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Three Constructs of Systems Thinking for Better Governing a Globalized World in the Anthropocene†

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<Abstract>

Living in a globalized society implies that political thinking necessarily extends beyond the national level to reach us in our roles as citizens of the world. Living in today's globalized society also requires a new level of political thinking commensurate with the complexity of its challenges. To overcome the many difficulties we, and the planet we live on, face in the Anthropocene era, It is more important for humans to act as systematic thoughts. This paper will examine how general systemic thinking, critical systems thinking, and whole healing systems thinking can help us both comprehend and overcome these challenges.

[Keywords] *Global citizen, cosmopolitanism, globalization, Anthropocene, Earth System, systems theory*

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인류세 시대의 세계화된 사회를 보다 잘 관리하기 위한 시스템적 사고 모색

심연수

<국문요약>

세계화 된 사회에서 살아가는 것은 정치적 사고가 필연적으로 국가 차원을 넘어서서 세계 시민으로서 인류 각자의 역할에 도달한다는 것을 의미한다. 오늘날의 세계화 된 사회에서 생활하려면 도전 과제의 복잡성에 비례하여 새로운 차원의 정치적 사고가 필요하다. 인류가 인류세(Anthropocene)시대에 많은 어려움을 극복하고 살아가기 위해서는 인간 사고와 행동에 있어서 견인적인 시스템 사고를 실천하는 것이 필수적이다. 일반체계이론적 사고(general systemic thinking), 비판체계적 사고(critical systems thinking) 및 전체론적 치유 시스템 사고(whole healing systems thinking)는 인류가 처한 어려움을 어떻게 이해하고 극복하는 데 도움이 되는지를 검토하였다.

[주제어] *세계 시민, 세계시민주의, 세계화, 인류세, 지구 시스템, 시스템 이론*

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I. Introduction

As one observer (Senior 2017) has pithily expressed the hard, bitter truth facing humanity in the twenty-first century, Political time now lags behind geological time.

Geological time assumed an unwonted urgency with the recent conceptualization of a new stratigraphic epoch, the Anthropocene. In Paul Crutzen's (2002) view, Since the 18th century, the use of human fossil fuels has led to the era of the Anthropocene epoch with the increasing use of CO2 and methane. Human exploitation of earth resources has seriously affected the function of the earth itself (Lvbrand, Stripple, and Wiman 2009).

Crutzen and Will Steffen (2003) argued that dysfunctional activities in human sustainable ecosystems have transcended nature's natural ability to correct (Lvbrand, Stripple, and Wiman 2009). Humans now have the capacity to alter the Earth System in ways that threaten the very processes and components, both biotic and abiotic, upon which humans depend (Dalby 2004, 2).

As social and ecological systems around the world are becoming increasingly globalized, Anthropocene thinking requires that we merge the contemporary discussions of global change and globalization into one dialogue. Systems scientists studying globalization are worried about the dysfunctional global ecosystem that globalization brings (Dalby 2009).

Human actions on so significant a scale and extent that we can be said to live in a new geological period, the Anthropocene, require us to rethink our assumptions of living within an external environment. We need to understand the complex, multiple-scale feedbacks, critical thresholds, and abrupt changes across a staggeringly wide range of temporal and spatial variable characterizing Earth System dynamics. As a consequence Earth System discourse is concerned with non-linearity, the existence of bifurcations, flips between multiple unstable equilibriums, and physically chaotic behavior (Wiman 1991). Such an analysis also suggests the continued importance of critique as an intellectual practice in the academy (Dalby 2007, 103). To take one example, sustainability cannot exist without justice, and justice cannot exist without equity (LeVasseur 2014).

Above all, we must recognize that in the age of Anthropocene, mankind is fueling fossil fuels and posing a threat to human identity. Globalization reverberates throughout global society. It has, for example, also involved the expansion of urban spaces where most of humanity now live. People need to work together to maintain a global ecosystem of unstable security situations caused by environmental changes (Brauch et al. 2008; Dalby 2013).

Even if in different disciplines the concept of globalization has different nuances and even definitions, with some scholars studying globalization as the dominant ideology of this age, I would like to refer to the conceptualization of globalization by Chiu and

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Duit (2011) as the processes of global (i.e., worldwide) distribution of ideas and goods, most significantly with regard to scientific, technological, economic and cultural products and developments (cf. Gray and Colucci-Gray 2014, 18). The humanities, social sciences, and natural sciences need to cooperate to understand the drivers and barriers within societal organizations and human behavior, as well as the role of cultures in supporting the resilience capability of the Earth System.

