 'blueprint') that provided novel insights into (i) the realities of overlapping interests associated with multiple perspectives reflected in the different levels of governance, and (ii) how various components of governance relate to a variety of endogenous as well as exogenous interactions between themselves and their environment, respectively.

To a certain extent, there was considerable alignment of interests between the external environment as well as the different levels of the system-of-interest governance system analyzed in this research. There was evidence of several entities and groups outside of the university that have taken independent steps to promote healthy innovation and burgeoning entrepreneurial landscape for the greater. These included for instance a consortium of businesses and/or business industry leaders and also the city-level economic management teams. Representatives of each of these external entities were

mindful of the contributions by the university; they were committing to help nurture an environment for advocacy support and enhanced government-business-university that is conducive for collaborative practices. They were anticipating an increased role for the university in translating inclusive institutional gains into actual economic success stories for the local as well as wider regional area.

However, much needed progress was necessary to further align the structural organization of internal assets and processes within the university. Foreseen challenges emanating during the system governance framework implementation pose the more critical concerns emerging from the case study evidence. These were as follows: i) Inclusive "intelligent" representation at the metagovernance and governing system level; ii) Communication flow and purposeful reinforcement from governing system the governed system; and, iii) Evolving structural organization and enhancing existing mechanisms.

First and foremost, as an important enabler for innovation in behalf of the university, the system-of-interest needed to inclusively have an "intelligent" representation at its different interrelated metagovernance and governing system levels. By design, the system-of-interest like several other foundation existing in the university was governed at two levels namely at the Advisory Board level and the executive management team level. The Advisory Board embodies key elements of the basic metagovernance role while the executive management team faces the task of providing leadership at the governing system level. The task of identifying who will be invited to be perform these representative levels of governance is very important. The recommendation for inclusive "intelligent" representation is a reference to the need to

have leaders that understand the commercialization process and are most likely to have enjoyed some level of success in established or emerging segments within growing industries. Metagovernance steering provided via an experienced Advisory Board can be a source of invaluable insights accumulated across several years of experience from a diverse range of industries. Likewise, the Executive Management Team should also have individual leaders who enjoy the confidence of the Advisory Board and the industrial communities it frequently interacts with. In the interim, the system-of-interest Executive Management Team must grow beyond its current one-man operation set-up into a multi-dimensional team of management experts who each have their own organization and direct reports.

The framework application also revealed a need to improve the communication flow and purposeful reinforcement from governing system to the governed system. Specifically, during one-on-one interviews with research enterprise center director, each respondents welcome the introduction of the system-of-interest but remain wary about how much different it was going to be moving forward from currently existing procedures and processes. As primary research producers for the university, the feedback from these research centers is critical for the university to continue to sustain its level of research output. Noting the difference of adding the services the system-of-interest, they claim that with the existing structure there are just some funding opportunities they can't compete in. As an example, there are opportunities for collaboration with potential partners that require only service or consulting engagement that the university can readily supply. Some of the experiences have shown some degree of frustration emanating from the difficulty to deliver the level of engagement required to satisfy the customer. This

was inherently a structural limitation of the current research infrastructure that has since then evolved to become more proficient at regulatory compliance and achieving federal grant contract obligations and less about flexibility and efficiency to accommodating emerging business cases and models. The current configuration of services is well-adept at producing traditional outputs of basic research like design artifacts, proprietary hardware and software equipment, among others within the parameters of the grant contract but quite rigid to delivering service-type or hybrid innovation partnership arrangements. The leadership team which represents them metagovernance aspect reinforces the message that the formation of the system-of-interest implicitly suggests – that the university is open for business and is ready to go beyond traditional ways of doing research and business. This is important leading to the third and final finding in this discussion.

Third and last, top leadership recognize the need to resonate this message all the way through the governed elements – the faculty, research staff and students – that the university is ready heavily invested in making the needed changes for betterment of the university and also for the benefit of the wider community. That is, the system-of-interest must take the leadership mantle in evolving its current structural organization and developing better alternatives to existing innovation mechanisms. The short-term benefits of quickly getting the system-of-interest fully operational can fully fill-in the immediate gap of providing an alternative venue for external potential partners and collaborators (both individuals as well as private businesses interest groups) to engage with the university and its entire research infrastructure. With the array of services being offered by the university's business outreach team and soon the system-of-interest, the university

is in a unique position to leverage different kinds of innovative arrangements and scale of engagements outside of typical federal grant mechanisms. In the long-term, the system-of-interest envisions providing a complete range of commercialization-related support services such as provision of alternative funding/financing arrangements to emergent technology opportunities and also growing a risk-managed research and innovation portfolio that will shield the university the hassles and difficulties that may arise from intellectual property legal litigation or infringement claims/challenges.

This opens up the discussion for viable practical actions that can help refine the short-term focus, without compromising the long-term start-up outlook of the system-of-interest. Furthermore, as part of the exhibits developed as part of the implementation of the system governance framework, Appendix 7 provided an engineering "blueprint" - a tangible representation of the multi-perspective governance scope, the planning and deployment of system-of-interest documenting the conceptualization phase and later on can be used as the basis for problem diagnosis and resolving future structural and process deficiencies.

6.2 Implications of Research

There are now several examples of existing governance systems that are said to be unprepared for the practical difficulties of increasing complexity, change, emergence or uncertainty. Another set of suppositions hint on the need for governance within the context of the system. That is to say that there must of course be *a priori* an established awareness of a *system* in the first place. The focal question becomes, "Was the system developed with governance in mind?" And inextricably related to it is the question,

"When exactly was governance conceived with respect to a system's own conceptualization and development?" As one possible starting point, one may hold that no attempt of governance was conceived to begin with. For such a conceptual case, a complex organismic philosophy is adopted where a system, as it is starting out, evolves without any notion of governance similar to natural, biological and ad hoc network systems, making it likely that such systems (simple or complex) can exist without any form of governance. On the other hand, as another starting point, a mechanistic philosophy adopts the prevailing view of purposeful, carefully planned systems. The base assumption for such a technical view, whether tacit or implicit, is that governance is in fact present, and pre-planned during the conceptualization, design and development stage of the system. In either case, both assumptions can thus be simply a matter of how the system boundaries are being perceived, studied and established, whether naturally or by purposeful design.

Governance is dependent on how one draws the respective boundary regarding the exact state of the system by looking at one's experience with the system or any relevant documented or historical accounts. If one considers a system without any pre-conceived notion of governance, the main task is to design, develop and implement a suitable governance system. If governance is already built-into the system, then the argument shifts into how to proceed towards "good" or "effective" governance as a system response to recurring system problems.

The development of the system governance framework made several contributions across the spectrum of theoretical, methodological, and practitioner considerations. The concern of the theoretical contributions included extensions of the

body of multidisciplinary body of knowledge directed toward offering explanation for the nature and role of system governance. The methodological contributions were focused on the development of the approach by which system governance could be explored. Finally, the practitioner focused contributions were directed toward understanding the implications of the framework and approaches for development of system governance holds for improving practice. Each of these contribution areas are explored below.

The theoretical contributions included: (i) articulating and organizing the current state of knowledge for governance, including identification of gaps, and (ii) an original theoretically based framework developed for exploring complex system governance. Note that the system governance framework, built from the multidisciplinary body of knowledge informing system governance, is by design generalizable and may be performed without having in mind specific disciplinary or practitioner boundaries. The grounding of the necessary perspectives for localized application is composed at the later contextualization phases based on the purposeful boundary scoping and context specific interpretations. It would be shortsighted to consider applicability of different formulations of generalized theoretically grounded system governance efforts to be binary (all or none) applicability. System governance efforts may also be used for preliminary structuring or redesign with respect to a (partially) known set of perspectives and interests which would will play a significant stake in the governance effort. In particular, several contributions to governance theory were produced in this research. Specifically, as a result of the content analysis, a set of themes relevant to contemporary system governance were revealed. These themes were to a certain degree a reflection of the different generalizable elements of governance which was in response to the research

question posed as "*What are the distinctive characteristics of governance?*" As such, the knowledge boundaries for system governance have been pushed by the multidisciplinary synthesis of multiple strands of: (1) governance knowledge and concepts that have evolved within the boundaries of isolated disciplines, and (2) identification and incorporation of once disparate concepts for governance into a multidisciplinary coherent set, and (3) inclusion of the intersection of systems theory based principles with the governance literature.

The preceding discussions support the first objective and have answered the first research question. Since the research purpose was for an integrated articulation of the philosophical, theoretical, axiomatic and methodological basis for system governance, and the research objectives drove the research to find a comprehensive theoretical formulation, the content analysis results have produced a set of closely interrelated themes (eight major themes with four sub-themes in two of the major thematic categories). These themes were broad and multidisciplinary in order to take into account the wide range of definitional, conceptual, operational and theoretical similarities and differences pervasive in this "governance" research domain. The theoretical contribution of these findings can be useful in updating other related governance-related theories on accountability, collaboration, power, authority, influence and control.

From a methodological perspective, given the diverse set of situations where governance may be observed in practice, there was not one available applicable systems-based framework that could be used and be considered transferable to various systems context. The framework develop from this research stands as a theoretically grounded basis for systemically understanding of system governance and can be used as a 'model'

that may be applied to governance in other complex systems. However, it must also be understood that this development stands as a first formulation, with much theoretical development left to be 'tested', explored, and evolved with new discoveries and knowledge. However, against the multidisciplinary backdrop of system governance, the research certainly stands as a separate, distinct, and original contribution to the body of knowledge.

