System Governance

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Abstract This chapter offers a synopsis mapping of the recent and significant advances in the research of *systems* and *governance* concepts; highlighting any conceptual synergies of one to the other, and altogether strengthening any other obvious emergent themes resulting from the confluence of ideas across several disciplinary fields and/or problem domains. This synthesis is designed to establish the current state of the field, to provide a scholarly critique of the literature and to present relevant research gaps in need of further exploration, elaboration, or confirmation. An additional goal of this chapter was to establish the position and fit of the current research within the larger body of knowledge for which it will become an original contribution.

Keywords Complex systems · Governance · Systems theory · Systems thinking

1 Introduction

The present chapter highlights the state-of-the-art research and practice involving both systems and governance concepts. There are three primary objectives of this review. First, a synthesis of the literature related to system governance is designed to establish the current state of the field. Particular attention was given to works that feature 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 overarching goal for these primary objectives 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. 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

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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 Generating Science Overlay Maps

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 established a coarse research context (mainly by setting main disciplinary and seminal works sources) which was then used to narrow down previous works that were deemed to be relevant to this research.

Using a science overlay map [19, 73], a visual interdisciplinary knowledge domain representation of the resulting search records can be visualized like those shown in Fig. 1 thru 3 below. These representations provided "simple and quick" visualizations of the disciplinary diversity of governance-related research context without the need for sophisticated combined indices.

The below mappings 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 has 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.

For instance, as one interpretation from the set of retrieved data, a cognitive knowledge space mapping of mainstream "governance" research is predominantly contextualized from specific disciplines. There were also dispersed weak accounts of "governance" research that are 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,

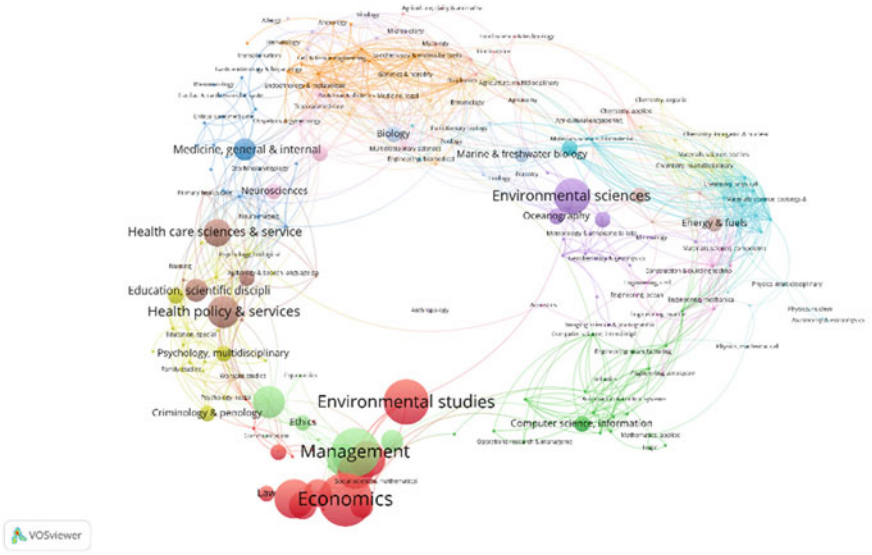

Fig. 1 A science overlay map of governance-related research: Year 2000 and prior years

and ontological) orientations and methodological choices that were inherent in the domain under which different strands of governance research were explored. We have partitioned our observations across primarily three epochs.

2.1 Prior to 2000

Figure 1 shows a glimpse of "system governance" research from prior years up to the year 2000. A high-level assessment of the diversity of research for system governance from research work up to year 2000 can be seen as already active research 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, management (highly dense disciplinary nodes in mentioned areas as an indicator of low disparity), political science, and regional urban planning. From an engineering management and systems engineering standpoint, quantifiable research on systems governance was practically nonexistent, if not limited to concepts associated with computer and information science fields.