Now we must have a responsibility and a sense of responsibility as a co-owner of the whole earth and act systematically. If we reconsider the implications of geopolitics, the conditions of international cooperation are gradually changing. Today's humans need to look at security from a sustainable ecological perspective, not from war (Dalby 2009; Dalby 2013).

Cooperation with the international community is becoming commonplace in response to global disasters. Despite the fact that many countries are still very suspicious of the principles of humanitarian intervention and protection obligations for disasters, it is desirable that human beings are cooperating and willing to cooperate (Dalby 2009; Renner and Chafe 2007).

Jürgen Habermas has differentiated the concepts of system and lifeworld. The most fundamental connection between the two realms relates to the process of rationalization. Lifeworlds are connected to systems via rationalization, a process that joins the two together (Lloyd-Jones 2004). As a corollary, in this paper I would like to explore the differences and interactions between system theory and the real-life world in creating the contemporary crisis and offering a way out of it.

My primary focus will be on how political life in the world should play out in the cosmopolitan era. Due to climate change within the Anthropocene era, a new conceptualization of political citizenship is required. To achieve it, I want to explore how systems thinking can be applied to effectuate the needed changes. The main questions addressed in this paper are: a) How does the parametric paradigm of politics change in a globalized society? b) How can we manage to control the activities and interactions of what I will argue are the three levels of political life in a globalized society? c) What kind of thought and practice must we engage in to restore the only planet we live on? d) What is the proper management methodology to insure the sustainability of the Earth System?

II. A Paradigm Shift: Globalized Earth System Politics

The Earth System is a coupled human and ecological system incorporating basic feedbacks between human society and the global environment. Biermann (2007, 4) defines Earth System Governance as the sum of all the systems of human society that affect the evolution of human and natural

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systems for ensuring the sustainable development of human society. Biermann (2007) notes that Earth System governance involves a myriad of public and non-state actors at all levels of decision-making.

The assumptions underlying three aspects of contemporary global politics on the grandest scale are subject to critique here: the War on Terror, globalization and the notion of what constitutes the environment. The global War on Terror can be treated briefly as it is not really global, and might well be better understood by using imperial analogies from the past. The definition of the environment, we find, shifts once we recognize that globalization manifests itself in the centrality of crowded metropolises in a process of glurbanization.

But what exactly is globalization? Globalization has created a complex interdependence relationship that integrates economic, cultural, technological and governance across borders. Each country is experiencing the complexity of identity.

Historically cultural memories of symbolism and national identity based on economic, legal and political rights have transcended nationalism. But cosmopolitans can be understood as those who identity with a broader cosmos than either form of nationalism, sometimes with a continent, or with the world as a whole. They consequently have greater faith in the institutions of transnational governance.

Here, the global citizen should be free from the protection of the economic barriers of his country, and on the other hand, take stronger environmental control measures and pay more attention to foreign aid. Cosmopolitans can be expected to be comfortable living and working in different countries, familiar with travel well beyond their national boundaries, and fluent in languages, as well as well connected to international networks through global communications (Norris 2000).

Although scholars have suggested a range from two to six levels at which world politics can be analyzed, the most widely chosen scheme utilizes three levels of activity and engagement based on Kenneth Waltz's use of three images in 1959 to analyze the causes of war (Rourke and Boyer 1996,18). We can conceptually differentiate these three levels from one another, but we also tend to mix them up in practice in global political activity.

- First, as global citizens we may act at the global system level, with our activities drawing attention at the system level by political analysts. This level presupposes that the world's social-economic-political structure and pattern of interaction (the international system) strongly influence the policies of states and other international actors (Rourke and Boyer 1996, 19). In other words, the political life in this level is strongly influenced by the powerful social-economic-political structure and

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its patterns of interaction.

- Second, we may act within the characteristic patterns of an individual country; the impact of those traits will affect the country's behavior in state-level politics among nations. Analysts can also elucidate the characteristics of political actors at this level. Because states are the key international actors at this level, we may act through the institutions sanctioned by the constitution of our sovereign state.
- Third, we can act and make decisions at a personal individual level. At this level, understanding how people make choices can help us understand how international politics operate (Rourke and Boyer 1996, 18).