On the methodological front, the approach developed and deployed to apply the governance framework provided a significant contribution. The system governance framework provides an outline for governance process identification of one or more high-level governance interests. These interests may be informally defined but should tentatively answer the question: what governance level is the organization situated and what purpose will it serve? Such interests can be identified by the analyst or emerge through communication and/or exploration with the involved stakeholders. In the second case the resulting governance interests reflect to some extent the specific interests of the individual stakeholder groups. In this way some possible future conflicts between individual and organizational interests are identified and the opportunity to preclude their manifestation can be presented before they escalate and potentially impact system performance. If conflicts do appear, they can be made explicit, documented properly and recommended for realignment through close examination and redesign. Additionally, the rigorous application of a case study method to provide a level of "face" validation for research that is largely theoretic-conceptual was in itself a methodological contribution. This was particularly significant, as the case study method is not a predominant one in the engineering management and systems engineering disciplines. Finally, the use of a novel

method for enhanced literature content analysis represented a significant contribution on the methodological front. As information escalates in volume and accessibility, new methods to allow enhanced efficiency in synthesis of expansive literature is essential. This will allow researchers to more effectively perform multidisciplinary literature reviews.

Lastly, the research also has important implications for practice. Through a successful deployment of a single case study, practitioners responsible for conducting or maintaining 'governance' systems were able to find utility in using the analytic framework and its associated methodology in enhancing existing or new developments of governance in complex systems. Using the system governance framework as a basis for analysis, the planning of governance activities within an organization at a certain time point (for a certain period) is made more explicit making it easier to determine realistic outcomes. These key governance outcomes might range from high-level abstract goals to very specific ones. High-level goals (such as the case at the metagovernance level) need to align to more specific goals (at the related governing system and governed system levels) making it easier for measurement, monitoring and improvement purposes. The practice contributions stemming from this research certainly introduces the potential to improve practices related to enhancing system governance.

6.3 Future Research

Several areas of future research on system governance are outlined in this section Any research can focus on i) *theoria* - explanatory knowledge for its own sake, ii) *praxis* - acting upon one's situation to improve one's condition, and iii) *techne* - making

artifacts. A comprehensive research program for system governance must reflect each of the focus areas within its evolving body of knowledge. Explaining 'governance' is interested in *theoria*, but transforming 'governance' solicits both *praxis* (to solve governance problems by acting on existing entities), as well as in *techne* (to realize novel and innovative solutions). Both *praxis* and *techne* are important for systems and governance studies for these address assessment, transformation and implementation concerns. Ideally, future system governance research must aim to advance theoretical knowledge as the scientific ideal and also to use this knowledge to design *systems* (coherent structures and processes) to solve practical problems. Three possible future research offshoots may help to advance the *theoria*, *praxis* and *techne* research threads.

First, a good *theoria* piece is the formulation of new emergent principles or theory that helps influence the performance or behavior in each of the component, environment, structure and mechanisms proposed by the system governance framework. For instance, what new forms governance were emerging? How do we ensure that the complex system has sufficient governing capacity to remain? What are available means to build that governing capacity into an organization or a complex system? These are all interesting future research questions that require new theory. Alternatively, researchers can use the system governance analytic framework as an aid to testing their existing theory. There is several governance theories put forth in other disciplines or application contexts. The system governance framework may be extended to advance further development or integration of those theories towards a more general and scalable 'grand theory' of governance. As shown in this research, governance is a multi-faceted activity; therefore any proposed new theory makes the system governance framework much more scalable

in specifying diverse aspects of governance implementations. New theory should help clarify scalability concerns in the actual usage of the system governance framework. Many parts of the proposed system governance framework can be considered at different aggregation levels: e.g., the interests, the goals, the structural relations, and the mechanisms. Different aggregation levels can be developed and represented separately, which decreases the complexity of later modeling processes.

Next on the *praxis* end, using the methodology outlined in this research, the system governance framework may be applied in the modeling and analysis of structure and behavior on a different case context. This further increases the face validity and also helps establish that the proposed framework is practical and useful for the understanding of the governance-related phenomena, for the identification of governance implementation errors and inconsistencies, and for the investigation of the governance dynamics in different environmental settings.

Next, at the *techne* spectrum, several different artifacts can be produced in tandem with the insights generated by the system governance framework. The system governance framework provides an outline that allows for the identification of diverse aspects of governance implementation at a detailed level. Future research can advance the system governance framework by incorporating a formal language that offers detailed language expressivity of the governance perspectives identified in the framework. A formal language should ideally allow the specification of both static structures and the dynamic rules of behavior defined when presented with a governance context. It must be capable for concept articulation at a high level of abstraction, where the important norms and regulations on lower level governance may be formalized as constraints. Later work that

can make use of the expressive power of such a formal language can lead to several case studies, performed using the simulation results of actual executions of governance implementation scenarios. In general, actual executions may diverge from each of the governance implementation scenarios defined by the formal specification. Diverging interest may influence the implementation performance and the satisfaction of the governance goals both in a positive and in a negative way. One of the ways to perform such analysis is by simulation as it is described here.

6.4 Chapter Summary

The research conclusions and recommendations were discussed in this section. The summary of the main findings of this research were reviewed together with the stated research purpose, study objective and research questions. Next, the implications of the research were given. These included an articulation of the implications of the research on contemporary governance practice and highlighted the research contributions to theory, methodology, and application. Also, some further research ideas and questions for future research in line with the research recommendations were identified.

REFERENCES

Aberbach, J.D. ,& Christensen, T. (2003). Translating theoretical ideas into modern state reform: Economics-inspired reforms and competing models of governance. *Administration & Society*, *35*(5), 491-509.

Ackoff, R.L. (1971). Towards a system of systems concepts. *Management Science*, *17*(11), 661-671.

Adams, K.M. (2011). Systems principles: Foundation for the SoSE methodology. *International Journal of System of Systems Engineering*, *2*(2), 120–155.

Adams, K.M. (2012). System theory: A formal construct for understanding systems. *International Journal for system of Systems Engineering*, *3*(3/4), 209-224.

Adams, K.M., Hester, P.T., Bradley, J.M., Meyers, T.J. & Keating, C.B. (2013). Systems theory as the foundation for understanding systems. *Systems Engineering*, Online version, DOI: 1002/sys.21255.

Andrews, N.O. and Fox, E.A. (2007). Recent developments in document clustering. (Tech. Rep. TR-07-35) Virginia Tech Department of Computer Science.

Ansell, C. & Gash, A. (2007). Collaborative governance in theory and practice. *Journal of Public Administration and Theory*, *18*, 547-571.

Baldwin, W., Sauser, B., Boardman, J., & John, L. (2010). A typology of systems paradoxes. *Information, Knowledge, Systems Management*, *9*(1), 1-15.

Barr, P. S., Stimpert, J. L., & Huff, A. S. (1992). Cognitive change, strategic action, and organizational Renewal. *Strategic Management Journal*, *13*, 15-36.

Bar-Yam, Y (1997). Dynamics of complex systems. Colorado: Westview Press Boulder,

Bedeian, A. G. (2004). Peer review and the social construction of knowledge in the management discipline. *Academy of Management Learning & Education, 3*(2), 198-216.

Bennett, A., & Elman, C. (2006). Qualitative research: Recent developments in case study methods. *Annual Review of Political Science, 9*(1), 455-476.

Berger, P. & Luckmann, T. (1967). *The social construction of reality: a treatise of sociology of knowledge*: New York: Anchor Books.

Bertalanffy, L. (1950). The theory of open systems in physics and biology. *Science, 111*(2872):23-29.

Bevir, M. (2004). Governance and interpretation: What are the implications of postfoundationalism? *Public Administration, 82*(3), 605–625.

Bevir, M. (2006). Democratic governance: Systems and radical perspectives. *Public Administration Review, 66*(3), 426–436.

Biermann, F., & Pattberg, P. (2008). Global environmental governance: Taking stock, moving forward. *Annual Review of Environment and Resources, 33*, 277-294.

Bovaird, T. (2005). Public governance: balancing stakeholder power in a network society. *International Review of Administrative Sciences, 71*(2), 217-228.

Bordons, M., Fernández, M., & Gómez, I. (2002). Advantages and limitations in the use of impact factor measures for the assessment of research performance. *Scientometrics, 53*, 195-206.

Boulding, K.E. (1956). General systems theory-The skeleton of science. *Management Science, 2*(3), 197-208.

Boulding, K. (1985). *The world as a total system*. Sage Publications.

Braha, D., Minai, A., & Bar-Yam, Y. (2006). *Complex engineered systems: Science meets technology*. Cambridge, Massachusetts: Springer.

Brennan, N. M., & Solomon, J. (2008). Corporate governance, accountability and mechanisms of accountability: An overview. *Accounting, Auditing & Accountability Journal, 21*(7), 885–906.

Brinkerhoff, D. (2005). Rebuilding governance in failed states and post-conflict societies: Core concepts and cross-cutting themes. *Public Administration and Development, 25*(1), 3-14.

Brown, I., Steen, A., & Foreman, J. (2009). Risk management in corporate governance: A review and proposal. *Corporate Governance – An International Review, 17*(5), 546-558.

Buchinger, E. (2006). The sociological concept of autopoiesis: Biological and philosophical basics and governance relevance. *Kybernetes, 35*(3/4), 360-374.

Buchler, J. (Ed.). (1955). *Philosophical writings of Peirce*. New York: Dover Publications.