2.2 2001 Thru 2010

Next, Fig. 2 shows a glimpse of "system governance" research from 2001 thru 2010. There was even more diversity of research for system governance continuing from the momentum from the same singular disciplines. There are arguably more varieties of problem contexts. Research interest purporting "system governance" sees increasing focus in the mainstream economics, management, and political science disciplines. However, related disciplines and domains of practice like public administration, environmental studies/sciences, geography, and international relations have also caught on to the suitability of these concepts. There is also a sense that problems getting tackled as the purview of "system governance" encompass slightly more expansive in scope typical of "complex" problem domains that start to involve more than just one discipline like in ecology, laws, urban planning, water resource management, health policies, and public environment occupational health to mention a few. Albeit an indicator of things to come, more and more researchers are investigating research theories and frameworks that are increasingly useful research constructs beyond their own disciplines. There is cross-cultivation of ideas, and we find similar concepts and theories getting explored as alternative approaches to new problem domains. Even still focusing on the engineering practice field, quantifiable research on systems governance have slowly started to gain traction.

Figure 3 brings us to the current snapshot and state of "system governance" research from 2011 thru 2021. If anything, there is a lot more research activity that are more multidisciplinary in nature. Problem domains are no longer tackled within the

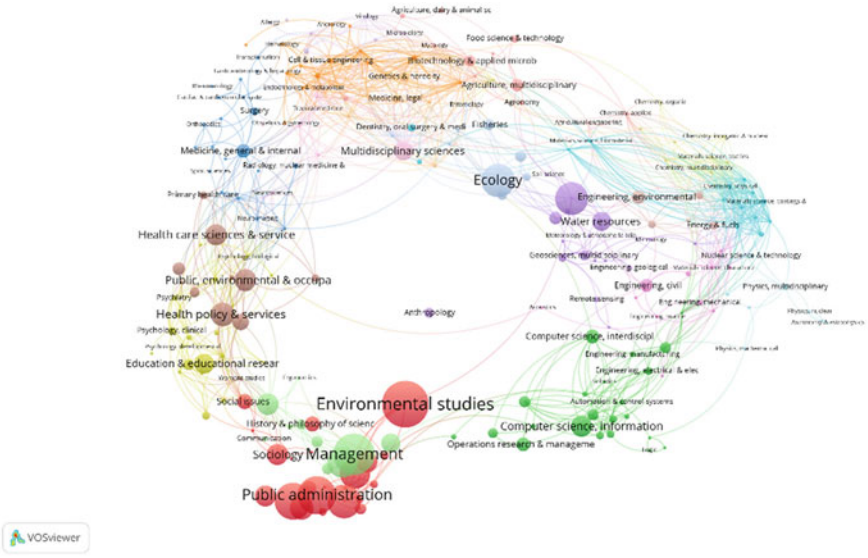

Fig. 2 A science overlay map of governance-related research: Year 2001 thru 2010

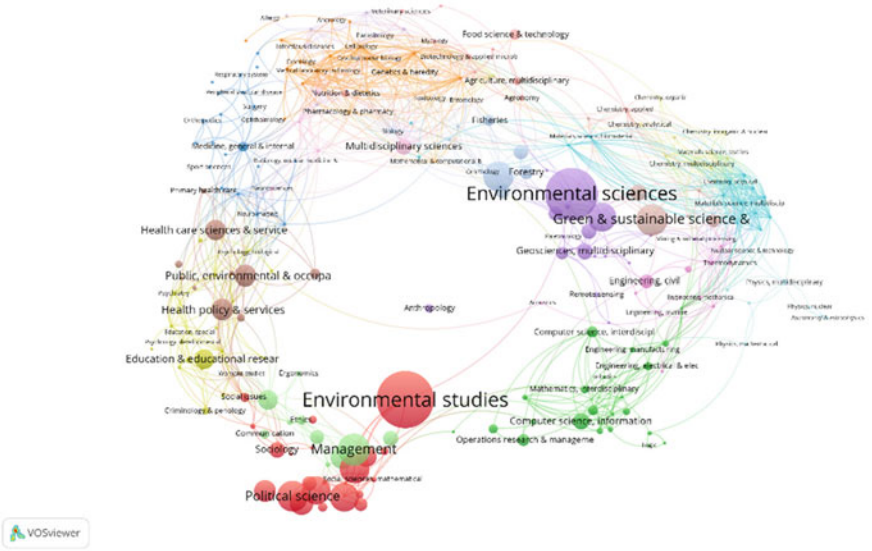

Fig. 3 A science overlay map of governance-related research: Year 2011 thru 2021

confines of a single discipline. Instead, we can easily pick out research that supports solutions originating from more multidisciplinary approaches. For example, during this past decade, where communities and cities are increasingly sounding the alarm if not directly feeling the effect of climate change, large research initiatives spanning multiple disciplines, countries, and expertise are leveraged altogether to address the systemic roots of the problem.