The most familiar definition of politics was provided by David Easton in his identification of the political system with the authoritative allocation of values for a society (Easton 1971, 129-133). Extending the meaning of Easton's analysis on a wider scale, we can define global politics as the authoritative allocation of values for a global society. As many forms of political competition exist in the international community as in an anarchic Hobbesian society. The actors of the international community are often left with limited resources, and must compete in accordance with ground rules set by their already successful rivals.

At this point we need to match the traditional conception of international politics with global politics as its reorganizes within a transformed nationalist-cosmopolitan dimension. Many of the time-honored traditional boundaries are frayed or missing entirely. To take one prominent political issue of the day, social inequality should be analyzed through the perspective of new cosmopolitan community societies because the world is becoming ever more networked and interconnected. Territorial, state, economic, social and cultural borders still exist, but they no longer coincide (Beck 2012, 302).

Most textbooks about international politics have dealt with globalized politics as its plays out under the nationalism-cosmopolitan dimension. Scholars have suggested many approaches to the study of international politics since the Cold War, including realism, a society of states, the pluralist-interdependence model, the dependency model, and the world society model (Holsti 1995, 5-16). In this context, as William Shakespeare already mentioned, the world is a stage and we are all players in the age of globalization. But this means that the roles they play must change as the world stage changes. The interplay of contemporary international relations stems primarily from the world's political, economic, and social fragmentation (Rourke and Boyer 1996, 2).

This fragmentation problematizes all categories of political thought and activity, not least the concept of citizenship. According to the Stanford Encyclopedia of Philosophy, a

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citizen is described as a member who has duties and rights in the political community. Since the early 1990s, citizenship has been examined in terms of the need to acknowledge the diversity of modern liberal democracy and the pressure on the globalization of sovereign states (Citizens, Resident Aliens, and Rights 2011). The Encyclopedia notes that the main dimensions of citizenship (legal, political, and personal and group identity) can be instantiated in very different ways within the three dominant models shaping views of the concept: the republican, the liberal and cosmopolitanism (Citizenship and Borders 2011).

Global politicians should pursue the authoritative allocation of values for a global society, especially in the area most crucial for most global citizens, the principle of global justice. Global citizens must form values and attitudes to live in a society. Citizens of the world need to learn freedom and democratic values and attitudes for a politically better society and to live from a world citizen perspective (Voegelin 2003, 227).

III. Systems Thinking and Global Complexity

In confronting fragmentation and the interaction of rapidly changing roles, systems thinking provides tools for dealing with complexity. It allows us to track and examine a myriad of nonlinear relationships, feedback loops, hierarchies, emergent properties and so on, even after critical systems thinking (see below) has problematized the issue of boundaries and analyzed their consequences for inclusion, exclusion and marginalization (Bammer 2003; Midgley 2000).

Peter B. Checkland (1985, 31) explains that system thinking is founded upon two pairs of ideas: those of emergence and hierarchy, and communication and control. Systems thinking is a way of thinking that explores and exploits the componential, relational, contextual, and dynamic components of interest within a system (Davidz and Nightingale 2008). At the same time that a hierarchy emerges among the components of the system, mutual relationships develop across them. In this context we can present systems thinking as a pair of concepts: systematic and systemic. Systematic thinking means using a method, or following a plan or an explicit and rational procedure. Systemic thinking means using systems ideas and treating things as systems or from a systems point of view (Shim 2015).

From either perspective, the crucial first step must be to visualize and apply the properties of systems thinking. Ross D. Arnold and Jon P. Wade said that systems thinking can be used in a variety of educational settings. Their definition was derived from a review of the systems thinking literature combined with the application of systems thinking to itself (Arnold and Wade 2015, 676-677). After synthesizing definitions in the current literature, primarily those

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offered in Booth Sweeney and Sterman (2000), Hopper and Stave (2008), and Plate and Monroe (2014), Arnold and Wade suggest that their principal deviations from the existing literature consist of two elements: Reducing Complexity by Modeling Systems Conceptually, and Identifying and Understanding Non-Linear Relationships.

Their definition is conveniently summarized in the systemigram depicted in Figure 1, in which thick lines illustrate strong connections, while thin dotted lines explain weaker, but still important, connections. As systemigram shows, Systems Thinking's system operates as a series of continuous feedback loops.

Arnold and Wade insist that the system does not cease to function at the final node; rather, as each of the elements improves.