Bunge, M.A. (1996). *Finding philosophy in social science*. Yale University Press.

Bunge, M.A. (2000). Systemism: the alternative to individualism and holism. *Journal of Socio-economics, 29*, 147-157.

Bunge, M.A. (2003). *Emergence and convergence: Qualitative novelty and the unity of knowledge*. Toronto, Canada:University of Toronto Press.

Burrell, G., & Morgan, G. (1979). *Sociological paradigms and organizational analysis*. Portsmouth, NH: Heinemann.

Cabrera, D., & Colosi, L. (2008). Distinctions, systems, relationships, and perspectives (DSRP): A theory of thinking and of things. *Evaluation and Program Planning*, *31*(3): 311-317.

Calida, B., & Hester, P. (2010). Unraveling future research: an analysis of emergent literature in open innovation. *Annals of Innovation & Entrepreneurship*, *1*(1). doi:10.3402/aie.v1i1.5845.

Carley, K. (1993). Coding choices for textual analysis: A comparison of content analysis and map analysis. *Sociological Methodology*, *23*, 75-126.

Carroll, J. & Swatman, P. (2000). Structured-case: A methodological framework for building theory in information systems research. *European Journal of Information Systems*, *9*(4), 235-242.

Casti, J. (1981). Systemism, system theory and social system modeling. *Regional Science and Urban Economics*, *11*, 405-424.

Checkland, P. (1981). *Systems thinking, systems practice*. Chichester, UK: John Wiley and Sons.

Colyvas, J. A. (2007). From divergent meanings to common practices: The early institutionalization of technology transfer in the life sciences at Stanford University. *Research Policy*, *36*(4), 456–476.

Corman, S., & Dooley, K. (2006). Crawdad text analysis system (v. 2.0).Chandler, AZ: Crawdad Technologies, LLC.

Corman, S. R., Kuhn, T., Mcphee, R. D., & Dooley, K. J. (2002). Studying complex discursive systems. *Human Communication Research*, *28*(2), 157-206.

Creswell, J.W. (2003) *Research design: Qualitative, quantitative, and mixed methods approaches*. Thousand Oaks, CA: Sage.

De Alcantara, C. (1998). Uses and abuses of the concept of governance. *International Social Science Journal, 50* (155), 105-114.

Descartes, R. (2009). Discourse on the method of rightly conducting the reason, and seeking truth in the sciences. *Annals of Neurosciences, 16*(01), 17-21.

Deetz, S. (1996). Describing differences in approaches to organization science: Rethinking Burrell and Morgan and their legacy. *Organization Science, 7*(2), 191-207.

Digby, J. (1989) "Operations Research and Systems Analysis at RAND, 1948-1967", Tech. Rep. no. N-2936-RC, The RAND Corporation.

Dixon, J., & Dogan, R. (2003). Analyzing global governance failure: A philosophical framework. *Journal of Comparative Policy Analysis: Research and Practice, 5*(2-3), 209–226.

Driver, C. (2008). Varieties of governance. *Recherches Economiques De Louvain-Louvain Economic Review, 74(4),* 425-+.

Duit, . & Galaz, V. (2008). Governance and complexity – Emerging issues for governance theory. *Governance: An International Journal of Policy, Administration, and Institutions, 21*(3), 311-335.

Dunsire, A. (1990). Holistic governance. *Public Policy and Administration, 5*(1), 4-19/

Duriau, V.J., Reger, R.K., & Pfarrer, M.D. (2007). A content analysis of the content analysis literature in organization studies: Research themes, data sources, and methodological refinements. *Organizational Research Methods, 10*(1), 5 -34.

Eisenhardt, K.M. (1989). Building theories from case study research. *The Academy of Management Review, 14*(4), 532-550.

Etzkowitz, H., Webster, A., Gebhardt, C., & Terra, B.R.C. (2000). The future of the university and the university of the future: evolution of ivory tower to entrepreneurial paradigm. *Research Policy, 29*(2), 313–330.

Fligstein, N., & Choo, J. (2005). Law and corporate governance. *Annual Review of Law and Social Science, 1,* 61-84.

Folke, C., Hahn, T., Olsson, P., & Norberg, J. (2005). Adaptive governance of social-ecological systems. *Annual Review of Environment and Resources, 30,* 441-473.

Forrester, J. (1961) *Industrial dynamics.* Waltham, USA: Pegasus Communications

Garcia-Meca, E., & Sanchez-Ballesta, J. (2009). Corporate governance and earnings management: A meta-analysis. *Corporate Governance – An International Review, 17*(5), 594-610.

Gheorghe, A. V. (2004). Risks, vulnerability, sustainability and governance: A new landscape for critical infrastructures. *International Journal of Critical Infrastructures , 1* (1), 118 - 124 .

Gibbons, M., Limoges, C. Nowotny, H., Schwartzman, S., Scott, P. & Trow, M. (1994). *The new production of knowledge: The dynamics of science and research in contemporary societies.* London: SAGE.

Gideonse, H. (1993). The governance of teacher-education and systemic reform. *Education Policy, 7*(4), 395-426.

Gigch, J.P. (1987). *Decision making about decision making: Metamodels and metasystems.* Abacus Press.

Gilbert, G. N. (1976). The transformation of research findings into scientific knowledge. *Social Studies of Science, 6*(3/4), 281-306.

Gioia, D., & Pitre, E. (1990). Multiparadigm perspectives on theory building. *The Academy of Management Review, 15*(4), 584-602.

Goles, T., & Hirschheim, R. (2000). The paradigm is dead, long live the paradigm: The legacy of Burrell and Morgan, *Omega, 28*, 249–268.

"governance" (2004). *The American Heritage (c) Dictionary of the English Language,* 4th ed. (Houghton Mifflin Company) Retrieved from http://dictionary.reference.com/browse/governance

Greene, J., Caracelli, V. & Graham, W. (1989). Toward a conceptual framework for mixed-method evaluation design. *Educational Evaluation and Policy Analysis, 11*(3), pp. 255-74.

Gruber, T. R. (1993). A translation approach to portable ontology specifications. *Knowledge Acquisition, 5(2),* 199–220.

Guarino, N. (1995). Formal ontology, conceptual analysis and knowledge representation. *International Journal of Human-Computer Studies, 43*(5–6), 625–640.

Guba, E., & Lincoln, Y. (1994). Competing paradigms in qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (pp. 105–117). Thousand Oaks, CA: Sage.

Hall, A. (1965). Systems engineering from an engineering viewpoint. *IEEE Transactions on Systems Science and Cybernetics, 1*(1), 4-8.

Hawley, J., & Williams, A. (2005). Shifting ground: Emerging global corporate-governance standards and the rise of fiduciary capitalism. *Environment and Planning A, 37*(11), 1995-2013.

Hempel, C.G. (1965). *Aspects of scientific explanation*. New York: Free Press.

Hermans, H. (1988). On the Integration of nomothetic and idiographic research methods in the study of personal meaning. *Journal of Personality*, 56(4), 785-812.

Hill, C., & Lynn, L. (2005). Is hierarchical governance in decline? Evidence from empirical research. *Journal of Public Administration Research and Theory, 15*(2), 173-195.

Hitch, C. (1955). An appreciation of systems analysis. *Journal of the Operations Research Society of America, 3*(4), 466-481.

Holland, J. (1998) *Emergence: from chaos to order*, Reading, MA: Addison-Wesley.

Hoogervorst, J.A.P. (2009). *Enterprise Governance and Enterprise Engineering*. The Enterprise Engineering Series. Diemen, Netherlands: Springer.

Huitema, D., Mostert, E., Egas, W., Moellenkamp, S., Pahl-Wostl, C., & Yalcin, R. (2009). Adaptive water governance: Assessing the institutional prescriptions of adaptive (co-) management from a governance perspective and defining a research agenda. *Ecology and Society, 14*(1), 26. Retrieved from http://www.ecologyandsociety.org/vol14/iss1/art26/

Huse, M. (2003). Renewing management and governance: New paradigms of governance? *Journal of Management and Governance 7,* 211–221.

Hyden, G. (1999). Governance and the reconstitution of political order. In R. Joseph, *State, Conflict, and Democracy in Africa*. Boulder, CO, USA: Rienner.

Jacobs, J.A., & Frickel, S. (2009). Interdisciplinarity: A critical assessment, *Annual Review of Sociology*, *35*, 43-65.

Jackson, M.C. (1985). Social systems theory and practice: The need for a critical approach. *International Journal of General Systems*, *10*, 135–151.

Jackson, M.C. (1991). The origins and nature of critical systems thinking. *Systems Practice*, *4*(2), 131–149.

Jackson, M. (1997). Pluralism in systems thinking and practice. In J. C. Mingers & A. Gill, (Eds.), *Multimethodology: the theory and practice of combining management science methodologies* (pp.347-378), *Chichester: John Wiley and Sons.*

Jackson, M.C., & Keys, P. (1984). Towards a system of systems methodologies. *The Journal of the Operational Research Society*, *35*(6), 473-486.

Jessop, B. (1998). The rise of governance and the risks of failure: The case of economic development. *International Social Science Journal*, *50*(155): 29-45.

Jessop, B. (2003). Governance and metagovernance: On reflexivity, requisite variety, and requisite rrony. In Bang, H. P. (Ed.), *Governance, as Social and Political Communication.* (pp. 142-172). Manchester: Manchester University Press.