2.3 2011 Thru 2021

This resulted in the sudden emergence of sustainability, green technologies, environmental engineering, ethics, resiliency building, and various risk mitigating approaches to the forefront of the climate change challenge. Also, coincidentally, the contributions from engineering practice are slowly becoming more relevant to this problem domain.

To demonstrate further, 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 Fig. 4 resulted in several informative articles. However, one can easily cast doubt concerning their cross-concept consistencies, more specifically on the development of the concepts

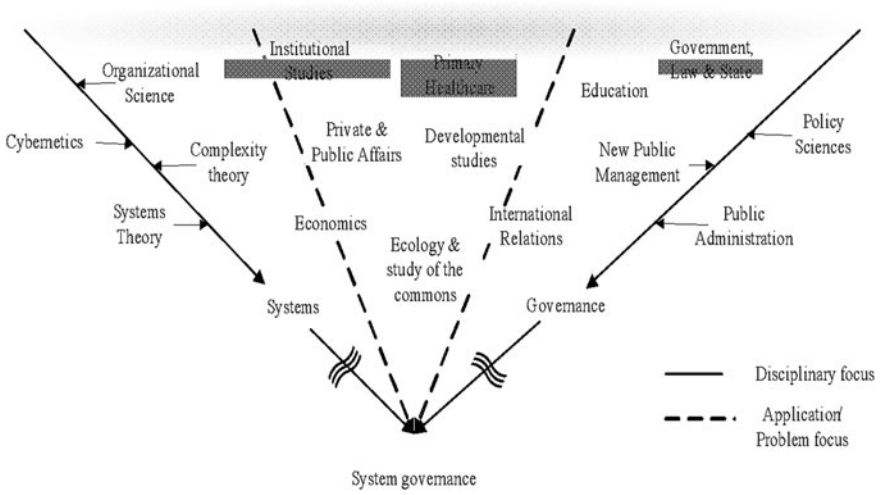

Fig. 4 Multidisciplinary evolution of "system governance" concepts

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.

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 were closely followed by the state of the literature for governance research mostly from more predominantly "governance" focused disciplines.

3 System Philosophy Highlights

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 has grown in prominence over the years since Von Bertalanffy [6] first posited his theory on open systems that became the basis of the renowned general systems theory or simply GST [11]. Resulting from these seminal works, the body of knowledge or BoK has been enriched by several closely woven

research threads in complex systems [5, 48, 79], systems analysis [22, 37], second-order cybernetics [87], system dynamics [28, 78], soft systems methodology [21], critical systems thinking [40, 41, 85], systems architecting [65], systems engineering [34], and systems of systems [1, 42, 50, 51]. 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 [70, 89]. 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 [21], 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 [20] 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, manmade structures, and several possible social interactions. Based on this premise, an alternate philosophy is being argued that would consider the possibility of considering the absence of laws and of operational forms of key concepts in the social sciences [70].

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 [18] 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 unanalyzed wholes, systems 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 [18].

Having recognized that both macro- and micro- entities and their processes are at best partial contributors toward complete understanding, systems require 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 closely follows Bunge's 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.

Fig. 5 Systemic research paradigm

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 Fig. 5, these may fall under the following several classes: (i) epistemological, (ii) ontological, (iii) methodological, (iv) axiological, and (v) ethical.

By epistemological, these refer to the starting assumptions of knowledge, or in this case the manner in which "system governance" constructs are 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 [45] 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 prediction become an important part of the behavior aspect. These provide an important consideration for systemic research where Johannessen and Olaisen [45, 46] 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 [45].

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, it 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 considered? 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 because 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, the methodology helps to maintain the interconnections, both in terms of concrete things, ideas, and knowledge of the problems or phenomena 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 [33] suggest 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" [17]. Johannessen and Olaisen [46] further added that a systemic approach must reasonably always include actors, observers, and social systems. The methodology should investigate the mental model 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, and society). Thinking in terms of systems, this unit of analysis should be viewed considering 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 has 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' [46]. 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 deal, 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 [2] succinctly summarized these tenets among many others. These systems tenets are discussed below to draw out some underlying system foundations 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 toward 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 view systems as a function of their composition, environment, and structure, with the appreciation of the necessary linkages or mechanisms that specify their 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 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 other cases may be "global" because 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 to the other key concepts on governance.

