Translational Systems Sciences 1

Gary S. Metcalf *Editor*

Social Systems and Design

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Translational Systems Sciences

Volume 1

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In 1956, Kenneth Boulding explained the concept of General Systems Theory as a *skeleton of science*. The hope was to develop something like a "spectrum" of theories—a system of systems which might perform the function of a "gestalt" in theoretical construction. Such "gestalts" in special fields have been of great value in directing research towards the gaps which they reveal.

There were, at that time, other important conceptual frameworks and theories, including cybernetics. Additional theories and applications developed later, such as synergetics, cognitive science, complex adaptive systems, and many others. Some focused on principles within specific domains of knowledge and others crossed areas of knowledge and practice, along the spectrum described by Boulding.

Also in 1956, the Society for General Systems Research (now the International Society for the Systems Sciences) was founded. One of the concerns of the founders, even then, was the state of the human condition, and what science could do about it.

The present Translational Systems Sciences book series aims at cultivating a new frontier of systems sciences for contributing to the need for practical applications that benefit people.

The concept of translational research originally comes from medical science for enhancing human health and well-being. Translational medical research is often labeled as "Bench to Bedside." It places emphasis on translating the findings in basic research (*at bench*) more quickly and efficiently into medical practice (*at bedside*). At the same time, needs and demands from practice drive the development of new and innovative ideas and concepts. In this tightly coupled process it is essential to remove barriers to multi-disciplinary collaboration.

The present series attempts to bridge and integrate basic research founded in systems concepts, logic, theories and models with systems practices and methodologies, into a process of systems research. Since both bench and bedside involve diverse stakeholder groups, including researchers, practitioners and users, translational systems science works to create common platforms for language to activate the "bench to bedside" cycle.

In order to create a resilient and sustainable society in the twenty-first century, we unquestionably need open social innovation through which we create new social values, and realize them in society by connecting diverse ideas and developing new solutions. We assume three types of social values, namely: (1) values relevant to social infrastructure such as safety, security, and amenity; (2) values created by innovation in business, economics, and management practices; and, (3) values necessary for community sustainability brought about by conflict resolution and consensus building.

The series will first approach these social values from a systems science perspective by drawing on a range of disciplines in trans-disciplinary and cross-cultural ways. They may include social systems theory, sociology, business administration, management information science, organization science, computational mathematical organization theory, economics, evolutionary economics, international political science, jurisprudence, policy science, socio-information studies, cognitive science, artificial intelligence, complex adaptive systems theory, philosophy of science, and other related disciplines. In addition, this series will promote translational systems science as a means of scientific research that facilitates the translation of findings from basic science to practical applications, and vice versa.

We believe that this book series should advance a new frontier in systems sciences by presenting theoretical and conceptual frameworks, as well as theories for design and application, for twenty-first-century socioeconomic systems in a translational and trans-disciplinary context.

Gary S. Metcalf
Editor

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*This book is dedicated to the memory
of Bela H. Banathy, and to the empty chair
which he always placed in the middle
of Conversation events he hosted.
That chair represents the future generations
that we should keep in mind as we design
our worlds.*

Preface

This book is about the worlds that we inhabit. (*Worlds* is used intentionally—it is not one uniform place for every individual.) It is also about our abilities to affect, and even to create, those worlds.

As a species, we are amazing and we are dangerous. Like adolescents, we have many more capacities than we know how to predict or control.

Some have referred to our present time as the Anthropocene Era. We are no longer just another biological form on the planet. Our collective impact may irrevocably change the world itself—for good, or for ill.

The title of this book, then, involves two concepts at the heart of these matters: *social systems*, which are the human worlds that we inhabit, and *design*, which is a process through which we consciously create possibilities.

The concept of design has expanded and become more familiar recently. It is probably still most associated with producing physical objects, in everything from fashion design to architecture. It is also used in the development of software, and to create business processes. It has become a new focus of study in business schools and other academic disciplines.

One of the most recognized applications of design may have been by the late Steve Jobs. In his work at Apple, Jobs was clear that simply being *customer-focused* would only create more of what already existed. Instead, he intentionally worked to create what people *would* want, but had not yet envisioned.

Applying design to the creation of human social systems multiplies the challenges tremendously. The question is the degree to which we can consciously create the worlds in which we truly want to live.

My formal introduction to systems theories came from my doctoral professor and mentor, Bela H. Banathy. He introduced me not only to the ideas, but also to a community of forward-thinking writers, theorists, and practitioners, and to the organizations and meetings where they could be found.

In 1991, Bela published the book *Systems Design of Education: A Journey to Create the Future*. The book emerged from his two decades of experience as a researcher at the Far West Laboratory—essentially a think-tank for education. At that time he was already convinced that *fixing* the educational system in the U.S.

was not adequate. It was a system based on an industrial model, created to train standardized laborers such as assembly-line factory workers. The solution was to design a new educational system for the future (Needless to say, very little has changed since then. We are still suffering the consequences of a system ill-fitted to its environment).

I met Bela in 1995, around the time that he was completing and publishing *Designing Social Systems in a Changing World*. It was an expansion of systems design from education to society at-large. He drew on the work of Nigel Cross and others in describing design as a *third culture* (along with science and humanities). He saw design as a necessary human capacity. His strongly held view was that no one had the right to design the social systems in which other people lived, and everyone had the responsibility for being involved in the design of their own respective systems.

Bela drew on the work of other systems theorists, as well. A number of them had also explicitly incorporated principles of design, including Russell Ackoff, John Warfield, Alexander (Aleco) Christakis, and others.

The chapters in this book represent a small selection of ideas and examples from the systems scientists who have made the connections with design. They have moved beyond describing *what is* to proposing ways for creating *what could be*. They also incorporate systems scientists and theorists whose work may not be directly associated with design, *per se*, but has been applied to the intentional creation of social systems.

In terms of coverage, this volume is certainly not complete. Even for the small percentage of systems scientists explicitly associated with design, there are theorists whose work remains to be explored in more detail. However, collectively, the chapters provide a combination of history, theory, and prospective applications which should allow readers to see the most critical concepts. While individual systems theorists have varying views and approaches, expressed in different ways, there are common themes that should become evident.

The first chapter is mine. It attempts to set the stage for the challenges involved if you seriously consider designing human systems on a global scale. It traces ideals about social systems from Plato and situates them in the context of different realities, from the vestiges of colonialism to the *Arab Spring* in the Middle East and nation-building efforts following military interventions. It explores possibilities for *first principles* of design in creating social systems. It includes examples which may well have changed even before this book is published—emphasizing another ever-present challenge. We do not have the luxury of designing in a *clean room* or a perfect vacuum. We are considering the design of dynamic systems in an active world of increasing complexity. The rest of the book moves from historical accounts of systems design, through theoretical foundations for participative systems design, to prospective, future applications of existing systems design approaches.

The second and third chapters provide first-hand reflections about two of the largest and most well-known system design projects from the twentieth century. In the second chapter, Alexander N. Christakis looks back on more than four decades of systems work to the formation of the Club of Rome. In what he describes as a *scientific* *biography*, he offers personal insights about one of the first attempts to model the human impact on the Earth. He traces his own evolution as a systems scientist, explaining how he arrived at his conclusions regarding communication and design. His work included years of collaboration with John Warfield, another giant in systems work.

The third chapter offers Raul Espejo's reflection and critique of Stafford Beer's work in Chile—known as the *Cybersyn project*. Espejo offers a unique, insider's perspective about the culture, politics and social environment in which the project took place, and thoughts about what might have been different had it been attempted at a different moment in time.

The next three chapters delve into some of the theoretical foundations for social systems design. Beyond any ethical beliefs about individual rights for civic and political involvement, there are also very practical reasons for bringing stakeholders into the design of social systems.

Peter H. Jones provides a designer's perspective about the principles of design, and how those apply to the creation of complex human systems. He explores basic systems principles in-depth, and their relationship to design, creating a rare and important convergence of the two domains of thought and practice.

Ken C. Bausch uses the concept of *Third Phase Science* (as initially proposed by Gerard de Zeeuw) in explaining how assumptions from science affect the ways in which we approach systems design. The complexity of the human world requires moving toward shared understandings from different viewpoints rather than assumed objectivity of one correct *truth*.

Thomas R. Flanagan addresses governance of social systems, and explains in detail the rationale for democratic principles in design. He bases his argument, in part, on the work of Elenor Ostrom, and compares it with principles of Structured Dialogic Design.

In seventh chapter, Yiannis Laouris, Kevin M.C. Dye, Marios Michaelides, and Alexander N. Christakis give concrete examples of systems design activities based on their work using *co-laboratories of democracy*. This involves the application of Structured Dialogic Design, whose roots trace back to the work of John Warfield in Interactive Management, and its development through numerous stages with, and by, Alexander N. Christakis and his colleagues.

In eighth chapter, Merrelyn Emery takes several decades of work, dating back to her collaboration with Fred Emery and other colleagues, and proposes an application of Open Systems Theory to create solutions for climate change. This includes facilitated Search Conferences and Participative Design workshops. Embedded in the proposal are descriptions of Design Principle 2 (democratic, self-managing groups), and a rationale for the importance of participative design, refined through many years and applications.

In the final chapter, Doug Walton describes the application of Bela Banathy's social systems design concepts to a high-tech organization. While Bela was often reluctant to work with corporations, due to the power structures and lack of true collaboration in their decision-making, Walton adapts the principles to explain how they can be used successfully in a modern organization.

My hope is that this book creates a valuable overview about the state of, and the possibilities for, social systems design. Its intent is to inform readers about ideas and approaches that have been maturing for decades, about the foundations believed to be important to our creation of social systems, and about some of the possibilities for moving forward. There is a critical need to consider how we are shaping the worlds in which we live, and to learn to do so with purpose and conscious intent.

Finally, publishing a book requires more time and effort than most people ever imagine. Academic writing, in particular, is purely a labor of love or dedication to readers. If you find the ideas of these authors to be useful or inspirational, I hope that you will take the time to contact them directly, to let them know.

Acknowledgments I wish to thank Jim Kijima and Hiroshi Deguchi for their work and inspiration in initiating the Translational Systems Science series. I also want to thank each of the authors who contributed to this volume. They were incredibly gracious with their time, generously sharing ideas which are the products of decades of their lives. This is not a book that could have been written alone. Lastly, my continuing thanks to Teri, my wife, who keeps being patient with me in spite of all of the extra, unpaid projects that never seem to end.

Ashland, KY, USA Gary S. Metcalf
September 2013

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Creating Social Systems

Gary S. Metcalf

Abstract Increasingly, the concept of design is being applied to organizations, cities, and social systems of many kinds. There is still no clear foundation, however, on which such designs would be based. This chapter explores current global dilemmas for which design approaches could be appropriate, and describes possible *first principles* on which human social systems might build.

Keywords Design • Governance • Nation-building • Plato • Social systems

Introduction

Can we consciously create the kind of world in which we want to live? On one hand, it appears to be a simple question. We have been *taming* the world for millennia; shaping it to better meet our human needs. If our knowledge of history is correct, we went from living as other primates to becoming the dominant species on the planet. We moved from learning to plant and irrigate crops to genetically engineering plants and animals. We moved out of caves and built magnificent cities. We harnessed the power of animals and of fire, then of fossil fuels and atoms. We created tools and built machines, from oxcarts and chariots to space ships and the Internet. We learned to speak and to write, then to store data and communicate around the globe via satellites circling in space.

Our use of tools and development of technologies has been remarkable. Our senses of purpose and meaning have not always kept up. There are increasing numbers of things that we can do—potentially. Another question is whether we should

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do them—and how we decide that answer. A third question, though, is how we actually bring into reality the result that we want.

We often speak about the world getting smaller. Physically, of course, it is not. The connections between people and locations, though, have gotten both closer and more distant than even our recent ancestors might ever have guessed. We can talk with people literally on the other side of the world, in real time, but we may barely know the people who live down the street. We can travel to the other side of the world in less than a day while it may take hours to get a few miles across a city in the gridlock of traffic.

We have managed to organize ourselves well enough to have accomplished countless tasks. We still operate socially, though, through patterns which look much like our primate cousins. We need each other, and we live with greed, jealousy, and rage. We form attachments and alliances, and play games of sexual politics. We have literally changed the face of the Earth, but we have never left behind our ancient roots.

If we were to create a new and better world, what would that mean, and how would we go about it?

It is an old question. Nearly 2,400 years ago, Plato proposed the necessary characteristics for rulers of a state in "The Republic." Sir Thomas More penned his concept of utopia in the early 1500s. Karl Marx gave us his view of society, as did the framers of the US Constitution. All of those visions have influenced our world in different ways, but none of them are the specific realities with which we live today.

Some of our world has been planned, but much of it has simply evolved over time. We have endless questions about our origins and our futures. Authors Sagan and Druyan (1992), in their book *Shadows of Forgotten Ancestors*, summarized many of the key questions facing us in this way:

> Who are we? Where do we come from? Why are we this way and not some other? What does it mean to be human? Are we capable, if need be, of fundamental change, or do the dead hands of forgotten ancestors impel us in some direction, indiscriminately for good or ill, and beyond our control? Can we alter our character? Can we improve our societies? Can we leave our children a world better than the one that was left to us? Can we free them from the demons that torment us and haunt our civilization? In the long run, are we wise enough to know what changes to make? Can we be trusted with our own future? (p. 4).

One of the differences now, from the past, is the magnitude our ability to affect the planet, both through our technical abilities and due to our population size. As with most things, there are both challenges and opportunities. In spite of all of our achievements, we seem to continue on trajectories which take us to results with which we are not satisfied. Serwer (2009) labeled the first 10 years of the new millennium (that is, 2000–2009) as the "decade from hell." In the US, it began with a controversial presidential election, which was ended by a legal decision rather than a clear majority of votes. That was followed by the terrorist attacks of September 11, 2001, and the subsequent invasions of Afghanistan and Iraq. A tsunami in the Indian Ocean killed an estimated 200,000 people, and then Hurricane Katrina devastated New Orleans. By the end of the decade, we faced the potential collapse of the largest financial systems in the world, along with some of the largest corporations.

In the following years, questions about mounting debt threatened economic stability in Europe, and the existence of the euro as a currency. Another tsunami caused the tidal wave which washed over the Fukushima power plant in Japan, triggering the meltdown of its nuclear reactor. Major earthquakes caused disasters in Haiti, China, and other countries. Political unrest spread through countries in the Middle East, in what became known as the Arab Spring, toppling governments and sparking violence and battles for power. Terrorist attacks by radical groups continued. A major hurricane hit the New Jersey coast in the US, while record heat, wildfires, and flooding plagued Australia.

Humans seem always to have faced adversity, relative to what we wanted or believed might be. Some of that has come from natural events such as weather (droughts, floods, hurricanes, tornadoes, etc.), or earthquakes and volcanoes. Some of that has come from our relationships to other organisms (e.g., pests, parasites, viruses, or predators). Often it has come from competition or differences with other humans.

Wars have caused millions, and even tens of millions of casualties at different points in history. Famines and plagues have created similar tragedies. Money is so closely tied to our access for basic needs now that financial collapses can create similar disasters. It is possible that what we see as catastrophes are just parts of natural cycles, but they are not results to which most humans aspire. Are these problems inevitable, or can we choose to create something different?

Shaping the Landscape

For most of human history we lived as a part of nature. We were primates, evolving through many biological relatives. Depending on the viewpoint that you take, we were either animals trying to survive the whims of nature or we were one of many species living in harmony with our environment. In either role, we would not expect our ancestors to have done much contemplation of design.

As we evolved through the millennia, though, humans learned to design, plan, and bring to reality all manner of innovations. Some 2.5 million years ago, our ancestors discovered how to use tools. Harnessing the use of fire, possibly 800,000 years ago, for heating, light, and cooking extended our capabilities. We learned to hunt cooperatively. Those skills allowed us to move from one ecological niche to another; from being mostly prey for larger carnivores to becoming effective predators. Wearing the skins and fur of other animals let us explore and live in climates to which we would not otherwise have been suited. At some point, we developed the capacity for language.

We planted and irrigated farms to better control the availability of food. We built stronger structures in which to live, and developed progressively better tools for construction. We learned to use the power of animals, of wind, and of water. Eventually, we learned to harness the power of ideas, and to record them.

Our earliest social structures may have looked much like our primate relatives, a combination of competition for dominance and cooperation, built around small family groups. Larger collectives became tribes, and more settled groups created villages. Judging from what we know of indigenous peoples, there were probably various arrangements of leadership and cooperative decision-making.

Larger groups seemed to create greater hierarchy and division of labor. Eventually, kings and queens ruled nation-states, consolidating massive wealth and power into the hands of ruling families. Their judgments were the decisions by which others lived. They enforced their rule through command of armed guards and military units. Most of our recorded history is dominated by legends of men and women ruling through the exercise of various forms of power.

Today, we think in terms of urban planning and economic development. Most of our efforts and resources, though, continue to be focused on structure and infrastructure. Only at various tipping points have we consciously considered the governance of our social systems; how we live together in those places that we build.

A U.S. view of progress has the world moving towards systems of democracy and free-market capitalism (as understood by Americans.) Not everyone in the world agrees. In general, though, progress seems to include better jobs, access to education and to health care, more comfortable living conditions, and so on. The exact forms those take varies.

Both biologically and socially, we live with the vestiges of our history. We remain a species on the planet Earth, intimately tied to resources in a thin layer of atmosphere. We also share, and differ about, the ideologies by which we make sense of our existence, and we are willing to fight to the death about both resources and beliefs.

Where, then, do we begin our quest for creating a better world?

Thinking in Terms of Design

Systems scientists including Russell Ackoff, Bela H. Banathy, Aleco Christakis and John Warfield, began talking decades ago about the purposeful design of human social systems. Cross (2011), in his study of design processes, arrived at three key characteristics that he found in common: "(1) taking a broad 'systems approach' to the problem, rather than accepting narrow problem criteria; (2) 'framing' the problem in a distinctive and sometimes rather personal way; and (3) designing from 'first principles'" (p. 75).

Beginning with the last point first, agreeing on the first principles of human social systems is not simple. Materials have various properties, all of which may make a difference if you are designing a physical object. How would that relate, though, to the design of human social systems?

For design related to human biology, topics such as biomedical engineering, or genetic engineering, come to mind. First principles in those areas are based largely on the properties of human cells and organs. What, then, might be the first properties of human social systems, understanding that they are not just aggregates of biological functioning?

We base many of our beliefs about societies and human nature on our assumptions about history. What we know of history, though, has to be understood as a matter of interpretation. As Eisler (1987) notes:

> Archaeology as a science dates back only to the late 1800s. Even then, the earliest archaeological excavations, though also motivated by intellectual curiosity about our past, primarily served a purpose akin to that of grave-robbing: the acquisition of striking antiquities by museums in England, France, and other colonial nations (p. 9).

Even our assumptions about hierarchies of power in other animal groups need to be calibrated. As explained by explained by de Waal (2009), a primatologist and ethologist:

> Every debate about society and government makes huge assumptions about human nature, which are presented as if they come straight out of biology. But they almost never do… Many animals survive not by eliminating each other or keeping everything for themselves, but by cooperating and sharing (pp. 4–7).

We also have theories, of course, from sociology, anthropology, archaeology, and historians. Most, though, have been forced into the molds of science, attempting to build explanatory models, and assuming that past patterns predict future behavior. Certainly, there are enduring patterns at varying scales of the ecosystem, including for humans. As first principles for the design of social systems, though, they leave us with little from which to work.

Another candidate for first principles, the psychoanalytic work of Sigmund Freud, was as a milestone in explaining the basic principles of human nature and behavior. Freud's concepts of innate drives and of our necessary progression through developmental stages (or the disabilities caused by lack of proper development) revolutionized much of our modern thinking. de Waal (2009) pulls together threads from various areas of study to reflect such influences:

> The sexual connotations of Freud's origin story may serve as a metaphor for all of our political and economic dealings, a connection confirmed by brain research. Wanting to see how humans make financial decisions, economists found that while weighing monetary risks, the same areas in men's brains light up as when they're watching titillating sexual images. In fact, after having seen such images, men throw all caution overboard and gamble more money than they normally would. In the words of one neuroeconomist, "The link between sex and greed goes back hundreds of thousands of years, to men's evolutionary role as provider or resource gatherer to attract women" (pp. 161–162)

As described, though, by the British psychoanalyst John Bowlby, Freud's groundbreaking ideas were theoretical models, again strongly influenced by the prevailing molds of traditional science. As Bowlby (1982) explains:

> For Freud the psychical energy model was an attempt to conceptualise the data of psychology in terms analogous to those of the physics and chemistry at the time he began his work,

> and thus was thought to have the great virtue of linking psychology to science proper (pp. 19–20).

Bowlby's own work involved replacing the notion of instinctual drives with concepts from what we now know as cybernetics. As Bowlby (1982) states this:

> Models that promise to make great contributions to our understanding of the prototypic structures of instinctive behavior are models developed by control theory… The two features [of control systems] we shall start with concern the age-old problem of purposiveness and the modern concept of feedback (pp. 40–41).

Bowlby's (1982) ideas help to provide an explicit link between what we design and what continues to evolve in our natural ecosystems:

> When the structure of a system is considered, the environment within which it is to operate must be considered simultaneously… It is sometimes useful to refer to the environment of adaptedness of a man-made system as its environment of designed adaptedness and to that of a living organism as its environment of evolutionary adaptedness (p. 50)

With respect to questions of human nature and instinctive behavior, Bowlby (1982) further explains that:

> Instinctive behavior is not inherited; what is inherited is a potential to develop certain sorts of system, termed here behavioral systems, both the nature and the forms of which differ in some measure according to the particular environment in which development takes place (p. 45)

Effectively, a significant part of what we must design (or discover) are the proper conditions—the necessary environment—in which the human social systems that we want will develop and evolve.

While Bowlby's work definitely hints at the systems approach which Cross (2011) noted, it is the theories of yet another psychiatrist which provides a more explicit foundation. Andras Angyal's (1941) work underpinned Socio-Technical Systems, as attributed to Emery and Trist, and their colleagues (see: Trist, 1992), and later, Socio-Ecological Systems (Emery, 2012). The philosopher and biologist, Ludwig von Bertalanffy, is more well-known in the US for his connections to systems theories, but it is actually the work of Angyal which brings fundamental systems theories closer to human social systems.

Because of his primary work in psychiatry, Angyal (1941) tends to use the terms organism and environment. The same principles apply, though, when he shifts to using system in place of organism.

It is common for people to hold the idea that systems have to do with collective parts, in some spatial relation to each other. Angyal (1941) makes clear that this is not what he means by systems. There are elements, or members, or constituents of systems, but their physical relationship to each other in space is irrelevant. It is their collective behavior in relation to each other which matters. As Angyal states:

> It is, in principle, impossible to draw any line of separation between organism and environment because organism and environment are not static structures separable in space, but are opposing directions in the biological total process… We cannot tell whether a structure belongs to the organism or to the environment, but we can determine to what extent a process is respectively organismically or environmentally governed (pp. 92–95).

The distinctions are important because of the change in understanding which Angyal tries to convey. Living systems cannot be understood through the collective properties of elements. They must be studied and understood as dynamic wholes. As Angyal (1941) specifically explained this, "Since the existential form of the organism is a dynamic one, it has to be studied from the dynamic point of view, that is, as a process" (p. 50).

What distinguishes the elements of a system, then, is not the physical or spatial proximity, but the fact that the elements act as a part of the system. Constituents behave in relation to the governing principles of the system. As expressed in Angyal's (1941) words:

> In every whole there is a leading principle according to which it is organized. Thus the necessity arises of defining the leading principle of organization of the biological total process. The problem can be stated as follows: What is the general pattern which the organismic total process follows? (p. 21)

To be a part of a system, then, is to act in relation to its governing principle. But because systems exist in a dynamic universe, there are influences and signals of all kinds occurring at all times. Angyal (1941) explains this dynamic process as the flux between autonomy and heteronomy. Autonomy represents the internal governance patterns of the system itself. Heteronomy represents the external influences from the relevant environment. Every system evolves in a balance between *self-government* and *government from the outside* (p. 39).

Angyal's description would seem to be very similar to that of Maturana and Varela (1992), regarding ontogeny. As they state:

> Ontogeny is the history of structural change in a unity without loss of organization in that unity. This ongoing structural change occurs in the unity from moment to moment, either as a change triggered by interactions coming from the environment in which it exists or as a result of its internal dynamics (p. 74).

Angyal (1941) sees a general trend in the development of systems towards autonomy. In light of his work as psychiatrist, it is easy to see why that might be. As humans mature it assumed that they should become more independent and self-sufficient. The process of autonomy has to do with a system working to act on its environment rather than being controlled by it.

Again, this appears similar to other work in systems, this time from von Bertalanffy (1984), in his use of the term progressive mechanization:

> At first, systems—biological, neurological, psychological or social—are governed by dynamic interaction of their components; later on, fixed arrangements and conditions of constraints are established which render the system and its parts more efficient, but also gradually diminish and eventually abolish its equipotentiality (p. 44).

The conditions of restraints refer specifically to what Bertalanffy calls secondary regulations, to which he connects processes of feedback as described by Norbert Wiener in cybernetics. The principles are similar to what Maturana and Varela called operational closure, essentially, the system being directed only by internal rules, but responsive to external stimuli as interpreted through those internal principles.

As a foundation for first principles of human social systems, we are still in difficult territory. Bertalanffy, and Maturana and Varela, developed their theories from work in biology. Bowlby and Angyal worked primarily from an individual level in psychiatry, but with obvious implications for functioning in society. Luhmann (1995) applied the work of Maturana and Varela to his theories of social systems, with some degree of acceptance. We have yet to achieve a consensus, though, about the principles of social systems as such.

Trist (1992) challenged Angyal's (1941) work in this regard. As he expressed it:

> The systems with which Angyal is concerned are what would now be referred to as tightly coupled systems. The body is his constant analogue in which the parts have no independent existence of their own, and by extension, he treats the psychological level of the psychobiological individual in the same way. At the social level, however, as Ackoff and Emery (1972) point out, an organization or group is composed of parts (individuals) which are themselves purposeful systems and have their own independence value. Social systems have a higher degree of openness than the psychobiological systems on which Angyal focused (p. 125).

To some degree, Trist is correct in that Angyal's interest is in developing a theory (actually a science) of human personality. Angyal (1941) is clear, though, about some of the connections with the larger environment. As he describes this:

> The integration of the individual into the social group, the assimilation of its culture, of its written and unwritten codes, are just as essential for the personality development and personality organization as any of the physiological functions. Thus it appears that personality is a larger unit than a mere individual organism, because it also includes those factors through which it functions as a participant in the superindividual units of society and culture (p. 170)

So for Angyal (1941), personality is not just an individual trait, but extends to the superindividual parts of society. While difficult conceptually, it would seem to stay consistent with his thought that systems (organisms) do not exist without environments. It is also critical for the development a third key concept which he terms homonomy. As he explains and defines this:

> While the trend toward increased autonomy aims at the domination of the surroundings, the characteristic attitude toward superindividual wholes is rather a kind of submerging or subordination of one's individuality in the service of superindividual goals… For this principle we propose the term "trend toward homonomy," that is, a trend to be in harmony with superindividual units, the social group, nature, God, ethical world order, or whatever the person's formulation of it may be (pp. 172)

Still, Trist's criticisms should not be taken lightly. Our affiliation with, or participation in, social systems, is not an all-or-none proposition. There are varying degrees to which we respond to different governing principles in our lives. Trist (1992) cites Ackoff's classification of organizations according to "what he calls 'nodality' and 'geneity'" (p. 125). This creates a spectrum from tight to loose couplings, where heterarchy would be an example beyond Angyal's descriptions. Another comparison might be with Maturana and Varela's (1992) notion of structural couplings. As they explain:

> In these interactions, the structure of the environment only triggers structural changes in the autopoietic unities (it does not specify or direct them), and vice versa for the environment…

> We speak of structural coupling whenever there is a history of recurrent interactions leading to the structural congruence between two (or more) systems (p. 75).

Rather than proposing to answer the question about first principles of human social systems, what has been provided should serve as an adequate foundation for a continuing discussion. If we think about something analogous to building social systems, it leads to concepts such as artificially replicating them. We might, for instance, think in terms of robots which act out familiar human roles in familiar ways. Establishing first principles there is conceivable. If we are concerned about purposefully creating the social systems in which we live, the complexity raises enormously. It may be that the ways in which we think about design are simply not yet adequate.

Dynamic Systems

In dealing with human social systems (and truly, any real system), we are concerned with dynamic systems already in some state of development or evolution. Elements act as parts of systems to the degree that they are guided by the governing principle of the system. Systems also exist as parts of their relevant environments, and therefore respond to some degree to those governing principles as well. As described by Angyal (1941), this creates an ongoing balance between autonomy and heteronomy of the system. Systems can also reach varying states of homonomy with their environments, to the degree that all of the governing principles align.

If we design our world, can we build it?

As noted earlier, much of Western thinking about social structures has been dominated by assumptions of power, authority, hierarchies of organization, and so on. As noted by de Waal (2009), we need to be careful about those assumptions. But in thinking of terms such autonomy and heteronomy, what are the signals about governance to which we respond, relative to each of the systems of which we are parts? Religious organizations, for instance, are primarily systems of faith. They also, though, provide strong social connections for regular contact, support, affiliation, etc. Work organizations are primarily systems of organizing labor, tied to the economy. But they, too, provide many social connections. Both religious and work organizations are embedded in cultural environments to which they respond in different ways, just as examples.

In dealing with human social systems, we also face the complexity of dealing with individuals (agents) who not only act with autonomy, but who conceptualize the world symbolically and adapt through learning. To assume direct causality between signal and response would be naïve. Alternately, though, there are relatively stable and long-standing patterns of human behavior. Individuals fight and die in response to cultural, religious, and national systems of beliefs.

If we attempt to purposefully create such a system, what process should we use? Most approaches to social systems design place a great deal of emphasis on the participation of stakeholders. Banathy (1996) stated this more clearly than most:

> When it comes to the design of social and societal systems of all kinds, it is the users, the people in the system, who are the experts. Nobody else has the right to design social systems for someone else. It is unethical to design social systems for someone else. Design cannot be legislated, it should not be bought from the expert, and it should not be copied from the design of others. If the privilege of and responsibility for design is "given away," others will take charge of designing our lives and our systems. They will shape our future. (p. 228)

While Banathy's (1996) ethical convictions are more strongly stated, Cross (2011) echoes the same presumptions about participation in design:

> Even engineering design, traditionally seen as a strictly technical process, is in reality a social process of interaction and negotiation between the different participants who each bring to bear their own 'object world'—their own specific knowledge and awareness of aspects of the object being designed. His [Larry Bucciarelli's] thesis is that 'the process of designing is a process of achieving consensus among participants with different "interests" in the design, and that those different interests are not reconcilable in object-world terms … The process is necessarily social and requires the participants to negotiate their differences and construct meaning through direct, and preferably face-to-face, exchange.' (Cross, p. 20)

Inherent in these ideas, though, are deeper assumptions about the role of participants and outcomes. In many industrial processes, design is separate from production. The plan which results from the design is handed off to other individuals or groups who are tasked with varying stages of implementation. Particularly in Banathy's (1996) concepts for the design of social systems, stakeholders were to be both the planners and implementers of design. (Many organizational theorists believe the same about work groups or teams.) The underlying belief has been that involvement leads to commitment. In some cases, that is true, but it is a dangerous assumption on which to build a world. It also assumes a great deal of rationality about the entire process, from design to implementation to behavior.

From a rational standpoint, a social system might be guided by rules of behavior for its constituents. In reality, as soon as rules are established, some individuals will immediately begin finding ways either to avoid the rules or to manipulate them for their own gain. That is one of the creative aspects of agents which learn.

Goals for Our Systems

A critical question in considering design is the goals that we want to achieve. In this case, the key question may be the guiding principles around which we want our social systems to operate. This would influence not only the outcomes which are produced, but most likely the processes of design as well.

Attributes to consider as drivers of our systems could include fairness, equality, security, prosperity, peace, democracy, and justice. The problem is that these are not inclusive categories. Fairness, for instance, implies that each individual should get what is deserved—good or bad—according to some criteria. Equality implies that all individuals should get the same, regardless of their attributes or behaviors.

Security implies a focus on the protection of what exists. Prosperity implies an increase in the acquisition of resources, but not necessarily in equal or fair distribution. Democracy is a process of equal decision-making by all, irrespective of individual attributes. Justice implies the upholding of some higher standards.

For thousands of years, we have thought about social structures as largely governed by rulers, whether that was the chief of a tribe, or the king, queen, or president of a country. As noted earlier, Plato proposed his own idealized social system nearly 2,400 years ago. His primary concern was justice, and he believed that the ideal society rested upon the attributes of the rulers.

Plato and Social Systems

Plato (trans. 1973) thought in terms of social systems at the level of the state. States came into being out of collective need. "A State, I said, arises, as I conceive, out of the needs of mankind; no one is self-sufficing, but all of us have many wants… The barest notion of a State must include four or five men" (p. 53).

Within that, he anticipated the concept of division of labor:

> There are diversities of natures among us which are adapted to different occupations… We must infer that all things are produced more plentifully and easily and of a better quality when one man does one thing which is natural to him, and does it at the right time, and leaves other things (p. 54)

This notion of a natural order plays heavily into Plato (trans. 1973) ideals for the state, and is part of his concept of justice. As he proposed, "our State, if rightly ordered, is perfect" (p. 117); and "that one man should practise one thing only, the thing to which his nature was best adapted;—now justice is this principle or a part of it" (pp. 122–123).

Following the concept of *diversities of nature*, Plato believed that some people were naturally more suited as rulers than others. He is renowned for proposing the concept of the philosopher-king.

> Until philosophers are kings, or the kings and princes of this world have the spirit and power of philosophy, and political greatness and wisdom meet in one…then only will this our State have a possibility of life and behold the light of day (p. 166).

For Plato (trans. 1973), philosophers are those "who are lovers of the vision of truth" (p. 168). Future rulers were to be "by nature [lovers] of wisdom and knowledge;" and to unite in themselves "philosophy and spirit and swiftness and strength" (p. 61).

In order to produce such individuals, Plato (trans. 1973) proposed a combination of selective breeding and education. Some of the practices he suggested would seem draconian today, or even associated with the worst of racist beliefs. For instance:

> God proclaims as a first principle to the rulers, and above all else, that there is nothing which they should so anxiously guard, or of which they are to be such good guardians, as of the purity of the race (p. 105).