Johannessen, J. & Olaisen, J. (2005a). Systemic philosophy and the philosophy of social science – Part I: Transcendence of the naturalistic and the anti-naturalistic position in the philosophy of social science. *Kybernetes*, *34*(7/8), 1261-1277.

Johannessen, J. & Olaisen, J. (2005b). Systemic philosophy and the philosophy of social science: Part II: The systemic position. *Kybernetes*, *34*(9/10), 1570-1586.

Johnson, R., & Onwuegbuzie, A. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher, 33*(7), 14-26.

Johnson, R., Onwuegbuzie, A., and Turner, L. (2007). Toward a definition of mixed methods research. *Journal of Mixed Methods Research, 1*(2), 112 -133.

Jose, J. (2009). "Conceptualising 'Governance': Discourse, theory and ontology" Paper presented at the annual meeting of the WPSA Annual Meeting "Ideas, Interests and Institutions", Hyatt Regency Vancouver, BC Canada, Vancouver, BC, Canada Online Retrieved from

http://www.allacademic.com/meta/p316878_index.html

Kabanoff, B., Waldersee, R., & Cohen, M. (1995). Espoused values and organizational change themes. *The Academy of Management Journal, 38*(4), 1075-1104.

Kauffman, S. (1993). *The origins of order: Self-organization and selection in evolution.* Oxford: Oxford University Press.

Keating, C.B. (2005). Research foundations for system of systems engineering. In Systems, Man and Cybernetics, 2005 IEEE International Conference on (Vol. 3, pp. 2720-2725 Vol. 3). Presented at the Systems, Man and Cybernetics, 2005 IEEE International Conference on. doi:10.1109/ICSMC.2005.1571561.

Keating, C.B. (2009). Emergence in system of systems. In Jamshidi, M. (Ed.) *System of systems engineering: Innovating for the 21ˢᵗ century* (pp. 169-190). Hoboken, NJ: Wiley.

Keating, C., Hester, P., Meyers, T. & Calida, B. (2010). R&D system governance: An emerging perspective. *Proceedings of R&D Management Conference:*

Information Imagination & Intelligence in R&D Management. Presented at the

R&D Management Conference, Manchester, London: RADMA.

Keating C.B., & Katina, P.F. (2011). System of systems engineering: Prospects and

challenges for the emerging field. *International Journal of System of Systems*

Engineering, 2(2/3), 234-256.

Kempf, R.F. (1990). Legal ramifications of intellectual property. *Government*

Information Quarterly, 7(2), 197–209.

Keohane, R., & Nye, J. (1989). *Power and interdependence*. New York: Harper Collins.

Keohane, R., & Nye, J. (2000). Governance in a globalizing world. In J. Nye, & J.

Donahue (Eds.), *Governance in a globalizing world*. Washington DC, USA:

Brookings Institution.

Kersbergen, K., & Waarden, F. (2004). 'Governance' as a bridge between disciplines:

Cross-disciplinary inspiration regarding shifts in governance and problems of

governability, accountability and legitimacy, *European Journal of Political*

Research 43, 143–171.

Kettl, D. (2000). The transformation of governance: Globalization, devolution, and the

role of government. *Public Administration Review*, 60(6), 488–497.

Kettl, D. (2004). *System under stress: Homeland Security and American politics*.

Washington DC, USA: CQ Press.

Kjær, A. (2004). *Governance: Key concepts*. Malden, MA, USA: Polity Press.

Klein, H. (2004). Seeking the new and the critical in critical realism: Déjà vu?

Information and Organization, 14(2), 123-144.

Kooiman, J. (1993). *Modern governance: new government-society interactions*. Sage.

Kooiman, J. (1999). Social-political governance: overview, reflections and design. *Public Management* , *1* (1), 67-92.

Kooiman, J. (2000). Societal governance: Levels, models and orders of social-political interaction. In J. Pierre (Ed.), *Debating governance. Authority, steering and democracy* (pp. 138-166). Oxford, UK: Oxford University Press .

Kooiman, J. (2003). *Governing as governance*. London: Sage.

Kooiman, J., & Jentoft, S. (2009). Meta-governance: Values, norms and principles, and the making of hard choices. *Public Administration*, 87 (4), 818-836.

Krahmann, E. (2003). Conceptualizing security governance. *Cooperation and Conflict*, *38*(1), 5–26.

Krippendorff, K. (2004). *Content analysis: An introduction to its methodology* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Kuhn, T. (1976). *The structure of scientific revolutions*. Chicago, IL: Chicago University Press.

Lemos, M., & Agrawal, A. (2006). Environmental governance. *Annual Review of Environment and Resources, 31*, 297-325.

Lewis, M., & Grimes, A. (1999). Metatriangulation: Building theory from multiple paradigms. *The Academy of Management Review, 24*(4), 672-690.

Lewis, M., & Kelemen, M. (2002). Multiparadigm inquiry: Exploring organizational pluralism and paradox. *Human Relations, 55*(2), 251 -275.

Lobkowicz, N. (1967). *Theory and practice: History of a concept from Aristotle to Marx*. Notre Dame, IN: University of Notre Dame Press.

Luhmann, N. (1977). Differentiation of society. *The Canadian Journal of Sociology / Cahiers canadiens de sociologie, 2*(1), 29-53.

Luhmann, N. (1982). The world society as a social system. *International Journal of General Systems, 8*(3), 131-138.

Lycan, W.G. (2010). What, exactly, is a paradox? *Analysis, 70*(4), 615 -622.

Lynn, L., Heinrich, C., & Hill, C. (2000). Studying governance and public management: Challenges and prospects. *Journal of Public Administration Research and Theory, 10*(2), 233-261.

Maasen, S., & Lieven, O. (2006). Transdisciplinarity: A new mode of governing science? *Science and Public Policy, 33*(6): 399-410.

Mahoney, M.J. (1985). Open exchange and epistemic progress. *American Psychologist, 40*(1), 29-39.

Maier, M.W. (1998). Architecting principles for systems-of-systems. *Systems Engineering, 1*(4), 267-284.

Marks, E. (2008). *Service-oriented architecture governance for the services driven enterprise.* Hoboken, New Jersey, USA: John Wiley & Sons.

Mathiason, J. (2009). *Internet governance: The new frontier of global institutions.* New York, USA: Taylor & Francis.

Mattessich, R. (1990) Mario Bunge's influence on the administrative and system sciences, In Weingartner, P. & Dorn, G.J. (Eds.), *Studies on Mario Bunge's Treatise* (pp. 397-420), Amsterdam, Netherlands: Rodopi.

McCarthy, J. (1980). Circumscription—A form of non-monotonic reasoning. *Artificial Intelligence, 13*(1–2), 27–39.

McGinnis, M. (2008). Legal pluralism, polycentricity, and faith-based organizations in global governance. In M. Sproule-Jones, B. Allen, & F. Sabetti (Eds.), *The struggle to constitute and sustain productive orders: Vincent Ostrom's quest to understand human affairs* (pp. 45-64). Plymouth, UK: Lexington Books.

Merton, R.K. (1948). The bearing of empirical research upon the development of social theory. *American Sociological Review, 13*(5), 505-515.

Miles, M.B., & Huberman, A.M. (1999). *Qualitative data analysis* (2nd ed.). Thousand Oaks, CA: Sage Publications.

Nicolescu, L. (2010). Governance in higher education: Theories and practices applied in metallurgical industry. *Metalurgia International, 15,* 201-205.

Niiniluoto, I. (1991). Realism, relativism, and constructivism. *Synthese, 89*(1), 135-162.

Neuendorf, K. A. (2002). *The content analysis guidebook.* Thousand Oaks, CA: Sage Publications.

Ostrom, E. (2009). *Understanding institutional diversity.* NJ, USA: Princeton University Press.

Ostrom, V. (2008). Constitutional foundations for a theory of system comparisons. In M. Sproule-Jones, B. Allen, & F. Sabetti (Eds.), *The struggle to constitute and sustain productive orders: Vincent Ostrom's quest to understand human affairs* (pp. 11-26). Plymouth, UK: Lexington Books.

Pickel, A. (2007). Rethinking systems theory: A programmatic introduction. *Philosophy of the Social Sciences, 37*(4), 391–407.

Pierre, J. (Ed.). (2000). *Debating governance: Authority, steering, and democracy.* New York, NY, USA: Oxford University Press.

Popper, K. (1959). *The logic of scientific discovery*. London: Hutchinson.

Popper, K. (1968) *Conjectures and refutations*. New York: Harper & Row.

Post, R. (1987) Between governance and management: The history and theory of the

public forum. *Faculty Scholarship Series*. Paper 214. Retrieved from

http://digitalcommons.law.yale.edu/fss_papers/214.

Provan, K., & Kenis, P. (2008). Modes of network governance: Structure, management,

and effectiveness. *Journal of Public Administration Research and Theory*, *18*(2),

229 -252.

Rafols, I., Porter, A.L., & Leydesdorff, L. (2010). Science overlay maps: A new tool for

research policy and library management. *Journal of the American Society for*

Information Science and Technology, *61*(9), 1871-1887.

Rhodes, R.A. (2000). The governance narrative: Key findings and lessons from the

ESRC's Whitehall programmes. *Public Administration*, *78*(2), 345-363.

Rhodes, R. A. (2007). Understanding governance: Ten years on. *Organization Studies*,

28(8), 1243–1264.

Romesburg, C.H. (1984). *Cluster analysis for researchers*. North Carolina: Lulu Express.