4 Governance Highlights

Like 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.

4.1 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" [88]. Walters further adds that beyond mere asymmetry of concepts and practice, the problem is 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 was 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 [56]. Rosenau [76] 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 is not 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 [86] 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 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 1).

Tables 2 and 3 provide many more perspectives on the streams of governance one may encounter when examining the literature. Underlying these notions of governance, one may ponder what ideas or concepts reinforce each notion.

Vignette Water and Governance?

*At first glance, the terms water and governance may seem incompatible. However, the terms 'water governance' convey the political, social, economic, and administrative systems in place that influence water use and management. Essentially, it refers to who gets what water, when and how, and who has the right to water and related services and their benefits. It determines the equity and efficiency in water resource and services allocation and distribution and balances water use between socio-economic activities and ecosystems. Governing water includes formulating, establishing, and implementing water policies, legislation, and institutions and clarifying the roles and responsibilities of government, civil society, and the private sector concerning water resources and services. The outcomes depend on how the stakeholders act concerning the rules and roles that have been taken or assigned to them. The water sector is a part of broader social, political, and economic developments and is thus also affected by decisions by actors outside of the water sector (*https://www.watergovernance.org/governance/*what-is-water-governance/).*

4.2 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,

Table 1 Survey of "governance" from discipline and practice

Type	Definition/Description	Sources
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."	[3]
	"Social turbulence kept within bounds, and change steered in desired directions… preserves order and continuity, but not necessarily the maintenance of the status quo."	[25]
	"…the totality of conceptual ideas about these interactions" (these in relation to the act of governing)	[58]
Structure-centric	"…the activity of coordinating communications in order to achieve collective goals through collaboration."	[93]
	"…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."	[44]
Hybrid	"…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."	[75]
	"…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."	[13]
Restrictive corporate governance	"…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."	[64]
	"…the ways in which stakeholders interact with each other in order to influence the outcomes of public policies."	[10]
New public management	"…the processes and institutions, both formal and informal, that guide and restrain the collective activities of a group."	[53]

(continued)

Table 1 (continued)

Type	Definition/Description	Sources
Public policy	"…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."	[52]
International security	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	[60]
Social and political	"…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."	[57]

Table 2 Core usages (Part 1): Governance "IS"

Governance "IS"	References
The act, process, or power of governing; government: The state of being governed	[32]
The activity of coordinating communications in order to achieve collective goals through collaboration	[93]
Mainly concerned with creating conditions for ordered rule and collective action	[82]
Stewardship of formal and informal political rules. Rules refer to measures that involve setting the rules for the exercise of power and settling conflicts over such rules	[39]
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	[53]
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	[59]

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 [16] 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 [68] 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 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

Table 3 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

like those by [14] for international relations, environmental development [27, 38] as well as primary clinical practice [83].

While there is a distinct set of literature constructs that mainly report on governance challenges in practice (see for instance [9, 61, 84]), 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.

4.3 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 are also several 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 [74] enumerates several diverse usages of governance as given in Table 3.

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 which is collected and the corresponding interpretations of that evidence. Kersbergen and Waarden [54] 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 consider that empirical data reflects 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 [64].

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 from a specific level with the involvement of users, approving bodies, sponsors, etc. [31, 36, 80, 91], mode—in terms of economic firms or assets, public, or private markets [24, 26, 35, 59], 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 [59]. Like Kooiman and Jentoft [59], 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. [15] and Garcia-Meca and Sanchez-Ballesta [29]. 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.

5 Synthesis of Themes for System 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 [55]. Under the paradoxical reality of globalization and devolution, terms used to refer to 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 this research has highlighted.

5.1 Need for a Systems Perspective

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 help in resolving the practical difficulties in theorizing about governance. Keating [50], like Baldwin et al. [4], 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 [63] 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 [50]. 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 accounts of governance, the main argument in this work is toward 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.

5.2 Diverse Notions of 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" [47, 56]. 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 [58, 71, 82]. 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 toward 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. 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 [67], urban culture [69], knowledge [81], enterprise information systems [66], networks [72], resilience and vulnerability [30] 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 toward correct "governance" will progress toward 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 [62]. There are of course several available ways to reveal the state of a system by way of systematic classifications or typologies [1, 11, 12, 79, 90]. 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 to comprehensively allow the system to accomplish their purpose.