He went on to describe "gold and silver parents" contrasted with "brass and iron" (p. 105). His notion of purity of the race extended even to the suggestion that, "the offspring of the inferior, or the better when they chance to be deformed, will be put away in some mysterious, unknown place, as they should be" (p. 151).

Selecting the best individuals, though, did not presume that they would mature into the best rulers. Plato (trans. 1973) saw their potential going in both positive and negative directions, as he explained:

> Our philosopher follows the same analogy—he is like a plant which, having proper nurture, must necessarily grow and mature into all virtue, but, if sown and planted in an alien soil, becomes the most noxious of all weeds, unless he be preserved by some divine power (p. 182).

As for education, Plato (trans. 1973) was clear that there were two important subjects: "gymnastic for the body, and music for the soul" (62). These aligned with the "the two principles of human nature, one the spirited and the other the philosophical" (p. 101).

This was not, as many might imagine, though, a caste system, or one of royal bloodlines. The "inferior" offspring of rulers were to be "degraded" and the "naturally superior" offspring of lower classes were to be elevated, according to the natural order (Plato, trans. 1973, p. 112).

Education was seen as a means for improving the race as well:

> The State, if once started well, moves with accumulating force like a wheel. For good nurture and education implant good constitutions, and these good constitutions taking root in a good education improve more and more, and this improvement affects the breed in man as in other animals (p. 112).

Moreover, despite historic assumptions about the role of women, Plato (trans. 1973) advocated some level equality both in education, and in military service. As he explained, "if the difference consists only in women bearing and men begetting children, this does not amount to a proof that a woman differs from a man in respect of the sort of education she should receive" (p. 144). Women were to be allowed to "share in the toils of war and the defence of their country; only in the distribution of labors the lighter are to be assigned to the women, who are the weaker natures, but in other respects their duties are to be the same" (p. 147).

On one level, Plato appears to have been an elitist to an extreme degree. That was not reflected in the individual lifestyles of the rulers he described, though.

In the kind of society that Plato envisioned he saw taking the role a ruler to be a necessary burden rather than a powerful privilege. That required rulers who were selfless in their devotion to the good of others. Finding individuals willing to fill such a role meant not only finding and nurturing the right characteristics, but also motivating those individuals to serve.

Due to both nature and upbringing, the ideal ruler would not have been motivated by money or recognition, and would not have sought out a role in public office. They would therefore have to be pressed into service through fear of punishment. But as Plato (trans. 1973) explained, "*the worst part of the punishment is that he who refuses to rule is liable to be ruled by one who is worse than himself*" [emphasis added] (p. 31).

After all of this, the result of the selection and training was to be a life of austerity and sacrifice—the ultimate servant-leader. These guardians of the state were not to own private property of any kind. What they did own was only what would have been customary for a soldier. They would receive pay, but again, only similar to that for a soldier; just enough to live on. They were not to own, or even touch, gold or silver. "The diviner metal is within them, and they…ought not to pollute the divine by any such earthly admixture …" (Plato, trans. 1973, p. 106).

While this may sound like the vow of poverty, similar to that of a monk or priest, rulers were not denied marital relationships. The form of those relationships, though, was in keeping with a focus on the "good of the state." It was the ultimate commune. "The conclusion [was] that in the perfect State wives and children are to be in common; and that all education and the pursuits of war and peace are also to be common" (Plato, trans. 1973, p. 234).

For Plato, creating ideal rulers seemed to be virtually synonymous with creating an ideal state. As noted, they were highly interdependent. The proper environment and education had to be created in order for the desired qualities to mature, and creating such an environment was thought to improve the society as a whole.

What appear to be radical views, regarding both elite individuals and communal rights and responsibilities, take on a different tone in light of their relationship to state. This might be seen a Plato's version of the relationship between system and environment, or Angyal (1941) described it, between autonomy and heteronomy. As Plato (trans. 1973) expressed this, "justice, which is the subject of our inquiry, is, as you know, sometimes spoken of as the virtue of an individual, and sometimes as the virtue of a State" (p. 52). As regards first principles, for Plato, states were not formed from oak or rock (his analogies), but "the States are as men are, they grow out of human characters" (p. 235).

Moving from the individual to the state, at one level, Plato (trans. 1973) envisioned the potential for a tranquil existence in which:

> [Citizens] and their children will feast, drinking of the wine which they have made, wearing garlands on their heads, and hymning the praises of the gods, in happy converse with one another. And they will take care that their families do not exceed their means; having an eye to poverty or war (p. 56).

As to the ideal size of the state which Plato (trans. 1973) envisioned, he said simply, "I would allow the State to increase so far as is consistent with unity; that, I think, is the proper limit" (p. 112).

He compared this, though, to the creation of a luxurious state, where all manner of material delights were available. The result would be that "we must enlarge our borders; for the original healthy State is no longer sufficient. Now will the city have to fill and swell with a multitude of callings which are not required by any natural want" (p. 57). The outcome of continued growth and the need for excessive accumulation of wealth was war.

As for the governance structures of the state, Plato (trans. 1973) became more pragmatic regarding the forms which already existed. There were, in his view, five examples of governance, which reflected five "forms of the soul" (p. 137). Interestingly, he describes these in terms of how they tend to devolve from higher to lower forms.

Aristocracy (the government of the best) represents the ideal to which Plato strived. Much has already been said about his ideals for this type of society. Over time, conflicts would arise between the different classes in society about material wealth. The end would be the division of land and houses into individual ownership, and the neglect and even enslavement of the regular populace. This created *timocracy* (the government of honor)—a half-way point between aristocracy and oligarchy. In structure it would appear much as aristocracy, but with rulers who were less ideal and more inclined towards war and the possession of wealth.

Plato (trans. 1973) even explains the deterioration of character which tended to create timocracy. His example is that of a young person raised in a family where the mother criticizes the father as being inadequate in social standing and wealth. The conflict that this creates in the young person leads him to try to overcome his father's deficiencies in his own adulthood, and this focuses on wealth rather than virtue.

The deterioration in character of rulers then leads to oligarchy, "a government resting on a valuation of property, in which the rich have power and the poor man is deprived of it" (Plato, trans. 1973, p. 241). The concern for individual wealth becomes greater than the concern for the law, and these values spread through the society. Disparity in wealth grows, and eventually even citizenship is awarded only to those who can afford it. "They allow no one whose property falls below the amount fixed to have any share in the government" (p. 242). Ultimately, there are two states rather than one; the poor state and the rich state, always in conflict. At that point, protecting the state as a whole becomes a problem. If the rulers arm the general populace they could face more internal than external threat. If they do not arm them, they face the prospect of having to fight an overwhelming external army themselves. "And at the same time their fondness for money makes them unwilling to pay taxes" (p. 243).

As the oligarchy deteriorates, new social classes seem to appear. Upper classes that had only lived off the state become drones. People who formerly had wealth lose all property, but remain within the state. Paupers and criminals appear, and in an oligarchical state, "nearly everybody is a pauper who is not a ruler" (p. 244).

As rulers increasingly focus on their personal wealth, the character of the state degrades. The next form of governance to emerge is democracy, by which Plato (trans. 1973) means essentially a society functioning around the basest of human nature. "In democracies almost everything is managed by the drones" (p. 257). It is a culture lacking virtue or self-discipline. Rulers "refuse to curtail by law the extravagance of the spend-thrift youth because they gain by their ruin" (p. 247); that is, the youth become merely a part of the economy. In the end, the typical youth in such a society, "lives from day to day indulging the appetite of the hour… His life has neither law nor order; and this distracted existence he terms joy and bliss and freedom; and so he goes on" (p. 254). There is no virtue and no respect for authority. In the end, "the excess of liberty, whether in States or individuals, seems only to pass into excess of slavery" (p. 257).

The final state of governance is tyranny, in which Plato (trans. 1973) aptly describes the typical ruler:

> At first, in the early days of his power, he is full of smiles, and he salutes every one whom he meets…making promises in public and also in private liberating debtors, and distributing land to the people and his followers, and wanting to be so kind and good to every one… But when he has disposed of foreign enemies by conquest or treaty, and there is nothing to fear from them, then he is always stirring up some war or other, in order that the people may require a leader (p. 260).

In the end, even tyranny becomes its own ruin. As Plato (trans. 1973) explains it, the tyrant becomes a prisoner of his own condition. He can truly trust no one and therefore tends to isolate himself. More specifically:

> He has desires which he is utterly unable to satisfy, and has more wants than any one, and is truly poor, if you know how to inspect the whole soul of him: all his life long he is beset with fear and is full of convulsions and distractions, even as the State which he resembles… (p. 273).

Plato's (1973) ideal state never existed except in theory. It was his hope that, "if philosophy ever finds in the State that perfection which she herself is, then will be seen that she is in truth divine, and that all other things, whether natures of men or institutions, are but human…" (p. 188).

Making sense of Plato's ideas also requires some context. He lived during the classical period—the Golden Age—of Athens. It was a time of beautiful art and architecture, but also a time of wars between city-states. Maybe most importantly, it was a time of tremendous ideas emerging around the world.

The classical period of Athens set the stage for modern science, in trying to understand the natural world through principles of nature rather than purely mystical sources. According to Tarnas (1991), Thales and his followers…

> made the remarkable assumption that an underlying rational unity and order existed within the flux and variety of the world, and established for themselves the task of discovering a simple fundamental principle…that both governed nature and composed its basic substance (p. 19).

Succeeding theorists, like Democritus, furthered those ideas into concepts such as atomism, the idea that "All human knowledge was derived simply from the impact of the material atoms on the senses" (Tarnas, 1991, p. 22).

The end of the fifth century B.C. saw the rise of the Sophists. They continued the intellectual development which was characteristic of that day, but with an emphasis on humanism. As Tarnas (1991) captured it, "The ultimate value of any belief or opinion could be judged only by its practical utility in serving an individual's needs in life" (p. 27). Knowledge also became independent and subjective. There were no absolute truths.

The Sophists became popular as teachers and their views spread. The implications of these new ideas, though, were not just philosophical, they were also ethical. Tarnas' (1991) description helps to explain the concerns that Plato (trans. 1973) expressed. Rather than education being focused on the development of character, students learned to formulate arguments to support most any position, moral or not. As Tarnas describes the situation which developed:

> More concretely disturbing was the concurrent deterioration of the political and ethical situation in Athens to the point of crisis – the democracy turning fickle and corrupt, the consequent takeover by a ruthless oligarchy, the Athenian leadership of Greece becoming tyrannical, wars begun in arrogance ending in disaster (p. 30).

Plato witnessed the rise of human brilliance and the deterioration of human societies. Much of his struggle seems to have been in trying to reconcile the potential for perfect order with the realities of imperfection and chaos.

As described by Tarnas (1991), that struggle was most represented through the study of astronomy. Humans had long perceived the contrast between the perfect order of the heavens (the predictable movement of the moon and stars, and other bodies in space) and the often-unpredictable vagaries of weather, pestilence, fate, and so on, which dominated human life on Earth.

Plato's intellectual and philosophical heritage came down through Pythagoras, who saw mathematical patterns as representative of divine order. As stated by Tarnas (1991), "To uncover the regulative mathematical forms in nature was to reveal the divine intelligence itself, governing its creation with transcendent perfection and order" (p. 46).

The human search for truth and perfection, and the willingness for self-sacrifice in order to pursue those goals, was embodied in Plato's teacher, Socrates. He was, apparently, the model for the philosopher-ruler that Plato described. He was the recreation of the ancient Greek hero (Tarnas, 1991).

A Question of Relevance

Are Plato's ideals worth considering today? Readers will interpret his concepts in different ways. Some may dismiss them outright as being ancient and idealistic; as having no true relevance. Technologically, a great deal has changed in the last 2,400 years. Socially and politically, there are many similarities.

We still live in a world defined largely by sovereign nation-states, or countries. They constitute the legal boundaries for rights to land. They are the recognized, legitimate authorities for economies, militaries, laws and courts, etc. They define the rights and responsibilities for their citizens, they engage in official treaties and trade agreements, and they still wage wars as means of resolving disputes.

There are currently 193 members of the United Nations, and two official observer states (Vatican City and Palestine). The International Standards Organization (ISO), by contrast, lists 249 countries, dependent territories, and special areas of geographical interest (ISO 3166-1) for inclusion in their coding system. The World Factbook of the U.S. Central Intelligence Agency includes 226 sovereign states ("CIA—The World Factbook," n.d.).

By comparison with Plato's five forms of government, the *CIA World Fact*-book (n.d.) lists approximately 50 variations and combinations. Those include constitutional democracies, monarchies and republics; democratic and federal republics; parliamentary structures involving democracies, republics and commonwealths; five remaining Communist states (including North Korea, also a dictatorship); three pure monarchies; and the most common, pure republics.

As noted, they are the internationally recognized bodies of the world. All are intended to establish some form of stability, to create and protect valuable resources, and so on. They do not, however, represent all of the relevant entities and actors to which people respond or feel a sense of loyalty—not by a long shot.

A paper published as a result of a series of seminars on the role of nonstate actors in international politics (National Intelligence Council, 2007), describes a wide range of influential entities which they define as follows:

> Nonstate actors are non-sovereign entities that exercise significant economic, political, or social power and influence at a national, and in some cases international, level. There is no consensus on the members of this category, and some definitions include trade unions, community organizations, religious institutions, ethnic groupings, and universities… (p. 2).

They go on to give examples of such actors, including multi-national corporations, nongovernmental organizations, and super-empowered individuals.

Multinational Corporations

As one of the largest corporations in the world, ExxonMobil is an interesting example of a multi-national corporation. According to Coll (2012), ExxonMobil effectively operated at the level of a nation-state. As he describes the corporation which was created from the merger of Exxon and Mobil in 1999:

> A United Nations analysis, designed to calculate by more subtle measures the relative economic influence of particular companies and nations, concluded that ExxonMobil ranked forty-fifth on the list of the top one hundred economic entities in the world, including national governments, during its first year. Its net profit along—$17.1 billion that inaugural year—was greater than the gross domestic product of more than one hundred nation-states, from Latvia to Kenya to Jordan (p. 66).

Coll (2012) compares the influence of Lee Raymond, CEO of ExxonMobil at the time, with then-U.S. Vice President Dick Chaney:

> In protocol, power, and habit of mind, Raymond and Chaney were each, in effect, deputy heads of state – when they traveled, they met with kings and presidents, and perhaps ministers or chiefs of national oil companies, but rarely with anyone less powerful (p. 70).

Coll (2012) describes a meeting in Washington, D. C., at which Lee Raymond was asked about building more refineries in the US, as a matter of helping protect the country against energy shortages. His reply was, "'I'm not a U.S. company and I don't make decisions based on what's good for the US'" (p. 71). As Coll goes on to explain, ExxonMobil essentially developed its own foreign policies, in line with its need for securing reserves of crude oil (the essential factor affecting its stock price.) As oil reserves became increasingly nationalized, owned by nation-companies such as Saudi Aramco, ExxonMobil found itself negotiating with dictators in order to acquire new reserves.

ExxonMobil obviously was not, and is not, a recognized legitimate state, despite its size and wealth. It is, though, one of many large and powerful influences on recognized states. As noted by Coll (2012), ExxonMobil had easy and direct access to decision-makers in Washington, including the White House. In 2001 alone, it spent $6 million on lobbying efforts, largely for its own fulltime staff of employees devoted to influencing energy policies. Because of its global position it was also closely tied with national security agencies.

The reverse of this independent corporate status is also true. As noted in an article by The Economist (2011a):

> State-controlled companies account for 80 % of the market capitalisation of the Chinese stockmarket, more than 60 % of Russia's, and 35 % of Brazil's. They make up 19 of the world's 100 biggest multinational companies and 28 of the top 100 among emerging markets (par. 4)

As explained in the article, the East India Company, chartered in 1600, actually created the model for such companies. While not government-owned, per se, many of its investors were British politicians, and regular "gifts" to politicians were required in order to maintain its standing, and its monopoly rights on trade in the territories where it operated. By 1800, the company had grown into an entity which had its own standing army of 200,000 soldiers; ruled India (a country of 90 million people); controlled 70 million acres of land, and issued its own currency.

Super-empowered Individuals

Super-empowered individuals have taken on new prominence in recent years, influencing issues at an international level. Many of them have promoted and/or funded humanitarian efforts. That list includes former US Presidents Jimmy Carter and Bill Clinton. It also includes wealthy individuals such as Bill Gates and George Soros, and a long list of Hollywood actors and other entertainment stars. Other world figures such as Nelson Mandela have inspired us, and affected our views. In addition, there have been individuals promoting terrorism at an international scale, using inexpensive social media, to great effect. They are the "freedom fighters" for some.

The importance of the influence of super-empowered individuals is dramatized in a recent presentation and book by Lawrence Lessig (2011), a Harvard Law School professor. The problem in the US, as in many other countries, is the lack real democracy, even in those countries in which it is professed. As Lessig explains, there are essentially two election cycles for every official election. The first is the selection of the candidates by the political parties. The populace gets to vote only in the second cycle, and only for the candidates vetted by the parties.

Largely because of the cost of media advertising needed to become a viable candidate, one of the prime characteristics of a good politician is the ability to raise money. Even after being elected, that need does not stop. According to Lessig (2011), U.S. representatives spend between 30 % and 70 % of their full-time schedules involved in ongoing fundraising, in order to be prepared for the next election cycle.

Here, the influence of super-empowered individuals becomes critical. As Lessig (2011) explains, in the 2010 election cycle only 0.26 % (just over one quarter of one percent) of Americans donated $200 or more to any congressional candidate. Only 0.05 % donated the maximum of $2,400 to any candidate. And only 0.00024 % (750 Americans) gave $100,000 or more to any combination of federal candidates. The great majority of these individuals were associated with the financial industry.

These are still not the super-empowered, though. To understand that level of influence you have to know about Super-PACs (meaning *super political action committees*, or technically, *independent expenditure-only committees*.) Super PACs were legally created in 2010 legislation, allowing for organizations which "may raise unlimited sums of money from corporations, unions, associations and individuals, then spend unlimited sums to overtly advocate for or against political candidates" (OpenSecrets n.d.). In the 2012 election cycle, 99 individuals gave 60 % of the Super PAC money which was spent. According to a report in the Los Angeles Times (Los Angeles Times, 2012), 266 Super PACs spent $546.5 million in that cycle, mostly opposing candidates that they wanted to defeat.

Lessig (2011) goes on to explain that, in his view, it is the entire system which has become corrupted, relative to what was intended by the framers of the U.S. Constitution. The system no longer promotes democracy. Instead, it seems to attract donors who want to influence legislation for their own gain, and representatives who are individually ambitious. Between 1999 and 2004, 50 % of Senators and 42 % of House members left to become lobbyists (people paid to influence legislation.) The average increase in salary for the 12 House members studied was 1,452 %.

At the same time, according to polling data by the Gallup organization (Brown, 2013), approval ratings for the US Congress are at historic lows. As of April, 2013, nearly 80 % of the American public disapproved of the job that the political representatives were doing. The approval rating has not been above 25 % since November of 2009.

The connection between money and power is certainly not restricted the U.S., of course. A New York Times article (Barboza, 2012) reported significant accumulation of wealth by the family of the Chinese Prime Minister.

> Many relatives of Wen Jiabao, including his son, daughter, younger brother and brother-in-law, have become extraordinarily wealthy during his leadership, an investigation by The New York Times shows. A review of corporate and regulatory records indicates that the prime minister's relatives — some of whom, including his wife, have a knack for aggressive deal making — have controlled assets worth at least $2.7 billion (par. 4)

Evolving Nation-States

We are a long way from Plato's ideal of the servant-leader, philosopher-king.

Are there broader implications of these issues? The paper referenced earlier (National Intelligence Council, 2007) divides the nations of the world into three categories: "weak states, modernizing states, and developed/post-industrial states" (p. 4). As the paper elaborates:

> Weak states tend to be former colonial holdings that never made the transition to viable nationstate. Such governments as exist struggle to provide order to society, and will often resort to force in an effort to do so. Ethno-religious and tribal factionalism predominate over nationalism. Examples include Afghanistan, Somalia, Lebanon, Congo, and a host of others (p. 5).

Modernizing states represent 80 % of the current nations (National Intelligence Council, 2007). They tend to be highly centralized and bureaucratic; to suppress minority views; and to have significant overlap between government and economic interests. Examples include the BRIC countries (Brazil, Russian, India and China.)

Developed/post-industrial states have moved beyond a traditional sense of nationalism and absolute borders. The prime example there is the European Union.

North Korea is the most recent and extreme example of an absolute form of government. Power passed from the country's founder, Kim Il Sung, to his son, Kim Jong Il, and now to the next heir, Kim Jong Un, in unbroken succession. What began as rules for creating an independent, self-sufficient country turned into a system in which the ruling Kim at the time is (according to many accounts) worshipped as a god-like figure. Massive portions of the economy are spent in devotion to the ruler, and to the military, while the majority of the citizens live in abject poverty. News media and education are tightly controlled, and power is absolutely centralized.

According to Lee (2003), there were three essential tenets on which North Korea was founded: political independence, economic self-reliance, and military defense. Instilling these values in order to establish and strengthen the country put Kim Il Sung, its founder, in absolute control. As Lee explains,

> Kim Il Sung was the only one who could successfully wield and implement the philosophy. Thus, implementing and executing policies based on juche effectively consolidated Kim Il Sung's absolute political power and indirectly provided ideological justification for his dictatorship in North Korea (p. 108).

Deeper, there is a strong philosophical underpinning to juche. As Lee (2003) describes this:

> The *juche* idea is a *Weltanschauung*, or world view, that affirms the penultimate value of man's interests. According to *juche* ideology, man has ultimate control over the world and of his own destiny because he alone has *chajusong*, or creativity and consciousness. Adherents to the *juche* philosophy claim that this viewpoint of man as dominating and reshaping the world is a unique contribution of *juche* ideology to the body of philosophical knowledge (p. 109).

It is of no small interest that North Korea (the Democratic People's Republic of Korea) stands in such stark contrast to its neighbor, South Korea (the Republic of Korea), considered one of the *Asian Tiger* economies due to its rapid economic and social development since the 1980s. By culture and language, they are one people, but the lives they lead could hardly be more different.

South Korea began as a military dictatorship under the rule of Park Chung-hee. Its economic rise has been credited in various ways to *chaebol*, or large, industrial conglomerates such as Samsung and Hyundai. These firms began as family-owned operations with strong ties to the government, which helped to direct both foreign investment and technological assistance to them. There were challenges and criticisms about excessive power, poor relationships with labor unions, and the collapse of some large corporations in the financial crisis of 2008–2009. Today, South Korea is a member of the Organization for Economic Cooperation and Development (OECD), and its ranking in terms of democracy is on par with Japan. Their education system is excellent, and they are often considered a model of modern economic development.

According to an analysis by The Economist (2011b), "the Korean model had four distinctive features: a Stakhanovite workforce [exceedingly productive]; powerful conglomerates; relatively weak smaller firms; and high social cohesion" (p. 2). As in many cases, though, strengths can become weaknesses. The *chaebol* are prone to corruption in order to maintain power. They attract the best and brightest graduates, which creates much weaker small firms, and also stifles innovation and entrepreneurship. South Korea's population is aging rapidly, and their elderly are three times as likely to be poor as in other OECD countries ("South Korea's economy").

The Rise of Cities

There is another category that falls outside of the traditional nation-state, and yet is not exactly a non-state actor. The modern city plays a somewhat unique role in social systems today.

More than half of the world's population now lives in cities. Two recent reports by the McKinsey Global Institute (Urban World, 2011, 2012) focus on the growing economic importance of cities, and more specifically on what they term the City 600, defined as "the top 600 cities by contribution to global GDP growth from 2007 to 2025".

According to the MGI reports (Urban World, 2011, 2012), cities in general already create 80 % of global gross domestic product (GDP). Just 600 urban centers, though, account for 20 % of the total population, and over half of global GDP. By 2025, there will still be 600 top cities, hosting 25 % of the population, creating 60 % of GDP. The critical change, though, is that it will not be the same 600 cities. As stated in Urban World (2011), "By 2025, we expect 136 new cities to enter the top 600, all of them from the developing world and overwhelmingly (100 new cities) from China" (p. 1).

The current largest megacities (e.g. Tokyo, New York, London, Beijing, and Shanghai) are forecast to remain major economic centers. The greatest percentage of growth, though, will come from what MGI terms middleweight cities, currently between 150,000 and ten million inhabitants. Most of those will be in what are, at present, still developing regions of the world.

This rise of cities in the world presents both opportunities and potential problems. The challenge for social system design is summarized in the second MGI report (2012):

> Cities can be part of the solution to such stresses, as concentrated population center can be more productive in their resource use than areas that are more sparsely populated. But if cities fail to invest in a way that keeps abreast of the rising needs of their growing populations, they may lock in inefficient, costly practices that will become constraints to sustained growth later on. How countries and cities meet this rising urban demand therefore matters a great deal. Beyond the direct impact of the investment, their choices will have broad effects on global demand for resources, capital investment, and labor market outcomes (p. 2).

Just to note, the focus on cities has been growing for some time. IBM's original concept of Smarter Planet shifted towards a strategy on Smarter Cities, helping to bring the power of technology to the improvement of efficiencies in many kinds of services and infrastructure, from health care, to energy, to transportation, and so on.

Nation-Building

For better, and sometimes for worse, we are actively engaged in the creation and perpetuation of social systems every day. If we didn't participate, they wouldn't exist. We rarely think, though, about how we create them, consciously or not.

If we do happen to think about what we create, it tends to be in terms of specific disciplines such as architecture, urban planning, economic development, or maybe systems engineering. Design is connected to all of those, but not always directly—and rarely, if ever, at the scales which we have been describing here.

The closest that we may have come in recent centuries is through colonization. Rather than simply invading and enslaving another state, empires established new forms of governance in those states. A great many of our nations today emerged from being former British, Spanish, or French colonies.

Imposing new rules or laws on a people may elicit compliance, at least for a time. Reflecting back to Angyal's (1941) concepts of autonomy and heteronomy, an absolute autocracy is essentially absolute heteronomy (external governance). It creates what might be considered a *hive mind*, living out roles like insects in a colony, occasionally swarming in response to cues. It is difficult to keep humans living at that level, even if it were morally acceptable.

The human world today is a complex array of cultures and ideologies, intertwined with economic and political entities. Aboriginal tribes in Australia still maintain practices estimated to be 60,000 years old. The number and age of indigenous ethnic groups in Africa is hard to estimate. Chinese and Indian cultures date back more than 5,000 years. Hinduism may be 4,000 years old, with ancient roots much earlier. Buddhism, Confucianism, and Taoism, as well as the Greek roots of modern science, are 2,300–2,500 years old, or so. Christianity appeared 2,000 years ago, and Islam about 600 years later.

India is comprised of 35 states and territories speaking 22 official languages. Afghanistan has 14 distinct ethnic groups. In the modern megacities of the world, you find some variation of almost all of these differences: language, ethnicity, ideology, economic diversity, and so on.

This is all academic, until we face the implications for designing social systems.

In terms of artificially creating structural order in a state, colonization has been replaced by nation-building, or state-building. It is the means through which stronger countries attempt to establish favorable governance structures in places they deem necessary. According to Fukuyama (2004),

> The fact is that the chief threats to [the U.S.] and to world order come today from weak, collapsed, or failed states. Weak or absent government institutions in developing countries form the thread linking terrorism, refugees, AIDS, and global poverty (p. 1.)

As he further explains, "What we are really talking about is state-building—that is, creating or strengthening such government institutions as armies, police forces, judiciaries, central banks, tax-collection agencies, health and education systems, and the like" (p. 2). The problem, however, is that "no one has solved the more serious problem of how to implement the second phase of nation-building—the transition to self-sustaining indigenous institutions" (p. 6).

In the best cases, nations peacefully depose the rulers they no longer find adequate and replace them. Transitions of governments are expected in democratically-elected regimes.

In many cases, though, rulers do not leave so quietly. Hosni Mubarak stepped down as the President of Egypt in 2011, following large-scale protests, and was later replaced by Mohammed Morsi, the candidate of the Muslim Brotherhood. Morsi was later ousted in a military coup, and then the Muslim Brotherhood banned by the Egyptian courts.

Muammar al-Gaddafi managed to seize power in Libya through a bloodless coup in 1969, only to be killed in an uprising in 2011. The insurgents in that case were supported by NATO troops. Bashar Hafez al-Assad continues to wage what has become a civil war in Syria, with regional and international interests taking sides and offering support and assistance, hoping to influence the outcome.

The most extreme cases, of course, involve direct military overthrow of a government, as in the U.S. invasions of Afghanistan in 2001, and Iraq in 2003, following the September 11, 2001 attacks in the US.

The corollary to nation-building is often counterinsurgency, as described in a Field Manual of the U.S. Marine Corp:

> An insurgency is an organized, protracted politico-military struggle designed to weaken the control and legitimacy of an established government, occupying power, or other political authority while increasing insurgent control. Counterinsurgency is military, paramilitary, political, economic, psychological, and civic actions taken by a government to defeat insurgency… Political power is the central issue in insurgencies and counterinsurgencies; each side aims to get the people to accept its governance or authority as legitimate. Insurgents use all available tools—political (including diplomatic), informational (including appeals

> to religious, ethnic, or ideological beliefs), military, and economic—to overthrow the existing authority… Long-term success in COIN depends on the people taking charge of their own affairs and consenting to the government's rule (Counterinsurgency, 2006, p. 1)

To be clear, the U.S. Military had not initially approached either Afghanistan or Iraq as targets of counterinsurgency. While the concepts had been around for some time, they harkened back to frustrating losses from the Vietnam War, and the deep emotional wounds that had been left. It was only through the work of a small group of different-thinking military officers that the concept was applied to these current wars (Kaplan, 2013).

The building part of nation-building had long been an entirely separate effort, conducted through assistance and relief agencies, such as the U.S. Agency for International Development. In military terms, the needed work was sometimes referred to as *winning hearts and minds*. This is similar to a concept from Joseph Nye of Harvard, called soft power—persuasion through positive aspects, such as admiration and imitation of another culture.

The notable problem that General David Patraeus and his colleagues recognized was the aftermath of the battle. If you defeated the enemy, what was left? How did you now create a functional, stable society?

Counterinsurgency wisdom says that you leave soldiers in place until you reduce local violence. Eventually, local leaders emerge and order takes over.

A glaring omission in counterinsurgency planning would seem to be the larger concept of social systems design. If the goal is the conscious creation of a self-sustaining state with the potential to engage with other world nations, what might that look like from the beginning? In order even to begin, there has to be some sense of creating social systems—not just building and bridges, or power plants, or aid for starting businesses and trade. There has to be some understanding about the first principles from which human systems might be created.

According to Kaplan (2013), what remained in Iraq after the ouster of Saddam Hussein were the long-standing rivalries between Sunni and Shiite Muslims. These further splintered into warring groups. A key problem in the attempted rebuilding was that the Shiite-dominated Iraqi government itself was just another warring faction.

Similar problems arose in Afghanistan. Hamid Karzai was strongly supported by the coalition of Western countries, and elected to head the new government. Unfortunately, he lacked real legitimacy with the Afghan people, and the further his leadership deteriorated the stronger support for the Taliban regained. As the officially elected president, though, he was the legitimate head of state with whom other national leaders had to deal.

As of the writing of this chapter, the civil war in Syria has overtaken news headlines. There, the presidency has remained in the hands of the same family for four decades—again, a minority Shia-backed government ruling a majority Sunni population (Stack, 2013). Peaceful demonstrations which began with the Arab Spring in 2011 resulted in a violent response by the government and apparent use of chemical weapons on its own citizens.

There are massive issues of very complex realities that we will continue to have to face. There are calls for regime change in Syria, but with the threat of it becoming much like Iraq or Afghanistan; places of ongoing instability and lack of governance.

Similarly, some would advocate for a change of government in North Korea. It has long been considered a rogue state and with the entry of a new young leader, still in his 20s and apparently full of hubris, it presents challenges—if not immediate threats—to other nations. Given its proximity to South Korea, and both the commonalties and contrasts noted earlier, could the two not just be joined into one prosperous nation?

Germany might offer caution. According to a report by the New York Times (Kulish, 2012), the former West Germany has invested the equivalent of $2 trillion over the last 23 years, attempting to incorporate what was East Germany into a unified economy and social structure. And it still has a great deal of work to go. In all likelihood, that would be an easy task compared to the social structure and economy of North Korea.

More broadly, costs are an issue. The cost of arming and supporting one U.S. soldier in Afghanistan was reported to be $750,000 per year (Kaplan, 2013). Leaving tens of thousands of soldiers in foreign countries at that cost is simply unsustainable. (The cost of one Afghan soldier, by contrast, was $12,000.) Estimates of costs to US taxpayers for the wars in Iraq and Afghanistan begin at well over $1 trillion, and escalate rapidly depending on the variables included (e.g. future payments to soldiers and dependents for medical care, etc.)

Fundamentally, it is much easier to destroy than to build. It is one of the dark aspects of technology. Estimates of the cost for producing an improvised explosive device (IED) used in Iraq or Afghanistan vary, but by 2009 a Pentagon source put it at only $265 (Ackerman, 2011). (As expertise and production increased, costs decreased.) The costs of the pressure cooker bombs used by two young extremists at the Boston Marathon—for which the instructions were easily available through the Internet—were about $100. Two of those devices killed three people and injured well over 200.

Human ingenuity knows few bounds, especially when it is fueled by passion or hatred. Training terrorists to hijack and crash jetliners cost almost nothing compared to the destruction that resulted on September 11, 2001. Developing a shoe bomb created the next tidal wave of reaction. The budget for the Transportation Security Administration (those people responsible for all of the airport screening, amongst other things)—just one part of the U.S. Department of Homeland Security—was $7.9 billion in 2013 (U.S. Department of Homeland Security, 2013).

The U.S., of course, has thus far experienced nothing relative to the violence which occurs in other places around the world. The availability and simplicity of explosive devices only exacerbates the problems. Making highly sophisticated shoulder-fired missiles means that most any adolescent, with a little training, could use one. The latest state-of-the-art drone technology is bound to start showing up in undesirable places in the near future, mandating the development of anti-drone technologies. Cyber-attacks on high stakes targets, including security and financial institutions, are only likely to increase as well.

The costs of violence and disruption are not incidental. Assigning exact figures to them is difficult, and in the end not the most important factor. The simple correlation is that highly unstable social environments are not likely to attract investment capital or innovative people, or families seeking stable lives. High risk also demands high rewards, meaning that the associated costs rise, too.

Wealth and Happiness

An assumption of capitalism has been that improving economic conditions lead to improved satisfaction. There is logic to the argument, in that declining economic conditions certainly seem to make people unhappy. Presidents and other heads of state tend to have current economic conditions reflected in their approval ratings, as if they were responsible or could directly change the economy. Failing banks and job layoffs, in the extreme, send people into the streets to protest. Improving economies tend to pacify people—at least for a time.