Rosenau, J. N. (1997). *Along the domestic-foreign frontier: Exploring governance in a*

turbulent world. Cambridge, UK: Cambridge University Press.

Royce, J. (1978). Three ways of knowing and the scientific world view. *Methodology and*

Science, *11*, 146–164

Ryan, A.J. (2008). What is a systems approach? Retrieved from

http://arxiv.org/abs/0809.1698

Santas, G. (2001). *Goodness and justice: Plato, Aristotle, and the moderns*. Malden, MA, USA: Wiley-Blackwell.

Santas, G. (2006). *The Blackwell guide to Plato's Republic*. Malden, MA, USA: Wiley-Blackwell.

Senge, P.M. (1980). A system dynamics approach to investment-function formulation and testing. *Socio-Economic Planning Sciences, 14*(6), 269-280.

Shadish, W. (1995).Philosophy of science and the quantitative-qualitative debates: Thirteen common errors. *Evaluation and Program Planning, 18*(1), 63-75.

Simon, H. (1957). *Administrative behavior*. (2nd ed.) New York: Macmillan.

Simon, H. (1962). The architecture of complexity. *Proceedings of the American Philosophical Society, 106*(6), 467-482.

Simon, H. (1996). The architecture of complexity. In H. A. Simon, *Sciences of the Artificial* (3rd ed.). Cambridge, MA, USA: MIT Press.

Slowther, A., Boynton, P., & Shaw, S. (2006). Research governance: Ethical issues. *Journal of the Royal Society of Medicine, 99*(2), 65-72.

Smith, J. (1983). Quantitative versus qualitative Research: An attempt to clarify the issue. *Educational Researcher, 12*(3), 6-13.

Sousa-Poza, A., Padilla, J., & Bozkurt, I. (2008). Implications of a rationalist inductive approach in System of Systems Engineering research. In *SoSE '08, IEEE International Conference on System of Systems Engineering, 2008* (pp. 1-6).

Stavros, R., & Dettman, M. (2007). *Engineering governance*. Retrieved April 30, 2010, from http://nesipublic.spawar.navy.mil/misc

Stehr, N. (2004). A world made of knowledge. In N. Stehr, *The Governance of Knowledge* (pp. ix-xxvi). New Brunswick, New Jersey, USA: Transaction Publishers.

Stivers, C. (2008). *Governance in dark times*. Washington DC, USA: Georgetown University Press.

Stoker, G. (1998). Governance as theory: Five propositions. *International Social Science Journal, 50*(155), 17-28.

Tait, A. (2004). Clinical governance in primary care: A literature review. *Journal of Clinical Nursing, 13*(6), 723-730.

Tate, W., Ellram, L., & Kirchoff, J. (2010). Corporate social responsibility reports: A thematic analysis related to supply chain management. *Journal of Supply Chain Management, 46*(1), 19-44.

Tickell, C. (1997). Security, environment, and global governance. *Interdisciplinary Science Reviews, 22*(3), 246-250.

Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *British Journal of Management, 14*(3), 207-222.

Trochim, W., & Land, D. (1982). Designing designs for research. *The Researcher, 1*(1), 1-6.

Tsoukas, H. (1996). The firm as a distributed knowledge system: A constructionist approach. *Strategic Management Journal, 17*, 11-25.

Türke, R. (2008). *Governance: Systemic foundation and framework*. Heidelberg, Germany: Physica-Verlag, Springer.

Ulrich, W. (1983). Critical heuristics of social planning: A new approach to practical philosophy, Haupt: Berne.

Voegelin, E. (2003). The theory of governance and other miscellaneous papers, 1921-1938. University of Missouri Press.

von Foerster, H. (1979). "Cybernetics of cybernetics", communication and control in society, (K. Krippendork ed.). NY, USA: Gordon and Breach.

Voorhees, B. (1987). Systems, models, methods, epistemic instrumentation. In J.P.V. Gigch (Ed.), *Decision making about decision making: Metamodels and metasystems* (pp. 99-108). Massachusetts, USA: Abacus Press.

Walters, W. (2004). Some critical notes on 'governance', *Studies in Political Economy, 73,* 27-46.

Wan, P. Y. (2011). Emergence à la systems theory: Epistemological totalausschluss or ontological novelty? *Philosophy of the Social Sciences, 41*(2), 178–210.

Weaver, W. (1948). Science and complexity. *American Scientist. 36,* 536-544.

White, L. (2001). 'Effective governance' through complexity thinking and management science. *Systems Research and Behavioral Science, 18*(3), 241-257.

Whitehead, M. (2003). 'In the shadow of hierarchy': Meta-governance, policy reform and urban regeneration in the West Midlands. *Area, 35*(1), 6-14.

Williamson, O.E. (1994). Visible and invisible governance. *The American Economic Review, 84*(2), 323-326.

Willke, H. (2007). *Smart governance: Governing the global knowledge society.* Frankurt, Germany: Campus Verlag GmbH.

Wittgenstein, L. (1953). *Philosophical investigations.* Oxford: Blackwell.

Yin, R. K. (2009). *Case study research: Design and methods* (4th ed.). Thousand Oaks,

    CA: Sage Publications.

Zucker, L.G. & Darby, M.R. (2011). COMETS Data Description, release 1.0, Los

    Angeles, CA: UCLA Center for International Science, Technology, and Cultural

    Policy, Released July 1, 2011.

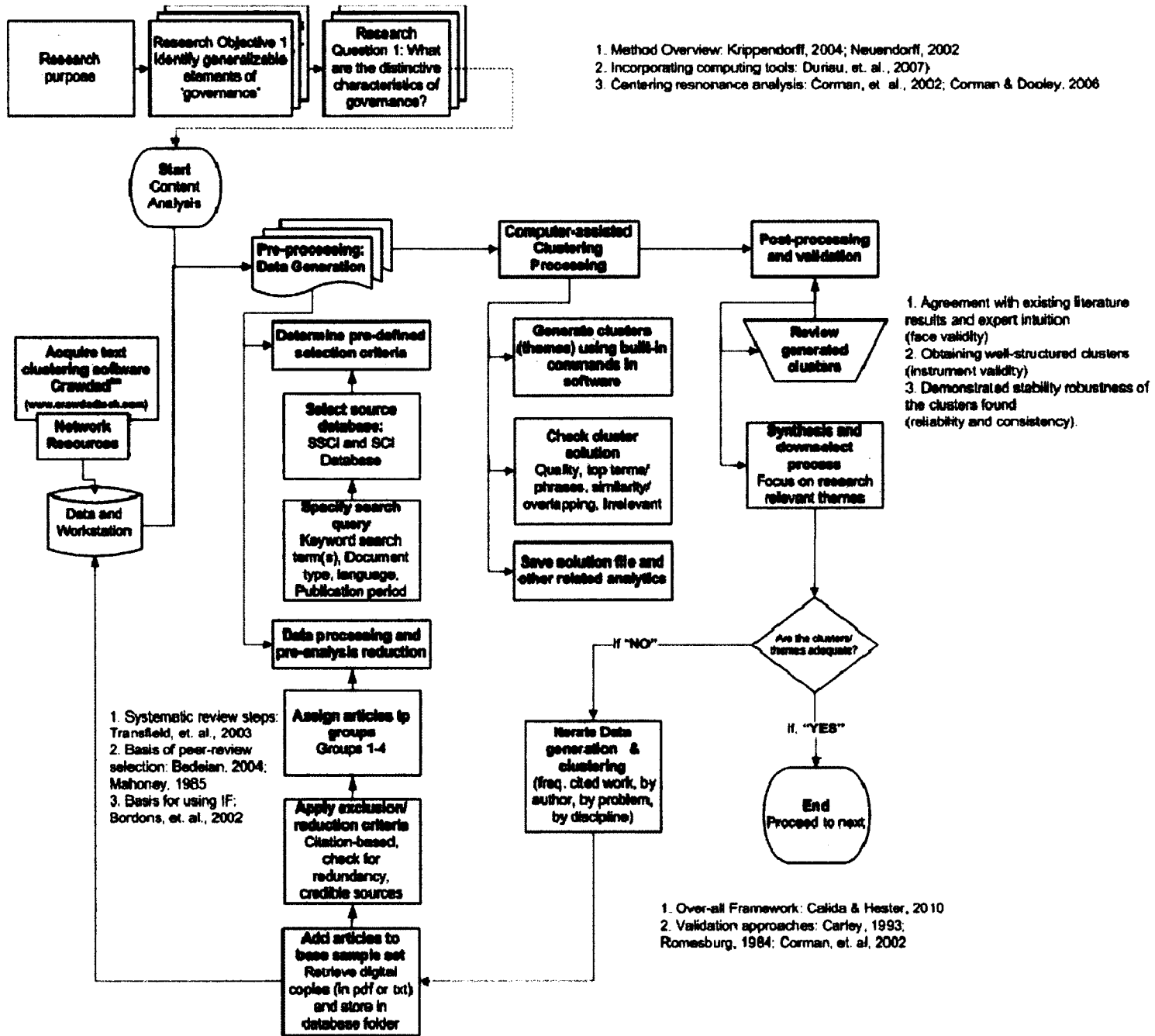Figure 17. Content Analysis Detailed Research Flow