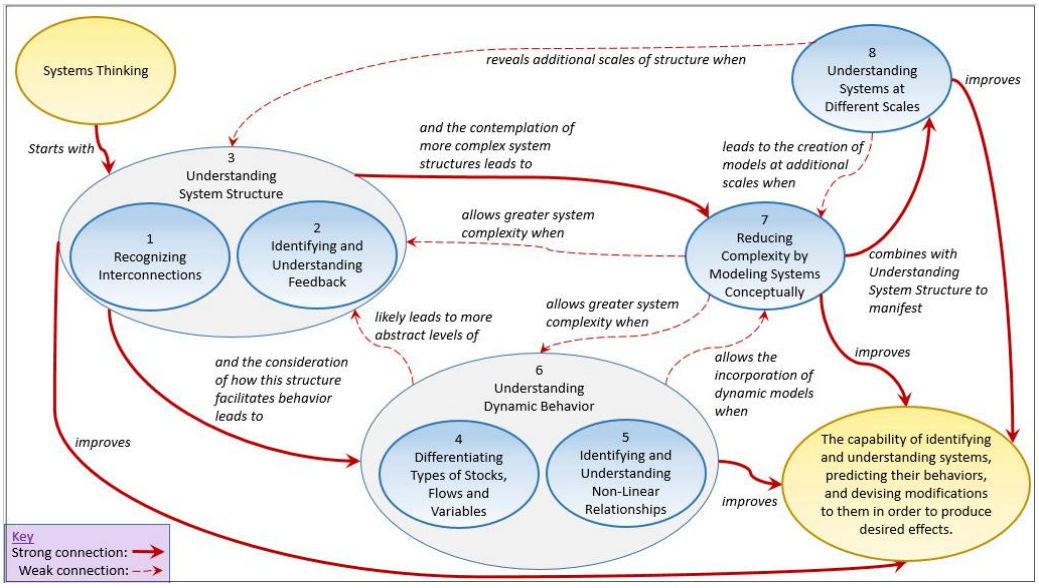

Figure 1 Systems Thinking Systemigram (Arnold and Wade 2015, 676)

Following are descriptions of each of the elements in their presentation.

First, Arnold and Wade assert that Recognizing Interconnections is the base level of systems thinking. The skill of recognizing Interconnections involves the ability to identify key connections between parts of a system. Even adults with higher education without systems thinking are generally known to lack this ability (Plate and Monroe 2014).

Second, Arnold and Wade note that some of the interconnections combine to form cause-effect feedback loops (Hopper and Stave 2008). Citizens who are thinking of systems thinking need those feedback loops and understanding how they impact system behavior (Plate and Monroe 2014).

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Third, Arnold and Wade note that system structure consists of elements and interconnections between these elements. Through system thinking, citizens understand this structure, and system thinking helps them to facilitate behavior in the system (Ossimitz 2000; Richmond 1994).

Fourth, Arnold and Wade describe abilities to differentiate three concepts stocks, flows, and variables and to recognize how they operate as critical skills central to systems thinking. Stocks refer to any resource pools in a system, flows are the changes that occur in their levels, and variables are the changeable parts of the system that affect stocks and flows, such as a flow rate or the maximum quantity of a stock. Any of these conceptual components can be physical or emotional for example, the amount of paint in a bucket, or the level of trust between two people.

Fifth, they separate non-linear relationships from other connections among stocks, flows, and variables. They note that the taxonomies created by Hopper and Stave (22008) and Plate and Monroe (2014) tend to imply for most readers linear flows, which could be confusing when we are forced to confront the complexity of non-linear flows.

Sixth, Arnold and Wade describe how interconnection is combined into a feedback loop, and how these feedback loops consist of stocks, flows, and variables to form dynamic behavior within the system. System thinking training can only be used to understand these dynamic behaviors (Plate and Monroe 2014). Emergent behavior is a dynamic behavior through system thinking. They suggest that differentiating types of stocks, flows, and variables, as well as identifying and understanding non-linear relationships, are keys to understanding dynamic behavior.

Seventh, Arnold and Wade focus on the element of Reducing Complexity by Modeling Systems Conceptually, which for them represents a deviation from the models of Hopper and Stave (2008) and Plate and Monroe (2014). Although it sounds similar to Hopper and Stave's Using Conceptual Models, their element differs, they feel, in the ability to conceptually model different parts of a system and view a system in different ways. According to them, performing this activity extends beyond the scope of defined system models and enters the realm of intuitive simplification through various methods, such as reduction, transformation, abstraction, and homogenization (Wade 2011). They point out that research shows that perceptual wholes can reduce the conscious accessibility of their parts (Poljac, De-Wit, and Wagemans 2012). This ability is one of the ability of citizens to simplify excessive and complicated phenomena in analyzing phenomena occurring in a system.