Broader implications come into play when these assumptions are applied in global fashion (literally.) Western approaches to *helping* other nations, whether through military and political intervention, or simply through monetary aid and technical assistance, frequently focus on ending with improving economies. Usually, that implies creating industrial or technical jobs which can feed exports and links to regional or global trade.

There are two important points about wealth and satisfaction which need to be understood. The first is known as the Easterlin Paradox, or the happiness-income paradox, first described in 1974. This is summarized by Easterlin and Angelescu (2009), as follows: "at a point in time happiness varies directly with income, but over time happiness does not increase when a country's income increases" (p. 2). If you live in poverty and your income rises so that you begin having predictable supplies of food, shelter, clothing, and so on, income is a pretty direct factor. If you have at least a basic standard of living, the rest becomes relative. How are you doing in relation to other people, against whom you compare yourself?

The second point is that income disparity does matter. As explained by Muller (2013):

> Inequality is indeed increasing almost everywhere in the postindustrial capitalist world. But despite what many on the left think, this is not the result of politics, nor is politics likely to reverse it, for the problem is more deeply rooted and intractable than generally recognized. Inequality is an inevitable product of capitalist activity, and expanding equality of opportunity only increases it—because some individuals and communities are simply better able than others to exploit the opportunities for development and advancement that capitalism affords. Despite what many on the right think, however, this is a problem for everybody, not just those who are doing poorly or those who are ideologically committed to egalitarianism—because if left unaddressed, rising inequality and economic insecurity can erode social order and generate a populist backlash against the capitalist system at large (par. 2)

Economics is important, but not by itself. Amongst the many types of data which the Organization for Economic Cooperation and Development (OECD) produces, they have begun compiling a Better Life Index ("OECD Better Life Index," n.d.) The major categories evaluated in the index include: housing, incomes, jobs, community, education, environment, civic engagement, health, life satisfaction, safety, and work-life balance. As reported in the Wall Street Journal (Curan, 2013), Australia has been ranked the happiest industrialized country in the world for the third year in a row. That puts it ahead of Sweden, Canada, Norway, and Switzerland—and in sixth place—the United States.

Still, the WSJ report attributes the overall ranking to Australia's economy, including the fact that it has not had an economic recession in 21 years. Australians reported having less work-life balance than average OECD countries, and less leisure time. On balance, 85 % report being in good health, and their life satisfaction ranking was 7.2 out of 10. (The US actually had the highest self-report health ranking, at 90—conflicting with other evaluations of US healthcare—and a life satisfaction score of 7.0.) There were marginal differences across most of the other categories—enough to create the best overall scores for Australia.

A notable contrast to the OECD Better Life Index is captured in the World Happiness Report (Helliwell, Layard, & Sachs, 2012). A key finding explains the problems in the US:

> The world's economic superpower, the United States, has achieved striking economic and technological progress over the past half century without gains in the self-reported happiness of the citizenry. Instead, uncertainties and anxieties are high, social and economic inequalities have widened considerably, social trust is in decline, and confidence in government is at an all-time low. Perhaps for these reasons, life satisfaction has remained nearly constant during decades of rising Gross National Product (GNP) per capita (p. 3).

The problem is not that economics and satisfaction are unrelated; it is that the relationship is just not simple and causal. As they further explain:

> It is no accident that the happiest countries in the world tend to be high-income countries that also have a high degree of social equality, trust, and quality of governance. In recent years, Denmark has been topping the list. And it's no accident that the U.S. has experienced no rise of life satisfaction for half a century, a period in which inequality has soared, social trust has declined, and the public has lost faith in its government (p. 7).

The World Happiness Report includes data from three other large studies: the Gallup World Poll, the European Social Survey, and the World Values Survey. The major contrast in the World Happiness Report focuses on an alternative measure altogether. The Gross National Happiness (GNH) Index was developed in Bhutan. While it was officially adopted in 2008, its roots go back much further. As described in the report:

> The 1729 legal code, which dates from the unification of Bhutan, declared that "if the Government cannot create happiness (dekid) for its people, there is no purpose for the Government to exist" (Ura 2010). In 1972, the Fourth King declared Gross National Happiness to be more important than Gross National Product (GNP), and from this time onward, the country oriented its national policy and development plans towards Gross National Happiness (or GNH) (p. 111)

The GNH Index covers nine domains: psychological wellbeing, time use, community vitality, cultural diversity, ecological resilience, living standard, health, education, good governance. These are measured through 33 cluster indicators, which include 124 variables in total.

There is also a strong ethic which underlies this index, as was explained by the first elected Prime Minister of Bhutan in 2008:

> We have now clearly distinguished the 'happiness' … in GNH from the fleeting, pleasurable 'feel good' moods so often associated with that term. We know that true abiding happiness cannot exist while others suffer, and comes only from serving others, living in harmony with nature, and realizing our innate wisdom and the true and brilliant nature of our own minds (Helliwell et al., 2012, p. 112)

The Elements with Which to Work

It is important to remember that we are not discussing the building of a static, physical structure, but working to create a process which will continue to perpetuate itself through time, as it evolves in concert with its environment. This is not some new version of social engineering, through which human behaviors are simply manipulated in accordance with a central authority. It is the question of our ability, as individuals, to consciously shape the worlds that we inhabit.

Allen, Tainter, and Hoekstra (1999) make an important point in their research on Supply-Side Sustainability, saying that what makes resources renewable is the whole ecosystem and therefore it is the whole ecosystem that has to be managed and kept healthy. Related to this they remind us that we do not know how to manipulate ecological systems in detail because we have insufficient understanding of how they work. An encouraging fact is that "natural resource systems significantly rebuild themselves" compared to structures we make. (p. 18.)

Envisioning the situation from which we have to begin involves many, many layers of factors. As Bela H. Banathy used to admonish, we should not be constrained in our design by existing limitations of ideas and possibilities. We must exercise the freedom to envision what we truly want, and works towards it. At the same time, there are always realities that we will have to address—things that can change, but that will make a difference in some way.

Imagine, if you will, a three dimensional globe, like an online map. There are now well over seven billion of us on the planet. Paint that as the first layer of the graphic that you envision. That has to be segmented, of course, in many ways: by the places where we live; by age; by income; by education; by size of household; by ethnicity; by ideology. All of those things matter. Next add a layer showing resources, beginning with fresh water, energy, and food sources. Add another layer showing transportation routes—how people and things get from one place to another. Now add economics—the accumulations of wealth and how they move, including where jobs are located. Add military capabilities—trained and armed people, and stockpiles of weapons. Include a layer for information, with everything from where it gets generated and stored to where it gets used. Now add another layer for communications, describing the networks which represent the communities in which we participate, regardless of physical geography. Finally, add climate and natural change—the patterns of rainfall and drought, storms and floods, shifts of tectonic plates, etc. Those trace patterns in the fragile ecosystems in which we live. Now put it into motion, with all of the factors interacting over time.

Some people would refer to this as complex. It is a lot more than we could typically comprehend, much less model, accurately. Even so, many other factors might be added, all of which would make a difference. It all matters, and it is all tightly interwoven and interconnected.

Moving Forward

We are left with an array of challenges. The world is made up of dynamic processes which are not simply going to come to a halt while we ponder and plan. There are regular patterns of working, eating, sleeping, and so on, that people will continue while they can. Even in the most war-torn and poverty-stricken places, life finds ways to continue.

At the same time, every day is new. It is never just a copy of the previous day. Some days are filled with familiar patterns but others bring dramatic and unpredicted change.

Our visions for the future vary, as do our influences on it. Most of us feel little real power, but all of us participate in creating what comes about.

Some visions for the future are bright and shiny, based on promises of human ingenuity and technology. They see worlds rescued through science, in which humans continue to overcome the limitations of nature: fuels are grown through biochemical processes; food production continues to get more efficient; human biology becomes fully repairable, and so on.

Other visions see a world of righteousness, dominated by one view of theology or theocracy. The world will not be OK for them until that view prevails (and of course, in those minds, it will—for every different fundamentalist view that exists.)

Others see a continuing world of competition, with themselves at the pinnacle. After all, there will never be enough resources for the entire human race to live at the standards to which the elite aspire. For them, the best and brightest, the most skillful and well-bred, the strongest-willed and most cunning, should prevail.

Other views envision a world of natural tranquility—a Garden of Eden in which humans embrace nature and it embraces them back. For some, that might look like a return to old, indigenous ways, and for others, a new state yet unrealized.

For the majority of people, it's fairly safe to say that they would like the world to look a bit like themselves—compatible with their values, beliefs, needs and wants. Stability and familiarity tend to run high as priorities, even if on relative scales. That is a challenge in a massively connected and diverse world.

So where do we begin? It is fair to assume that technology will be increasingly integrated into our physical and social infrastructures. Siemens, IBM, and Cisco, for instance, all have variations of smart technologies. Siemens is working on smart grids as part of its sustainable infrastructures for cities efforts. IBM's work in

Smarter Planet and Smarter Cities has focused on three characteristics of smart technology; how it is instrumented, becomes intelligent, and is interconnected. Cisco's work includes its collaboration with the National Aeronautics and Space Administration (NASA) in developing Planetary Skin, a system for monitoring climate change and natural resources.

Integrated circuits (i.e. computer chips), RFID (radio frequency identification) chips, bar codes and scanners, video camera systems (connected to surveillance systems, embedded in cell phones, swallowed by patients, etc.), medical and scientific equipment, along with other current and future tools, all function as possible inputs—or sensors—as sources of data. In a white paper for Cisco, Evans (2011) traces the origins of the Internet of Things (or Internet of Objects) as a concept, back to a working group at MIT starting in 1999. (At the time, they focused mostly on RFID sensors.) By 2003, with 6.3 billion people on the planet, there were 500 million devices connected to the Internet. Somewhere between 2008 and 2009, the number of Internet-connected devices exceeded the number of people—well over 6 billion. Estimates are that by 2015 there will be 25 billion connected devices, and that will double again to 50 billion by 2020. (Evans makes a point of distinguishing between the Internet and the World Wide Web. He sees the connections to the underlying structure of the Internet as being the critical tie, not just to the Web as the common interface with which most people are familiar.)

Paralleling this projected growth, China has committed significant efforts and resources to its development of the Internet of Things (IoT). According to Voigt (2012):

> Beijing plans to invest 5 billion yuan ($800 million) in the IoT industry by 2015. The Ministry of Information and Technology estimates China's IoT market will hit 500 billion yuan ($80.3 billion) by 2015, then double to 1 trillion yuan ($166 billion) by 2020 (par. 7).

Wasik (2013) refers to this growing convergence of technology as the programmable world. He describes a progression which sounds much like IBM's three aspects of smart technology:

> The first is simply the act of getting more devices onto the network—more sensors, more processors in everyday objects, more wireless hookups to extract data from the processors that already exist. The second is to make those devices rely on one another, coordinating their actions to carry out simple tasks without any human intervention. The third and final stage, once connected things become ubiquitous, is to understand them as a system to be programmed, a bona fide platform that can run software in much the same manner that a computer or smartphone can. Once we get there, that system will transform the world of everyday objects into a designable environment, a playground for coders and engineers (par. 8)

The technological possibilities continue to bring us back to the larger questions. Who will direct, or control, or manage these systems—and based on what values?

In 2003, the US White House published a report titled The National Strategy to Secure Cyberspace (The White House, 2003). It summarized the concerns about the growing connectedness of key industries through the Internet. As it stated:

> Our Nation's critical infrastructures are composed of public and private institutions in the sectors of agriculture, food, water, public health, emergency services, government, defense

> industrial base, information and telecommunications, energy, transportation, banking and finance, chemicals and hazardous materials, and postal and shipping. Cyberspace is their nervous system—the control system of our country (p. vii).

The report went on to describe strategies whereby the Department of Homeland Security would work to address potential security threats.

In February, 2013, the New York Times reported that a computer security firm had traced large numbers of security attacks on American corporations and government agencies to a particular building near Shanghai, believed to be controlled by the Chinese military (Sanger, Barboza, & Perlroth, 2013). In May, 2013, the same newspaper ran another story, digging deeper into the computer hacking culture in China. As Wong (2013) reported:

> The culture of hacking in China is not confined to top-secret military compounds where hackers carry out orders to pilfer data from foreign governments and corporations. Hacking thrives across official, corporate and criminal worlds. Whether it is used to break into private networks, track online dissent back to its source or steal trade secrets, hacking is openly discussed and even promoted at trade shows, inside university classrooms and on Internet forums (par. 4).

In an interview with a Chinese hacker, Wong (2013) was offered a different view of the problem. Rather than being a state-funded conspiracy, it might just be a new arena for individual opportunism. As explained in the article: "'In China, everyone is struggling to feed themselves, so why should they consider values and those kinds of luxuries?" the former hacker said. "They work for one thing, and that's for money'" (par. 30.)

In the US, by contrast, the National Security Agency is opening the Utah Data Center in 2013, as part of the implementation of its Comprehensive National Cybersecurity Initiative (The White House n.d.). The $1.5 billion, one million square foot facility, will store data measured in zettabytes (i.e. one sextillion, or 10^{21}, bytes.) A partial list of citizen data to be stored there, according to information from the Domestic Surveillance Directorate ("Domestic Surveillance National Data Warehouse," n.d.) includes: internet searches; websites visited; emails sent and received; social media activity (Facebook, Twitter, etc.); blogging activity including posts read, written, and commented on; videos watched and/or uploaded online; photos viewed and/or uploaded online; music downloads; mobile phone GPS-location data; mobile phone apps downloaded; phone call records; text messages sent and received; online purchases and auction transactions; bookstore receipts; credit card/ debit card transactions; bank statements; cable television shows watched and recorded; commuter toll records; parking receipts; electronic bus and subway passes/ Smartpasses; travel itineraries; border crossings; surveillance cameras; medical information including diagnoses and treatments; prescription drug purchases; guns and ammunition sales; educational records; arrest records; and, driver license information.

The center will make use of the US Department of Energy's Titan Computer, which is capable of processing 20 trillion calculations per second. It is moving, though, towards having the first exaflop computer built by 2018, which could process one quintillion instructions per second. That would allow the NSA to "break the AES encryption key within an actionable time period and allow us to read and process stored encrypted domestic data as well as foreign diplomatic and military communications" ("NSA Utah Data Center - Serving Our Nation's Intelligence Community," n.d., par. 8). (The AES encryption key is the 256-bit, Advanced Encryption Standard, currently used for top-secret US government communications.)

Despite the fact that these programs had been authorized and under development for at least 10 years, and that information about them was publicly available, reports from a contract employee revealing information caused domestic and international outcries. Some people interpreted the programs as unprecedented breaches of privacy. Others defended them as necessary for national security. Yet others dismissed them as just newer examples of long-standing practices of spying by nation-states.

In reality, the issues only take us back to earlier questions:

What kind of world do we want, and what do we value? If security is our highest priority, whom do we trust to create that, and what are we willing to sacrifice in order to achieve it?

Evolving Systems

How, then, will this new, massively integrated world function? In theory, it should become much more efficient, and much better regulated. If we focus on existing processes (e.g. production, services, transportation, trade, etc.) then we could accomplish them using less time, energy and resources, and producing less waste.

What will this new world look like in the long-term, though? It could become much better at putting control into the hands of the few and the powerful. Looking again to the example of the East India Company, "It ruled millions of people from a tiny headquarters, staffed by 159 in 1785 and 241 in 1813" (The Economist, 2011a, par. 13). And while it was an incredible example of efficiency for its time, "Its dispatches to and from India for the 15 years after 1814 fill 12,414 leather-bound volumes" (par. 17). What if that same level of control could be accomplished simply by typing and executing a few lines of code?

It is also possible that technology could enable democracy in ways that could never be accomplished without it. According to a report from the International Telecommunications Union (International Telecommunication, 2012), approximately one-third of the people in the world use the Internet, but there were over six billion mobile phone subscriptions, equal to 86 % of the human population in 2012. If citizen participation and open government initiatives were taken seriously, the means for accomplishing them have never been better.

A total sum of opinions does not necessarily result in good decisions, though. There are issues about which being informed, and even educated, are important.

There are also issues about what drives and influences our decisions, and how they can be swayed. Values, beliefs, and senses of identity run deep. They directly affect how we process information, and often override rationality. At present, being either Sunni or Shiite is a distinction for which people are willing to die, and more important than any sense of nationality. Being Muslim versus Christian is an equally defining distinction. Black versus White, Chinese versus American, Hutu versus Tutsi, conservative versus liberal, gay versus straight, rich versus poor—all are distinctions which may cast people as "others" who cannot be understood or reasoned with.

In the midst of discussions about US counterinsurgency efforts in Iraq and Afghanistan, a question was raised by retired Army intelligence analyst Ralph Peters (2006): "What if they just don't want what we want?" (par. 21). Broadening the question, will we be able to find what we all want, or are even willing to live with?

In systems terms, the questions take us back to Angyal's (1941) distinctions of autonomy and heteronomy. Which systems are most strongly influencing the larger environments, and what factors in those environments are most strongly regulating the whole? In the context of this chapter, will we have a world dominated by powerful individuals, or economic actors such as multinational corporations, or autonomous city-states, or religious leaders and institutions?

Before leaping ahead too quickly, it is worth considering the complicated condition described by Emmerson (2013):

> The leading power of the age is in relative decline, beset by political crisis at home and by steadily eroding economic prowess. Rising powers are jostling for position in the four corners of the world, some seeking a new place for themselves within the current global order, others questioning its very legitimacy. Democracy and despotism are locked in uneasy competition. A world economy is interconnected as never before by flows of money, trade, and people, and by the unprecedented spread of new, distance-destroying technologies. A global society, perhaps even a global moral consciousness, is emerging as a result. Small-town America rails at the excessive power of Wall Street. Asia is rising once again. And, yes, there's trouble in the Middle East (par. 1).

The article from which the excerpt is taken was written in 2013. The excerpt describes situations in 1913, on the eve of World War I. It was an amazing time, and no one expected a catastrophe. As Emmerson (2013) goes on to summarize:

> In the end, technological advances, remarkable in themselves, change things much more than we can ever expect—the speed of adoption of new technologies is hard to predict, and the second- or third-order impacts of adoption even less so—but also much less. However new the technology, it is ultimately being grafted onto the rather old technology of the individual human, or the community, or the state. And even the newest of technologies can be manipulated for the oldest of ends (par. 11).

If Plato Ruled the Internet

Plato's philosopher-king seems never to have materialized in human form—or certainly not in recent times. Most of the governance structures of existing nation-states continue to devolve as he described. What might it be like, though, if Plato's principles governed the values and behaviors of the Internet as it evolves?

Those principles would not demand that everyone was equal, but would allow for each person to do the things to which he or she was best adapted. Its intent would be to move towards creating wisdom and knowledge. It would be governed selflessly for the good of the whole, not dominated by the greed of the few. There would be no rights by heritage. Influence over its direction would come through those most suited at the time to fulfill its purposes.

Homonomy

Homonomy was Angyal's (1941) term for dynamic harmony and balance between systems and their environments. As we consider the world that we might purposefully design, it is important again to remember our context. However sophisticated our Internet of Things, or other future innovations might become, they are still human inventions. They are tools that extend our limited sensory and cognitive abilities. It would be dangerous to assume that they could, or should, replace the self-regulating processes of the biosphere which have developed through millions of years of Earth's evolution. They may help us better understand how things work, but they should not fuel our arrogance about how and what we design. However impressed we get with our knowledge and abilities, we should never lose the wonder in a child's eyes about the beauty and the elegance of life—how it all fits together and keeps going without a single direction from us.

In 1990, Sagan convinced controllers at NASA to have the spacecraft Voyager 1 take photographs back in the direction of Earth from 3.7 billion miles away. His comments about the photograph have been captured in his own speeches, videos, and books, and widely quoted by others. Those remarks are most often referenced in terms of the "pale blue dot," which is all that could be seen of Earth in the photograph. As spoken by Sagan himself, captured in a recording, here are the excerpts:

> Look again at that dot. That's here. That's home. That's us. On it everyone you love, everyone you know, everyone you ever heard of, every human being who ever was, lived out their lives. The aggregate of our joy and suffering, thousands of confident religions, ideologies, and economic doctrines, every hunter and forager, every hero and coward, every creator and destroyer of civilization, every king and peasant, every young couple in love, every mother and father, hopeful child, inventor and explorer, every teacher of morals, every corrupt politician, every "superstar," every "supreme leader," every saint and sinner in the history of our species lived there—on a mote of dust suspended in a sunbeam… The Earth is the only world known so far to harbor life. There is nowhere else, at least in the near future, to which our species could migrate. Visit, yes. Settle, not yet. Like it or not, for the moment the Earth is where we make our stand… To me, it underscores our responsibility to deal more kindly with one another, and to preserve and cherish the pale blue dot, the only home we've ever known. (Sagan, 2009).

Whatever we design has to fit; it has to find rhythm and harmony with the rest of the natural order. We aren't likely to have many second chances on a global scale. For the same reasons we should dream large. We won't get many second chances to create the world that we really want.

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An Epic Learning Journey: From the Club of Rome to Dialogic Design Science and DEMOSOPHIA

Alexander N. Christakis

Abstract Dialogue is a vehicle for understanding cultures and subcultures in organizations. And organizational learning depends upon such cultural understanding. It facilitates the development of a common language and collective mental models. Thus, the ability to engage in dialogue becomes one of the most fundamental and most needed human capabilities. Dialogue becomes a central component of any model of evolutionary transformation [Banathy (2000). *Guided evolution of society: A systems view*; Quoted by Christakis, A., & Bausch, K. (2006). In N. Roberts (Ed.), *Transformative power of dialogue*].

Keywords Club of Rome • DEMOSOPHIA • Dialogic design science • Dialogue • Ekistics • Problematique

Introduction

When Gary Metcalf asked me to write a chapter for the book Social Systems and Design, and proposed such an inspirational title, I realized that he was asking me to write an autobiographical chapter based on my learning journey. The professional journey started with the experience of the Club of Rome and my good friend and mentor Hasan Ozbekhan in the 1970s. It was followed by my association, in the last 40 years, with many systems thinkers, such as John Warfield, LaDonna Harris, Bela Banathy, Erich Jantsch, Enrique Herrscher, West Churchman, Ken Bausch, Norma Romm, Reynaldo Trevino, Roxana Cardenas, Ioanna Tsivacou, Kevin Dye, Tom Flanagan, Peter Jones, Yiannis Laouris, and many more. All of these colleagues have contributed to the research, development, and testing of the science of dialogue, which is the main theme of this chapter. I am grateful to all of them for being partners on the road. I will try to tell the story of my learning journey by

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highlighting some milestones of my professional and personal life. These two facets of my journey are strongly intertwined in a way that it is almost impossible for me to talk about one without relating it to the other. So I am not really sure myself whether this chapter can be called *scientific biography* or *biographical science*. Maybe the distinctions we draw between the personal and the professional lives are useful for languaging purposes, but are not truly relevant to our life experiences.

The personal journey, like any actual journey, begins from a port; the port of Piraeus in Greece, where in September of 1956, at the age of eighteen, I had to say good-by to my parents, and board an ocean liner that brought me, after thirteen days of sailing, like a modern Odysseus, to New York City. From New York, I caught a train and went to Princeton University in New Jersey, to study physics. I was fortunate, during these 3 years of undergraduate study at Princeton, to have as my thesis advisor the great theoretical physicist, John Archibald Wheeler. He taught me early-on his theory of *geometrodynamics*, related to the black holes, as well as Einstein's General Theory of Relativity (GTR). My undergraduate thesis, which Wheeler thought should have been published, was focused on finding rigorous solutions to the GTR differential equations. Unfortunately, my work in physics at the graduate school level was not as inspiring as what I was able to accomplish with the tutoring of Professor Wheeler, which is a testimonial on the influence teachers and mentors have on our life journey.

From Physics to Ekistics

I graduated with a Bachelor of Arts from Princeton in 1959, and went to Yale University to study theoretical nuclear physics with Professor Gregory Breit, another distinguished physicist of the twentieth Century. However, my experience at the Yale graduate school was very disappointing, particularly when compared to my undergraduate studies at Princeton, where I was encouraged to think creatively. After obtaining the Ph.D. degree in physics in 1964, my enthusiasm for the science of physics had diminished. I did not want to continue my career as a physicist. At the request of Professor Breit, I spent one year as a post-doctoral fellow and instructor at Yale. In 1965, I left Yale with my wife, Lenna Saranti, who also had completed an MS degree in theoretical chemistry at Yale, along with our two sons, 3-year old Nicholas, and 1-year old Dimitri, to return by another ocean liner to Greece to join the Greek army. My intention was to spend the rest of my life in Greece; however, one month after the completion of my service in the Greek army, i.e., in April 21 of 1967, there was a military coup in Greece. Living under a military dictatorship reinforced my belief in the value of freedom and democracy for humankind (Christakis, 1993). Circumstances forced me to leave my country again, this time in order to escape the dictators.

After finishing my first year of basic training in the Greek army, I was assigned, because of my Ph.D. degree in physics, to the Democritus Nuclear Laboratory in Athens. My job was to help a group of theoretical physicists, who were working on high energy physics at the Democritus laboratory. As I already had my own family to support, I tried to find a second job during the evenings, after the Democritus lab shifts. I heard about the Doxiadis Associates consulting firm in Athens, and I arranged an interview for myself. I was lucky to be interviewed by the owner and the founder of the company himself, the famous Greek Architect/planner Constantinos Doxiadis. Strangely enough, as he didn't know me and was actually meeting me for the first time during that interview, he hired me on the spot as his personal consultant. My job was to help him invent *the science of human settlements*, which he had defined as *Ekistics* from the Greek word "Οίκος (Ekos)", which means *home* (Doxiadis, 1968). Doxiadis' vision was to make the science of Ekistics as elegant and rigorous a science as physics; that was the main reason that he had hired me. He wanted me to work in his large interdisciplinary consulting firm, engaging a variety of professional disciplines, such as Architecture, Engineering, Sociology, Economics, Urban Planning, etc. I was the only physicist.

During the years that I worked for the Doxiadis Associates firm, I had the good fortune to participate, despite the fact that I was too young (in my thirties), at the *Ekistics seminars* that Doxiadis was organizing every summer in Athens. At these seminars, prominent thinkers from all around the world were invited to participate; for instance the American anthropologist and systems' scientist Margaret Mead, the British historian Arnold Toynbee, the American environmentalist Barbara Ward, and many more. In the summer of 1967, during the Ekistics seminar of Doxiadis, I met Hasan Ozbekhan. Hasan was at the time the Director of Planning for the System Development Corporation (SDC), an offshoot of the Rand Corporation Think Tank, located in Santa Monica, California.

Ozbekhan and Doxiadis were both visionaries and became good friends. They agreed to start a new venture focusing on integrating information technology, which was the expertise of SDC, with the urban planning experience of Doxiadis Associates. The new venture was named Doxiadis-System Development Corporation (D-SDC). It was to be located in Washington, DC. I was assigned the role of the Director of Research of D-SDC. So in 1967, I was lucky to escape the military dictatorship and move with my family to Washington, DC.

From 1967 until 1970, I developed with my D-SDC colleagues a variety of mathematical models for the new science of Ekistics by using my physics training. Some of these models were employed for making population and employment projections and distributions for an urban development project of D-SDC in Detroit, Michigan, funded by the Detroit Edison Electric Company. This futuristic project was focusing on the development of the Urban Metropolitan Detroit Area to the year 2000, i.e., 30 years into the future. It was during that period of my life, from 1967 till 1970, that I realized the futility of trying to apply the science of physics in developing the science of Ekistics (Fig. 1). It became clear to me that these two sciences belong to two distinct phases in the evolution of science. I will say more about this fundamental distinction between physics and Ekistics, when I discuss the three phases of the evolution of science.

Fig. 1 The domains of Ekistics

The Club of Rome

In the late 1960s, Aurelio Peccei, an Italian industrialist and philanthropist, was traveling around the world meeting with world leaders and trying to persuade them that there was an impending unprecedented global crisis. Peccei had written a book titled *The Chasm Ahead* (Peccei, 1969). In this book Peccei was making the prediction that there was an ever-growing gap between the technologically developed North America and the rest of the world, including Europe. He was forecasting that this technology gap would materialize in the next 20 years in a major global crisis between the *developed* and the *less developed* regions of the world, unless some measures were taken by world leaders to close the gap.

Even though Peccei dedicated all his energy and significant personal resources to influence the stream of world events, he gradually came to the conclusion that he was not very effective in his discussions with world leaders. In 1968, at a conference in Belaggio, Italy, Peccei met Hasan Ozbekhan. Hasan had delivered a very inspiring lecture at the conference titled "A General Theory of Planning." This lecture was published later as a chapter in a book titled *Perspectives on Planning*, edited by Jantsch (1969). When I read this chapter in 1970, I found it as elegant as Einstein's General Theory of Relativity that I had studied with Wheeler at Princeton. At the Belaggio conference Ozbekhan and Peccei became very good friends.

As mentioned earlier, Ozbekhan had worked as the Director of Corporate Planning for SDC. In the 1970s Ozbekhan was considered by management gurus, such as Peter Drucker, one of the most prominent planning theoreticians. This was the golden era of systems thinking, and California, with such famous think tanks as the Rand Corporation and SDC, was the Mecca of the systems approach

(Churchman, 1979). Ozbekhan proposed that Peccei employ the systems approach for studying the global crisis. The idea was to employ the findings of a systems approach study in his discussions with the world leaders, in the hope that it will increase his effectiveness.

Peccei accepted the proposal and the two men agreed to a new strategy for the future. A think tank was created named The Club of Rome (CoR). The mission of the CoR, the headquarters of which were to be located in Geneva, Switzerland, would be: (a) to conceptualize the new systems approach for the global crisis, and (b) to fund projects by researchers around the world. All the projects would be focusing on the impending global crisis, as anticipated by Peccei.

An Executive Committee of the CoR was formed, consisting of a diverse multicultural group of members representing such countries as England, the Soviet Union, Germany, Austria, Hungary, Switzerland, Italy, the U.S.A., and many others. The Executive Committee commissioned Ozbekhan to write the prospectus of the CoR. He produced within six months the first draft of the prospectus titled "The Predicament of Mankind" (Ozbekhan, 1970). Towards the end of 1969, Ozbekhan, with whom I was collaborating in the context of the D-SDC, hired me as a consultant to the Executive Committee of the CoR.

The Predicament of Mankind prospectus was completed in 1970. The subtitle of the document was "Quest for Structured Responses to Growing Worldwide Complexities and Uncertainties." The prospectus was distributed to the executive committee, the 60 members of the CoR, and a variety of philanthropic foundations and institutes, such as The Rockefeller Foundation, The Volkswagen Foundation, The Battelle Memorial Institute, and others. A number of prominent systems scholars, such as Erich Jantsch and West Churchman, reviewed the document.

The reviews of the Prospectus were mixed. Some reviewers acclaimed it as a revolutionary contribution. Others, especially those trained in traditional analytic disciplines, like systems engineering and economics, thought the document was lacking in methodological rigor. Most of these latter reviewers did not realize that the prospectus was intended as an architectural design, rather than an engineering blueprint. Implicit in the prospectus was the research and development of a new systemic methodology for engaging the voices of the stakeholders in creating alternative futures.

In retrospect, the prospectus incorporated the seeds for a paradigm shift in designing social systems. It was sufficiently iconoclastic to be rejected by those in the analytical sciences and engineering community that were accustomed to the practice of normal science (Kuhn, 1970). These scientists were reluctant to consider the need for a shift to a new paradigm, just like in the age of Galileo the Catholic Church was not willing to shift from a geocentric to a heliocentric explanation of the planetary system. On the other hand, West Churchman was among the systems thinkers and philosophers that expressed great enthusiasm for the prospectus. Later, Ozbekhan and Churchman taught together at the Social Systems Sciences program at the Wharton School of the University of Pennsylvania, a very progressive systems science program established by Russell Ackoff during the 1970s.

As an example of the iconoclastic character of the prospectus (Ozbekhan, 1970), I will quote below two paragraphs included in the Introduction:

> The source of our power lies in the extraordinary technological capital we have succeeded in accumulating and in propagating, and the all-pervasive analytic or positivistic methodologies which by shaping our minds as well as our sensibilities, have enabled us to do what we have done. Yet our achievement has, in some unforeseen (perhaps unforeseeable) manner, failed to satisfy those other requirements that would have permitted us to evolve in ways which, for want of a better word, we shall henceforth call 'balanced.' It has failed to provide us with an ethos, a morality, ideals, institutions, a vision of man and of mankind and a politics which are in consonance with the way of life that has evolved as the expression of our success. Worse, it has failed to give us a global view from which we could begin to conceive the ethos, morality, ideals, institutions, and policies requisite to an interdependent world— this, despite the fact that the dynamics of our technologies and our positivistic outlooks are global in their impacts, their consequences, their endless profusion and, more importantly, in the promises they proclaim and in the promises they imply.
>
> This failure is often regarded as having created a number of separate and discrete problems capable of being overcome by the kind of analytic solutions our intellectual tradition can so readily generate. However, the experience of the past 20 or 30 years has shown with remarkable clarity that the issues which confront us in the immediate present, as well as their undecipherable consequences over time, may not easily yield to the methods we have employed with such success in the bending of nature to our will. Such apparent resistance could be attributable to many things, none of which must be pre-judged, but about which certain assumptions might be made. It could be due, for instance, to the magnification of the problems we must grapple with—that is, to the fact that almost all of them are global in scope, whereas the socio-political arrangements we have created are ill-equipped for dealing with issues that fall outside their strictly established jurisdictions. It could be due to heightened yet often obscure interactivity among phenomena, whereas our manner of solving problems owes its strength and efficiency to the identification of rather clear and direct lines of causality. It may be due to rapid rates of change, especially in the technological sector, whereas our institutions, outlooks and minds are geared by long-time habit to beliefs in slow unfolding and permanence -- beliefs which have sustained certain relatively stable concepts of polity, of social order and of intellectual orderliness. In brief, whatever it is due to, the conjuncture of events that surrounds us is to all evidence world-wide, complex, dynamic, and dangerous.

At the beginning of the twenty-first century, the statements above, written in 1970 by Ozbekhan, appear apocalyptic, and even more applicable and relevant to the *wicked problems* we are facing today. The agglomeration of 49 Continuous Critical Problems (CCPs) identified and included in the CoR prospectus, was named by Ozbekhan the Global *Problematique*, in order to draw a distinction between *ordinary problems* and *wicked problems*.