APPENDIX 1. Content Analysis Detailed Research Design

194

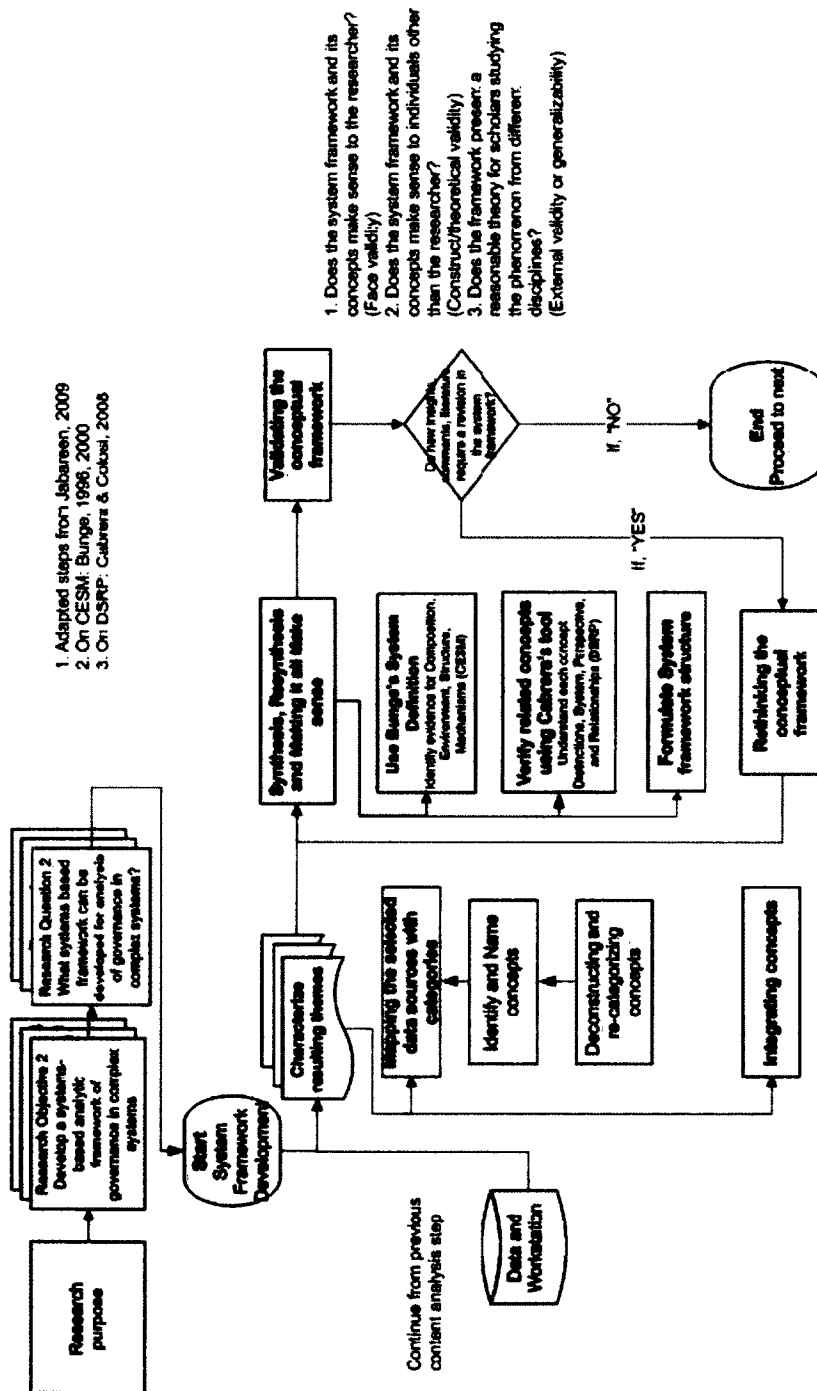# APPENDIX 2. System Framework Development Detailed Research Design

Figure 18. System Framework Development Detailed Research Flow

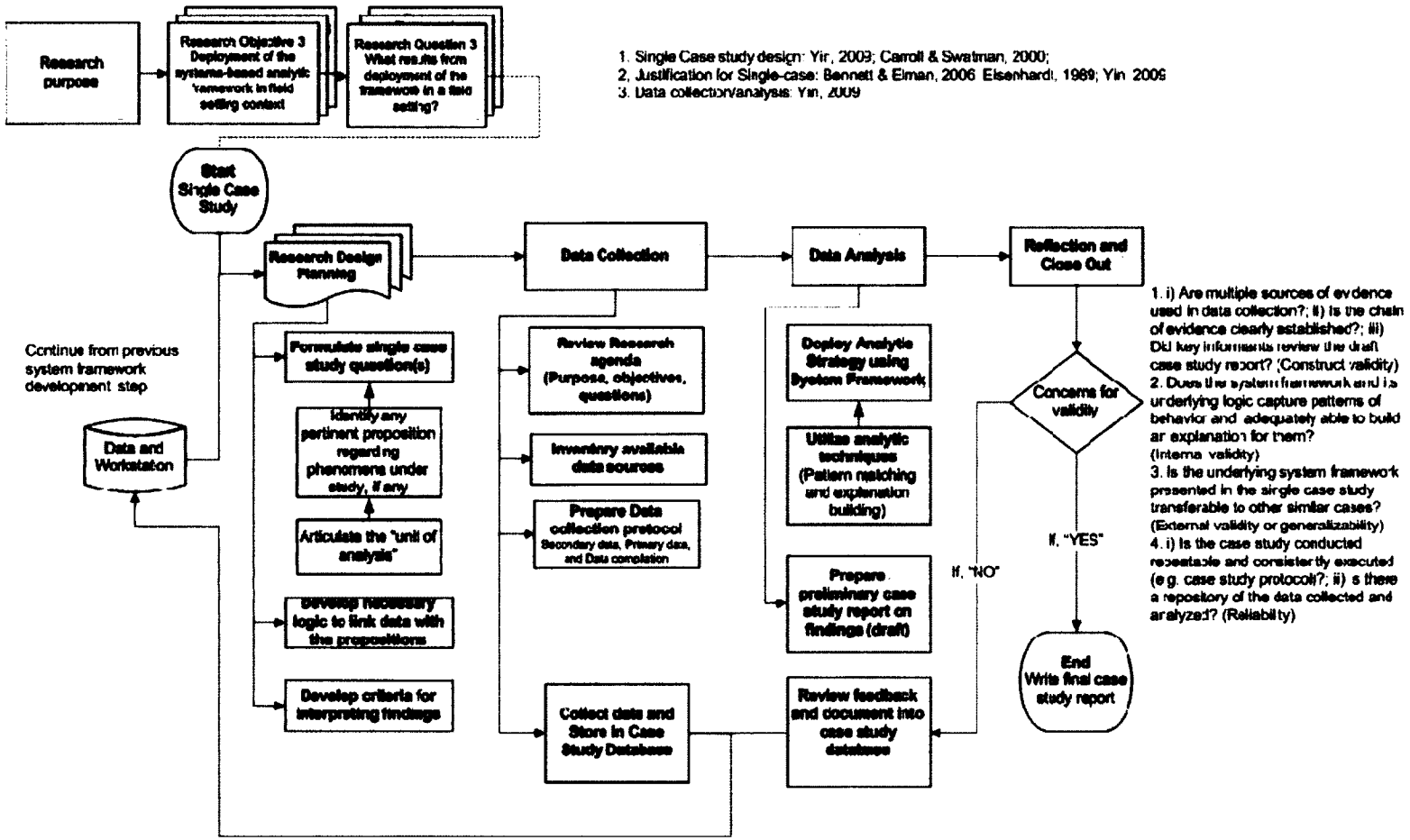Figure 19. Single Case Study Detailed Research Flow
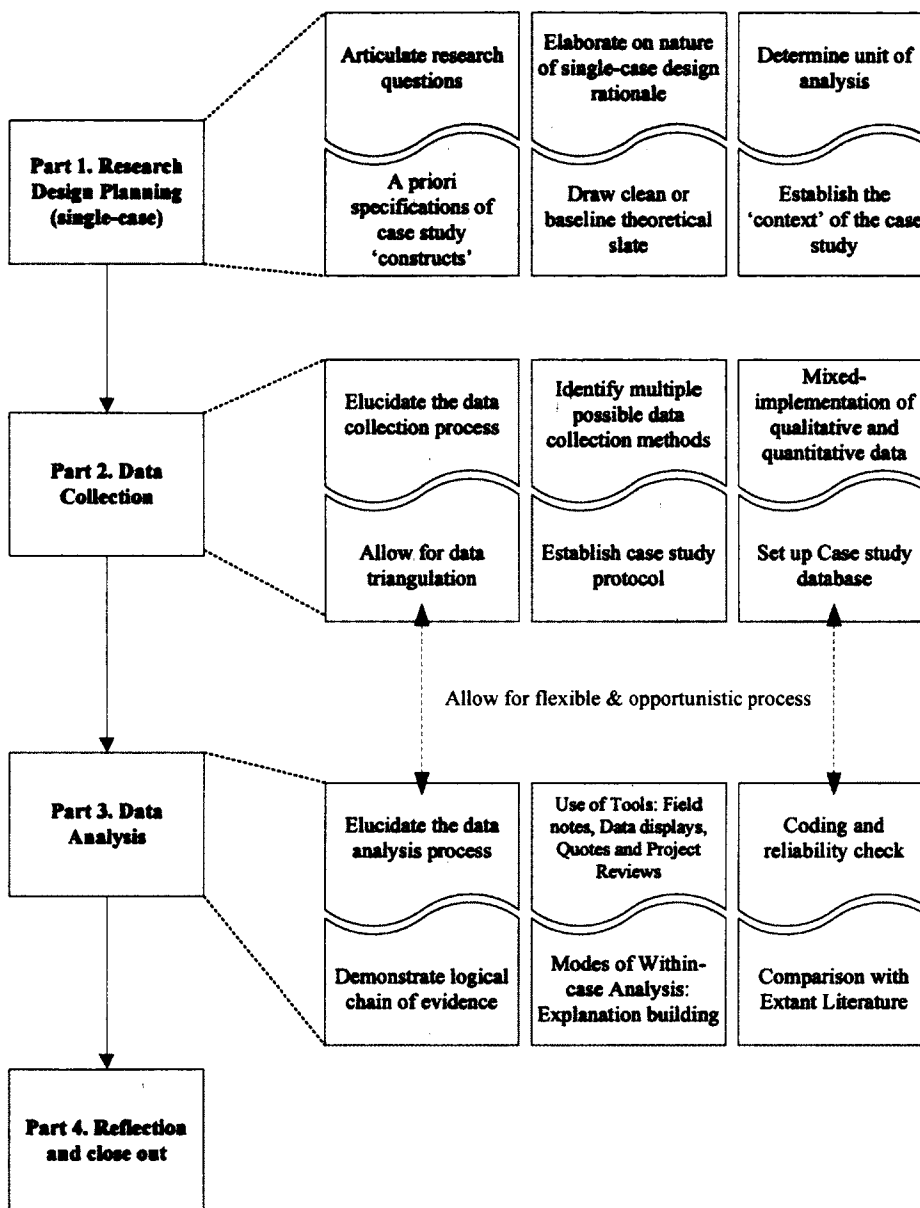
APPENDIX 4. Checklist of Tasks for Single Case Study