Eighth, Arnold and Wade argue that the skill of Understanding Systems at Different Scales is similar to Barry Richmond's forest thinking (Plate and Monroe 2014). It is said that this skill involves the ability to recognize different scales of systems, and systems of

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systems.

Ninth and finally, Arnold and Wade note that a workable definition must be subjected to a System Test that is, the definition must itself be systematic, adhering to the stringent criteria for systems. According to them, it passes Item 1 of the test, as it contains a clearly defined, understandable, and relatable goal. It also passes Item 2: its elements are described in detail. It also passes Item 3 on clearly specified interrelationships, as interconnections and dependencies between the elements are described in the systemigram. They therefore assert that their definition is the first that passes the System Test and successfully defines systems thinking as a system.

IV. Three Constructs of Systems Thinking

Defining systems thinking is only the first step; the next must be to apply it. For that larger, more daunting role, we must move from the abstract to the concrete, and in doing so, while the goal of systems thinking is always to conceptualize holistically, it is often necessary to break a problem into separate segments that require somewhat different approaches to systems theory. In this case, global citizens need to think holistically in three different ways if they wish to sustain the Earth System. They need to cultivate systems thinking in terms of *general systems thinking*, *critical systems thinking*, and *whole healing systems thinking*.

First, systems thinking is the process of understanding how things physical, non-physical, or any mixture that may be regarded as systems influence one another within a more complete entity, or larger system. A holistic system is any set (group) of interdependent or temporally interacting parts. (Systems Thinking 2015).

Second, critical systems thinking is a systems thinking framework, that wants to bring unity to the diversity of different systems approaches and advises managers how best to use them (Ulrich 2003; Critical Systems Thinking2015). Gabriele Bammer (2003) stated that Critical Systems Thinking aims to combine system thinking and engagement methods to solve large, complex, uncertain and imperfect nonpermanent problems. In addition, he considered non-linear relationships, feedback loops, hierarchies, and emergent properties as important in reviewing system and boundary problems.

In the Anthropocene era, experts in system thinking need to have global management. Also by general global citizens, it is very necessary to observe the complexities and risks that arise between humans and ecosystems, and realize sustainability through socio-political organization in various ways (Lvbrand, Stripple, and Wiman 2008, 13-14).

Critical systems thinking begins to give us the tools to adjudicate between the competing visions. Above all, it implies that

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to act systematically, we need knowledge, will, foresight, and the humility to accept that open-ended systems are often chaotic and typically yield unforeseen, unintended consequences. According to Crutzen (2002), In the Anthropocene era, proper human behavior is required to keep the meteorological conditions globally, and an engineering approach is needed at this level. Among various propositions, plans to control global (tropospheric) warming by injecting dust (aerosols) into the stratosphere (cf. Crutzen 2006; Wiman 1995). Activity on this level may well become necessary, a do-or-die bet to deal with climate change. But critical systems thinking warns that only the most exigent crisis within the Earth System could justify opening it to the unintended consequences that might flow from such a major intervention in its operation.

In this context, it is a hopeful sign for critical systems thinking about the crises of the Anthropocene that Earth System Governance is neither confined to states and governments as political actors, nor to scientists, even to the most percipient among them (a small group to which Paul Crutzen certainly belongs), as the only Earth System experts. As Frank Biermann argues (2007, 329), that In modern society, a large number of actors participate in all stages of decision making in a system. Unrestricted, unsupervised ad hoc activity is not, certain utopian free market economists to the contrary notwithstanding, a guarantee of positive results, but an open network of activity, especially when informed by the lessons of critical systems thinking, is more likely to achieve them than a small set of actors with necessarily limited experience and perspectives.

Critical systems thinking also requires a goal towards which to direct the activity. As Simon Dalby (2004, 2) has argued,In the Anthropocene era, mankind needs a sustainable life in a broader ecosystem beyond their own state, so universal universal ethics is needed, not national ethics. Karen Litfin (2005) also claimed the "function of Gaia," which raised sustainability and justice in a global sense beyond ethical behavior in a single country. The current hierarchical governance should be replaced by a participatory network of system members, and the ecosystem of the earth is maintained only if the symbiosis replaces the competition (Litfin 2005, 514). If her argument is correct, the role of governments that sustain the global ecosystem in the future needs to be improved in a better way.