It is not my intent in this chapter to engage in revisiting the power of the concepts so masterfully described in the CoR prospectus. I have done this elsewhere. There are, however, two concepts of the prospectus that I will discuss because they were instrumental and foundational in subsequent work by many researchers in the development and validation of the Dialogic Design Science (DDS) (Banathy, 1996; Christakis, 1973, 1993; Christakis & Bausch, 2006; Christakis & Brahms, 2003; Flanagan & Christakis, 2010; Laouris & Christakis, 2007, Magliocca & Christakis, 2001; Warfield, 1994, 1999; Warfield & Cardenas, 1994; Warfield & Christakis,

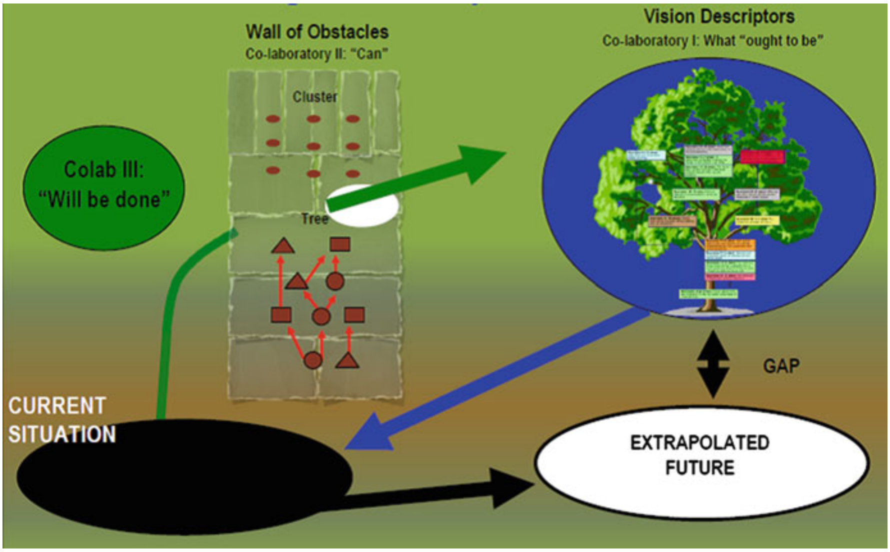

Fig. 2 Retroductive design and development frame

1987). The first concept is that of the *Problematique*, and the second is the idea of the *value-base*. It is important to appreciate both of these concepts, as well as the crucial role they played in the development and evolution of the science of dialogic design. I will use the diagram in Fig. 2 to discuss these two ideas and make them more transparent.

In Fig. 2 one can see the projection of the data base of the *current situation* to produce an *extrapolated future*. This future is based on historical data and trends of the past and present, such as population growth rates, social and economic events and trends, resource availability and depletion, and the like. The MIT systems dynamics model, funded by the CoR Executive Committee in 1970, which later produced the "Limits to Growth" report (Meadows, Meadows & Randers, 1972), corresponds to the extrapolation of the 1970 data base. When this report became public 2 years later, with a promotional event at the Woodrow Wilson Center in Washington, DC, it had a major impact in a variety of academic and governmental organizations. The report forecasted an environmental pollution and resource depletion crisis by the year 2050 unless some new policies were adopted and implemented by the world leaders. This projection of the 1970 data base into the future, just like the projections of the D-SDC team for the Urban Detroit Area population and employment to the year 2000, was informative in terms of predicting the critical future; however, it was based primarily on the value-base and worldview of the MIT team that constructed the systems dynamics simulation model, without any public input from the people of the world. It was basically an *elitist model* void of the diverse value-bases and voices of people from all walks of life, which was the initial intent of the CoR prospectus.

The value-based conceptualization of an *ideal future* with public input, namely of *what ought to be*, is shown in Fig. 2 as "the tree of a visionary anticipation." An ideal future can only be meaningfully constructed, and more importantly implemented, by engaging the voices of the stakeholders in a democratic dialogue. Unfortunately, at the time of the conceptualization of the CoR prospectus, no science-based democratic dialogue methodology was available for engaging stakeholders in imagining ideal futures. It was the lack of a scientific methodology for dialogue in 1970 which prompted members of the Executive Committee of CoR to criticize the prospectus as not being capable of implementation. They preferred to support the more pragmatic approach of an extrapolated future produced by employing the systems dynamics simulation model of the MIT team. I still have vivid memories of the conference at MIT in 1970, at which members of the Executive Committee, especially Eduardo Pestel, a German Mechanical Engineer, were fascinated by the novelty of computer model projections to the year 2050 and beyond. These projections were in essence self-defeating prophesies for humankind, instead of self-fulfilling images of a desirable future.

At a May 2012 conference in Washington, DC, the purpose of which was to revisit the "Limits to Growth" report 40 years later, a co-author of the report acknowledged that only a country with an autocratic governmental structure, such as China, would have had the power to dictate and implement the policies of the report. This is indeed an ironic testimonial about the lack of sensitivity to this day, by the authors of this report, of the significant advantages of democratic governments versus dictatorships. Imagine standing in front of a large audience at the conference in Washington, DC, with representatives from government and academia, and advocating that only an oppressive governmental structure would have been capable of preventing the global crisis they had predicted in 1972.

It is amazing to me that the authors of the report still ignore the critical role which public ownership of the *Problematique* can play in mitigating the catastrophe of the extrapolated future. In more than 40 years of practicing democratic dialogue in the arena, I have come to the conclusion that, *unless the stakeholders own the definition of their Problematique, progress towards its resolution is not plausible*. Stakeholders' ownership of their *Problematique* necessitates their authentic participation in the dialogue that defines it. A *Problematique* discovered and owned by the stakeholders is by far superior to the one delivered to them by political and academic elites. Colaboratories of democracy were invented and developed specifically with the intent to satisfy the requirement of engaging stakeholders in creating desirable futures (Christakis, 1973). By enabling people from all walks of life to create their futures, colaboratories are capable of helping stakeholders define and own their *Problematiques*, and consequently to implement those actions necessary for avoiding the perpetuation of the extrapolation of the present. (See a video produced by Jeff Diedrich on the Israeli-Palestinian conflict: Act Beyond, 2010.m4v, 2010).

Furthermore, the inability of the reviewers of the CoR prospectus to recognize the Global *Problematique* as the manifestation of the dissonance (or gap) between the idealized future and the extrapolated future (as shown schematically in Fig. 2, was a major consideration in not funding the CoR prospectus. As a consequence of this decision by the Executive Committee, Ozbekhan and I resigned from the Club. He proceeded to join the Wharton school at the University of Philadelphia, and I joined the Academy for Contemporary Problems, established by the Battelle Memorial Institute.

Figure 2 also displays graphically the important distinctions between the *ought to be*, the *can be*, and the *will be*. Ozbekhan wrote a paper titled "The Triumph of Technology: Can implies Ought" (Ozbekhan, 1968). The principal idea in his paper was that *feasibility* dictates *desirability*. We do what *we can do*, instead of doing what *we ought to do*. In the diagram the feasibility of the "can be" is shown by a "wall of barriers or constraints," preventing the stakeholders from attaining their idealization. Just like the ideal future is constructed with public input, the wall of barriers is also constructed by a colaboratory engaging the stakeholders in a dialogue that focuses on the identification of barriers and their linkages. Finally, a third colaboratory focusing on the *will be done*, enables the stakeholders to construct a transition scenario on how to change the current situation and approximate the ideal future. (For details see DialogicDesignScience: Matrix of Co-Laboratory Archetypes.)

In 2012, the colaboratory methodology was applied in creating a desirable future for a group of 15 wine villages in the Troodos mountain region of Cyprus. This application, implemented under the auspices of the Cyprus Academy for Public Administration (CAPA), with funding from the European Commission, is an exemplar of participative democracy to be emulated in other regions of the world. It has been written in a report in Greek by Maria Kakoulaki, a journalist from Crete. Marios Michaelidis, a Cypriot with more than 20 years of experience in the application of the science of dialogue in a variety of settings, including bi-communal colaboratories involving Greek and Turkish Cypriots, was the leader of this application. At this writing this project is being implemented with the commitment of the villagers and their leaders.

Colaboratories are capable of making the stakeholders cognizant of the feasibility constraints, as captured by the wall of barriers, but do not permit the *feasibility logic* of the *can do* to dominate the dialogue and the logic of creating the idealized future. The distinctive logic of *the ought to do* guiding the design of the *will do*, should be understood as being complementary to the traditional deductive and inductive logics dominating the first and second phases of science—to be discussed later in the axioms of the science of dialogic design. This alternative type of logic is referenced in the literature as *retroductive* or *abductive* logic. It is attributed to the American philosopher of the twentieth century Charles Saunders Pierce (Apel, 1981). It is the type of logic that is useful for theorizing or hypothesizing. Retroductive logic belongs to the Third Phase of science.

Finally, it should be pointed out that after 40 years of research, development, and testing of the colaboratory methodology in the arena (Christakis & Bausch, 2006), we have accumulated sufficient empirical evidence to make the assertion that it represents the correct response to the planning challenge articulated by Ozbekhan in the paper he delivered in the Belaggio conference in 1968, titled "Toward a

General Theory of Planning" (later published in Jantsch, 1969). Quoting from this paper:

> Is there anyway to free us from the present – or, what can we do to *will* the future? In my view there is no more important question in planning discourse; it is truly the heart of the matter.
>
> Let me begin by saying. "Yes, we can will the future," but only if change is caused to occur in values rather than an object's other attributes.
>
> What I mean is that any change that is not a fundamental change in values merely extends the present rather than creating the future. It seems to me that from this general postulate one can derive five statements which govern all planning.
>
> 1. Only change in the overall configuration of values can change the present situation.
> 2. Only individual will can bring about such value changes.
> 3. Value changes cannot be predicted.
> 4. Value changes always occur as individual ideas, or responses, or insights concerning betterment, and when they become socialized over a large part of the system we have "progress."
> 5. Planning is the organization of progress (pp. 93–95).

Planning is the organization of progress. Thus the main subject of planning is the *willed future.* All these ideas about planning and designing are encompassed in the foundation domain and the axioms of the science of dialogic design, and will be discussed later in this chapter.

The "DEMOSOPHIA" Paradigm

The scientific revolution (Kuhn, 1970) for the science of dialogue started in the 1970s (Christakis, 1973). It was a consequence of the failure of the Executive Committee of the Club of Rome to appreciate the two fundamental concepts of the prospectus discussed above, namely: (a) the nature of the Global *Problematique*, and (b) the role of the value-base in creating alternative futures. The new paradigm has been called DEMOSOPHIA, which in Greek means the "wisdom of the people" (Christakis, 1993). The name implies a paradigm shift from "the power of the people", which is the Greek meaning of the word democracy, to the "wisdom of the people". The rationale of the new scientific paradigm is founded on the notion that uncovering the wisdom of the people is the necessary, but unfortunately not sufficient, prerequisite for the people to exercise their power. The contemporary dominant pseudo-democracies will eventually be transformed, with the advent and appropriate utilization of the Internet technologies and platforms, to produce the wisdom of the people in the context of authentic democracies that are similar to the Athenian Republic (Laouris & Christakis, 2007; also see Funeral Speech of Pericles from Athens Democracy.)

However, in light of the escalating wickedness of the contemporary Global *Problematique*, is it reasonable to expect today to uncover the wisdom of the people without the support of a science of dialogue coupled to appropriate technology? We know, for example, that dialogue on contemporary *wicked problems* is on the average one order of magnitude more complex, as measured by the Situational

Complexity Index (SCI) of the science of dialogue (Christakis & Bausch, 2006), than the dialogue that was practiced 2,500 years ago by the citizens of Athens in the Golden Age of the Athenian Republic.

A series of experiments at a large research institute in the early 1970s, focused on answering the question of managing *interdisciplinary dialogue*. A group of researchers, working at The Academy for Contemporary Problems realized the importance of applying science to the challenge of reinventing the process of the dialogue. After conducting several experiments on complex design tasks, such as using a group of experts in a variety of disciplines to design a hypothetical new city of one million people, they realized that a new scientific paradigm was needed if the experts from diverse disciplines were to engage in productive interdisciplinary dialogue.

Dr. James Taylor, a social psychiatrist, was retained to observe the deliberations of the interdisciplinary team. Also, three other researchers, including the author of this chapter, were asked to observe the team work in order to determine whether any improvements could be made regarding interdisciplinary effectiveness and communication. One of the major findings of the researchers observing the deliberations of the team was that the rate of progress of the interdisciplinary team was extremely slow. Each member would come to the interdisciplinary team meeting with proposals drafted during meetings that he/she held with other members of his/her discipline. For example, the economist would come prepared to present the results of an employment projection and distribution model for the population of the city. These proposals were based on an economic model, and were drafted in collaboration with other economists during meetings which they held among fellow economists. The meetings involving only economists were very productive and effective. They were capable of translating the individual *mental models* of every team member into *a team mental model* representing the knowledge of their specific discipline.

The reason the dialogue among the team members belonging to any one specific discipline was very manageable and productive is that they used the scientific language of their particular discipline to communicate and agree on the recommendations to be submitted to the interdisciplinary team. The total breakdown in communications emerged during the team's efforts to engage in interdisciplinary dialogue, i.e., crossing disciplinary boundaries, in order to integrate the disciplinary knowledge and contributions into a systemic design of the whole city.

The level of frustration among the various representatives of the disciplines in the interdisciplinary team meetings began to escalate. Some team members declined to participate in team meetings, or found excuses not to attend and send another person to represent their discipline. The leader of the interdisciplinary team was changed three times, because selected leaders would resign from the leadership position. As psychiatrist James Taylor wrote, after observing the deliberations of the team for over a year:

> There appears to be a pressing, well-recognized need for a kind of social intervention, the interdisciplinary team which synthesizes knowledge in order to clarify complex problems. The promise of this social invention is clear, yet in fact no workable model has emerged. The question becomes obvious: why not? What has gone wrong in existing efforts to develop 'meaningful synthesis' of 'pertinent fields of knowledge'? (Taylor, 1976)

Dr. Taylor and the other researchers observing the interdisciplinary team working on the design of a hypothetical city realized that many other wicked problems—certainly those confronting our contemporary societies and organizations—could not be solved without the integration of knowledge and expertise originating from diverse disciplines. However, without empowering the members of the interdisciplinary team to use rigorous and understandable language to communicate across disciplinary boundaries, just as each member was capable of practicing in meetings with people from their own discipline, the prospect of designing the hypothetical city was not good. This observation prompted the researchers to launch a long-range research and development program leading to the discovery of the DEMOSOPHIA paradigm for boundary-spanning dialogue (Christakis & Bausch, 2006; Christakis & Brahms, 2003; Warfield, 1994).

It has been suggested that a shift to the new paradigm is inevitable (Christakis, 1993), because of the inability of organizations and the society as a whole to deal with the wicked problems of today. It represents a paradigm shift from the democracy practiced over 2,000 years ago in the Agora of the Athenian Republic, to the postmodern democracy advocated by leading scholars for the 21st Century Agoras (Institute for 21st Century Agoras.).

The Academy for Contemporary Problems

Following the disappointment with the Club of Rome, Ozbekhan joined the Social Systems Science group at the Wharton School of the University of Pennsylvania, and I joined the Academy for Contemporary Problems, which was established in Columbus, Ohio and Washington, DC, with funding from the Battelle Memorial Institute.

Prior to joining the Academy, I met John Warfield at a conference organized by the United Nations, focusing on population growth, in Bucharest, Romania in 1972. At that conference I presented a paper on alternative futures for Greece, which at the time was under a military dictatorship. The paper used a methodology called *Field Anomaly Relaxation* (FAR), to conceptualize alternative scenarios for Greece to the year 2000. At the conclusion of delivering the paper, Warfield approached me and asked me how I did the very tedious matrix algebra manipulations required by the FAR methodology for producing alternative futures.

I told him that I had done them manually—actually my adopted Chinese son Quan Yang Duh, who was very thorough and meticulous, had done them on my behalf. Warfield told me that he was in the process of developing an algorithm that would expedite these calculations. He proceeded to invite me to visit with him at the Academy for Contemporary Problems in Columbus, Ohio, where he was serving as a Fellow. I visited him and we became very good friends and collaborators, initially as Fellows at the Academy, and later-on at the University of Virginia faculty in the Department of Systems Engineering, where we established the first Center for Interactive Management (CIM), and later at George Mason University, where CIM operated for 5 years under my leadership.

The Center for Interactive Management

Starting in 1982 till 1989, at the CIM laboratory called DEMOSOPHIA, which was established for developing and testing the new science of dialogue, a team consisting of Warfield, other faculty such as Ben Broome, graduate students, and myself, designed and conducted more than 300 applications addressing a variety of *Problematiques*, with participants from the private, government, and public sectors.

DEMOSOPHIA at George Mason University in 1985

Two of the most prominent colleagues during the 10 years of operation of the CIM were Robert McDonald of the US Forest Service, and David Macket of the National Marine Fisheries Service. Bob and David were trained as master practitioners of the science of dialogue. They designed and conducted many colaboratories for many issues focusing on research and the management of natural resources for the forests and the oceans. Some of their applications, together with those conducted in the DEMOSOPHIA laboratory of CIM, are documented and archived in a room at the Library of George Mason University dedicated to the memory of John N. Warfield, who spent more than 20 years as University Professor there. Warfield was one of the giants of systems science of the twentieth century. He should be credited, among other contributions, for the development of the Interpretive Structural Modeling method, which is key to the construction of patterns of influence among ideas, and the science of generic design (Warfield, 1994). Readers who are interested to see a video of a colaboratory with the National Marine Fisheries Service (NMFS) Leadership team at the CIM facility in George Mason University may see an example at: (IM Design Workshop (NMFS Part 1), 2010).

One of the most memorable applications at the CIM facility at George Mason University was with a group of Native American tribal leaders in 1987, with the leadership of the founder and president of the Americans for Indian Opportunity (Americans for Indian Opportunity (AIO), 1989) my Comanche friend LaDonna Harris. I would like to tell this story because it is without any doubt a major milestone of my learning journey.

LaDonna and I met at a conference in Boulder, Colorado, organized on an annual basis by the World Affairs Council. I was invited at the conference to give a keynote talk on the CoR and the Global *Problematique*. After I finished my talk, LaDonna approached me and asked me if we can arrange for a meeting. She visited me at the Center for Interactive Management in June of 1987. She asked me, during our first meeting, if I would like to work with her on a tribal governance improvement project that she and her AIO colleagues were implementing with leaders of tribal nations. Initially, I was reluctant to get involved with the Native Americans, knowing how they were treated by the *White Man* in the USA history. I explained to LaDonna my reservations, namely my ignorance of the culture of Native Americans, especially given my Greek heritage. She offered me some books to read while vacationing to Crete the following summer, so I can learn more about the indigenous people of North America. When I returned from Crete, I called her and we agreed to design and conduct a colaboratory with tribal leaders representing about 15 different tribes.

The tribal colaboratory was held in September of 1987, at the Center for Interactive Management DEMOSOPHIA laboratory of George Mason University. It turned out that the complexity metric, i.e., the Situational Complexity Index (SCI), for the tribal governance *Problematique*, as diagnosed by the participating tribal leaders, is the largest we ever measured in the history of the applications of the science of dialogue (Broome & Christakis, 1988). At the end of the first day of diagnostics, all the tribal leaders were very discouraged about the future of tribal America. They were able, however, on the second day to collaboratively design an action plan to penetrate their *Problematique*. The colaboratory experience helped the chiefs internalize that the root cause of their *Problematique* was letting the *White people* define their existence, instead of the *native people* defining themselves. This colaboratory remains to this date as a breakthrough in tribal governance, because the leaders internalized the vicious cycle of their *Problematique*, and were enabled to start the journey of breaking the cycle.[1]

One of the tribal leaders at the CIM colaboratory in 1987, was Reuben Snake of the Winnebago tribe. He was very skeptical, even sarcastic, at the beginning of the CIM colaboratory regarding the applicability of the dialogue science to meet the challenges and predicament of tribal America. After the completion of the two-day colaboratory at the DEMOSOPHIA laboratory, and the design by the tribal leaders of a strategy for penetrating the tribal *Problematique*, Reuben reversed his position completely. He decided to apply the science for designing a self-sufficiency plan for the Winnebago tribe. He made arrangements for a CIM team of five individuals and LaDonna Harris, to travel to the Winnebago reservation in Iowa, and conduct a three-day colaboratory with about 30 tribal people from the Winnebago reservation.

Here is how he introduced me to the tribal people at the beginning of the colaboratory:

> Last year, when I came across our friend over here (speaking of Dr. Aleco Christakis) and what he has going, I thought, "This has some close relationships to the Indian way of developing a consensus."
>
> Chairman Reuben Snake of the Winnebago Tribe

[1] For more information on the extensive work of AIO with the structured dialogue process, which they have customized to their cultural requirements and named it "Indigenous Leaders Interactive System (ILIS)" the interested reader should visit the AIO web site at www.AIO.org. The ILIS has been applied by the AIO team with indigenous people all over the world, including the Maoris of New Zeeland, who have developed their own capacity.

At AIO they are currently working on an annotated Anthology of key AIO documents from the last 40 plus years, and they ran across the following notes written by LaDonna after the structured dialogue work with the Winnebago Tribe on their Self-Sufficiency Plan in 1987. Below is a very recent (January 9, 2013) private e-mail communication with Jackie Wasilewski, a long term colleague of LaDonna Harris, regarding LaDonna's assessment of the application of the colaboratory methodology with the group of participants from the Winnebago Tribe, back in 1987:

> What seemed to be conflict was but a symptom of an underlying problem. We were able to create a discussion environment in which Tribal realities were able to emerge. Key Tribal values supported were that the perspective of each member of the community is of value and that all perspectives should be part of the final decision. This enables Tribes to make more appropriate decisions. It enables Indian people to govern themselves using their own values while at the same time participating in the contemporary world. It creates an environment in which a mutual vision can emerge. Who is winning becomes unimportant. What becomes important is the effectiveness of the entire group. This collective success by way of individual participation is an ancient traditional value, and it enables us to see the collective reality.This is what attracted us at AIO to structured dialogue in the first place … that it renders traditional Indigenous consensus-building an effective tool for problem-management/solving for our times because it enables people from totally different backgrounds, carrying totally different histories, to see collective realities as they emerge in an ever dynamic present. In my humble opinion every governance system in the world needs the colaboratory of democracy approach…

The Consultancy Years with CWA Ltd

In 1989, I left George Mason University and established in Philadelphia a consulting company named Christakis, Whitehouse and Associates Ltd (CWA Ltd.). The transition from academia to a private consultancy was motivated by my desire to test the marketability of the dialogue science that we had developed and tested over the years at the Academy for Contemporary Problems, and at the Universities of Virginia and George Mason. John Warfield stayed at George Mason University and produced in collaboration with Roxana Cardenas a very impressive book titled *A Handbook of Interactive Management* (Warfield & Cardenas, 1994). This book is the best reference in terms of describing the consensus methods employed in the science of dialogue.

The transition from academia to private practice was supported initially by a contract with the Niagara Mohawk Power Company (NMPC) of the state of New York. The NMPC project was focused on working with a team of nuclear engineers on wicked problems prevalent in the safety of nuclear power plants. This work sustained CWA financially for 2 years, while we were trying to build a client-base with pharmaceutical companies located geographically close to Philadelphia.

During the transition period from academia to private consultancy, I learned the difficulty of marketing a process science, like Dialogic Design Science (DDS), to various industries, such as chemical or pharmaceutical. I discovered that without the knowledge of the specialized language of an industry, or possessing the relevant disciplinary credentials, it is very hard to penetrate the market. In other words, in the case of the Niagara Mohawk company, because of my Ph.D. in physics, the CWA consultancy was credible to the nuclear engineering professionals of the organization. When we tried to market the science of dialogue to pharmaceutical companies, it became apparent that we needed medical science expertise to become credible to the MDs dominating this industry. Fortunately, this expertise was available at the time to CWA, due to the fact that my two sons, Nicholas and Dimitri Christakis (who were 3 and 1 years old in 1965, when I left Yale University to return to Greece), had grown up and had received their degrees in medicine by 1992. I am positive that without their credentials, CWA would not have penetrated the pharmaceutical industry business.

Our first Pharmaceutical client was the Schering-Plough company. I still remember the first meeting with the enlightened chairman of the research institute of the company, Dr. Alexander Lane, in his office. Nicholas was with me during this visit. We explained to him very briefly our dialogue process. In about 10 min, Dr. Lane got up from his chair, shook my hand and said that he has been looking for many years for a scientific process like this, capable of supporting his interdisciplinary therapeutic teams. Therapeutic teams spend every year millions of dollars in drug research and development. We worked with Dr. Lane's therapeutic teams for about 3 years, and learned a lot about customizing the dialogue process to the requirements of the pharmaceutical industry. We learned from the arena of practice that we could not apply exactly the identical dialogue process that was meaningful to the nuclear engineers in the arena of the medical doctors, pharmacists, biologists, etc., that were the members of pharmaceutical teams.

Here there is a statement made by Dr. Lane in 1993, after his experience with the CWA applications of the Structured Dialogic Design (SDD) process, with three distinct drug development teams of his organization.

> My entire approach to R&D management was based on and directed towards the need for systems that expedited integration and communication … The Structured Dialogic Design (SDD) created the opportunity to hone its approaches in fields outside of, but just as complex as, those we faced in our own industry. CWA Ltd offers a methodological approach to the multi-disciplinary complexities inherent in the Drug Development Process.

Another interesting testimonial is offered by a pharmaceutical executive, Mr. Wilfred L. Shearer, past Vice President, Hoechst-Roussel Pharmaceuticals Inc.:

> The design technique provided a pharmaceutical company senior management team a clear pathway to improved profitability. We chose CWA's system to assist in a particularly complex drug development project because of its unique ability to build cross-functional teamwork while developing action plans that save time and money.

As it is well known, the US Federal government regulates the drug development process by an agency known as the Food and Drug Administration (FDA). At the recommendation of Dr. William Darrow, a team leader of two therapeutic teams of Schering-Plough, the FDA hired CWA in 1995, to support the improvement of the drug evaluation work of the Center for Drug Evaluation and Research (CDER). For the work the CDER stakeholders completed using the dialogue science, they won the Harvard University Kennedy School Excellence in Government Award ("Dialogic Design Science - Innovations in Government Award,") The Director of CDER, Dr. Janet Woodcock, had this to say about the application of the dialogue science with members of her Center:

> CWA Ltd has helped us develop a consensus and succeed in making meaningful internal process changes … and provided us with a road map to chart a new drug review process.

Third Phase Science

The diversity of applications in the arena provided the community of researchers of the science with empirical evidence to support the emergence and development of a *new phase of science* for the twenty-first century. We believe that this phase will gradually become appreciated as complementary to the other two phases developed in the eighteenth and nineteenth centuries (Christakis & Bausch, 2006; de Zeeuw, 1996). The distinctions among the three phases of science, and the three types of observations corresponding to each phase, are displayed in Fig. 3.

The contemporary world is like the river of the Greek Philosopher Heraclitus, who said: "You cannot step in the same river twice." The way that we step into the river defines the river for us, at the time we step in it. The imperative of developing the science of dialogue became even clearer to us when from the hundreds of applications in the arena, we recognized that different observers have different ways of stepping into that river, and that we can select and refine the way that we approach the river as a community of stakeholders.

Yes, we do use conversations and discussions in all aspects of daily life, but dialogue is a shared exploration into an unfamiliar river, and this is a specialized aspect of communication. Our consensus methods of inquiry (Warfield & Cardenas, 1994) represent a science that lies beneath and supports all of the ways that we collectively construct observations. Dialogue is the infrastructure—a word that means "beneath the structure"—for all of our collective learning. Dialogue science is a science for learning how to learn together. It is a very deep and inclusive science and it has come of age with the recognition of three major phases in the way that we construct observations individually and collectively, leading to the construction of consensual linguistic domains (Maturana, 1970).

First Phase science considered learning as a matter of observing phenomena which are understood to be independent of the observer. In other words, an observer seeing an apple falling from a tree in ancient Athens, in 500 BC, will report the same phenomenon as an observer seeing an apple falling from a tree in New York, today. It was a science deliberately focused on *objectivity*, as opposed to *subjectivity*. Classical Newtonian physics represents First Phase science. First Phase science has been dominating the discourse, including policy science and politics, for many generations. It has the advantage of the mythology (or *mythodology*) of objectivity, and the capacity to collect observer-independent data or facts. This science fueled the industrial revolution of the eighteenth and nineteenth centuries. The Newtonian approach to understanding an unfamiliar river is usable only in First Phase science phenomena, such as apples falling from trees.

Data Dependency	Phase One Science	Phase Two Science	Phase Three Science
Observer-Independent	Apples falling from trees at different times in different places, e.g., New York and Athens		
Observer-Dependent		A Doctor measuring the blood pressure of a patient	
Observer-Interdependent			A parent articulating what her child ought to learn at school, or a citizen of Cyprus imagining peace and reconciliation between Turkish and Greek Cypriots

Fig. 3 Synopsis of the three types of observations

Second Phase science considers learning to be shaped by an interaction between an observer and the entity being observed. Anthropologists understand this, as do business managers. The quality of observation is impacted by the presence of an observer within a community, such as the presence of a boss within the staff break room. In medicine, interactions with clinical staff in clinical environments can impact patient responses, including blood pressure. This is called the *white coat phenomenon*. In the physical sciences also, quantum physics recognizes that the observer's perspective impacts the way that fundamental states are understood. For example, one cannot observe the velocity and the position of a particle at the same time, which is known as Heisenberg's uncertainty principle.

In hindsight it may seem that the leap to recognizing Third Phase science might have been a small step. When a scientist in any discipline makes an observation, that observation is subject to the review of peers within that science—yet the view is not concurrently subjected to the review of scientists in other fields. Why not? The reason is sciences evolve to advance their discipline's consensual linguistic domain, and this language tends to converge upon the beliefs, tools, and prior understandings accumulated into that specific science discipline. Sciences become silos—they become specialized for viewing the world in accordance with the language that they view the world. What happens when a situation transcends disciplinary silos? How do we look at complex situations like the global *Problematique*, or even community infrastructure investments? Or, as we discovered with the Academy for Contemporary Problems experiment in 1970, how do we design a hypothetical city of one million people with the engagement of diverse disciplines? Our understanding of the situation changes depending on the lens that we use to look at it.

For this reason, we have come into an age of Third Phase science. As a global community we are learning how to learn together. This phase of science is not a matter of contesting which view is right and which view is wrong. It is a matter of merging understandings at elemental observations and constructing a new superior understanding, which embraces a larger view of the way that the world should operate as a visionary anticipation, i.e., not only the data about the *can be* but the ideas about the *ought to be*.

The future is an unfamiliar river that flows through time. When we step into this river, we must step into it together. If we do not use a Third Phase science form of dialogue, we will not construct a sustainable future that will exist for us all. So the focus of Third Phase science is on enabling observers from all walks of life to construct superior observations collectively, by employing the Science of Dialogic Design.

The Science of Dialogic Design

Dialogic design science has been developed as a discipline comprised essentially of fourteen principal components (Christakis & Bausch, 2006). A paper organizing thirteen of these components in accordance with the principle of *referential transparency*, as prescribed by the Warfield Domain of Science Model (DOSM), is strongly recommended for those readers interested to dig deeper into the theory of the science. The DOSM—shown graphically in Fig. 4 with a portrait of Professor John N Warfield—draws distinctions among the four domains of any science. It also draws a distinction between the corpus, and the arena of a science. The four Domains are: (a) Foundation, (b) Theory, (c) Methodology, and (d) Applications. The DOSM additionally characterizes *steering functions*, which link foundation, theory, methodology, and applications in a virtuous cycle, which advances the quality of the science.

The DOSM calls attention to the flow of experience from applications of the science in the arena, upon the foundation of the science in the corpus, which is to say upon the axiomatic base of the theories supported by the science. It is important that any science explicitly recognizes the axioms upon which it is founded, because disparities discovered in application of the science must be understood first as a manifestation of an axiomatic understanding or a manifestation of something which has not been considered in prior theories. It is also important in developing a science to appreciate the distinctions among data, information, knowledge, and wisdom, as shown in Fig. 4.

The corpus of a science—or the basic science—(of Dialogic Design, in this instance) consists of an axiomatic foundation (based upon an evolutionary understanding of the *reality* experienced in the arena of practice), and theory (including sets of theories; such as Theory of Mind, Theory of Relations, etc.). The arena—or the applied science—shares the methodology (which includes approaches for acting upon, with or through theories in the science) from the science, and places those methodologies into applications which interface with and engage the subject of the science (in our case communities of stakeholders engaged in designing their social systems by planning and creating their futures).

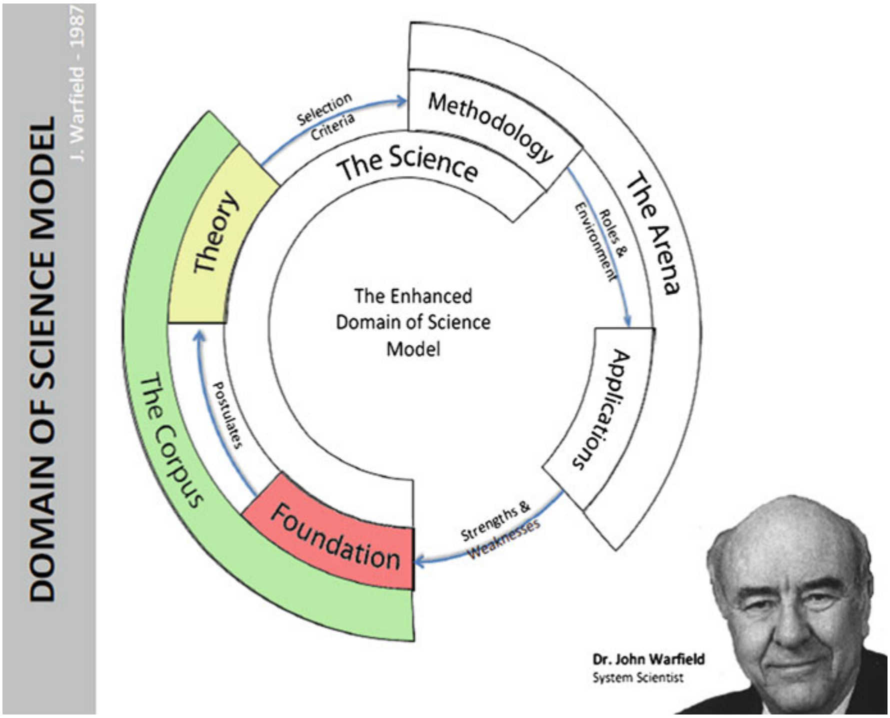

Fig. 4 Domain of science model, from John Warfield

The DOSM provides not only useful knowledge for general awareness of the intent of a science, but also ensures a needed discipline for the evolution of a science. Moreover, it can highlight the foundation of a science, namely that domain of the science that can propagate from fundamentals (Level VIII of the Referential Transparency diagram in Fig. 5) throughout the theory and methodology of the science to its applications. This is shown with the linkages among the 13 components of the science propagating from Level VIII, at the bottom of the diagram, to Level I at the top.