| Part 1. Research Design Planning (single-case) | Articulate research questions | Elaborate on nature of single-case design rationale | Determine unit of analysis |
| | A priori specifications of case study 'constructs' | Draw clean or baseline theoretical slate | Establish the 'context' of the case study |

| Part 2. Data Collection | Elucidate the data collection process | Identify multiple possible data collection methods | Mixed-implementation of qualitative and quantitative data |
| | Allow for data triangulation | Establish case study protocol | Set up Case study database |

Allow for flexible & opportunistic process

| Part 3. Data Analysis | Elucidate the data analysis process | Use of Tools: Field notes, Data displays, Quotes and Project Reviews | Coding and reliability check |
| | Demonstrate logical chain of evidence | Modes of Within-case Analysis: Explanation building | Comparison with Extant Literature |

Part 4. Reflection and close out

Figure 20. Single Case Study Task Summary

APPENDIX 5. University-based Entity Case Study Research Protocol

A5.1 Role of Protocol in Guiding the Case Study Investigator

From a methodological perspective, given the diverse set of situations where governance is implemented in practice, there is not one available applicable systems-based framework that can be used and be considered as transferable to various systems context. To the best of our knowledge, the framework development can be used as a 'model' that may be applied to governance in other complex systems. The case study research protocol discussed here will help guide the early stages of application of the deployment of the governance framework (model). Using the research protocol described here will allow the case study research to have the needed rigor in assessing a governance challenge/issue in a field setting. The research protocol will ensure that the case study method will satisfy the acceptable level of "face" validation for research that is largely theoretic-conceptual. This is in particular significant, as the case study method is not predominant in the Engineering Management and Systems Engineering disciplines. This research protocol will help to realize the potential of this study to reveal important implications for practice. Through a successful deployment of a single case study, practitioners responsible for conducting or maintaining 'governance' systems will be able to find utility in using the analytic framework and its associated methodology in enhancing existing or new developments of governance in complex systems.

A5.2 Data Collection Procedures

Names of sites to be visited, including positions of persons interviewed
Please refer to Table 13.

Table 18. Listing of Interview Sites and Contact Persons

Site #	Name of Site to be Visited	Position of Contact Person(s) Interviewed On Site
1	University, Administrative unit	Subject 1 University President
2	University, Finance control unit	Subject 2 Vice President for Administration and Finance
3	System-of-Interest, university-based start-up research venture unit	Subject 3 President and CEO
4	University Business Outreach center	Subject 4 Associate Vice President & Executive Director
5	Enterprise Research Center 1	Subject 5 Director
6	Enterprise Research Center 2	Subject 6 Director
7	City Economic Management Team	Subject 7 Assistant Director/Development Subject 8 Technology
8	Regional Business Interest Advocacy Group	Subject 9 President and CEO Subject 10 Program Director Subject 11 Project Director

A5.3 Data Collection plan

Types of evidence to be expected

As shown in the research design section, there are several different possible sources of case study evidence. While each of these different sources of evidence are potentially useful for these research, only three of these will be used in this research namely (i) interviews, (ii) existing documentation, and (iii) direct or participant observations. However, it must be noted that before a detailed data collection phase, it must be preceded with some preliminary research involving background literature, open-ended interviews and an assessment of research data access.

The first data collection method is through a semi-structured interview. A semi-structured interview technique will be utilized to collect data from individuals who are involved in the 'governance' process within each organization. The role or involvement from a prospective interviewee may vary from someone who is charged with the governance of the partnership arrangement, or to someone who is the recipient of the 'governance', while others have a hybrid of both roles. The people interviewed may include the governance champions or initiators, managers, and staff involved in various governance activities.

The next key source of evidence for this particular single-case study research will consist of historical documentation which had been in existence since the design, development, and even deployment of the governance effort. The documentation may vary from organization to organization (or from department to department) but may include forms of the following:

- Initial planning documents for the governance effort

- Descriptive documentation such as that available on Web sites

- Examples of individual governance agreements

- Internal review documents of the arrangements

- External consultancy reports

- Conference and journal papers describing the arrangements

In the evaluation of each of the documents, care must be taken to recognize the strengths and weaknesses of the various forms of documentation, particularly with respect to any bias. In case studies, one of the most important uses for documentation is to corroborate and augment evidence from other sources to minimize possible bias.

Finally, observations (either direct or participant) are another key source of evidence for this research. Yin (2009) notes that these observations "can range from formal to causal data collection activities (p. 109)." In this study, the observation component is going to be a piece of observation collected that overlaps with data analysis. To aid in later data analysis and possibly support the theory building phase. This is very similar to what Eisenhardt (1989) envisioned for 'field notes' taking, a running commentary to oneself and or the research team. This form of observation is that data analysis frequently overlaps with data collection. Field notes are, as Van Maanen was describing it and cited in Eisenhardt (1989), "an ongoing stream-of-consciousness commentary about what is happening in the research, involving both analysis – preferably separated from one another (p. 539)." What are then useful field notes impressions to take down? As a tentative guideline, this field notes may be impressions of what may seem important, or as a 'thinking piece' that pushes thinking about possible implications to the original research questions. These may be in the form of emergent ideas, "as cross-cutting comparisons, hunches about relationships, anecdotes, informal observations from team meetings" that are taking place in the field.

A5.4 Expected Preparation Prior to Site Visits

Before coming into this stage of the research, preliminary background research in the literature and informal interviews should have honed relevant ideas about the 'How?' and the 'Why?' research questions before embarking on a much more detailed investigation. If the case study is about an organization or group of organizations, what is particularly useful is to collect and analyze easily available literature about them for example, their annual reports, news coverage/marketing material, publicly-available

newsletters and other pertinent ones available from their website. This preliminary research can be complemented with open-ended interviews with 'involved experts'. These experts are individuals that are knowledgeable, easily accessible and safely available for discussion before even deciding that this is the case the research will be focusing on. Based on this exploratory phase, an assessment will be making clear as to how far the level of access is available in pursuing this research case.

The interviews will cover the following topics:

- Organization overview and role of governance

- Historical developments within the governance system

- Existing governance arrangements

- Understanding of the data and data sharing processes

- Operational and resource aspects of the partnership

- Organizational and institutional arrangements

- Barriers and issues (legal, technical, economic, institutional)

A5.5 Outline of Case Study Report

A.   The governance multi-level system of interest

B.   Mechanisms and processes in place or to be developed to enhance innovation

C.   Expected outcomes from the effort, to date

D.   System-of-interest context and history pertaining to the effort

E.   Recommendations to future practice

F.   Exhibits to be developed: chronology of events covering the conceptualization, planning and deployment outcomes of the effort at the specific site; logic model for the practice; multi-level relationship nodal analysis; references to relevant documents; list of persons interviewed

A5.6 Case study Sample Questions

For contextualization step

1. Who influences the design and implementation of 'governance' mechanism?

2. Who authorizes delivery of 'governance outputs' to its intended stakeholders?

3. What are the relevant governance challenges/issues faced by the target organization?

4. How do these authorities relate to its intended stakeholders?

5. What is the target organization's proposition as to how it responds to governance challenges/issues?

6. What are the contextual varieties in the given environment?

7. Where are the different centers of authority/influence/power within the target organization and the key player(s) that has to be involved?

8. In what ways are the target organization's accountability and responsibility structures congruent with its intended purpose and approach in dealing with the governance challenge/issue?

9. Does the target organization have the necessary assets/resources to respond accordingly with anticipated governance challenges/issues?

For analysis step

10. How does the target organization depict its governance strategy? Is it driven from centralized based or decentralized based?

11. How do current in-house processes/structures accommodate needed changes in response to the dynamic environment?

12. Is there an approach previously implemented that can show capability and experience in performing needed organizational and technical change within the organization?