5.3 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 is 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 collapses 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 of 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, and standards through a complex interaction between public, private, and government sectors [93]. 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 [92]. This shows that no matter which assumption is held, governance is perceived sometimes as a solution and sometimes as the problem.

5.4 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 [77]. It is not the intent of this work 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.

6 Critique of the Literature

The 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.

6.1 Need to Address Conceptual Ambiguities

Jessop [43] 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 has "precursors of the current interest in governance in various disciplines" (p. 31). These precursors call out a distinct set of assumptions, models, and theories that bring about a concept of governance characterized by *heterarchy*, understood as 'self-organization across different levels. Walters [88] 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*.

6.2 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 the following vignette.

Criteria set for 'theorizing' on system governance

We suggest that governance should be seen through the lens of ***ontology****, where concerns of scope and simplicity (e.g., parsimony) address the principal question of "What can be said to exist?". It should also focus on the* ***theoretical*** *implications that embody a degree of testability given presented evidence and conservatism when compared with other related theories. It needs to be* ***pragmatic*** *through the judgment of a posited theory by its usefulness. Finally, offer* ***axiological*** *implications, where the suggested theory tracks the "truth" based on some measure of value, worth, and quality.*

An *ontological* criterion, 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 at 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, and 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. One such exemplar articulation is a growing body of knowledge related to complex system governance (CSG) that supports the view of governance from the perspective of cybernetics and systems theory. [49] suggest an evolved definition of CSG as the "Design, execution, and evolution of the [nine] metasystem functions necessary to provide control, communication, coordination, and integration of a complex system.". A quick reframing of this definition aligns the notion of a "metasystem" as an appropriate focus and analytic resolution for its ontological and theoretical basis. As part of its metasystem construct, we are presented a set of nine interrelated functions that each focus on different aspects of the performance of a system, including (i) policy and identity, (ii) system context, (iii) strategic system monitoring, (iv) system development, (v) learning and transformation, (vi) environmental scanning, (vii) system operations, (viii) operational performance, and (ix) information and communications. With these nine functions, there are now pathways to a more pragmatic as well as an axiological grounded framework toward a purposeful, "holistic" and comprehensive approach when addressing problems pertaining to the design, execution, and evolution to sustain and evolve system performance. In CSG, it becomes evident that while systems may be different (e.g., operational, tactical, managerial), there can be a great degree of interconnectedness tied together by the meta-aspects of the system. Once again, the metasystem idea highlights consideration of the whole, including interactions, complexity, emergence, and ambiguity traversing the boundaries within and external to a single system.

In practice, systems and the analysis of any governing capacity can benefit from insights drawn from systems principles and the perspective they invoke as in the CSG framework. The CSG framework draws from system principles like emergence, holism, and complementarity that forms a basis of a language to inform governance thinking from a systems theoretic perspective. To fully design an existing system, geared toward system performance, it is crucial to recognize that governance encompasses both the control and informational linkages of the system. These linkages originate across different metasystem functions of governance and involve various implementing practitioners tasked with executing the purpose of the system. In addition, these interactions, and in turn their input/output exchange relationships, exist within the contextual environment. The governance challenge recognizes that inevitably practitioners face the difficulties of dealing with systems, events, and contexts that cannot be fully grasped. Rightfully so, the concern needs to shift instead to how best to implement governance while representing the "true" situation building on advances in our toolkit of frameworks, theories, concepts, and methods.

7 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 [7, 10]. 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" [8]. 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 [23, 54]. 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 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.

8 Exercises

The following exercises provide an opportunity to examine the concepts presented in this chapter through several questions.

1. Imagine the 2021 wildfires in the West Coast that affected families, communities, threatening livelihoods, and entire economies as our "hypothetical" problem context. Find out the definition of a *system* that is relevant to this context. Write up (i) the specific system purpose, (ii) the system boundaries, and (iii) the system(s) elements as well as interrelationships that are meaningful for such a *system*.
2. With the same problem context laid out in the previous question, what does *governance* look like from the perspective of (i) the homeowners, (ii) the insurance industry, (iii) the local and state leadership?

3. Give an example of a system and discuss how management is the same/ or differs from governance.

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