Notice that there are two distinguishable pathways in this diagram: (a) the first pathway propagating upwards leading from the "foundation" component through the "Archanesian geometry" of the science—to be discussed in a following section—to the "face-to-face colaboratories" in the arena; and (b) the second pathway propagating downwards is connecting the *face-to-face colaboratories* component of the science in the arena, to the *foundation* via the remaining eight components of the science. The Interpretive Structural Model (ISM) graphic connecting the 13 principal components of the science is a validation of the *referential transparency* among the components of the science, as required by the DOSM of Warfield. The seven axioms of the Foundation domain of the science are listed below, with attributions to their originators.

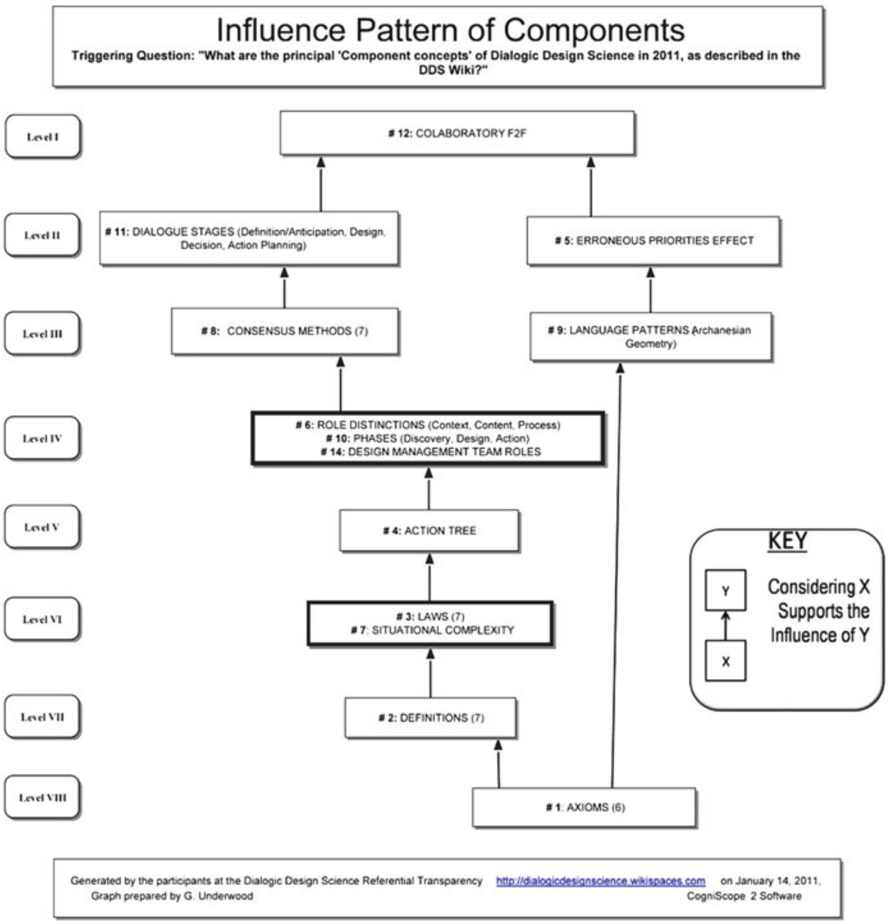

Fig. 5 Influence pattern of components

The seven foundational axioms for Dialogic Design Science:

1. *The Complexity Axiom*: Social system designing is a multi-dimensional challenge. It demands that observational variety be respected when engaging observers in dialogue, while making sure that their cognitive limitations are not violated in our effort to strive for comprehensiveness (John Warfield).
2. *The Engagement Axiom*: Designing social systems, such as health care, education, cities, communities, without the authentic engagement of the stakeholders is unethical. It results in inferior plans that are not implementable (Hasan Ozbekhan).

3. *The Investment Axiom*: Stakeholders engaged in designing their own social systems must make personal investments of trust, committed faith, or sincere hope, in order to be effective in discovering shared understanding and collaborative solutions (Thomas Flanagan).
4. *The Logic Axiom*: Appreciation of distinctions and complementarities among inductive, deductive and retroductive logics is essential for a futures-creative understanding of the human being. Retroductive logic makes provision for leaps of imagination as part of value-and emotion-laden inquiries by a variety of stakeholders (Norma Romm, and Maria Kakoulaki).
5. *The Epistemological Axiom*: A comprehensive science of the human being should inquire about human life in its totality of *thinking, wanting, telling,* and *feeling,* like the indigenous people and the ancient Athenians were capable of doing. It should not be dominated by the traditional Western epistemology that reduced science to only intellectual dimensions (LaDonna Harris, and Reynaldo Trevino).
6. *The Boundary-Spanning Axiom*: Stakeholders act beyond borders to design social systems that enable people from all walks of life to bond across cultural and religious barriers and boundaries as part of an enrichment of their repertoires for seeing, feeling, and acting (loanna Tsivacou, and Norma Romm).
7. *The Reconciliation of Power Axiom*: Social systems designing aims to reconcile individual and institutional power relations that are persistent and embedded in every community of stakeholders and their concerns, by honoring Requisite Variety of distinctions and perspectives as manifested in the Arena (Peter Jones)

The seven axiomatic statements presented above were the result of discussions with a community of theoreticians and practitioners of the science employing a wiki platform over a period of several months. (See: Dialogic Design Science: Home.).

The Archanesian Geometry

In 1997, while vacationing on the beautiful island of Crete, in Greece, I decided to look for a home to purchase. My hope was that when I retire, I would come back to the homeland and enjoy its natural beauty and my heritage. So, a sunny summer morning, a taxi cab driver drove me to the Minoan village of Archanes. When I saw the beauty of the lush green valley, planted with magnificent vineyards and olive trees, and discovered that Archanes used to be the main centre of the Minoan Civilization, I was overwhelmed. It was there that the three-floor splendid winter palace of King Minos was built, parts of which are still preserved amongst traditional and modern houses. While at the neighboring Phourni, one can visit today an impressive Minoan cemetery, and a little further up, at the location *Anemospilia*, excavations have revealed sensational evidence of human sacrifice. The inspiration of the 6,000 years-old Minoan civilization, that has been always peaceful and creative, made me decide to look for a traditional house of Archanes to renovate. After all, it was the ideal *Ithaca* for an *Odysseus*, who had spent almost his entire life far away from his homeland.

I was lucky enough to come across an abandoned traditional house that was 150-years old, located at a street called "Labyrinth." The name of this street brought me back memories of King Theseus, the son of Aegeus. He had courageously decided to be one of the seven young men that would go from Athens to Crete, and find his way through the Labyrinth of the Minoan Palace, in order to kill the monster Minotaur and end the human sacrifices of Athenian young men and women to the monster. When he went to Crete, he met Princess Ariadne, the daughter of King Minos who fell in love with him. She decided to help him find his way out of the Labyrinth by giving him a thread. It was the thread of love that showed to Theseus the pathway for the victory against the Minotaur, and the exit from the maze.

Gradually, the Labyrinth Street house became my own challenge for *killing the monsters* threatening my commitment to the values of freedom and democracy, and finding my own pathway for redemption. After 2 years of renovation, the *Labyrinth house* started to come back to life. It became the summer *palace* for my family; my children and grandchildren have been visiting it ever since, particularly during the summer; maybe they will follow a similar thread of love, like Ariadne's, in order to find every time their heritage from this beautiful island.

For me, the home of Labyrinth Street has been the realization of my nostalgic dream to return back to Crete, after spending almost all of my life in the USA. As you might recall from the beginning of my journey, I left Greece when I was 18 years old in 1956, returned briefly to serve in the Greek army from 1965 till 1967. I have spent the last 46 years of my life in different American cities. Although I was born in Athens, my ancestors were originally from Crete, so after raising a large family in the USA, with 5 children and 12 grandchildren, I was yearning to return home. Living in the village of Archanes during the summers made me realize the incredible magnetism of the village life and the Cretan culture. Even though I have been away almost 50 years, apparently I never abandoned my roots and my heritage.

In August of 2011, I was interviewed by a Cretan journalist, Maria Kakoulaki, who identified me in her article as a "Contemporary Zorba the Greek" (Kakoulaki, 2011). This interview touched my soul. It made me internalize how deep my roots to the Greek language, the people, and the culture always have been. It was then, when a *wave of realization* hit my heart; I felt I could not spend the rest of my life away from Crete, and the village of Archanes.

Nowadays, as time goes by, my love and my nostalgia for these Minoan roots of my past, together with my anticipation for a better future for Crete and Greece, have become stronger and stronger. From the veranda of my Labyrinth home, I can stare every morning and every night at the mountain of Giouchtas (the name derives from the Latin word *Jupiter* which is translated as *Zeus*), where the myth says that Zeus, the Greek Olympian King of Gods, came to die. For this reason the shape of the mountain looks like a huge human face of a male (god). Today, the calling of Zeus has become so intense for me, that I must confess that I have been anticipating my return to Archanes, similarly to Odysseus' nostalgic desire for return to Ithaca, or similar to Theseus brave decision to walk towards the hidden danger of the Labyrinth in order to fulfill his vision and achieve *the exit*.

At the beginning of the chapter, I mentioned that at Princeton University I was a student of Professor John Archibald Wheeler, who introduced me to his theory of *geometrodynamics*. This association, i.e., studying with Wheeler the General Theory of Relativity, made me aware of the linkage between *languaging* and geometry (Warfield & Christakis, 1987). I learned that the construction of observations and explanations is dependent on alternative geometries of languaging, as experienced by observers in the context and process of languaging about a phenomenon. For example, talking about the Doppler Effect in physics, which describes the curvature of light in space, requires that we use the language of Riemannian geometry and the theory of General Relativity. Without the advent of Riemannian geometry and the development of the theory of relativity by Einstein, this effect would not have been observed and discovered.

Another example of the crucial role geometry plays in constructing observations is the transition from the Euclidean geometry, which was useful in the development of classical (Newtonian) physics during the First Phase of science, to Riemannian geometry and its utilization in developing relativistic physics. Euclidean geometry postulates a flat two-dimensional space. An observer using Euclidean geometry is axiomatically capable of drawing only one line parallel to another line from a point in Euclidean space. Riemannian geometry, on the other hand, is spherical and postulates that there can be an infinite number of lines drawn from a point to another line in the Riemannian space. The revolutionary transition from Euclidean geometry, which legitimizes observations of observers in the domain of classical physics, to Riemannian geometry, which legitimizes observations and explanations by the same observers in relativistic physics, has been well document in the philosophy of science literature (Kuhn, 1970).

During the years I worked as the CEO of the CWA consultancy, I had the good fortune to collaborate with some very thoughtful systems scientists, such as Ken Bausch, Kevin Dye, Tom Flanagan, and others, all of whom have had distinguished careers in research and development organizations. One of the most inquiring colleagues happened to be Kevin Dye, with whom I have spent many sleepless nights in my home and in hotels. Kevin and I spent many hours discussing interesting questions, such as:

- Are there alternative ways of designing and conducting discourse on complex socio-political issues among observers, and if so how can we human beings select the most appropriate alternative?
- Is it conceivable to think of an alternative for public policy languaging as an *axiomatic construct*, such as the Euclidean or Riemannian geometries?

- Can we envision the evolution of observations and explanations constructed through languaging among a set of observers to be substantially different depending on the geometry they adopted for constructing their observations?
- Are there alternative geometries that are more suitable for languaging in certain linguistic domains, as for example the Euclidean geometry is suitable for classical mechanics and not suitable for relativistic mechanics?
- Is it possible for human beings to make a transition to a new geometry for languaging in socio-political domains, just as they did 100 years ago when they accepted the transition from the observations made in the domain of Newtonian physics, which is based on Euclidean geometry languaging, to the observations in the domain of Einstein's theory of relativity, which is based on Riemannian geometry languaging?
- Is the use of modern Information Technology in languaging an oxymoron?

It is well known that geometry deals with ontological entities which are denoted by such words as straight line, point, pattern, field, etc., and that these entities do not take for granted any knowledge or intuition whatsoever, but they presuppose only the validity of the axioms on which they are founded. The axioms of Dialogic Design Science (DDS), which were presented previously, are to be taken initially in a purely formal sense, i.e., as void of all content of intuition or experience. The science postulates the axioms, and proceeds to derive ontological entities for the geometry suitable for languaging in the context of the science.

On account of the complexity of the challenge of *Designing Social Systems in a Changing World* (Banathy, 1996), the geometry of Dialogic Design Science (DDS) is multi-dimensional (Warfield & Christakis, 1987). I have chosen to name the DDS geometry *Archanesian*, in honor of my village in Crete, which has 6,000 years history of languaging among its inhabitants. Just like the Euclidean geometry was instrumental in the development of the science of classical physics, and Riemannian geometry was instrumental in developing and validating the science of relativistic physics and the discovery of the Doppler effect, the Archanesian geometry (to be defined below) has been instrumental in the development and validation of the science of dialogic design and the discovery of the Erroneous Priority Effect (EPE).

The evolutionary validation of the science must be compatible with the virtuous cycle of the Domain of Science Model (DOSM) of John Warfield, and also the requirement of referential transparency among the thirteen components, shown previously by the ISM diagram (Fig. 5). A recent study validating the utility of the Archanesian geometry for helping the transparency of complex graphic representations of the global Problematique has been completed by two Mexican colleagues, and published as a monograph by the Institute for 21st Century Agoras.

On the foundation of the seven axioms of Dialogic Design Science, the following ontological entities of the Archanesian geometry are derived (Schreibman & Christakis, 2007):

- *Nodes*: Observations of trends, events, issues, action options, challenges and choices;
- *Classifications*: Categorical Schema and inductive clusters involving observations;

- *Links*: Observed interdependencies amongst nodes constructed abductively;
- *Field*: Ordered set of categories;
- *Profile*: Selections of observations in a field;
- *Maps*: Nodes and their interdependencies (links);
- *Pathways*: A walk of links;
- *Superposition*: Links from a profile to a map.

The geometric representations of these entities are shown graphically in Fig. 6.

A major consequence of the adoption of the Archanesian geometry was the discovery and validation by Kevin Dye of the *Erroneous Priorities Effect*. The EPE states that failure to take into consideration the distinction between preferences in voting on relative importance among a set of observations by a group of stakeholders, as compared to the results obtained when the same group is engaged in determining and voting on the influences among the same set of observations, leads to erroneous priorities and ineffective actions. This distinction between the two types of voting is depicted in Fig. 7:

The graph in Fig. 7 depicts along the X-axis the digitized numbers of a set of observations generated by stakeholders during a colaboratory, such as observation #3, observation #63, and so on. This set of digitized observations has been assessed, individually and collectively, by the participants in terms of influence (bars in graph) voting, and importance (line) voting. These voting results are displayed along the Y-axis by the histogram (in blue), and the line graph (in red). These two graphs show: (a) the results of influence voting among the observations on the left (bars), and (b) the results of importance voting on the right (line). Notice that observation #3, which happens to be the most influential, and hence of a higher priority because it exerts influence on 8 other observations, as shown by the blue bar, received only 2 importance votes, i.e., only two stakeholders voted on #3 as being relatively important. On the other hand, observation #56 is of very low influence, and yet its relative importance is very high (seven votes), as shown in the graph by the line.

The articulation of this effect, which has major implications in designing social systems and in policy-making, is stated very succinctly, as follows:

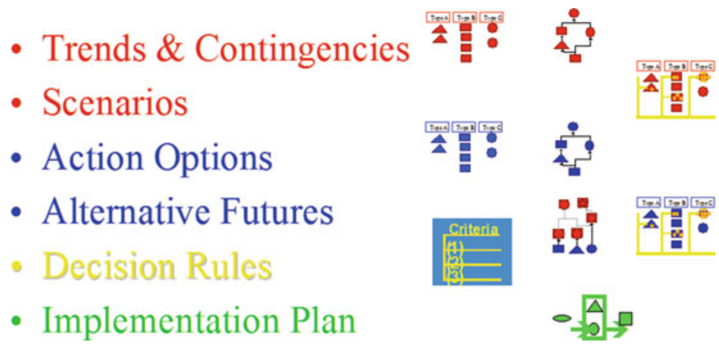

Fig. 6 Definitions of observation types

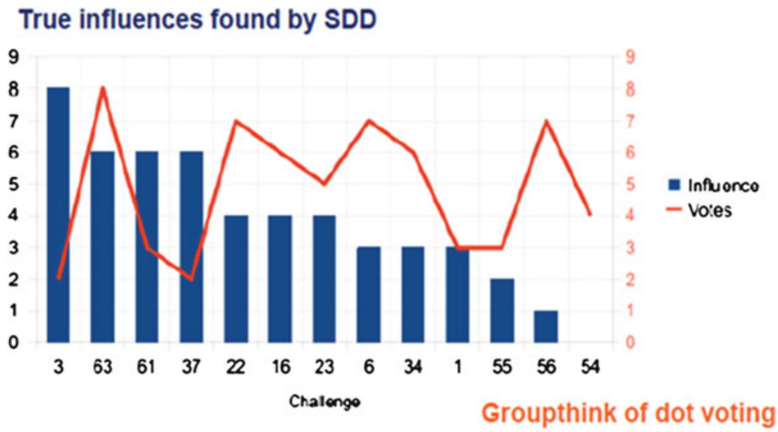

Fig. 7 Erroneous priorities effect graph. Dye and Conaway (1999)

Erroneous Priorities Effect:

> Issues with highest awareness or popularity among participants may not be those with the most influence on other issues, often leading to erroneous priorities. Effective priorities emerge ONLY after evolutionary, democratic, and authentic inquiry of the interdependencies among the ideas – the stage of influence mapping of the ideas, minimizes the risk of erroneous priorities. (Also see Christakis & Bausch, 2006.)

Colaboratory of Democracy Architecture

The application of Dialogic Design Science can most efficiently be presented and discussed by means of a generic colaboratory of democracy architecture. Even though there are variations of the generic architecture appropriate for specific applications, called Archetypes, there is a common thread in all applications.

For example, all applications should encompass three distinct and complementary phases. Phase I delivers: (a) an Orientation Session for the stakeholders/designers team, (b) a pre-colaboratory White Paper based on literature review and interviews, and (c) a refined design for the conduct of the group work during the colaboratory. During this phase the client's staff plays a critical role in stakeholder identification, recommending a bibliography, inviting stakeholders to participate, and arranging the date and logistics for the colaboratory location. Phase II delivers the "Collaborative Action Plan" generating products in real-time. Phase III delivers a survey eliciting organizational commitments to highly-leveraging actions, and produces with the support of a Steering Committee, a detailed implementation plan (See Appendix A of Christakis & Bausch, 2006).

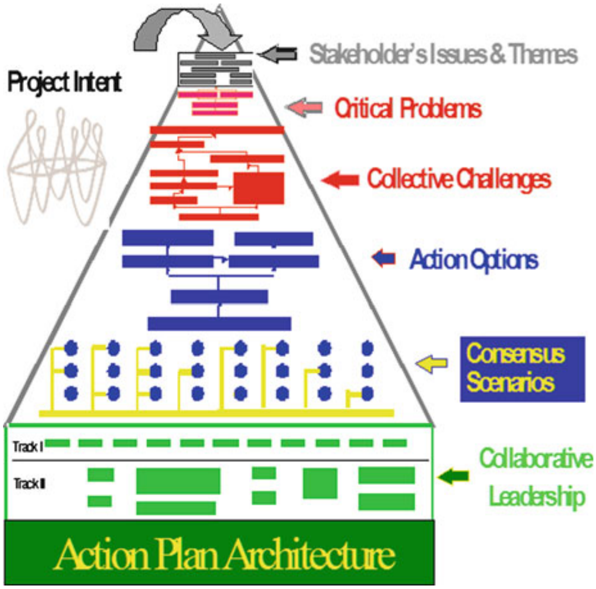

Fig. 8 Action plan architecture. Copyright ©1999–All rights reserved

Colaboratory Application Deliverables:

1. Capacity-Building Orientation Session (Phase I)
2. Pre-Colaboratory White Paper (Phase I)
3. Colaboratory Event (Phase II)
4. Colaboratory Products Delivered in Real Time (Phase II)
   (a) The System of Challenges & Optimal Leverage Points
   (b) Collaborative Action Plan
5. Survey of Organizational Commitments & Implementation Plan (Phase III)
6. Project Report (Phase III)

The colaboratory process platform, shown in Fig. 8, constructs the Action Plan for a specific wicked problem situation in the arena through a progressive series of inquiries. The Orientation session of Phase I, reconfirms and refines the sponsoring organization's stakeholder identification, literature review and interviews, elicit issues and themes, assesses the complexity of the situation, determines the collaborative readiness of the participants, and guides the focus and design of inquiry for the colaboratory. Experience tells us that Phase I is the most challenging for the practice of the science in the arena.

The Phase II colaboratory engages the stakeholders in investigating deep-seated issues, providing for a diversity of viewpoints, and a requisite variety of pertinent themes. The methodology is employed to enable participants to engage in a disciplined deliberation on substantive challenges in managing complexity. Alternative solutions are cultivated. The colaboratory culminates in the determination of those actions which have the strongest leverage on the resolution of the wicked problem. The participants internalize these selections through the construction of consensus scenarios.

In follow-up work to the colaboratory, organizational commitments to a Collaborative Action Plan are registered and the results packaged in a report. A Steering Committee is formed with the responsibility to oversee the implementation of the plan.

Epilogue

Today, it has been almost 60 years since I left from the port of Piraeus for the USA, and 42 years since the Club of Rome experience, which was the milestone for my transition from the natural sciences to systems science. One of the principal lessons that I have learned throughout my journey is that those so called *hard sciences*, belonging to the First and Second Phases of science, are soft, and those which are called *soft sciences*, belonging to the Third Phase of science, are hard. The reason is that the traditional hard sciences, like physics, are easier to learn and apply, primarily because of their rigor and objectivity, while the soft sciences, like sociology, are hard to master because of the complexity of the subject matter and their subjectivity.

I remember my first working experience with Hasan Ozbekhan in the Doxiadis-System Development Corporation venture in 1967. Hasan had asked me to write a *think piece* about an urban planning issue. When I delivered it to him, he said that I had to start all over again by *defactualizing*. I had not heard the word *defactualizing* before, so I asked him to clarify its meaning. His answer was that it means "to temporarily suspend the data base of the present and imagine an alternative data base for the future." In the 1970s, this was really a very revolutionary concept, as we both found out through our experience with the CoR prospectus. He was asking me to visualize a desirable future and avoid perpetuating the present. I think today, i.e., the beginning of the twenty-first century, the concept of visioning has become more legitimate, even in political campaigns and languaging. I am encouraged by the recent phenomenon of prominent politicians, like Hillary Clinton and the Mayor of Chicago Rahm Emmanuel, using terminology like *wicked problems*, *value-base*, etc., that were popular in systems science 40 years ago. This phenomenon gives us a rough estimate of the time lag between the *political thinking and languaging* and the *systems thinking and languaging*.

My experience in the arena, with hundreds of different *wicked problems* has taught me that, when groups of stakeholders are offered the opportunity to practice structured dialogue, they can collaborate in managing and resolving the complexity of their wicked problem. By applying the axioms and laws of Dialogic Design Science, stakeholders are enabled to step into the fast, unstoppable changing flow of the *Heraclitus River* collectively, and thus to discover a new consensual language of convergence and action.

In conclusion, I would like to share a story of a recent experience in the arena. In the beginning of 2012, I received a call from Dr. Susan Jacoby, the Executive Director of the Laurent Clerc National Deaf Education Center of the Gallaudet University. She had heard about the colaboratory methodology, and she was interested to apply it to her community of deaf, hard of hearing, and hearing stakeholders, whose languages are English and American Sign Language (ASL). Her call reminded me of the time LaDonna Harris approached me at George Mason University in 1987, and asked me to work with her in addressing Native American governance issues. As you probably have gathered by now, I am sensitive to the strong linkage between language and culture, so the idea of entering the bilingual culture of the deaf and hard of hearing population, was to me a challenge very similar to the challenge of entering the culture of the Indigenous people of North America. I reluctantly accepted the invitation of Dr. Jacoby, just like I had done 25 years ago with LaDonna Harris. To my amazement this bilingual community has been integrated and delighted with the opportunity to use the colaboratory methodology in their strategic planning endeavors. We needed to make some accommodations to customize the methodology to their culture, just like we had to make accommodations in transitioning from applications with nuclear engineering teams to the therapeutic teams of the pharmaceutical industry.

Here is a quote from a private communication of Dr. Jacoby to the person who recommended to her the use of structured dialogue, following the successful completion of the first colaboratory by the Clerc Center team of trained SDD facilitators using ASL and English, focusing on setting national priorities for their strategic planning initiative:

> Ed Bosso (Clerc Center Vice-President) and I were reminiscing this morning about the first time you and I met in Wilmington and you sharing with us that you had read about a process that you thought might fit our needs perfectly. We couldn't have envisioned then where that journey would take us or how very right you were. Bringing that vision to a reality has been an exciting and intensive journey for me and others at the Clerc Center and far exceeded any expectations we might have had for what we could do to collect public input and establish our priorities.

On the basis of the diversity of applications in six continents and the many languages (English, Greek, Spanish, Japanese, Portuguese, and now ASL), I believe that there is sufficient evidence from the arena regarding the universality of the science of dialogue and the power of the Archanesian geometry for graphic representations of ideas and their linkages. We have also gathered significant evidence of the emancipatory power of the methodology, which is an enhancement to its universality (Alexander, 2002). People from all walks of life are finding the methodology of the science as liberating, as opposed to imprisoning their consciousness.

I am also very encouraged and optimistic about the evolution of the science, thanks to a new generation of practitioners, who have emerged in the last 5 years. These are young people, such as Gayle Underwood, Jeff Diedrich, Maria Kakoulaki, Julie Carlston, Andy Hegedus, Susan Jacoby, the many young members of the

Future Worlds Center and the Academy for Public Administration in Cyprus, and many more. These young practitioners, spread all over the globe, are prepared to carry on and improve the practice and the theory of the science in accordance with the DOSM of John Warfield.

"Our Constitution is called a democracy because power is in the hands, not of a minority, but of the greatest number." This is the way that Thucydides, the Greek Historian, defined the essence of democracy thousands of years ago. After almost six decades of personal and professional experiences, research, theory and practice in the field of dialogic design, while democracy has become a global imperative, I am still wondering what is the very essence of democracy; how it can be applied to our society so that it will override decisions that are imposed by the few for the benefit of the many.

Democracies cannot just occur by themselves! They depend on citizen's information and wisdom, our ability to perform authentic and productive dialogue, to express ourselves and to be heard for our opinions and aspirations. Finally, they depend on our right and obligation to participate in the conscious evolution of our fast changing realities. For it is only the connection of ideas, the connection of people's voices, that can co-create the solutions for our current predicament and reveal through successive approximations our new visions and our new pathways for the sustainable future.

The pathway for democracy is not an easy one. It goes through our remembering that not long ago, only in the nineteenth century, the right to express an opinion was connected with the owning of land, and the fact that women and people of color were not considered competent to participate in elections. Today, there are still exclusions, discriminations, ready-made answers and distorted realities. For this reason, democracy can also be a pathway of painful realization that even today, it is being used as a mask and an excuse by those in power who do the decision-making and do not give the opportunity for the citizens to know, express an opinion, and play an active role in what is happening around the globe.

From the Occupy Wall Street movement to the Arab Spring, and the demonstrations in Southern Europe for job and salary cuts and austerity measures, new perceptions about changing our world are required, along with the means for the people to create new meaningful futures. Respect for diversity and humility for our ignorance and imperfection can be new beginnings for democracy, for both younger and older people. The conscious evolution for a true democracy is connected to the respect for the integrity and dignity of every citizen to have a voice and the right to express it freely. This is, according to my humble opinion, the pathway for DEMOSOPHIA (people's wisdom) and for society's real metamorphosis, solutions deriving from everyone for the benefit of everyone!

In conclusion, I would like to offer the prophesy, that unless humankind adopts the graphic language of the Archanesian geometry to practice authentic, democratic dialogue to address the contemporary wicked problems, it is not plausible to attain the ideal state of "peace with justice" proclaimed by President Barack Obama in his Berlin speech of 2013 (The White House).

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Cybernetics of Governance: The Cybersyn Project 1971–1973

Raul Espejo

Abstract In this paper I offer personal reflections 40 years after Cybersyn's demise the 11th of September 1973. This project was Stafford Beer's creation, underpinned by his Viable System Model. The emphasis of these reflections is in contrasting its rather limited achievements with its vision and relevance for our societies today. Its claims were large; it was presented as a project that achieved important results in a short period of time. The paper compares its actuality with these claims. Particularly I explore the project's methodological and epistemological shortcomings. Unravelling these shortcomings gives us a platform to gain an understanding of its potentialities. I will argue that Stafford Beer's vision of a "Liberty Machine" was ahead of its time and furthermore that it has profound implications for our current societies, in particularly for the organization of our economies.

Keywords Cybersyn • Economy • Epistemology • Liberty Machine • Methodology • Viable System Model

Introduction

Chile went into a highly significant political process in the early 1970s. It was an attempt to have a socialist revolution in freedom. The government of Presidente Salvador Allende, supported by political forces from the center-left to the extreme left, was intent upon transforming the country's socio-economic relationships. It was a government for the workers and with the workers. The transformation had deep structural implications. From an economy that traditionally had supported the interests and consumption of the country's privileged groups, the government

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wanted a people's oriented economy. However, it was difficult to appreciate the complexity of this transformation. Socialists' experiences, such as in the Soviet Union and Cuba, were driven by a centralized model of the economy and constructed on the shoulders of millions of people following the dictates of a planning system reflecting the views of a relatively small group of bureaucrats and experts. Enforcing centralized planning in Chile was not feasible; its long-term democratic tradition had made that option difficult, if not impossible. Tensions between a centralized planning and representative democracy were present throughout the three years of the Allende's government. It is in this highly charged environment that the Cybersyn project emerged. Then-General Technical Manager of the National Development Corporation (CORFO), Fernando Flores, saw both the conflicting nature of the government's intended economic transformations and the opportunities offered by Stafford Beer's organizational cybernetics. Beer was invited to Chile to discuss his insights about complexity and how they could be used in Chile's political situation. This invitation was the origin of the Cybersyn project. With Beer in Chile the idea of a cybernetic alternative to centralized planning started to take shape. Presidente Allende gave the green light to proceed with this project. However, it was not so much an alternative to the activities of the main governmental departments, responsible for the country's economy, as it was a project to support CORFO's management of the nationalized industry.

Since the late 1930s, CORFO had been responsible for a strategic state-owned industry, controlling among others the oil, electricity, steel, and forestry industries. In 1970, the new government wanted to add to these industries medium sized enterprises; those producing electro-domestics, electronic products, furniture and so forth. These were strategic industries in the sense of offering a significant leverage to transform consumption patterns in the country. People at CORFO were grappling with this issue before Beer's arrival to Chile. At his arrival, in November 1971, Beer proposed focusing on the cybernetics of the industrial economy, that is, on the communications and regulation of this exceedingly complex system. He had articulated this cybernetics in *Decision and Control* (Beer, 1966), the book that introduced several of us into his work in the late 1960s. This time, additionally, he had with him the manuscript of his yet unpublished book *Brain of the Firm*, the first of a trilogy about the Viable System Model (Beer, 1972, 1979, 1985). Soon the project's core group, about a dozen of us, was immersed in it.

During the two weeks of Beer's first visit he managed to set up the Cybersyn project with a clear sense of urgency. Supported by our briefings he produced several documents during those days. Perhaps a salient demonstration of his sense of purpose was encapsulated in a Plan of Action (Fig. 1), in which he proposed precise tasks to braid organizational, informational and communication activities into a program for the management of the country's industrial economy, which he named Cyberstride. In this Plan he also identified specialized teams in Santiago (Team A) and in London (Team B). That Plan of Action was the beginning of the Project Cybersyn (Beer, 1981; Espejo, 1980, 2009; Medina, 2006, 2011; Schwenberg, 1977). The project lasted until September 11th, 1973, when Salvador Allende's government was overthrown by a military coup d'état. Since then Cybersyn has received

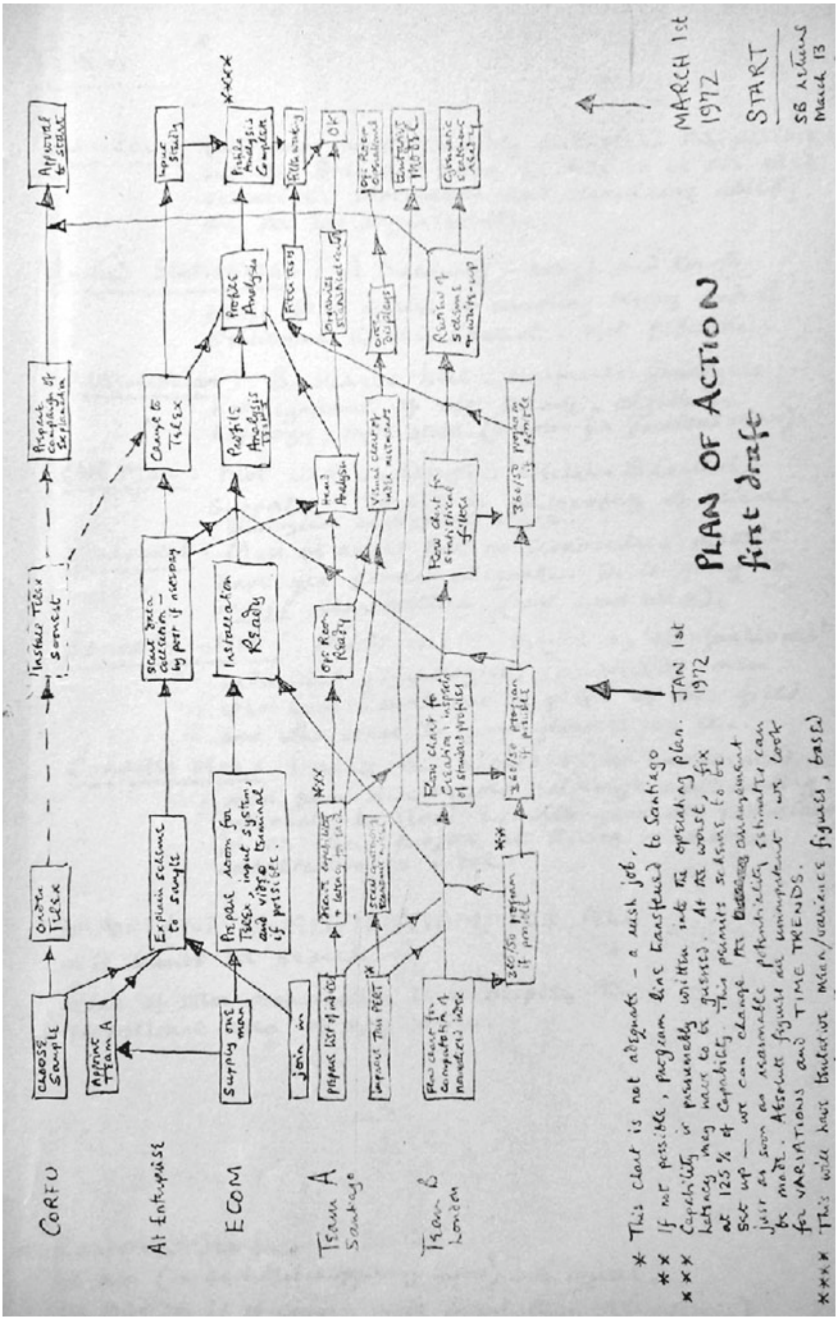

Fig. 1 Cyberstride plan of action, November 1971–March 1972

varied attention in the press (Barrionuevo, 2008; Beckett, 2003) and other media, not always positive. Among other reasons, this was because of its submission to the restricted knowledge generation capabilities of the computers of those days (Ulrich, 1994), its unwarranted technical claims (Axelrod & Borenstein, 2009), and even its Orwellian overtones (Baradit, 2008).