Even to conceptualize and articulate that goal, though, we need access to a third approach to systems thinking. To restore a system to functionality that serves the interest of as many of its constituent parts as possible is only an elaborate way of saying that we need to heal it. Whole systems healing is a holistic healing approach led by personal thinking and self-reflective thinking that leads to social change and environmental restoration.

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The Whole Systems Healing program should emphasize interdependence and change within the framework of systems thinking. (Kreitzer 2014).

V. Conclusion

It seems axiomatic that no one, not even the scheming U.S. Secretary of State plotting world domination through targeted climate change in the disappointing ecological thriller *Geostorm* (Devlin 2017), presumably not even the real-life administration of U.S. President Donald Trump, intends the cataclysmic consequences of the transition to the Anthropocene predicted by most scientists. But good intentions are not enough, as David Peter Stroh explains in introducing the subject of systems thinking (Stroh 2015, 13).

Yet Stroh is also clear that, while demanding a much higher degree of rationality and purpose than the wishful thinking of good intentions, systems thinking is more than a purely technical and cognitive set of tools (Stroh 2015, 17). His multiple dimensions of systems thought track closely with what we identify as the three constructs of systems thinking necessary for dealing effectively with the growing crisis.

- Stroh's mental dimension, the ability to recognize how our individual and collective thinking affects the results we want, corresponds to the approach called here simply systems thinking.
- His physical dimension, by which he means the ability to bring people together and enable them to collaborate, closely resembles what is called here critical systems thinking.
- Two dimensions identified by Stroh, the emotional the ability to master our emotions in service of a higher purpose and the spiritual the ability to see and articulate what will benefit diverse people over time would be incorporated in the Whole Systems healing category described above.

Whichever terminology is preferred, the message and moral injunction are the same: acting effectively acting politically in dealing with a complex situation requires different approaches within the broader context of systems thought.

- We must first understand its nature and implications through systems thinking.
- We must then engage the minds and wills of as many people as possible to resolve the crisis through critical systems thinking.
- Then we must commit hearts and souls personal emotions and universal empathy to their resolution through Whole System Healing.

Only then can we solve the crisis of the Anthropocene, and leave behind us a new generation capable of sustaining the Earth System into the future.

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References

Arnold, Ross D. and Jon P. Wade, 2015. “A Definition of Systems Thinking: A Systems Approach.” *Procedia Computer Science* 44 (2015 Conference on Systems Engineering Research): 669-678.

Bammer, Gabriele. 2003. "Embedding Critical Systems Thinking and Other Integration and Implementation Sciences in the Academy." Presented at the International Critical Management Studies Conference (CMS-3), Lancaster University Management School, July 7-9, 2003. Accessed at http://www.mngt.waikato.ac.nz/ejrot/cmsconference/2003/proceedings/orsystems/Bammer.pdf.

Beck, Ulrich. 2012. “Global Inequality and Human Rights: A Cosmopolitan Perspective.” In *Routledge Handbook of Cosmopolitanism Studies*, edited by Gerard Delanty, 303-315. New York: Routledge.

Biermann, Frank. 2007. “Earth System Governance' as a Crosscutting Theme of Global Change Research.” *Global Environmental Change* 17: 326-337.

Biermann, Frank and Aarti Gupta. 2011. “Accountability and Legitimacy in Earth System Governance: A Research Framework.” *Ecological Economics* 70 (11) [Special Section - Earth System Governance: Accountability and Legitimacy]: 18561864.

Booth Sweeney, Linda and John D. Sterman. 2000. “Bathtub Dynamics: Initial Results of a Systems Thinking Inventory.” *System Dynamics Review* 16 (4): 249-294.

Checkland, Peter B. 1985. “Science and the Systems Movement.” In *Systems Behavior*, 3rd ed., edited by Open Systems Group. London: Harper and Row.

Chiu, Mei-Hung and Reinders Duit. 2011. “Globalization: Science Education from an International Perspective.” *Journal of Research in Science Teaching* 48 (6): 553-566.

Citizenship and Borders. 2011. Citizenship Section 3.1 in *Stanford Encyclopedia of Philosophy*, revised August 1, 2011 available at http://plato.stanford.edu/entries/citizenship/#3.1.