13. How will the organization ensure that the recommended changes once implemented will not be abandoned?
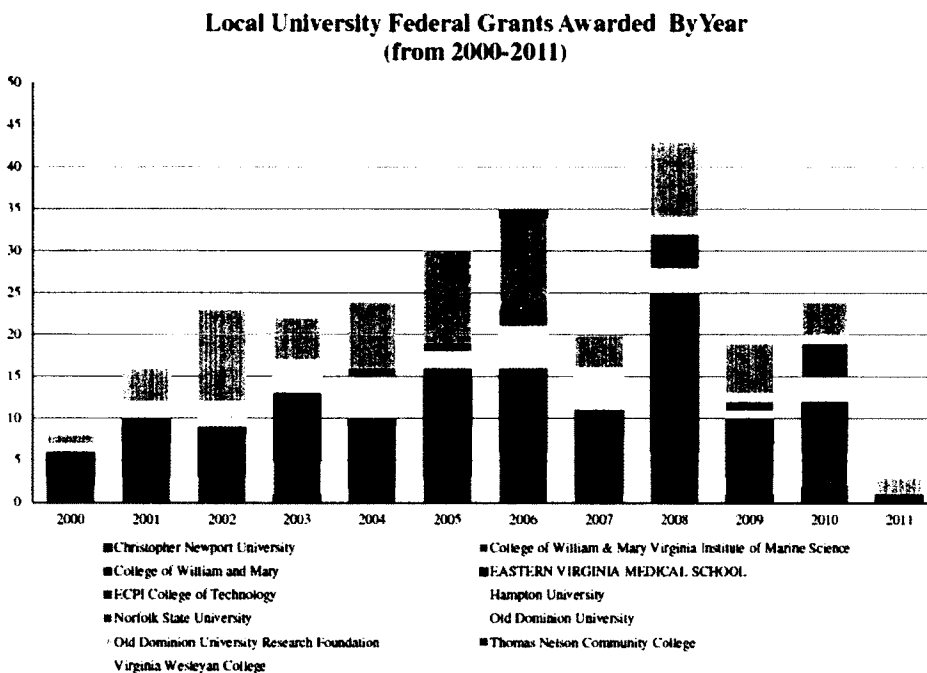
APPENDIX 6. System-of-Interest Regional Context

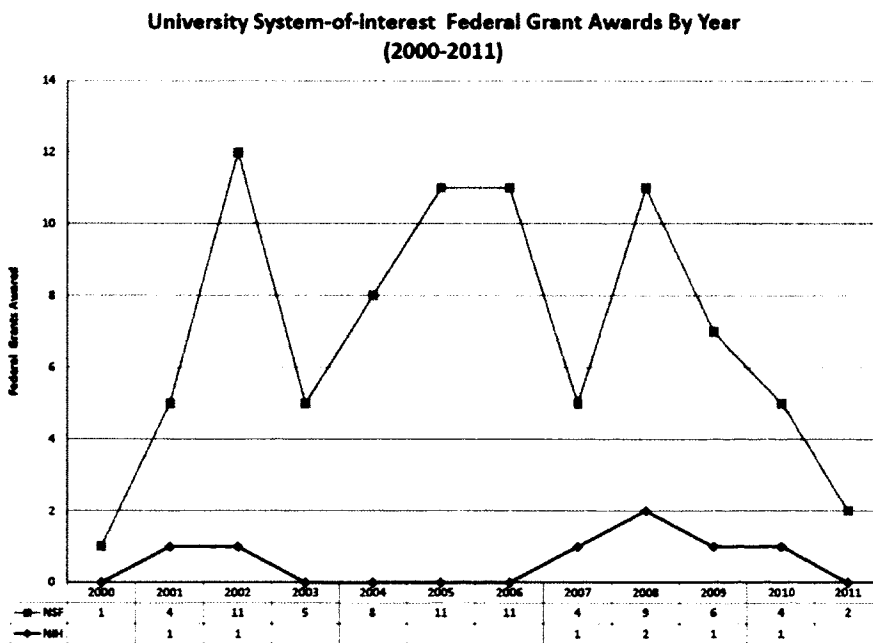**Figure 21. Local University Federal Grants Awarded by Year**

Figure 22. University system-of-interest Federal Grants Awarded Trend

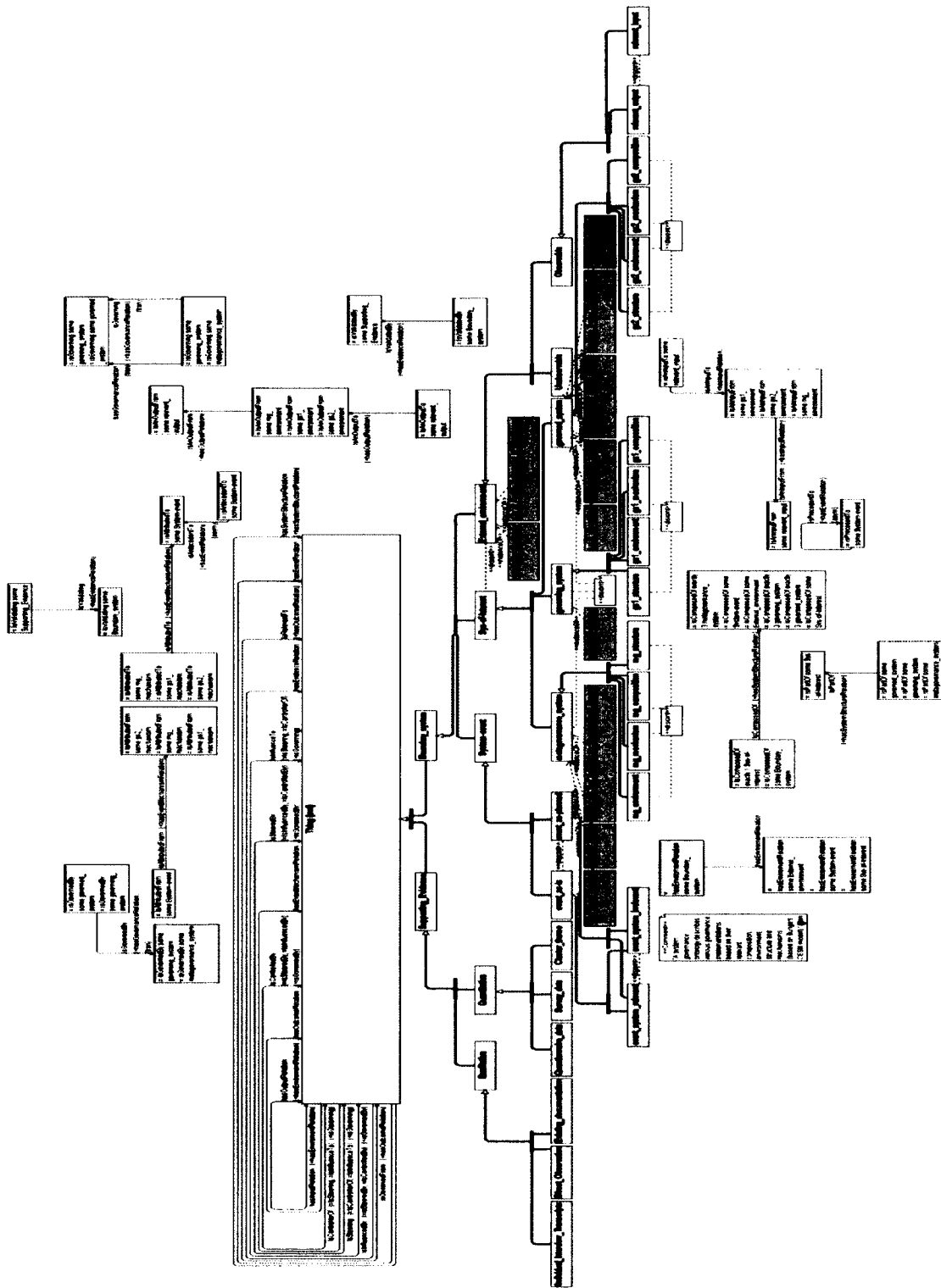# APPENDIX 7. System-of-interest Engineering Blueprint

Figure 23. Engineering "blueprint" (modeled using OWL)

VITA

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Dr. Behnido Calida received his Master of Engineering Management degree from Old Dominion University's Engineering Management and Systems Engineering Department in 2009, and his Bachelor of Science degree in Applied Physics from the University of the Philippines – Diliman, Quezon City in 2000. After some years in the high-tech semiconductor and electronics industry and while pursuing graduate studies, he was a full-time instructor for undergraduate level Introduction to Engineering Management course in live, online and televised mediums for the Engineering Management program.. He was also a Graduate Research Assistant for the department and also for the National Centers for Systems of Systems Engineering, an enterprise research center at Old Dominion University. He has collaborated with several faculty members and also actively engaged in multiple research threads in the areas of system of systems engineering, critical infrastructures, complex adaptive systems, model-based engineering, and system governance. His published work includes a couple of book chapters appearing in a late 2013 Springer book entitled *"Infranomics: Sustainability: Engineering Design and Governance"* as well as a chapter in the ASEM 2010 edited book *"The Engineering Management Handbook."* He has publications in several peer-reviewed journals such as *Int. J. of System of Systems Engineering, Int. J. of Critical Infrastructures, Administrative Theory and Praxis, Annals of Innovation and Entrepreneurship and the Int. J. of Knowledge, Culture and Change Management.*