In this paper I offer personal reflections 40 years after the project's demise in 1973. The emphasis of these reflections is contrasting its rather limited achievements at the time with its vision and relevance for our societies today. Its claims were large; it was presented as a project that would make significant contributions to the management of the country's economy in a short period of time. For its own sake I think it necessary to compare its actuality with this claim. Particularly, it is necessary to appreciate the project's methodological and epistemological shortcomings to gain an understanding of its potentialities. My argument in this paper is as follows: First, I discuss Cybersyn's actuality, and what did we do in those two years. This is followed by a methodological revision of this work and reflections about the epistemological evolution of the Viable System Model in the last 40 years. The third section explores the project's potentialities and vision. Finally, I discuss Cybersyn's evolving meaning over the past 40 years.

Cybersyn's Actuality

The Viable System Model (VSM) is one of Beer's most important contributions to organizational cybernetics (Beer, 1972, 1979, 1981, 1985). The VSM emerged from Beer's understanding that nature's long-term evolution of viable systems had much to say about the viability of exceedingly complex systems such as firms (Beer, 1972, 1989). The focus of his attention was on the evolution of the human nervous system. From his understanding of this system he argued that any viable system had five systems. System 1 (S1) was an operational system, the one producing the system's products. System 2 (S2) was an anti-oscillatory function to coordinate the operational units of System 1. System 3 (S3) distributed and optimized the use of resources within the viable system. System 4 (S4) was responsible for the system's adaptation to its environment, and System 5 (S5) was responsible for policy-making (Beer, 1972). Additionally, a key aspect of this model was its structural recursion. Each operational unit constituting System 1 had adaptation and production challenges just as the global system had, that is, each operational unit had S1, S2, S3, S4 and S5, and within each of these units the same structure for adaptation and production was responsible for the viability of their own units.

Within days of being briefed about CORFO and the nationalized industry, Beer mapped it into a recursive structure with CORFO as the system-in-focus, embedding four ramas (groups of related industrial sectors). Each of these ramas contained a set of so-called industrial committees or group of related industrial sectors, each of these committees embedded enterprises and enterprises embedded plants.[1] He then hypothesized that all these operations, starting from CORFO, had to have a viable organizational structure. In this sense the VSM was used as a heuristic rather than as a diagnostic or design tool.

Variety engineering was a key concept underpinning the VSM. For Cybersyn the design was reducing the large complexity of production activities at all structural levels, from plants to CORFO, to relevant information for management. The point was ignoring what deserved to be ignored and reporting significant changes. An aim for variety engineering in the project was offering a model driven approach to reducing situational complexity to a manageable level, while at the same time improving performance.

The hypothesized recursive structure was used as a platform to design performance indices, based on the actualities (ACT), capabilities (CAP) and potentialities (POT) of essential variables for all the operational units, from the local to the global (Beer, 1981). The intention was measuring in real-time significant changes in the behavior of essential variables for workers and managers. Significant methodological and practical developments were made designing indices. Local people measured their daily actualities to compare them to their capabilities, or the best they could achieve with existing resources, and their potentialities, or the best they ought to have achieved with investment to remove restrictions and bottlenecks. These indices were used to collect data in as near to real-time as practically possible and processed using a statistical formalism.[2] The Cyberstride suite was the software for this processing. The data collection was underpinned by a significant modeling capacity. Operational researchers produced quantified flowcharts for plants, enterprises and sectors to work out their capabilities and bottlenecks, and discuss with managers potentialities to design performance indices. Designing indices consumed the largest amount of resources in Cybersyn. In practice, the emphasis was on designing production and human resources indices. Operational research modeling was used to design aggregated indices for enterprises and sectors. By the end of the project about 60 % of the nationalized industrial economy was included in one way or another in this system.

Geographically, industrial plants were distributed throughout a very long and thin country; capturing data required more than traditional mailing procedures. Real-time communications was the challenge. Serendipitously, we found a large number of spare telex machines in one of the state-owned enterprises. Their installation followed in plants and enterprises throughout the country, as well as in industrial committees, CORFO and other government offices. A telex room with tens of machines was installed at CORFO. In practice, it was an operations room for the state-owned industry that offered an incipient nervous system for the industrial economy; it was called Cybernet.

Enterprises' data were transmitted to the government's computer center, where Cyberstride did the data processing. If significant changes were detected reports

[1] In fact more recursion levels were hypothesised but for the sake of this argument no more are necessary.

[2] It was used a short-term forecasting model by Harrison and Stevens (1971).

Fig. 2 Cybersyn's operations room

were sent back to the affected units. The expectation was that problems would be solved locally, however if problems persisted, after an agreed period with the affected managers, indices reports automatically jumped to the next level up under the assumption that these managers would have more chances to solve the related problems. This jumping up of *algedonic* signals was intended for all structural levels (Beer, 1981).

Beer also wanted an economic modeling capacity in CORFO. Its purpose was the ability to model the dynamic behavior of the industrial economy. Particularly, it was to balance *the ear on the ground* provided by Cyberstride's indices with the *eye on the future* provided by these dynamic models. This part of the project received the name CHECO (CHilean ECOnomy). A small group of economists undertook this task with the support of a small team of system dynamic experts in London. Simple models of the Chilean economy were produced in collaboration by these two teams. This dynamic modeling of the Chilean economy used MIT's Dynamo software (Forrester, 1971).

Finally, the display of the indices' reports, related information and dynamic models, was focused on the design and construction of an Operations Room (Fig. 2). Beer envisaged this room as a *liberty machine* (Beer, 1975; Medina, 2011); a physical space to support policy-makers' conversations. The emphasis was its ergonomics; a man-machine interface to improve decision-making. The room had several screens. One helped focus the participants' attention on the system-in-focus. The next two were used to project significant changes in performance indices relevant to the users of the room (e.g. energy performance indices if the managers were senior managers of the energy sector) and the algedonic signals of unsolved problems at lower levels of recursion. The next set of four screens, called *datafeed*, gave information relevant to the actuality, capability and potentiality of relevant performance reports. Slide projectors controlled by managers from their chairs projected information. The room also had two screens to project the outcomes of CHECO models and support discussions about the dynamics of the system-in-focus and its long term behavior. Decisions emerging from conversation in this room could be transmitted via telex (i.e. Cybernet) to the affected units and people. This room was a prototype that seldom was used by senior managers and politicians. However, the idea captured the imagination of people in the shop floor and at least in a couple of plants the walls of workers' meeting rooms were used to display performance indices and relevant information.

Of the four tools, Cybernet was the one that changed our understanding of information and communications. At the beginning, Cybernet was a tool for data transmission from plants, enterprises and committees to the telex room, and from that room to the computer center where Cyberstride produced exception reports to send them back to the appropriate structural levels. These data flows were in themselves valuable contributions to management requirements, but CORFO managers soon learned that Cybernet could be used for other purposes. Rapidly, documents, reports, and request of all kinds started to flow. These flows increased the use of Cybernet beyond the industrial economy; soon requests for machines came from ministries and other government institutions. What was unexpected was that when lorry drivers and small retailers went on a politically motivated strike in October 1972,[3] Cybernet played a key role in defeating it. The network worked 24/7 and in practice became a powerful tool for horizontal coordination. Requirements and supplies were managed by enterprises among themselves, reducing the need for hierarchical intervention. This was a most clear example of cybernetics in action. Not surprisingly, this experience led many to relate Cybersyn to supplies and transportation activities beyond industrial production; an incipient *value chain* was in operation. The capabilities of Cybernet emerged from the turbulences of a country almost paralyzed by political fights. In politicians' and managers' minds, Cybernet and the Operations Room became one. Now the Presidential Palace wanted to have *this room* in their own premises. The potentials of Cybernet as an incipient *internet* became apparent, but unfortunately it was too late to change the situation. At that time Beer became aware that Cybersyn had to be extended beyond industry and proposed a re-structuring of the project that for the first time had the chance to include the whole economy and not industrial production alone. He made a detailed proposal to that effect, but it was already too late for Cybersyn to improve the cybernetics of the country's economy. People in government were aware that a military intervention was in the offing and that there was no time for significant changes in relationships and management. Ironically, Cybersyn's major success was the beginning of its demise.

One of Beer's preoccupations as the project evolved was the inclusion of the people in policy-making processes. This was a concern for an inclusive democracy, giving policy-makers the chance to align their purposes with those of the people.

[3] CIA orchestrated according to USA Congress reports.

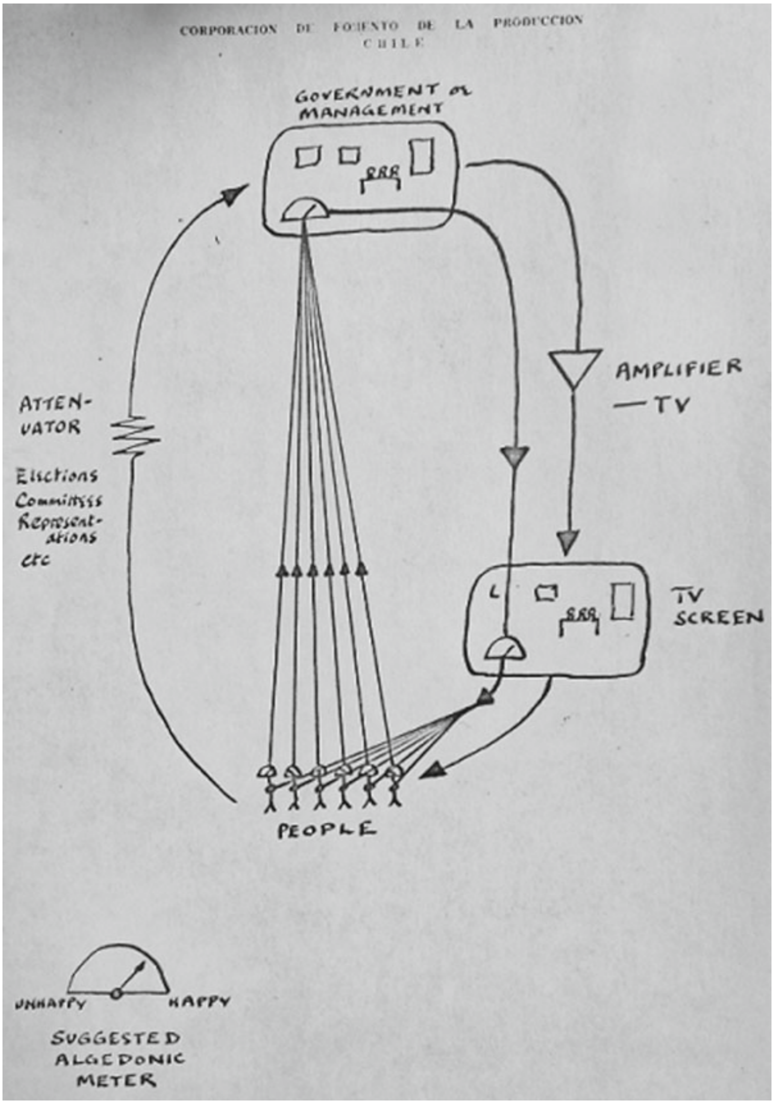

Fig. 3 Suggested algedonic meter

This concern was articulated in an off-shoot of Cybersyn, the project Cyberfolk. Perhaps the root of this later project was in Presidente Allende's utterance, "at last, the people" as Beer explained to him the VSM. Cyberfolk was a technology aimed at including the people in policy processes; it was an attempt for a real-time response of the people to politicians as they discussed a policy in a public space (see Fig. 3). Underpinning Cyberfolk was Beer's attempt at designing a homeostat to balance, in this case, the high complexity of the people (i.e. their individual concerns) with the low complexity of a relatively small number of politicians, managers and experts dealing with these policy concerns. In terms of the VSM, Cyberfolk wanted to give closure to policy-making (the VSM's System 5). His paradigmatic contribution for this purpose was the algedonic meter (Fig. 3), a device to measure people's satisfaction or dissatisfaction with progress in public conversations (Beer, 1981). This was a tool to help them steer these conversations. Cyberfolk together with Cybersyn's tools were the contributions made by this project in the early 1970s. Now, in what follows, I offer a critical review of these developments.

Critical Review

In what follows I offer a critical review of Cybersyn's methodological implementation and discuss the epistemological lens used in it. The aim is preparing a platform to make visible its potentialities for a better society in the next section.

About Methodology

It can be argued that methodologically, Cybersyn emphasized technology at the expense of a significant involvement of those transforming the Chilean economy on the ground. A good cybernetics of the Chilean economy was, and indeed is, equivalent to its effective organization (Beer, 1975).[4] To create a good economy, it is necessary to have an effective organization, and to achieve that the Viable System Model is a powerful tool. It offers an effective recursive structure for the implementation and adaptation of the government's economic policies. Specifically, from plants to CORFO, it would have been necessary to produce relationships of autonomy and cohesion.

A first challenge for Cybersyn was creating a system for the effective management of the complexity of the industrial economy through well-articulated recursion levels. That was a tall order for Cybersyn and there was not much time to work out an effective unfolding of the industrial economy's complexity. The recursive structure of ramas, sectorial committees, enterprises and plants was agreed on pragmatic political grounds and not on sound cybernetic principles for managing complexity. Cybersyn did not diagnose and design the industrial economy's structure; instead, it used hierarchies emerging from political processes. These were power hierarchies and relationships between levels driven by politics. Although the prevailing ideology was respecting the autonomy of enterprises, committees and so forth the organization structures of these operational units were not mature. The cybernetics of the nationalized industry was weak.

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[4] Beer defines cybernetics as the science of effective organization (Beer, 1975, p. 425).

Structural recursion is by and large the outcome of self-organizing processes, which can be enabled by organizational design. The assumption was that ramas, industrial committees, enterprises and plants were all autonomous units embedded within autonomous units. This was a strong assumption that hid hierarchical relationships, which denied structural recursion (Espejo, 2011). There was pressure to make things happen in the economy, and Cybersyn did not have time to reflect enough upon critical relationships. It is now clear that these were hierarchical rather than recursive.

Cyberstride's focus was on designing performance indices for the essential variables of enterprises and plants. In practice, these indices were designed to measure the performance of their internal operations, at the expense of measuring relations with economic agents in the environment. This focus reduced the chances of using some form of market relations to build up an effective economy. The focus was on existing production processes and not on the *dynamic capabilities* that were necessary for organizational adaptation to environmental changes (Teece, 2008). This was an important methodological issue not considered in Chile at the time but its implementation was latent in Cybersyn. Over the years this methodology has evolved in the context of multiple organizations, for instance at Hoechst AG in Germany (Schuhmann, 2004). At a more general level since that time, several methodologies for indices design such as Critical Success Factors (Rockart, 1979), Balanced Scorecard (Kaplan & Norton, 1996) and others, have been implemented in enterprises of all kinds.

Overall, Cybersyn emphasized the filtration of operational complexity rather than the amplification of organizational complexity. Not much attention was given to enabling lateral coordination within and among plants and enterprises. Coordination was necessary to increase the chances of distributed *local* problem solving. Coordination systems are huge amplifiers at the local level. Unless people in an organizational system— in this case, units of the Chilean economy—share operational standards as well as values, mores and purposes, they will find it very difficult to coordinate their actions by mutual adjustment. Lacking these coordination systems the natural orientation of communications is vertical, that is, hierarchical. Today, with our current understanding of the VSM, it is clear that System 2, or its coordination function (Espejo, 1989), is a powerful function to enable autonomy. With current technologies such as the Internet and social networks, unit-to-unit software, and many more, this systemic function plays a role that was not thinkable, let alone possible, in the early 1970s. There were no information and communications technologies available in those days to implement real-time coordination. Not surprisingly, Cybersyn emphasized filtration; that is, indices of performance, rather than amplification (i.e. coordination systems). However, the VSM helps us see that both aspects are necessary for effective performance. Enabling autonomy in organizations is an aspect that I have since emphasized in applications of the Viable System Model (Espejo, 2001; Espejo, Bula, & Zarama, 2001; Espejo & Reyes, 2001; Reyes, 2001).

The Chilean Economy Model (CHECO) was a relatively under-resourced component of Cybersyn. The idea of producing a model of the economy without the participation of key actors, such as the Ministry of Economics, the Ministry of Finance, the Central Bank, the National Planning Office and so forth, condemned it to being no more than a learning exercise within the Cybersyn team. The system-in-focus for the CHECO modeling was the full economy. This was a pragmatic but inadequate choice; Cybersyn's system-in-focus was not the total economy. Good cybernetics for this modeling would have implied distributing modeling and planning capacity throughout the recursive structure of the industrial economy as a contribution to assess the dynamic capabilities and potentialities of all autonomous units, from CORFO to the local units. In practice CHECO had neither influence on the management of the Chilean economy nor on the management of CORFO and its operational units. From a VSM's perspective CHECO had to be a modeling tool to support *inside and now* and the *outside and then* debates within all autonomous units (i.e. S3, S4 and S5 in the VSM). It had to be a tool to relate the productivity of operational units such as CORFO, ramas, committees and enterprises to their longer term needs to contribute to their adaptation to turbulent environments. However, as stated earlier, these units were not autonomous and the dynamic modeling of their environments was not one of CHECO's concerns. In the end, the planning of the industrial economy was a centralized function of CORFO driven by macroeconomic concerns, not distributed to the ramas, committees and enterprises. The relationships of CORFO's Planning Department were with the National Planning Office rather than with the Cybersyn project.

As for the Operations Room (Fig. 2), from a methodological perspective Cybersyn stressed constructing a conversational technology rather than *designing conversations*. It offered a technology to include people in policy processes but did not offer a methodology for their meaningful inclusion. These have been controversial aspects of Cybersyn that over the years have been criticized as science fiction and fanciful technology (Axelrod & Borenstein, 2009).[5] However, the vision of a conversational space for self-reference was, and is, a strong one. It has been replicated in multiple enterprises and other institutions (Holtham, Lampel, Brady, & Rich, 2003). Those who see it mainly as flashing technology quite naturally will find it wanting. Those who see it as a conversational space for distributed policy-making throughout the organizational system will see operation rooms as a shorthand for policy-making requiring steering conversations between those running the operations *inside and now* and those dealing with the *outside and then*. This is a place for balancing the requirements of the internal operations and the stretching of environmental demands. The vision was blurred by the excitement of constructing a Liberty Machine (Athanasiou, 1980; Beer, 1975; Medina, 2011). In practice this meant that Cybersyn did not pay adequate attention to enabling conversation for

[5] Jeremiah Axelrod and Greg Borenstein delivered the paper "Free As In Beer: Cybernetic Science Fictions" at the 2009 Pacific Ancient and Modern Languages Association Conference. The link for the video recording of this presentation can be found in the references (Axelrod & Borenstein, 2009). The paper describes "how British cyberneticist Stafford Beer's writing, infographics, and industrial design for his ambitious Cybersyn Project worked together to create a science fictional narrative of omniscience and ominpotence for Salvador Allende's socialist government in Chile".

workers, managers and politicians to work out distributed but aligned purposes for the autonomous plants, enterprises, committees, ramas and CORFO. The overall global political strategy of developing a people's oriented industrial economy, in the context of a highly uncertain political environment, in the end restricted necessary conversations for distributed local self-reference and autonomy. CHECO and Cyberstride together could have supported these conversations; however, the Operations Room failed to engage the right stakeholders. It was an instance of a technology-dominated agenda at the expense of enhancing the autonomy of enterprises and therefore contributing to the performance of the national economy. Beer's later work in Team Syntegrity (Beer, 1994) was a powerful methodological contribution to designing conversations. Indeed, varied technologies are now available to enable these conversations that were unthinkable in those days, and they give credibility to Beer's vision 40 year ago.

Finally, Cyberfolk was yet another example of vision and technology anticipating future developments. Extending this idea of inclusion to on-going policy issues received limited methodological attention in those days and was restricted to a small group of scientists and experts. In the late 1990s and early 2000s, together with Clas-Otto Wene, I used the VSM and Habermas's communicative competence to propose an approach for inclusion and transparency in nuclear waste management policy in Europe (Espejo, 2003; Wene & Espejo, 1999) and later on with German Bula for a discussion of inclusion in Colombia (Bula & Espejo, 2012). Again, Beer's vision was ahead of its time.

Epistemological Lenses

Over the past 40 years significant social, organizational, economic and technological developments have increasingly helped transforming Beer's vision into reality; real-time management and coordination, autonomy within organizations, communication networks, conversational spaces, regulation of the economy and so forth. New information and communication technologies have gone hand in hand with an evolving epistemology to account for the complexity of interactions and communications in organizational systems. The VSM's information management epistemology, which dominated our work in Chile, is now being replaced by an operational epistemology (Espejo & Reyes, 2011).

This new epistemological lens for the VSM started, for me, in the days of Cybersyn. Its stronger information management epistemology, what I will refer below as the black box description of organizations, was increasingly challenged by a communications epistemology or operational description that highlighted the need to account for the moment to moment complexity of organizations striving for their viability. Today, our understanding of the VSM is much more sophisticated than in those days; we understand much more the *accounting for the complexity* of organizational systems. It was serendipitous that Heinz von Foerster, Humberto Maturana and Francisco Varela were working in Santiago precisely as Cybersyn unfolded. Conversations with them during the early 1970s helped us start seeing the economy with the lens of second order cybernetics—the cybernetics of the observer (von Foerster 1984), operational closure, structural determination and structural coupling (Maturana, 2002; Maturana & Varela, 1992; Varela, 1979). Their work has influenced the operational epistemology of today's Viable System Model (Espejo & Reyes, 2011).

A clean epistemological accounting of the complexity of social systems (Varela, 1979) should account for both the complexity of their input/output transformations, as observed by *external observers*, and the complexity of the relationships between the *observer participants* producing these systems. These are two complementary perspectives. One is accounting for external observations of transformations of inputs into outputs and the other is accounting for the observer participants' recurrent interactions or structural couplings. The latter is a far larger complexity but both are necessary.

In the former description, observers observe organizational systems as black-boxes; they are in a privileged position where they can observe both these systems and their environments simultaneously and establish correlations between the two through time. Their observations are associated with a mode of inference in which output information affecting the inputs of these systems determines, assuming a good model of their transformations and no unexpected disturbances, their future behaviour. It is a mode of inference that has associated with it a discourse about controlling a system's behaviour by choosing the appropriate controllable inputs.

In this type of description control is understood as restricting the system's behaviour to reach desirable outcomes or goals (Rosenblueth, Wiener, & Bigelow, 1943). This type of description helps accounting for the complexity of organizational transformations (Espejo & Reyes, 2011, Chap. 3). It recognises that often *it is not necessary to enter the black box to understand the nature of the function it performs*. This is Beer's First Regulatory Aphorism (Beer, 1979, p. 59).

This aphorism implies that the transformation of inputs into outputs is governed by regularities and that these regularities can be established through observation. Though this type of description is referred to as functionalist and often is dismissed as mechanistic, it is valuable to account for the complexity of the *boundary interactions* of an organization's transformation (Espejo, 1989). However for *autonomous systems* choosing variables to observe and control depends on the purposes ascribed to the organizational system and therefore, depends additionally on a wide range of inner conversations. Clarifying purposes permits us to work out the inputs and outputs relevant to the observers' purposes in the situation. The boundaries of the system are thus defined by the variables the '*inner*' *observers* choose to regulate.

The design of indices of performance in Cybersyn was mainly influenced by the government's policies and less by conversations about purposes and boundaries at the levels of CORFO, ramas, committees, enterprises and plants. In that sense the chosen essential variables to monitor in real time were less the outcome of autonomous conversations of operational units at different levels of recursion and more the outcome of global policies. No doubt conversations about purposes were happening in all those units, but the Cybersyn teams responsible for indices design, in general, were not involved in them. This was not a shortcoming of the VSM, but of Cybersyn's implementation. Critics of Cybersyn (Ulrich, 1994) failed to understand this distinction.

For operational descriptions of organizational systems there are no inputs or outputs (Varela, 1979, p. 85). Observers account for their systemic experiences by standing on the *inside*. The focus is on the relations that increase the chances for the system's viability, that is, its cohesion and adaptation to the environment's perturbations, naturally, including other economic and social agents. In other words, because observers are not in privileged positions anymore (i.e. *outside the system*) there is neither an environment nor a set of inputs, outputs or a transformation process (i.e. a function relating the outputs with the inputs) to account for the system's behaviour. All that observers have at hand are their interactions and communications constituting the system as a whole. These are *operational descriptions*. External perturbations may trigger changes in the internal structure of the system but they do not determine its future behaviour. This is why this mode of description is more appropriate with a discourse about autonomy and, therefore, for describing the behaviour of autonomous systems. This is an operationally closed system that makes its own decisions. In this type of description control is understood in terms of self-organization and self-regulation. Again, as explained before, Cybersyn designers did not focus enquires on these relations/conversations; they were not accounting for their complexity. This accounting would have been possible if these designers had had the chance to study and influence the cybernetics of the industrial economy at all its recursion levels; indeed a major endeavour, far beyond what was possible in Chile's circumstances.

Under the black box type of description it is commonly said that the organizational system operates with a representation of its environment. On the other hand, an operational description makes of the organizational system a cognitive nontrivial machine (von Foerster, 1984). This cognition arises as a result of the structural interconnectivity of operationally closed components. Under these circumstances, it is the structure of the organizational system that selects which patterns of disturbances in its environment are going to be *seen*, *heard*, or in general *perceived*. It is its internal structure that makes sense of the world *out there*. It is in this sense that we say that organizational systems are *structure-determined* (Maturana, 1988, 2002). In Cybersyn, CHECO models were (limited) representations of the Chilean economy. They were not outcomes of politicians' and managers' structural couplings producing, through these recurrent interactions, shared models of the economy for its regulation, and adjusting their relationships, that is, their models, as unexpected disturbances hit the economy.

The concept of *information* changes dramatically under these two types of system's descriptions. Information as referential, instructional and representational is a concept that pertains to the black-box type of descriptions (Simon, 1981). On the other hand, in the operational type of descriptions, we use the word *information* to endow its environment with meaning (Varela, 1986, p. 119). With this distinction, we are moving from questions about semantic correspondence to questions about structural patterns.

For Cybersyn black boxes were the dominant mode of description. The Viable System Model was used as a set of black box descriptions of the industrial economy. They took the form of quantified flowcharts. Today, the VSM is a far more complex and sophisticated tool to study and design organizations. The operational type of descriptions and related forms of intervention were not used in Cybersyn, and we now are clear that this type of description is necessary to make sense of black-box descriptions. It is necessary to account for conversations to clarify purposes, to build up responsible trust between autonomous units, to coordinate their operations and so forth.

Yet, in spite of recent developments in complexity theory, the study of economic and social phenomena still depends to a large degree on black box descriptions. There is little about relationships and mutual regulation to enable effective ecologies of organizational systems. In the book, *23 Things They Don't Tell You About Capitalism*, the Cambridge economist Chang (2010) highlights the fact that there is no such thing as a free market. Among other aspects, he argues that free-market policies rarely make poor countries rich; contrary to the centre-right view that governments often are lousy allocators of investment resources, i.e. pick up losers, they often do pick up winners; contrary to the view that self-regulating markets make the right choices, leaving these choices to the markets alone is not smart; even if we believe that free-market economies are not regulated, in general they are over regulated; contrary to the view that financial markets need to become more efficient they need to became less efficient, and he continues debunking free-markets. The traditional views about economic policies are supported by black box descriptions of the economy. Limited attention is paid enabling self-organization and supporting effective relationships. The VSM makes possible systemic views that counter fragmentation and support understanding economies as operational descriptions of relationships to make them more viable and just. Cybersyn's vision, albeit not its actuality, offered this regulatory and structural framework. This is our concern next.

Towards Beer's Vision

What did Cybersyn mean in the context of the Chilean government and in particular of its industrial economy? To what extent did it influence people's decisions in the industrial economy? Did it increase the reach of managers or enhanced the autonomy of the workers? Were its tools deskilling workers or increasing their problem solving capabilities? By highlighting Cybersyn's actuality, in particular its limitations, this paper has offered a dispassionate view to reflect upon these questions.

Cybersyn was a platform for change that still is unraveling. Though the project had technocratic overtones and limited political influence, its true value was its vision, which still has much to offer to improve society. In contrast to the traditional emphasis that economists put in mathematical modeling to support policy processes, Beer's Viable System Model points towards relationships and enabling by design the self-organization of economic agents. Beer acknowledges both the huge complexity of any economy and the need to support by design the regulation and self-regulation of its agents.

The VSM was at the core of Cybersyn, however the methodology for its application was blurred. We did not question whether CORFO, and its embedded autonomous units, had viable structures able to cope with the demands of the people and of other internal and external economic agents, and whether by structural design and improved communications we could have stretched the structures and improved their performance. Though its conceptual framework was powerful and made valuable technical contributions, Cybersyn failed to make the organization of the economy more effective. It neither produced inclusive policies for workers and the people in general nor did it improve the productivity and overall performance of the economy.

The challenge was making a state-owned industry productive. The transformation should have gone far beyond making available information and communication systems. Indeed, the methodological capabilities of the Chilean Team were incipient. Our emphasis was the implementation of information and communication technologies, and except for the October strike and Fernando Flore's political influence, we failed to achieve any significant economic and political influence. Cybersyn did not have much influence on developing people's potentials towards a more effective industrial economy, let alone towards an effective organization of society. The project had the Viable System Model as its foundation and indeed its key ideas, such as managing complexity, ultrastability, adaptation, recursion and others. They were most important for Cybersyn designers, but their embodiment in the practices of managers and workers were indeed limited. Success for these ideas required increasing the productivity, autonomy and entrepreneurship of economic agents within a regulatory framework that steered them towards aligning their actions with the government's policies. The acid test should have been producing a cohesive economy with productive autonomous enterprises. These were potentialities of Cybersyn.

Chile's economy was weak. It was dependent on minerals for its foreign currency and foreign technology and expertise for its industrial development. For consumables the policy had been protecting the local economy through high import barriers. Nationalizing a large number of enterprises in a short period of time had implied replacing relatively experienced managers with inexperienced ones and exploited workers with workers more focused on social justice than on innovation and entrepreneurship. In that context, let alone the context of an antagonistic international western world, achieving a high performance industry was a tall order and was going to require many years to become reality. The realistic challenge for Cybersyn would have been accepting that its meaning was opening the horizons for a better future rather than for an effective economy in the short term. However, at that time, it was difficult to see this distinction. It was *realistic* privileging the technological implementation of a visionary project rather than building in the short-term more effective relationships.

We accepted the VSM as a *liberty machine* rather than as a mean to support processes to transform society. Rather than focusing on social transformation our focus was on producing information systems and artifacts. The VSM had to be far more than a heuristic to map a hypothesized recursive structure for an industrial economy. In other words, its use required far more development to achieve social transformation. Beer's emphasis in designing and implementing a *liberty machine* made Cybersyn technology-focused at the expense of clarifying methodology and epistemology. However, it can be argued that because Cybersyn succeeded in designing and implementing this liberty machine that a platform for further exploration and future developments was created. It was the extraordinary energy that Beer imbued in an impossible task that avoided sending his vision into oblivion. Paradoxically, though Cybersyn was insufficient for its purpose of improving the cybernetics of the Chilean industrial economy, it was an anticipation of necessary technologies and means for achieving a better cybernetics in future societies. It made more likely the designing of social economies beyond the extremes of centralized bureaucracies and poorly regulated free-markets. These two extremes are ineffective as illustrated by the collapse of socialist economies in Eastern Europe and the short-comings of capitalist, free-market economies (Chang, 2010). Accepting that the VSM is still a paradigm waiting for its time, today it offers an option for designing self-organized, regulated, social economies. Beer had clear the scope of Cybersyn for *designing freedom* (Beer, 1975), for *designing the system for organizations* (Beer, 1985), for providing a *platform for change* (Beer, 1975) and so forth. In Chile, through Cybersyn, Beer's vision was offering organizational cybernetics as an alternative to achieve fairer social economies. Unfortunately, in Chile, a wider appreciation of this vision was constrained by an impossible socio-political context, a weak implementation methodology and an information oriented epistemology; all these aspects contributed to blurring an appreciation of its longer term meaning. The project's implementation failed to match the complexity of the social processes involved.