Citizens, Resident Aliens and Rights. 2011. Citizenship Section 3.2 in Stanford Encyclopedia of Philosophy, revised August 1, 2011 available at http://plato.stanford.edu/entries/citizenship/#3.2.

Critical Systems Thinking. 2015. https://en.wikipedia.org/wiki/Critical_systems_thinking, accessed May 11, 2015.

Crutzen, Paul J. 2002. “Geology of Mankind.” *Nature* 415 (January 3): 23.

———. 2006. “Albedo Enhancement by Stratospheric Sulfur Injections: A Contribution to Resolve a Policy Dilemma? An Editorial Essay.” *Climatic Change* 77: 211-219.

Crutzen, Paul J. and Will Steffen. 2003. “How Long Have We Been in the

www.kci.go.kr

Anthropocene Era?" *Climate Change* 61 (3): 251-257.

Dalby, Simon. 2004. "Anthropocene Ethics: Rethinking 'the Political' after Environment." Paper for the International Studies Association annual conference, Montreal, Canada, March 2004. Accessed at http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.203.1393&rep=rep1&type=pdf.

———. 2007. "Anthropocene Geopolitics: Globalisation, Empire, Environment and Critique." *Geography Compass* 1 (1): 103-118.

———. 2009. "Anthropocene Security." Paper for the International Studies Association Annual Conference, New York City, February 17, 2009, Accessed at http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.150.79&rep=rep1&type=pdf.

———. 2013. "Biopolitics and Climate Security in the Anthropocene." *Geoforum* 49 (October): 184192.

Davidz, Heidi L. and Deborah J. Nightingale. 2008. "Enabling Systems Thinking To Accelerate the Development of Senior Systems Engineers." *Systems Engineering* 11(1): 1-14.

Devlin, Dean, dir. 2017. *Geostorm*. Written by Dean Devlin and Paul Guyot. Movie presented by Warner Brothers.

Easton, David. 1971. *The Political System: An Inquiry into the State of Political Science*, 2nd ed. New York: Alfred A. Knopf.

Gray, Donald and Laura Colucci-Gray. 2014. "Globalisation and the Anthropocene: The Reconfiguration of Science Education for a Sustainable Future." *Sisyphus: Journal of Education* 2 (3): 14-31.

Holsti, K. J. 1995. *International Politics: A Framework For Analysis*, 7th ed. Englewood Cliffs: Prentice-Hall.

Hopper, Megan, and Krystyna A. Stave. 2008. "Assessing the Effectiveness of Systems Thinking Interventions in the Classroom." Prepared for Proceedings of the 26th International Conference of the System Dynamics Society, Athens, Greece, July 20-24, 2008. Available at http://www.researchgate.net/profile/Krystyna_Stave/publication/228574917_Assessing_the_effectiveness_of_systems_thinking_interventions_in_the_classroom/links/0f31752dd3c707bed3000000.pdf.

Kreitzer, Mary Jo. 2014. "Whole System Healing." http://www.csh.umn.edu/wsh/.

LeVasseur, Todd. 2014. "Teaching Sustainability via the Environmental Humanities: Studying Water, Studying Ourselves." *Journal of Sustainability Education* 7 (December), available at http://www.jsedimensions.org/wordpress/content/teaching-sustainability-via-the-environmental-humanities-studying-water-studying-ourselves_2014_12/.

Litfin, Karen. 2005. "Gaia Theory: Intimations for Global Environmental Politics." In *Handbook of Global Environmental Politics*, edited by Peer Dauvergne, 502-517. Cheltanham: Edward Elgar

www.kci.go.kr

Publishing.

Lloyd Jones, Deiniol. 2004. “Technical Cosmopolitanism: Systems, Critical Theory and International Relations.” POLIS Working Paper 6, School of Politics and International Studies, University of Leeds. Accessed at http://www.polis.leeds.ac.uk/assets/files/research/working-papers/wp6djones.pdf.

Lvbrand, Eva, Johannes Stripple, and Bo Wiman. 2008. “Earth System Governmentality. Critical Notes on Science in the Anthropocence.” Paper for the Berlin Conference on the Human Dimensions of Global Environmental Change, February 22-23, 2008 Accessed at http://www.researchgate.net/profile/Johannes_Stripple/publication/228431158_Earth_System_Governmentality._Critical_Notes_on_Science_in_the_Anthropocence/links/0f317534e9e6682508000000.pdf.