Coda

In 2008 Jorge Baradit published in Santiago, Chile, the novel Synco. The novel was about the Cybersyn Project. Synco was the Chilean name for Cybersyn. It was a composition of the ideas of *information* and *control,* the Spanish word CINCO, 'five', and the number of systemic functions constituting the Viable System Model. It starts by showing the Operations Room (Fig. 2), and setting it as a *retro-futuristic* novel that takes place in 1979. Its assumption was that the coup of 11th September 1973 did not succeed and that the Allende's government had continued for all those years with the support of General Augusto Pinochet. For Baradit the project's purpose was "…converting Chile into the first Cybernetic State in history, underpinned by a network which anticipated in decades the Internet as we know it". Chile appears as a neo-fascist State, dominated by the SYNCO machine, which controls all aspects of private and public lives. One of the protagonists, as he tries counteracting the state's drift towards a technocratic rightwing society, says:

> SYNCO, a god made of wires and a shared mind, a beehive, will establish the first technological dynasty in history…But we are building up an army of code breaking children.

> We have educated them in the secrets of SYNCO … a battalion of mind focused soldiers which will face up with their keyboards a new type of war for which they (the government) are not prepared…" (Baradit, 2008, translated from the Spanish version, pp. 230–231).

Another person states in relation to the government's socio-economic direction that "The *third way* is an illusion" produced by a network of black covered copper wires. Baradit appears to accept that a successful 1973 military coup was the lesser evil for Chile; the alternative was too awful to contemplate. It is sad that this popularization of the SYNCO project appears to give credence to the fears expressed by the right wing political press just before the coup in 1973. It re-enforces the view that the cybernetic project could only have led Chile to a neo-fascist, totalitarian outcome. This trivialization betrays a profound lack of grasp of organizational cybernetics as a science for democratic governance and not for autocratic control.

Cybersyn did not succeed in re-constructing the nature of the Chilean society. Its vision was offering an alternative to the extremes of either a centralized planning system or an unrestricted free market; it offered a third way for social cohesion and economic fairness. Cybersyn was a project ahead of its time. Its creation was visionary but unfortunately its intended implementation did not have requisite variety. The necessary social and organizational contexts to re-construct the nature of social relationships did not exist; however desirable it might have been to provide information in real-time and by exception, the necessary relationships for the cohesion and adaptation of the social fabric were not there. A mooted point is whether a longer period of implementation, uninterrupted by the coup d'état of September 1973, would have supported this requisite learning. Some of us in the project had a vague appreciation of the *need to embody these relationships in the social fabric of the economy* but collectively most of us did not see Cybersyn beyond being a powerful theoretical framework. Our practice was biased towards a technical implementation at the expense of the values of building up a truly autonomous decentralized industrial economy and furthermore an inclusive democracy.

In conclusion, Cybersyn did not succeed in reconstructing a more humane and just social nature in the Chile of the 1970s. However, the safeguards against technocratic tendencies were precisely in the very implementation of Cybersyn, which required a social structure based on autonomy and coordination to make its tools viable. Without a culture of autonomy, coordination and inclusion these tools were too weak to have any social impact. The control against any autocratic tendency was intrinsic to its conceptual framework, the VSM. Of course politically it was always possible to use *information technologies* for coercive purposes; however, that would have been a different project, not SYNCO. Its political and conceptual underpinnings were those of a democratic society and its tools were orders of magnitude less complicated than those required for centralized control. With the benefit of hindsight I think that had the 1973 coup failed, and *had the people and its socialist government supported the 3rd way offered by Beer's vision*, Chile would have emerged, after several years of painful learning and development, as a more cohesive and fair society with a large social capital of engaged citizens.

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Systemic Design Principles for Complex Social Systems

Peter H. Jones

Abstract Systems theory and design thinking both share a common orientation to the desired outcomes of complex problems, which is to effect highly-leveraged, well-reasoned, and preferred changes in situations of concern. Systems thinking (resulting from its theoretical bias) promotes the understanding of complex problem situations independently of solutions, and demonstrates an analytical bias. Design disciplines demonstrate an action-oriented or generative bias toward creative solutions, but design often ignores deep understanding as irrelevant to future-oriented change. While many practitioners believe there to be compatibility between design and systems theory, the literature shows very few examples of their resolution in theoretical explanation or first principles. This work presents a reasoned attempt to reconcile the shared essential principles common to both fundamental systems theories and design theories, based on meta-analyses and a synthesis of shared principles. An argument developed on current and historical scholarly perspectives is illuminated by relevant complex system cases demonstrating the shared principles. While primarily oriented to complex social systems, the shared systemic design principles apply to all complex design outcomes, product and service systems, information systems, and social organizational systems.

Keywords Design theory • Framing • Service systems • Social systems • Systems theory

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Introduction

Systems theory and its guidelines in practice—systems thinking—have been promoted as the best techniques for raising social awareness about interconnected complex systems, which might determine human destiny. Societal problems have grown to levels of existential risk, and human limits to cope have been reached or breached. We find ourselves socially incapable of marshaling the political will to enact appropriate decisions and forge long-term actions resolutely addressing these problems. The systems disciplines are not to blame for the failure of social will, but the analysis processes and methods claimed as uniquely effective for these problem situations have failed to advance the human crises of climate change, energy production, political organization, connected economies, globalized corporations and labor, and urbanization. The systems movement has been critiqued as failed, solipsistic or unrealistic (Ackoff, 2004; Collopy, 2009; Jones, 2009), leading some to call for integrating systems thinking with practical methods of design practice.

For decades we have seen cycles of convergence and divergence between systems theory methods and the creative design disciplines. While some thinkers have articulated systems thinking as a design process (Ackoff, 1993) or design as a systemic discipline (Nelson, 1994), these positions are not the norm within each field. Drawing across recent literatures, very few studies have defined this emerging position. In a conference paper, Pourdehnad, Wexler, and Wilson (2011) present a recent approach to define a consensus integration of system thinking and design thinking, as a strong systemic view of complex system problems addressable by the intuitive and abductive approaches implicit in design thinking. From a design science tradition, Baskerville, Pries-Heje, and Venable (2009) proposed an integrated view of generic design process with a soft systems/action perspective. Most of these ideas recognize the perspective of design as a practical problem solving epistemology, one that may be considered third culture with science and arts/humanities (Cross, 1990). This idea is supported by the increasingly-popular belief that "all people are designers," at least in the sense of people intentionally constructing their work and lives.

The first conceptual blending of design and systems thinking formed with design science, a systematic approach to defining large-scale systems. The development of design science attempted to bridge design practice and the empirical sciences, following Fuller (1981) and Simon's (1969) positions of design as a process of creating sophisticated forms and concepts consistent with scientific and engineering principles. In practice, design science evolved toward a strong orientation to design methods and process, manifesting a systematic mindset and approach, but without the creative discovery of science or design. The inherent rationalism of design science and the first design methods movement were later rejected by even some of the originating designers and theorists. As Cross (2001) explained:

> So we might conclude that design science refers to an explicitly organised, rational and wholly systematic approach to design; not just the utilisation of scientific knowledge of

artefacts, but design in some sense a scientific activity itself. This is certainly a controversial concept, challenged by many designers and design theorists.

New transdisciplinary applications of design science may be migrating toward the systemic design approach. Upward's (2013) strongly sustainable business model research develops a design process and ecological systems theory as a methodology for redesigning business models toward sustainability goals. With an evaluation model based partially on Baskerville et al. (2009) design science method, Upward's systemic design process formulates the sustainable business model not as an abstraction but as a social, ecological and economic system design.

The domains of systems theory and design have enjoyed an uneasy and irregular relationship that allows each field to claim knowledge of the other. Practitioners in both domains have attempted to entail the more effective models and techniques from the other field, but usually in piecemeal fashion, and only if a problem was so suited. Two contemporary examples include the principles of biomimicry, as developed in environmental design, and the instrumental forms of design thinking found in the professions and management.

There appears to be insufficient agreement regarding the name, scholarly positions, and curriculum in this emerging interdisciplinary field. However, the recent formulation of *systemic design* draws on the maturity of these long-held precedents toward an integrated systems-oriented design practice (Nelson & Stolterman, 2012; Sevaldson, 2011). Systemic design is distinguished from service or experience design in terms of scale, social complexity and integration. Systemic design is concerned with higher order systems that encompass multiple subsystems. By integrating systems thinking and its methods, systemic design brings human-centered design to complex, multi-stakeholder service systems as those found in industrial networks, transportation, medicine and healthcare. It adapts from known design competencies—form and process reasoning, social and generative research methods, and sketching and visualization practices—to describe, map, propose and reconfigure complex services and systems.

Systemic design views design as an advanced practice of rigorous research and form-giving methods, practices of critical reasoning and creative making, and of sub-disciplines and deep skillsets. As professional practices with deep specializations, industrial design, interaction design, service design, information and visual design all have relevant differential cases and unique adaptations of systems thinking. While a deconstruction of the design disciplines and their references might lead us far afield into further fragmentation, remaining in the territory of *all people are designers* leaves design practice and method as merely conceptual reasoning techniques that bestow the making rights of designers upon all problem solving roles.

Relevant principles and relationships between systems theory and design methodology are called for, independent of method. Contemporary systems theory has evolved to a stable set of preferred theories for system description (or explanation), prediction (or control), and intervention (change). Jackson (2010) mapped the predominant schools of systems thinking as hard systems, soft systems, system dynamics, emancipatory and postmodern systems thinking. Three other branches can be located in complexity science—complexity theory, network science and organizational cybernetics. The acknowledged schools do not promote a clear function of design or a relationship to design thinking. Most of them identify methods and conditions for intervention in a given system. We find no acknowledgement that the notion of "intervention" is both (a) an admission of system objectification and (b) a position on the necessity for a design process.

Systems can be described as emergent or designed networks of interconnected functions that achieve an intended outcome. Today we must conceive of all systems as social systems, or at least socially implicated systems of systems. Researchers have accepted a consensus (Stockholm Memorandum, 2011) that human intervention has intervened in all aspects of the planetary ecology, rendering even natural and ecological systems socially-influenced. The current era of time is now recognized as the Anthropocene, having passed from the relatively brief Holocene era into the human-dominated Anthropocene era in the late 1800s (Crutzen, 2002).

For the purposes of this article, a complex system refers to domains where it is nearly inconceivable that any single expert or manager can understand the entire system or operation. Typical systemic design problems are complex service systems, socially organized, large-scale, multi-organizational, with significant emergent properties, rendering it impossible to make design or management decisions based on sufficient individual knowledge. These include services and systems such as healthcare systems and disease management, mega-city urban planning and management, natural resource governance and allocation, and large enterprise strategy and operations. None of these are isolated "domains," as each of these are affected by unknowable dynamics in population and regional demographics, climate and natural ecology effects, political and regulatory influences, and technology impacts.

It is also insufficient simply to claim that these domains consist of multiple "wicked problems," which cannot be reduced and therefore must be intervened as design problems only. The complexity of such problem systems necessitates multi-reasoning and inventive methodologies well beyond the analytical systems modeling and simulation techniques preferred in system dynamics.

Systemic design is not a design discipline (e.g., graphic or industrial design) but an orientation, a next-generation practice developed by necessity to advance design practices in systemic problems. As a strong practice of design, the ultimate aim is to co-design better policies, programs and service systems. The methods and principles enabling systemic design are drawn from many schools of thought, in both systems and design thinking. The objective of the systemic design project is to affirmatively integrate systems thinking and systems methods to guide human-centered design for complex, multi-system and multi-stakeholder services and programs.

The Wickedness of Problem Systems

The concept of wicked problems (Rittel & Weber, 1973) is shared by systems and design theory, as a complex situation that cannot be reduced and analyzed with the techniques of classical problem solving and decision making. Wicked problems include most persistent social and environmental issues, such as the continuous global problems that have evolved over time. “Problems,” as we naively designate them, are essentially social agreements to name a salient concern shared within a culture. The designation of *concern* (Latour, 2008) reflects a thoughtful presentation of the social value of the meaning ascribed to problems as experienced. Latour distinguishes between *matters of fact* (problems as objectively determined) versus *matters of concern* (about which we experience care, entanglement, and share associated values with). Matters of concern are problems found relevant to the motivation for design for social betterment. Design theorists often prefer “fuzzy” or “ill-formed situation” as a rhetorical means to distanciate the social concerns embedded in the situation that could inhibit generative ideation or creative resolution. I will adhere to the common meaning of *problem* as a perceived deficiency or negative value state sufficiently significant to compel social agreement to repair or restore.

Significant societal or global problems (such as global poverty, hunger, sociopolitical violence, climate change) originally emerge from multiple root causes and become interconnected over time. As with designed systems, “problems” are situations that favor some constituents and cause unforeseen consequences to others. Problems are maintained by social agreement and tend to reinforce conditions over time, and they begin to resemble autonomous, complex adaptive systems. These co-occurring problematic manifestations can be termed problem systems. Problem systems demonstrate the whole-part identity of a system of systems, the interdependency of component systems, and the endurance of ultra-stable systems.

One of the earliest attempts to catalogue significant societal problems was the Club of Rome’s “Predicament of Mankind” project (Meadows, Meadows, Randers, & Behrens, 1972), a prospectus which invited proposals to address the most salient emerging global concerns. The Predicament was an attempt to marshal commitment across national boundaries due to the foreseeable setbacks in national political systems. The outcome of the winning proposal was the publication of “The Limits to Growth” (Meadows et al., 1972), defining the scenarios generated from the WORLD model global resources simulation. The alternative (and overlooked) proposal of Özbekhan (1970) to the Club of Rome’s project helped instantiate the social systems school of systems practice, as it was clearly distinguished as a social policy program rather than a technology-based (hard systems) simulation strategy. The rejected proposal was a design orientation to human-centered policy design and planning based on the engagement of invested stakeholders. His *problematique* was a framework for assessing the relationships among a system of closely-coupled interacting problems.

> We proceed from the belief that problems have "solutions" – although we may not necessarily discover these in the case of every problem we encounter. This peculiarity of our perception causes us to view difficulties as things that are clearly defined and discrete in themselves (1970, p. 6).

Özbekhan defined the global problematique as characterized by 49 critical continuous problems (CCPs). While these problems have been re-presented and reformulated since then (cf. Christakis & Bausch, 2006), agreement remains that these 49 remain as persistent, interconnected, and generally worsening challenges to all human societies.

The problematique was adopted by Warfield (1999) in the development of generic design science as a collective approach to address complexity surpassing individual comprehension. More recently the international Millennium Project identified 15 global challenges (Cisneros, Hisijara, & Bausch, 2013; Glenn, Olsen, & Florescu, 2012) that suggest the evolution of Özbekhan's 49 CCPs had indeed resulted in an identifiable number of significantly overlapping and interconnected global problem systems.

True wicked problems such as the 49 CCPs demonstrate changes over time, resulting in differences among problem stakeholders over the most critical issues and the definition, boundaries or problem framing. Dedicated societal and policy action toward progress on these problems inevitably reaches points of conflicting policy priorities and impasses. Original causal influences (such as bad regulatory decisions or perverse economic incentives) evolve into new effects (corrupt agencies and financial capture of regulatory regimes). Interventions have no testable solution (how would you know you have resolved the situation?) and the very acknowledgement of a "problem" results from the earlier effects of embedded, interconnected, "complicated" problems.

Problems Exist in Language

The language of design and systems differentiates with respect to the preferred actions to make progress toward the problematic situation. It is incorrect to speak of *solving* wicked problems, as there are no agreed or effective evaluation measures that would justify the claim. The idea of *dissolving* wicked problems by design thinking has a popular resonance, but little empirical meaning. According to social systems theorists, the so-called wicked problem does not exist in the world as an object or organization with definable boundaries. Warfield (2001) asserted that all problems we define, as human constructs, can be described as problem sets, with each distinct *problem* merely a component of a set or problem system.

Warfield (2001) stated that all complexity exists in the minds of perceivers, not in the system believed to be the subject of description. The frustration that occurs when observers find themselves unable to define and understand a situation leads to the explanation that the *system* is inherently complex. Stakeholders are unable to recognize that their own cognitive limitations explain the majority of the complexity. Also, most socially complex problem constructions are likely to contain *objectively complex* subsystems, or a complex of multiple relationships and feedback interactions that require significant analysis and domain expertise to unravel. Likewise, in any problem definition stakeholders underconceptualize the dimensions and factors of the field of interaction and therefore the field of designable options (or possibilities for innovation).

While this feature of complexity has been considered an argument for systems thinking, the necessity for variety and multiple reasoning pathways strengthens the argument for a strong design approach instead. Warfield's axiom, taken seriously, reveals the flaws of a hard systems analysis for optimization and problem definition. Design, or effective intervention, in complex systems requires deliberate variety enhancement and refraining from early closure. Universal design methods include reframing (boundary setting), iteration (trial-and-error of design options) and critical feedback (multiple modes of evaluation). System designers identify and reconfigure boundaries as ways of sensemaking with others, to evaluate design strategies, and to produce descriptive scenarios.

Wicked problems are predicated on the notion of *irresolvable* complexity, impossible to mitigate through analysis or the application of processes. The emergence of perceived complexity unfolds as observers investigate, learn and understand the relationships of constituent systems in the problem. Problems are considered *wicked* once understood in their ecology of relationships.

Rittel's ten distinctions of a wicked problem (Rittel & Weber, 1973) disorient any conventional view of the effectiveness of problem solving. Adapted for the purposes of this article, these are simply:

1. There is no definitive formulation of a wicked problem.
2. Wicked problems have no stopping rules (How do we know when design is enough?).
3. Solutions to wicked problems are not true-or-false, but better or worse.
4. There is no immediate or ultimate test of a solution.
5. Every solution to a wicked problem is a one-shot trial. Every attempt counts significantly.
6. You cannot identify a finite set of potential solutions.
7. Every wicked problem is essentially unique.
8. Each can be considered to be a symptom of another problem.
9. The discrepancies (and causes themselves) can be explained in numerous ways.
10. The planner has no right to be wrong.

Problems, as phenomena, only "exist" when declared by social agreement. Yet every stakeholder or participant in a situation will be primarily concerned with dynamics that occur within the problem system perceived as significant to their interests or values. This differentiation of care results in agreements not based on common understanding of the social system, but on individual concerns for possible outcomes and opportunities understood as individually meaningful. Different stakeholders will find salience in aspects of the situation they care about, which are compelling to their experience, giving them an actual stake in the problem, a motive for taking action. Social methods are necessary for enabling people to discover experienced phenomena and to reach understanding, if not consensus, about possible paths of action. Social methods are not necessarily democratic by design, but must be to facilitate substantive and invested participation from the range of stakeholders in a problem system. Finally, social methods are necessarily processes of design, not only ideation and deliberation. The most efficacious courses of action in a complex social system are not determined analytically, or by consensus of a group, but through the interactive co-creation and assessment of proposals that synthesize a whole intervention or actionable strategy.

Design Strategies for Complex Social Systems

Design practitioners have been drawn toward design thinking as a way of formulating proposals for change and creative outcomes as the complexity of those problems considered amenable to design has increased. Recent observers often consider design thinking a contemporary development. Some consider it a discipline with insufficient maturity, literature, and precedents upon which to formulate research. Due diligence will find little agreement for a preferred definition of design thinking from the scholarly literature. References to Simon (1969) reveal a misunderstanding that the rigorous rationalism of systems theory and engineering contribute a benchmark definition upon which design thinking is based. Yet contemporary design thinking shares little in common with Simon's epistemology or methods. Perhaps the strongest claim for the term and the most pertinent approach to design is that of Buchanan (1992), whose article was first presented as a 1990 lecture on changing orders of design practice according to different formulations of problem solving, including "systemic integration."

> In this sense, design is emerging as a new discipline of practical reasoning and argumentation, directed by individual designers toward one or another of its major thematic variations in the 20th century: design as communication, construction, strategic planning, or systemic integration (Buchanan, 1992, pp. 19–20).

Systems Influences on Design Methods

The history of design methods reveals the characteristics of design thinking expressed in the methodological perspectives of their time. Bousbaci (2008) depicted the generally acknowledged three generations of design methods, with each identifying the paradigmatic shifts in prevailing design theory that followed the systems theory principles in force during those times. Table 1 illustrates a summary of his analysis supported by the author's examples of influences and outcomes, and the addition of the fourth (generative) generation.

Table 1 Four generations of design methods

Generation	First	Second	Third	Fourth
Orientation	Rational 1960s	Pragmatic 1970s	Phenomenological 1980s	Generative 2000s
Methods	Movement from craft to standardized methods	Instrumentality Methods customized to context	Design research and stakeholder methods Design cognition	Generative, empathic and transdisciplinary
Authors and trends	Simon, Fuller Design science Planning	Rittel, Jones Wicked problems Evolution	Archer, Norman User-centered design Participatory design	Dubberly, Sanders Generative design Service design
Systems influences	Sciences Systems engineering	Natural systems Hard systems	System dynamics Social systems Soft systems	Complexity

Concurrent in history to the three generations of design methods we also find three theoretical streams of design philosophy, whose underlying intellectual frameworks share significant influences among systems theorists. These philosophies (epistemological stances) can be characterized as rational, pragmatic, and phenomenological. These philosophical influences have blended with each other over the years, so that their unique contributions are deeply embedded in design thinking. The emerging consensus on design thinking represents a fourth generation of design methods, based on generative epistemology and approaches (Sanders & van Stappers, 2013).

As other stances have emerged to enrich design research (e.g., constructivist, reflective, interpretive, emancipatory) relevant methods have emerged (e.g., activity analysis, hermeneutics, participatory design). These emerging positions have been quickly translated into methodology and practice. In design practice, and often as well in design research, the links back to the scholarship are often missing. The current project of design principles attempts to link generative design guidelines to systems theoretical principles.

Social system design largely consists of models of collective inquiry for engaging stakeholders in the many different activities of designing. As acknowledged by authors Banathy (1996), Gharajedaghi (2011), and Metcalf (2010) social systems design is more a guideline for systems thinking in complex social applications. It is a multidimensional inquiry, not a "studio" practice engaged by design firms. In practice social systems are not approached with a set of design methods or a toolkit (such as IDEO's Human-Centered Design). As the social system is that which is ultimately defined by its stakeholders, the methods and strategies adopted for systemic design must be accepted and understood by these stakeholders.

Yet a cultural-historical view of design for social applications reveals a more designer-driven artifactual perspective in theory and practice. Even if systems theory and practices are not embracing the shifts in design thinking, design practices have become more systemic. However, there is a surprising paucity of literature in systems-oriented design theory and few published cases that define a systems-orientation to design.

Over the evolution of design trends, including the four generations of design methods, strategies for designing products and services within complex social systems have been advanced. These strategies include meta-design frameworks and integrated methods associated with systemic approaches.

Perhaps first among the design theorists was Richard Buchanan's (1992) definition of the orders of design (for "wicked problems in design thinking") universally applicable across design thinking. The foundational premise claimed four "orders" or design contexts that express the products of design:

1. Symbolic and visual communications
2. Artifacts and material objects
3. Activities and organized services
4. Complex systems and environments

Buchanan's observation was that designers draw upon these contexts as "placements" or ways to creatively reconfigure a design concept in a situation. Placements refer to positions employed for integrated design strategies across four classes of design targets. All designers build vocabularies of design thinking and techniques, as well as a set of skills and styles applicable in their domains of work. Designers should not follow a fixed series of orders to reach an outcome, but rather adopt placements as a strategy for creative invention.

Recognizing that contemporary designers are now involved in more complex problems and require further guidance than the doctrine of placements, van Patter (Jones & van Patter, 2009) advocates four distinct design domains. The four domains advance from simple to complex, with a series of learning and skill stages necessary for negotiating increasing complexity.

Design 1.0–4.0 stages are based on observations and necessities drawn from practice. They show different levels of understanding and skill applied to four different domains characterized by relative complexity.

The stages require an evolution of design practice, research, and education to develop new knowledge bases necessary for this increased complexity. Different skills and methods apply in each domain, that are generally transferable up, but not down the levels (Fig. 1).

The four domains embody design processes for the following contexts:

1. **Artifacts and communications**: *design as making,* or traditional design practice.
2. **Products and services**: design for *value creation* (including service design, product innovation, multichannel, and user experience), design as *integrating.*

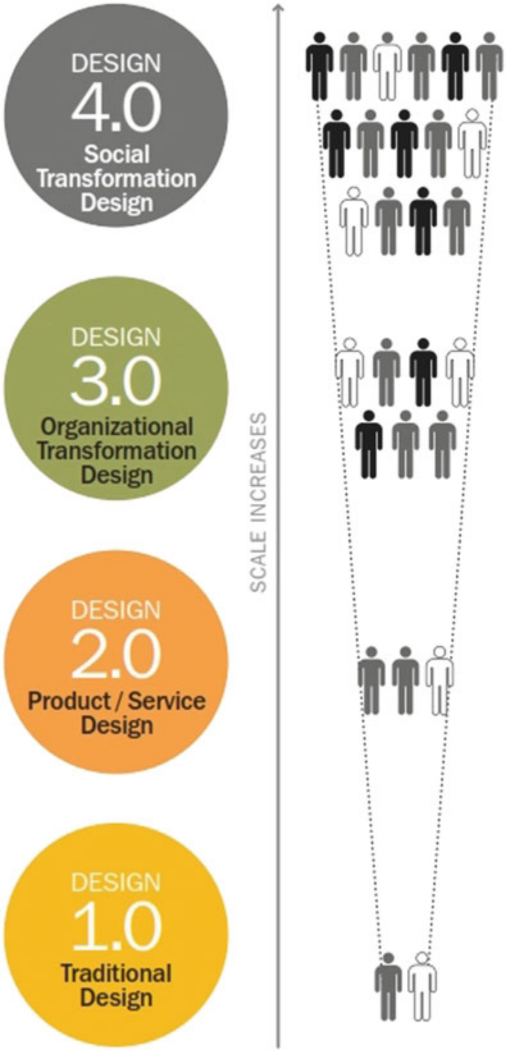

Fig. 1 Mapping design process to challenge complexity (Jones & van Patter, 2009)

3. **Organizational transformation** (complex, bounded by business or strategy): change-oriented, design of work practices, strategies, and organizational structures.
4. **Social transformation** (complex, unbounded): design for complex societal situations, social systems, policy-making, and community design.

Because of the magnitude of complexity difference in each level or stage, the stages are not interchangeable. In any given design process, the skills and orientations from *all* levels might be employed. Each higher stage is inclusive of the lower levels as the problem complexity expands from Design 1.0–4.0. An organizational process design (3.0) should present communications with the quality of the best

D1.0 work, and its process would normally be designed following the methods and practices of a D2.0 service.

The four domains differ in their strategy, intention, and outcomes. Each domain requires skill and coordination of distinct methods, design practices, collaboration skills, and stakeholder participation. These are not fixed requirements but merely entry criteria for skillful performance sufficient to meet the demands of that domain's complexity (or variety) in practice.

The relationship of these design strategies to systems practice has not been fully realized, but there are several essential influences. Each design stage reflects a distinct system boundary. The differences between a simple design project (1.0) and a market-facing product or service (2.0) are significant, and well-understood. The social complexity of an organizational boundary (Design 3.0) involves governance, operations, product line and service strategies, human resources, and all internal systems. The design context for the 3.0, complex system, requires different mindsets, value propositions, disciplinary composition, and skills. The boundary and the social system are further expanded with Design 4.0 problems of societal transformation (which includes policy design, a domain which has not generally evolved to advanced design and normative planning).

Systemic Design of Sociotechnical Systems

The four domains of design are highly interconnected in practice. A service process (Design 2.0) will necessarily require reciprocal organizational changes from its host company (3.0), and will require continual communications and enhancements designed as traditional (1.0) services. A multidisciplinary design project will coordinate appropriate designing skills relevant to the desired outcomes. However, complex social systems require significantly more dedication to social and user research than commercial products or single-vendor services. A systemic design approach integrates skills and domain knowledge across the social-organization-service levels and defines new artifacts (for example, integrated products and services) that adapt to the market (social) ecosystem and organization.

Sociotechnical systems recognizes the interdependent organization of work practices, roles, tools and technology. Fox (1995) states the goal of a sociotechnical system design is to integrate "the social requirements of people doing the work with the technical requirements needed to keep the work systems viable with regard to their environments." For services defined by their complex work, such as healthcare clinical practice, the sociotechnical systems view reveals a whole-system ecology that becomes the target of design. Figure 2 represents four layers of practices identified in the whole-system ecology of services. Each level constrains the social and work practices in the adjacent lower level within a range circumscribed by economics, practice, and professional norms. The Industry and Organization layers establish the long-term contexts, practices, roles and skills in which healthcare (or other work) is performed. Organizational change, considered a Design 3.0 problem, is

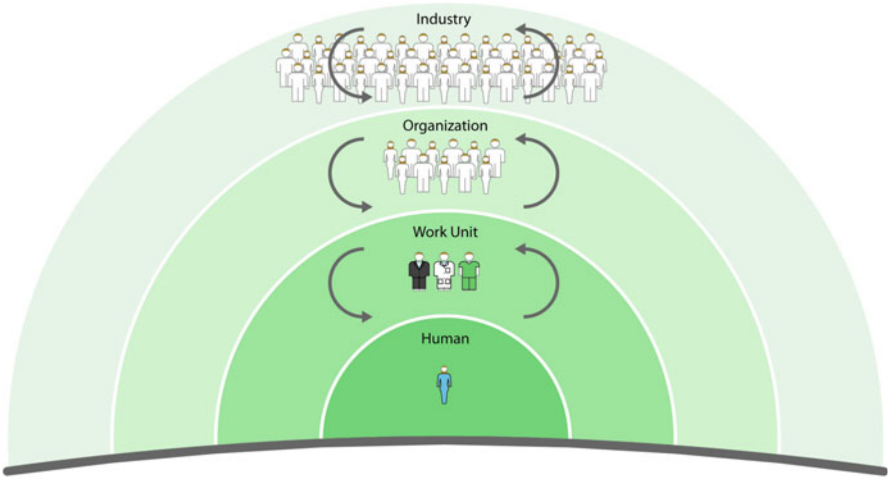

Fig. 2 Domains of social practices in a human-centered sociotechnical system

inherently limited to the historical constraints of industry and healthcare policy (both Design 4.0 concerns). Design options available to the Work Unit (Activity layer) are invisibly but powerfully determined by higher-level sociotechnical contexts.

The human in the system's center represents the conventional actor toward which technological interaction is applied—the "user," the "patient," or a "customer." The apparent isolation of the actor within the sociotechnical system model suggests that a given individual may be acted upon within the aggregate contexts of these nested social systems. The possible ranges of interaction and breakdown that may occur with the individual actor are too complex to account for. The human actor is inserted as a reminder that the purported rationale for the provision of service is to fulfill demands or needs of the given individual. In reality, service systems are designed for objectives of the highest-level contexts that supervise the process. Electronic health records systems are not procured for patient needs, or to enhance the work practices of a given activity. They primarily meet organizational objectives for reporting, information control, and operational economics. In the US, these systems have been encouraged by extraordinary financial incentives established by government policy (Industry layer), which essentially drive their procurement and deployment.

While there four layers in this model of a human-centered sociotechnical system, these layers are not isomorphic to the Design 1.0–4.0 domains. These four layers reflect a wide variety of systems and activities animated by ongoing socio-cultural practices in the world. The boundaries have well-defined meanings however, and there are typically distinct roles at the supervisory apex (CEO, division manager, policy maker) and at each subsequent unit of control. However, the design domains and skills and knowledge associated with D1.0–4.0 align with these unit-layers of sociotechnical analysis. Service designers provisioning at the work activity level (e.g. Emergency Room service redesign) will be forced to ignore larger systemic concerns, will be unable to acquire data at the organizational level, and will not be afforded access to the organizational system. However, organizational/enterprise design teams will have access and accountability to these activity systems within system-level boundaries. Design 3.0 teams would include or coordinate the resources and skills effective for the inclusive activities.

The sociotechnical perspective recognizes that real world organizations and practices are complex and messy, and technologies are appropriated into everyday work practices more than they are "integrated" in a rationalist, technology-centric approach. Rather than a formalized integrated "system" of systems, tools and socialized knowledge practices, we start to see organizations as aggregations of purposeful but historically-influenced, overlapping cultural and social systems distributed under common identities. Most of the practices we refer to as systems are merely representations; abstractions of abstractions referring to a culturally-constructed social reality.

Systemic Design Principles

Design principles provide theoretically-sound guidance for social and complex systems design. Design principles offer guidelines and a foundation for practitioners to enhance engagement and evolve better practices. Principles are elicited from systems theoretic concepts, yet do not propose any new theory. They provide elements for practitioners to form net new frameworks enabling integration of other concepts for specific design contexts.

What relationships between systems thinking and design thinking will improve design practice? How we might establish a set of principles to enable new forms of design, planning, and deliberative conversation for coordinated action? While design thinking has been developed toward business innovation and tangible design outcomes such as industrial products and branded services, the approach has more recently been adopted as a methodology for social systems change (Brown, 2009a, b; Brown & Wyatt, 2010). Design thinking has been recently promoted widely as a methodology for action in complex situations previously considered the domain of policy planning and systems engineering.

Nelson and Stolterman (2012) support the basis for design as systems thinking by integrating principles of both systems *sciences* and the systems *approach* as reasoning and thinking techniques for adapting design to complex whole system problems.

> Every design is either an element of a system or a system itself and is part of ensuing causal entanglements (Nelson & Stolterman, 2012).

We require a broad crossover of principles between systems and design theory for the purposes of expanding design practice to higher levels of complexity (Design 3.0 and 4.0). Such a fusion of design and systems thinking does not follow based on the principles held in current agreement within each school of thought. Systems and design theories and practices differ substantively, on basic principles of approach and action, and certainly stylistically. While both schools of thought and practice share appreciation for some common intellectual influences, their approaches to inquiry, research, method, action, and outcome significantly diverge. Because the two fields approach the definition of problems and the pursuit of problem solving in almost incompatible ways, the relationships between systems and design "thinking" ought not to be taken for granted.

The primary aim the two systems of thought share today is enabling appropriate, organized high-leverage action in the increasingly complex and systemic problems as *design situations*. Due to their purported efficacy in formulating action for systemic change, the tendency of theorists, if not practitioners, is to integrate the more sympathetic methods and underlying epistemologies between the two systems. As there may be several ways to elaborate such a fusion, systems designers and researchers might articulate the pivotal relationships between these schools of thought.

Systems and design thinking are both systems of organized cognitive models developed to enable practitioners to perform different types of problem solving for complex situations. The two orientations have very different approaches to formulating the "problems" of design and inquiry. Until these fundamental differences are renegotiated, their comprehensive systems of thought may be treated by designers as compatible or even similar, but their superficial relationships and shared methodologies should not be taken as evidence of meaningful integration or even compatibility.