———. 2009. “Earth System Governmentality: Reflections on Science in the Anthropocene.” *Global Environmental Change* 19 (1): 713.

Midgley, Gerald. 2000. *Systemic Intervention: Philosophy, Methodology, and Practice*. New York: Kluwer Academic/Plenum Publishers.

Norris, Pippa. 2000. "Global Governance and Cosmopolitan Citizens." Draft chapter for *Governance in a Globalizing World*, edited by Joseph S. Nye, Jr. and John D. Donahue, Brookings Institution Press, accessed at http://unpan1.un.org/intradoc/groups/public/documents/APCITY/UNPAN002060.pdf.

Ossimitz, Gnther. 2000. “Teaching System Dynamics and Systems Thinking in Austria and Germany.” Paper for the Systems Dynamics Society's 18th International Conference, Bergen, Norway, 2000, available at http://www.systemdynamics.org/conferences/2000/PDFs/ossimitz.pdf.

Palson, Gisli, Bronislaw Szerszynski, Sverker Srlin, John Marks, Bernard Avri, Carole Crumley, Heide Hackmann, et al. 2013. “Reconceptualizing the 'Anthropos' in the Anthropocene: Integrating the Social Sciences and Humanities in Global Environmental Change Research.” *Environmental Science and Policy* 28 (April): 3-13.

Plate, Richard and Martha Monroe. 2014. “A Structure for Assessing Systems Thinking.” In Creative Learning Exchange, available at http://static.clexchange.org/ftp/documents/implementation/IM2014_AStructureforAssessingST.pdf.

Poljac, Ervin, Lee de-Wit, and Johan Wagemans. 2012. “Perceptual Wholes Can Reduce the Conscious Accessibility of Their Parts.” *Cognition* 123 (2): 308-312.

Renner, Michael and Zo Chafe. 2007. *Beyond Disasters: Creating Opportunities for Peace.* Washington: Worldwatch Institute.

Richmond, Barry. 1994. “Systems Dynamics/Systems Thinking: Let's Just

www.kci.go.kr

Get On With It." Paper for the International Systems Dynamics Conference. Sterling, Scotland, available at http://webspace.webring.com/people/ah/himadri_banerji/pdf/systhnk.pdf.

Rourke, John T. and Marka A. Boyer. 1996. *International Politics on the World Stage: Brief Edition*. Connecticut: Brown & Benchmark.

Senior, Jennifer. 2017. "Not If the Seas Rise, but When and How High." *New York Times*, November 22, 2017. https://www.nytimes.com/2017/11/22/books/review-water-will-come-jeff-goodell.html?hpw&rref=books&action=click&pgtype=Homepage&module=well-region&region=bottom-well&WT.nav=bottom-well.

Shim (Sim), Yeon-soo (Youn-soo). 2015. "Systems Thinking for Strengthening National Competitiveness in South Korea." *Studies in Humanities and Social Sci*ences [Institute of Humanities and Social Sciences, Honam University, Gwangju, South Korea] 46: 17-26.

Stroh, David Peters. 2015. *Systems Thinking for Social Change: A Practical Guide to Solving Complex Problems, Avoiding Unintended Consequences, and Achieving Lasting Results*. White River Junction VT: Chelsea Green Publishing.

Systems Thinking. 2015. https://en.wikipedia.org/wiki/Systems_thinking, accessed May 11, 2015.

Ulrich, Werner. 2003. "A Brief Introduction to Critical Systems Thinking for Professionals and Citizens." Available at http://www.wulrich.com/cst_brief.html.

Voegelin, Eric, 2003. *The Theory of Governance and Others Miscellaneous Papers, 1921-193*8. Edited by William Petropulos and Gilbert Weiss, translated by Sue Bollans, Jodi Cockerill, M. J. Hanak, et al. Vol. 32, *The Collected Works of Eric Voegelin*. Columbia: University of Missouri Press.

Wade, Jon. 2011. "Systems Engineering: At the Crossroads of Complexity." Keynote address, Kongsberg Systems Engineering Event, June 9-10, 2011.

Wiman, Bo L. B. 1991. "Implications of Environmental Complexity for Science and Policy: Contributions from Systems Theory." *Global Environmental Change* 1 (3): 235-247.

———. 1995. "Metaphors, Analogies, and Models in Communicating Climate-Change Uncertainties and Economics to Policy: A Note on a Pre-UNCED U.S. Case." *Ecological Economics* 15 (1): 21-28.

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