The following section proposes an essential, yet incomplete, set of design and systems principles synthesized to examine their correspondences. These systemic design principles were drawn from the generalization of systems principles applicable to design, and design principles developed as guidelines from systems theory. A particular subset of systems-oriented design thinkers (Alexander, 2004; Dubberly, 2008; Krippendorf, 1996; Nelson & Stolterman, 2012; Sevaldson, 2011) and design-oriented systems scientists (Ackoff, 1993; Banathy, 1996; Christakis & Bausch, 2006; Ostrom, 1985; Ostrom, 2009; Warfield, 1990; Winograd & Flores, 1986) significantly influenced these selections and formulations of principles.

Shared Systemic Design Principles

A core set of systemic design principles shared between design and systems disciplines is proposed. The following are based on meta-analysis of concepts selected from system sciences and design theory sources. Design principles were selected that afford significant power in both design and systems applications, and are sufficiently mature and supported by precedent to be adapted without risk.

1. Idealization
2. Appreciating complexity
3. Purpose finding
4. Boundary framing
5. Requisite variety
6. Feedback coordination
7. System ordering
8. Generative emergence
9. Continuous adaptation
10. Self-organizing

While these principles may appear to assume universality across literatures, the intent is for applicability and adaptability of principles, not a fundamental baseline.

Process Model for Design Principles

Initial assessment of the design principles may be done by testing their fit across the phases of a design process, in abstract, and to a range of projects, to identify contributions and gaps within case studies. Nearly any well-established design process model would serve for the purposes of testing principles.

van Patter, Pastor and the OPEN Innovation Consortium (2013) recently completed a catalogue mapping over 50 innovation methods, identifying for each the design functions of pattern creation and pattern optimization. Pattern creation is the essential process of collective innovation, and pattern optimization is associated with system or process improvement. Four sets of patterns were found universally applicable across process frameworks:

- Discovery and orientation
- Definition and concept formation
- Optimization and planning
- Evaluation and measurement

Figure 3 maps these four patterns of creation and optimization within a reference design process model for service system innovation (derived in part from Evenson & Dubberly, 2010).

The model is a progressive design process, an activity timeline. Each phase contributes a significant and necessary output toward the deployed service system. The five phases provide opportunities for different creative and production team members to effectively research and design a meaningful deliverable that accrues form and function decisions and reduces market and adoption uncertainty. As a general design process model, the five phases offer our analysis a richer field of possible principles than a comparable 3-phase model (such as IDEO's HCD model, for example). Three meta-phases are indicated as major processes (exploratory,

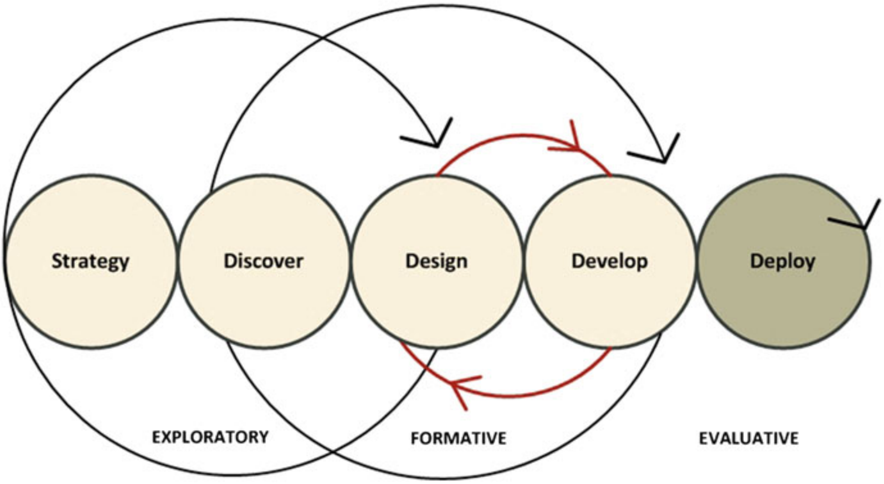

Fig. 3 Maps these four patterns of creation and optimization within a reference design process model for service system innovation (derived in part from Evenson & Dubberly, 2010)

formative, evaluative), containing variation and iteration, and as well mapping the model closely to more typical 3-phase models.

Each phase affords the resolution of one or more design principles necessary (but not fully sufficient) to fulfill the outcomes of the phase. The principles can be assessed either inductively, by testing against multiple representative scenarios, or deductively, by hypothesizing whether the principle is absolutely necessary to design success. An abductive evaluation approach is to iteratively assess the attendant risk to completion of a given design requirement if the principle remains underconceptualized.

Mapping Design Principles to Model

The ten design principles represent responses to challenges faced by most design projects, whether a commercial product, a healthcare service, or a complex social policy. If we accept the relative validity of the temporal model's orientation to processing decisions and risk from Strategy to Deployment, the design principles can be associated with risks or concerns faced by the design team (as a whole). Figure 3 illustrates the arrangement of these design principles recognized within associated phases in the conceptual design model.

Other design principles or systems axioms certainly might apply in each phase; here, only principles that *equally fulfill* design requirements and systemic relationships were selected (Fig. 4).

Different problem types will display significant variations of complexity across a given process. The proportion of effort applied to a principle's challenge will

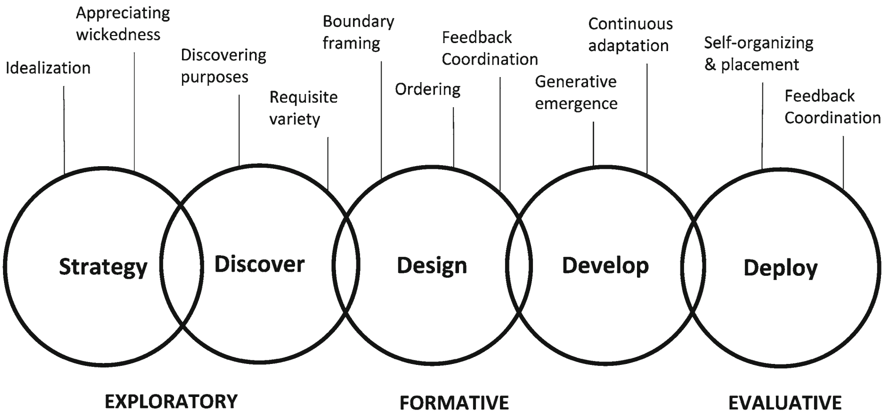

Fig. 4 Design principles mapped to design model

differ depending on whether the product is new or part of an installed platform, or the service is an integrated system or a simple service redesign. In other words, the more systemic the problem, the more critical will be the contribution of shared design principles. Design principles assume no measures of merit for their successful negotiation. But case studies drawn from actual projects will illustrate the necessity of these in each typical case.

Shared Systemic Design Principles

Further reference and definition of the design principles shows the relationship of each principle to the design and systems contexts from which they were drawn.

Idealization

Idealization is the principle of identifying an ideal state or set of conditions that compels action toward a desirable outcome, or signifies the value of a future system or practice. Idealized design (Ackoff, 1993) was codified as a systemic process for business or product strategy, developed from Russell Ackoff's insights into the organizational power of accomplishment when proposing an ideal system based on ultimate values irrespective of means.

> There is no more effective way for an organization to create its future than by continuously making its present closer to ideal. The benefits derived from idealized redesign lie not only in implementation of the plans that it leads to, but also in the learning and creativity that result from engaging in the process (Ackoff, 1993, pp. 401–402).

Idealization serves as a future-finding process. Future finding is the design function of searching for multiple alternative futures (or scenarios) consistent with a vision or intent. Strategic foresight reflects both strategic management and design practices oriented toward preferred future outcomes, as defined by Slaughter (1999).

> Strategic foresight is the ability to create and maintain a high-quality, coherent and functional forward view, and to use the insights arising in useful organisational ways. For example to detect adverse conditions, guide policy, shape strategy, and to explore new markets, products and services (p. 287).

Strategic foresight often posits idealized future scenarios as sets of options to be compared against alternative future outcomes, and develop a range of possible outcomes based on both trends studies and stakeholder engagement. Projects such as the Canadian Social Sciences and Humanities Research Council's *Imagining Canada's Future* (SSHRC-CRSH, 2013) develop both idealized strategic goals as well as a range of possible scenarios toward which planning and design might be targeted. Foresight projects tend to account for systemic changes in the search for a future ideal state.

More recently, Fry (2009) refers to design futuring as active envisioning and generative practices intended to redirect and reimagine future possibilities that lead and guide sustainability and ethical social outcomes. A classic case of an idealized design future is Buckminster Fuller's Old Man River proposal, envisioning an ideal city of 125,000 within a massive urban dome in the historically impoverished city of East St. Louis (Fuller, 1981).

Design futures are the emerging practices of formulating designed artifacts that reflect alternative future possibilities in ways that stimulate stakeholder imagination. These references reflect a definitive future orientation and even competency of envisioning, articulating, and persuasively designing for preferred human futures.

Appreciating Complexity

The principle of *appreciating complexity* acknowledges the dynamic complexity of multi-causal wicked problems and the cognitive factors involved in understanding the relationships that indicate problem complexity. The identification of wicked problems is central to the source review and a critical link between systems and design thinking. Whereas first expressed by C. West Churchman and articulated by Rittel and Weber (1973), wicked problems are distinguished from *tame* or mere simple or complicated problems by the ten factors associated with wickedness. The characteristics of multi-causal, evolving and ill-formed problems should be held to the standard of *wickedness*. Allowing any concern that has not been well-framed to be described as wicked contributes to a general diminishing of understanding.

The identity of a *problem* is essentially a frame of reference. It does not exist until it is declared, defined, and supported by argument. In design thinking it presents a lens within which a situation is recognized or declared as irresolvable by problem solving means. In design, the designation of *wickedness* is typically a shorthand reference for high complexity. Buchanan (1992) indicates wickedness as the indeterminacy that lies behind all but the most trivial design problems. Because a design solution could be one of an innumerable number of possible outcomes, the design orientation to wickedness remains flexible and intuitive, not analytic and procedural.

As noted above, Özbekhan (1970) presented a schema of 49 "Continuous Critical Problems" (CCPs) in the proposal to the Predicament of Mankind, based largely on his prior work (Özbekhan, 1968) identifying 28 such wicked problems that were increasing in complexity and "overlapping" with each other. Most of these CCPs are considered just as critical today, such as Urban and suburban sprawl, Spoilage of nature, Underemployment, Spreading social discontent, and Inadequate education. Özbekhan's insight was recognizing the nature of social complexity, where once-discrete problematic situations would converge due to overlapping root causes and become multi-causal problem systems.

Within this core principle is the problem of recognizing and declaring *requisite complexity*. Özbekhan (1969) and later studies of problematizing, such as Warfield (2001), suggest problem-finding and defining is a cognitive relationship of human perception of complexity. If a problem is recognized by both systems approach and design thinking as a cognitive percept, then a fundamental principle of *appreciating complexity* may be established. This appreciation can be recognized in the satisfaction of a design-resolution that (apparently) simplifies a complex indeterminate situation with an appropriate and salient response.

Purpose Finding

All designed products and services were implemented to serve a business or social purpose. All systems can be said to have a purpose, the abstract function that defines the whole system. The shared systemic design principle of purpose finding is not that a purpose is *identified*, but that purposes can be determined by agreement and therefore designed or redesigned.

The leverage of purposes differs across applications of the principle. Purposive systems (Banathy, 1996) are well-structured or institutionalized social systems that embed deterministic systems for a core purpose, such as a corporation or educational institution. Institutional frameworks are intended to establish purposive social systems dedicated to understood outcomes. A classical purposive social system is the hospital, which has well-defined goals and purposes built into its structure. Purposeful systems (Ackoff & Emery, 1972) are those where the same outcome of such a system can be produced in different ways, and can changes its goals, means, and ends within the system for meeting those purposes (for example, a regional transportation system).

Purpose-*seeking* systems, also called ideal seeking (Banathy, 1996), are dynamic processes of an open system seeking an ideal future state. Policies and laws are considered purpose seeking, as they are formulated based on images of the preferred future collectively shaped by society. Reform and changes to policy signal the desire to reposition society toward values consistent with the purpose being sought. Strategic foresight projects such as the SSHRC Imagining Canada's Future (SSHRC-CRSH, 2013) are also purpose-seeking in their articulation of a framework of ideals or purposes toward which future investments will be aligned. Ackoff and Emery (1972) originally defined purpose-seeking in terms of the unachievable ideals, but achievable goals:

> An ideal-seeking system is a purposeful system which, on attainment of any of its goals […] then seeks another goal […] which [it is believed] more closely approximates its ideal (Ackoff & Emery, 1972).

A startup is also a purpose-seeking entity, with an idealized product as a goal, which it is organized to achieve. Product and service design follows the purpose finding principle. Most management information systems have fixed purposes, and are designed and deployed to satisfy that purpose indefinitely. Numerous Internet services and sites may be considered purpose seeking. For example, the social media service Twitter is an open framework for posting content and following other posting authors. It has no definitive purpose, but enables its users to seek and satisfy other purposes, and may be collectively seeking an emerging purpose undetermined by the system designers.

The design guideline inherent in identifying purpose is to determine agreement on purposes, and to identify the appropriate level of purpose. Nadler and Hibino (1998) defined the Purposes Hierarchy to enable stakeholders to specify a series of purposes from "most tactical" (bottom) to highest human purpose (top of hierarchy). The purposes principle provides a whole-to-part view of the problem space, helping ensure that the right problem is being addressed. While defining purposes can lead to a more precise definition of a problem, the combination of clear purpose and creative framing resists fixation on the wrong problem or level of the problem system.

Boundary Framing

Problem framing and boundary judgments are sufficiently similar in intent and mechanics to be recognized as common principles shared between systemics and design. The aim of problem framing is to define the most effective fit between a concept and its target environment. Fit requires an iterative process of selecting boundaries and reflectively considering the associated meanings entailed by the boundary frame. For example, climate change entails an innumerable range of possible boundaries. Productive systemic design, and dialogue, requires participants to exchange their perspectives to understand the possible effects of action. Boundary frames might range from "individual behaviors" to "effects on our region" to "national climate adaptation." Each boundary has significantly different values, actions, and possible effects. The objective of boundary reframing is often to energize social or financial investment toward a defined problem, set the largest boundary that encompasses desired behaviors. Reframing a problem (such as the framing of climate change as "global warming") may have the effect of engaging some participants while excluding others, usually for expected benefits ranging from memory, to investment, to publicity.

Framing ensures that a sufficient variety of conceptual design options are considered and tested before selecting a position and (possibly) a purpose. We can consider this shared principle one of *boundary framing* when employed in the definitional stages of a design process. Buchanan's (1992) design technique of placements employs a similar mechanism of repositioning a concept, solution or option in different contexts where a new capacity for interaction or use might emerge. Placements are indicated as the movement of applications of a design concept, from "signs to action," such as an iconic image repositioned in a service function with a new meaning for a user's interaction. The symbolism of an artifact can be "placed" to reframe the purpose of a system by repositioning the function in another setting. The four orders of design (generally communications, artifacts, services, and complex systems) represent possible outcomes for designed functions identified in one context and framed and placed in another. Placement is helped by the designer's strategic ambiguity of the concept, to enable stakeholders to release their stance on preferred outcomes, or to "defactualize" the present to envision alternative future placements. Placements as frames can occur throughout a design process, from strategy to deployment. Consider that even the entrepreneurial concept of the "pivot" is essentially a new placement of an whole product concept after its definition and evaluation.

A primary function of design thinking is to obviate the necessity to analyze a problem's structure and behavior by finding a different problem to resolve than the default, the situation as given. Designers refer to this process as challenging the brief. Paton and Dorst (2011) show how designers modify and negotiate frames of design problem briefs provided to instantiate a design project. Reframing is an abductive reasoning process of identifying new metaphors and a "better problem" to resolve than the issue as given in the brief. Three processes are defined in reframing: (1) Use of metaphor and analogy, (2) Contextual engagement, and (3) Conjecture practices.

Metaphors are creative transformations of the problem to represent its behaviors or related elements as another model considered more familiar to the designers and team. In a design brief, designers might reimagine an abstract requirement (such as a website associated with a product) as another form entirely (such as a museum or analogy of a storybook). Contextual engagement refers to the practice of working with visual or verbal models (or mockups) in narratives that evaluate the functions of the brief within a context of use. Switching contexts enables the designers to reflect on the appropriate fit of the evolving idea in different uses. Conjecture asks multiple "what if" questions of the design model and situation itself. Conjecture can be playful and non-binding, but produces the serious effect of helping stakeholders release preconceptions of the initial frame and situation to allow something novel to emerge.

Reframing is inhibited by three barriers of (1) fixation, (2) a problem-solving mental model of design, and (3) resistance to journey. *Fixation* is a cognitive barrier or bias toward the known, the attachment to a previous idea or course of action. Fixation inhibits reframing as it commits an individual to a single preferred course. The *problem-solving mental model of design* refers to design thinking approaches that conceive of a problem as a target issue to be solved through methods or steps, the very caution raised by Özbekhan and Warfield. *Resistance to journey* is the bias toward reasonableness, or unwillingness to follow an imaginative path to possible transformations of the problem.

Requisite Variety

Theoretically, all ten design principles have a basis in cybernetics or natural systems. Requisite variety represents a foundational cybernetic principle adapted to systemic design. Ashby's (1958) law of requisite variety asserts that the variety in a control system must be greater than or equal to the variety in the system being regulated. In a fairly simple system such as a thermostat regulation of air temperature, all of the possible states of the output system (heating and cooling) are selected by the control unit. Temperature, fan, system settings are equally matched to the system capacities and the control limits the available outputs. In system or service design, requisite variety is observed when the coordination of a system is managed by processes that can adapt to outputs and effects of the system in operation. In complex systems such as corporate organizations, a combination of well-defined regulators (organizational structures), management (human activity systems), and procedures (variety limiters) collectively serve as a control system for the complex operation.

Whether in a social system or information system, the functional complexity of a given design must match the complexity of its target environment. However, in design terms complexity is not desirable, and the *environment* is not an objective reality of physical operations. The environment to which the control system adapts and regulates is the primarily human environment of the system that deploys these system functions. The thermostat is designed to limit the variety available in the mechanical system to the normal limits of human habitation. A user interface limits the full power of an interactive computing system to maximize the preferred ability to perform designated tasks easily.

The popularized notion of requisite variety is expressed by the statement "getting the whole system in the room," applicable to strategic engagements where stakeholders representing every function are expected to contribute. However, in a systemic design context the application of requisite variety to organizations or policy requires an active expansion of the design role from individual planner to collective stakeholders. The Design 3.0 and 4.0 domains extend design roles and skills from individual design decisions (1.0) or even a design team (2.0) to organizational functions (3.0) and communities and stakeholder groups (4.0). According to Espejo (2000) observing requisite variety in management practice becomes a process of attenuating variety among the "very large number of distinctions created within a situation" (2000, p. 2). The manager's control task is aided by amplifying selected distinctions with positive feedback to direct collective attention toward highly-valued outcomes. While hierarchy (structure) has been employed as a classical variety attenuator in most large organizations, Espejo recommends a balance of corporate discipline (i.e., chain of command) with local autonomy to enhance the capacity of the total organization to respond to complexity at the front lines.

There are several distinctions of variety and diversity for decision making in a social system. Christakis and Bausch (2006) state that for dialogue to be valid and lead to effective interventions, requisite variety among the stakeholders for a shared problematic situation must account for social system variety. In dialogic design, the law of requisite variety is applied to ensure the optimal selection of stakeholders in strategic dialogue. The observations made by participants in dialogue must be at least equal to the variety of observations that any other stakeholder group would have made if exploring the same system. Social variety considers all distinctions that could make a difference in outcomes and action in the world, which include the values, positions and stands, affiliations, perspectives, level of power and vulnerability, and so on. An exhaustive account of social variety would be impossible, but the selection of stakeholders by salient and significant determinants can be codified in practice.

A good example of planning for requisite variety was reported in the Imagining Canada's Future project (SSHRC-CRSH, 2013), where the Southern Ontario expert panel was selected from across areas of expertise, urban regions, age ranges, disciplines, sectors, and achieving gender balance. The process for achieving requisite variety in stakeholder selection has been described in numerous other applications of Structured Dialogic Design (Christakis & Bausch, 2006).

Feedback Coordination

Another fundamental cybernetic principle shared by systemics and design is the coordination of feedback, as defined by Wiener (1948) and developed in cybernetics and system dynamics. Negative (compensatory) and positive (reinforcing) feedback loops are distinguished in physical and control theory as designable functions to guide the output performance of a system to conform to desired effects. Feedback processes are conceived as continuous or iterative loops, gathering information from a state, applying control signals to obtain a desired performance, and measuring the difference and coordinating this control to achieve a preferred state. Feedback coordination provides the mechanism that drives the thermostat (a homeostat) in the requisite variety example. Such a simple feedback system represents a first order feedback loop. Second order feedback provides another (meta) control system, usually a human observer, measures and information about the first order system to enable coordination of the feedback system itself.

Product, service, and social design employ feedback coordination in fundamentally similar ways to the principles of cybernetic control. We can define three distinct, applied modes of feedback coordination in design practice. Each of these would have a separate control system (observers or decision team), yet they could be nested within the third order system (organizational) given the design approach.

- First order: System feedback coordination. Feedback designed within the product or system being designed (system control).
- Second order: System management coordination. Feedback systems coordinated to adapt system performance to environmental demands (evaluation and iteration).
- Third order: Organizational management coordination. Feedback coordination within the organization(s) coordinating the system design process (innovation management).

Each of these forms is addressed briefly.

System Feedback Coordination
The first order feedback loops are those control loops (negative feedback) and reinforcers built into the system or product as designed. Negative or control loops are information streams that monitor and control an output, such as the detection and management of very large data files or the prompts to software users to add inputs to an incomplete data record. Positive feedback is the reinforcement of desired system behaviors, such as an active prompt to share an article on social media services, which amplifies the external measures of that object's activity. Delays between feedback and response are minimal or response is immediate.

In a social system context, first order feedback coordinates information between functions among members of the social order. Essentially, most personal conversation for communication purposes about the social system would represent first order feedback.

System Management Coordination
Second order coordination feeds back or changes design functions on the system being designed. System users would not see or be affected by this feedback, but they may provide negative feedback by interaction and commentary that affects design (control) decisions. Most types of user feedback, usability research, and product/system level evaluation are second order feedback systems. Responses to system management feedback are highly variable, usually structured within a development or management lifecycle.

Organizational Management Coordination
Third order feedback observes the performance and values represented in system management, resulting in coordinating responses across the organization. Coordinated management efforts to increase investment or end a product offering are organizational feedback management, such as described in the case of organizational recovery from a significant product failure (Jones, 2008). Negative feedback is coordinated (for example) by performance and market reports, and positive feedback is managed by advertising (increasing usage), marketing (larger adoption in new markets), and direct user engagement.

Feedback processes are found in every interactive, online, service and social system. The distinction of the design principle is that of feedback coordination, or the inclusion of feedback management in a design process. The first opportunities for feedback coordination in a system or service design are when a prototype or "alpha" version undergoes controlled evaluation with informed users representative of the actual system population. Market surveys and customer evaluation are part of the normal monitoring and guidance of feedback in the post-design process. Third order feedback in the social system requires a different approach to coordination, where design managers must allow sufficient time to measure adoption, user responses, and peaks and valleys of use to understand the uptake of the designed process. Consider the complexity of the launch of any major system (such as an electronic health records system), where careful monitoring is required, without making interventions or changes until a planned period of operation and training.

System Ordering

System ordering is an essential function of design activity, as all information, assets, organizations, and social systems are ordered in meaningful ways by human custodians. Designers define humanly-useful structures that enable visibility and salience within complex situations.

Ordering the information and components of a system is a composition process (Nelson & Stolterman, 2012), which refers to the fact that authorial choices are made by designers or actors in managerial roles. Ordering defines the relationships of objects, system components, or abstract concepts to each other in a systematic way. The ordering of relations within a system set creates a compositional unity.

The design of data structures and information representations enables the ordering of coherent patterns and information flows that afford the recognition of meaningful relationships by an observer. Ordering activities define ideal system types and components, as in the specification, mapping and information structuring of planning architects and information architects.

An organization or policy system follows the same principles of ordering for compositional unity. The composition of organizations, relating roles and functions within hierarchies and networks, can be similarly viewed as a designing activity of management. Defining and managing organizational structures and business processes is a systemic ordering activity.

All systems are described as manifestations of order. Systems are represented as abstract organizations of artificial or natural ordering functions, and as such these organizations can be designed. Systems are designed by defining relations, reframing boundaries, and changing hierarchies and roles. The properties and services provided by social and information systems can be ordered by logical and creative structuring. Ordering systems enable the relating of placements across design concepts to achieve a well-integrated design purpose. Order functions range from the most minute and specific task (such as defining data types) to the system-level ordering of laws and transnational agreements.

In both design and systems contexts, ordering can be a recursive process. Systems are designed to instill and sustain new ordering systems, such as information technologies, software, or policies into a social or organizational context. These contexts require the structural definition of ordering and are maintained by ordering systems in future development. Therefore, orders endure through systems, which maintain ordering structures for the duration of expected operations. The multiple ordering systems within an electronic health records (EHR) system, for example, reveal an infrastructure of ordering systems within the interactive software platform. Medical ontologies (such as MEDCIN), databases (e.g. MUMPS), and classification coding systems (e.g. ICD-10 disease and procedure list) are incorporated into the larger EHR systems. These ordering systems are separately maintained, yet offer a core standard reference system used by the entire EHR process.

Generative Emergence

Emergence is a quality of complex adaptive systems whereby a higher, coherent level of organization arises from the interaction of system components. The emergent behaviors are those perceived to be novel or distinct from the mere collection of properties associated with the parts. Emergence properties in complex social systems are considered co-occurring with intentional, purposeful behaviors. The emergent characteristics may, as in natural systems, reveal inherent purposes of the system.

Emergence appears to be universal, as phenomena can be observed at virtually every level of scale from the cellular to the galactic. Emergent behaviors are exhibited in real time (the cyclic flashing of fireflies), in processes (the emergence of butterflies from cocoon gestation), and over periods of time (stock market wave patterns). As a design principle emergence shares with complexity theory the perspective of biomimetic observation, or simulation of natural processes. While emergence may display an unintended purpose, a signal characteristic of emergence is that of capabilities only achieved by emergence (van Alstyne & Logan, 2007).

> We noted that emergence refers to a new set of properties that arise from a new arrangement of the components of an entity that did not pertain to the individual components. The design of an entity, then, is the assemblage of a set of components that is able to achieve a function or purpose that the components by themselves cannot achieve (2007, p. 128).

For example, network effects in large social networks display emergent qualities that cannot be designed or planned in the absence of large numbers of active participants. For example, the Twitter social networking service was not intentionally designed as a comprehensive product. For at least two years before its network grew to sufficient scale, users of the social network service Twitter generally employed it as a lightweight resource for posting brief texts expected to be followed by a small number of known followers. As the number of users grew exponentially (after 2009) the emergence of communicative norms and content forms led to standards for web links, account identity, and network interaction norms. Because the basic Twitter architecture remained simple and standards were established, aftermarket innovations such as Tweetdeck and Hootsuite led the market for full-featured interfaces, surpassing Twitter's product development. While Twitter may not have produced a sustainable commercial product, its architecture demonstrates generative emergence—the medium enables other products and features to emerge and evolve.

The Occupy movement was observed as an emergent social system. With no designated leaders or organizers, it grew from the simple initial conditions of an email to a large mailing list suggesting a protest at New York's Wall Street area. The resulting local protest was copied by emergent groups in many other North American cities, which cooperated loosely with each other to maintain a continued presence in their chosen physical locations over the autumn of 2011. Among the many emergent behaviors that grew from the diverse coalition of participants was a unique communication protocol for public speaking, called the General Assembly. The "people's mic" process of speaking in phrases repeated by the audience was not a designed process, but an adaptation to the (New York location's) restriction on amplification in the mixed-residential area. It was one of many generative behaviors to develop during the social movement's encampment period.

Nelson and Stolterman (2012) define two protocols of *compositional* and *created* emergence in systemic design, which further distinguish generative emergence. Compositional emergence manifests in design activity as an outcome of *ordering*, or the construction of artificial micro-systems for adapting an artifact to environments. Consider an example such as metadata information hierarchies as ordering systems for a potentially large number of end-use information artifacts. Compositional emergence results from a designed formulation of relationships, categories, ideal types, and structures *for* organization.

Created emergence manifests from *organizing* systems, which include physical connections, designed forms, organizing processes and the synergies that emerge from among these functions. In systemic design, these connections among forms are anticipated, visualized, and represented in artifacts and systems. Yet there are real differences between the protocols. While the Twitter example above was a case of ordering, without much of an organizing system, the Occupy example represents an almost pure organizing protocol leading to created emergence.

Compositional emergence is never designed in a blank-slate environment. Desirable emergent qualities in artifacts and systems evolve from a pre-existing social or use context that gives shape and direction to an innovation. This is what Ciborra called *formative contexts* (Ciborra & Lanzara, 1994) or the pre-existing conditions of organizations, social systems and their norms, learned IT, and information-based work practices. A formative context is similar to the "installed base" that a new system attempts to reconfigure. New forms and structures will be necessarily shaped to adapt to the contexts of use, existing environments, and markets. The generative emergence arising from connecting new practices to formative contexts may not be recognized for a considerable duration, as systemic delays in feedback among connections will take time to resolve and recur. Also, emergence in human behavior is extremely imprecise without an a priori observation protocol that measures (expected) emergent behaviors against the baseline of the formative context.

A social research protocol must therefore measure emerging *figure* behaviors against a pre-existing *ground* of ongoing action and meaning, recognized as the context of its ground. The design principle, consistent with designing for emergence, suggests we explore the environment during highly interactive phases when the effects of perturbations of relationships can be observed and reconfigured by feedback to achieve anticipated outcomes.

Continuous Adaptation

The temporal pacing and duration of social systems are as important as the design of structures, processes and relationships. System maps are often designed as timeline models representing the relationship of design concepts to activity systems (e.g., service journeys) or temporal scenarios (e.g., long-range foresight models). One of the common errors in systemic design is the assumption of temporal consistency, that current system processes will continue unimpeded into an indeterminate future time, subject to the next (planned) intervention. The reality of complex/social systems shows that human observers are unable to determine temporal bifurcations, where processes diverge unexpectedly or where social regimes break down.

Social systems may be self-organizing, but they are not self-*ordering* systems. Organizational and institutional systems adapt the environmental demands through individual responses, and communication protocols maintain organizational integrity. However, collective evaluation or innovation remains limited or impossible without continuous adaptation to environments, societal changes, markets, and system participants. Social systemic design requires a continuous evaluation (scanning, measuring, judging) to assess systemic delays, intention drift, time-dependent functions, the diffusion of change and adoption of strategies. Stakeholders in different design and monitoring roles consciously identify variations over time, signal the onset of emergent situations, and co-design adaptive responses. Such adaptive monitoring is essential for organizational resilience and strategic flexibility.

Continuous adaptation maintains the preferred system purpose and objectives (or desiderata) throughout the lifecycle of adaptation, conformance to environmental demands, and related system changes. Effective systemic design applies the principle of continuous adaptation throughout the design process, from the phases of system design and development through deployment and operation. By incorporating cyclic feedback deeply into the social practices of the host organization, organizations and systems can become resilient to unforeseeable environmental requirements and system breakdowns. A good example of continuous adaptation in a complex service might be the strategic development of the multiple online stores and features incorporated into Amazon.com since its founding. Amazon launched with a strong focus on books and media, and developed its retail outlets by adapting to important market segments. It has continuously and almost imperceptibly adapted over its entire history, in its aim to become the world's largest and most comprehensive online retail center.

Self-Organizing

Self-organizing is a central principle developed in systems theories ranging from Wiener's cybernetics (1948) through Varela, Maturana, and Uribe (1974) biological theories of adaptation and autopoiesis, autopoietic social systems (Luhmann, 1986), to more recent complex adaptive systems theory (Holland, 1995).

Social systems are self-organizing human interaction systems that develop (evolve) through learning and flexible responses to changing circumstances. Human systems are self-organizing in the sense that no planned external inputs (from monitoring, for example) respond to human and environmental feedback as any type of living system. Even Ashby (1962) argued for a general systems principle of limited self-organization, that "every … dynamic system obeying unchanging laws will develop 'organisms' that are adapted to their "environments." This organizing principle was based on the observation that even simple machines actively select states of equilibria. When disturbed, a system seeks to stabilize an interrupted state by locating an equilibrium that accommodates the environment and the set of available states. In systems with rich variety (social systems) the available states would be numerous and support self-organization in that capacity.

Jantsch (1975) linked self-organizing, self-determination and evolutionary design as core systems principles. Jantsch's principle of self-organizing systems defined an evolutionary drive that used creative processes to break through system boundaries, and through self-transcendence, reached renewed states of new organization. This very process was observed as a design activity, as a natural process of interaction with the physical, social, and cultural (spiritual) worlds of humanity, serving an evolutionary purpose. Two related processes were articulated. Self-organizing serves a positive feedback or reinforcing process that enables creative organization of social systems by its participants. The cybernetic feedback processes of negative feedback (guidance) serves a self-*adaptation* capacity, the regulation of behaviors within preferred or sustainable limits.

The systems principle of self-organizing enables the design of actions that increase awareness, incentives and social motivations to accelerate organizing behaviors. These actions result in the effect of enacting reinforcing behavior loops and drawing additional participants into those loops. These processes can be specifically designed to increase participation. Social participation reinforces the self-organization of co-created content and purposeful interaction within the boundaries and norms of the social system.

In a design context, self-organizing is related to generative emergence, as it reinforces socially expected behaviors that lead to greater collective effects. Some of these emergent effects, such as network power or identity formation, may be preferred by organizers (designers), but these outcomes cannot be guaranteed by designed actions. Networks are self-organizing because the individual behaviors of thousands of market or network participants are predicated on individual expectations of the participation of others. The resulting communication network is considered self-organizing as a collective phenomenon. We may not be able to state that the network or system behaviors were *designed*, but rather that the conditions that created the network were carefully designed to instill those behaviors. The essential form of network creation arises in conversation, a self-organizing (autopoietic) outcome of languaging:

> In the case of human beings our particular manner of living is to converse, that is, to live together in the coordinations of coordinations of doings and emotions, and everything that humans do happens in networks of conversations (Yanez & Maturana, 2013, p. 79).

A prominent example exists in the popular group dialogue process *Open Space* (Owen, 2008). The guiding parameters of Open Space Technology are entirely based on the process of social self-organizing, through self-selection of small groups that form emergent organizational systems.

> In the world of self-organizing systems (the only world we have, I believe), organization will emerge (or not) and no amount of effort on our part to organize things will have any useful effect. Under the best of circumstances, our efforts will be a waste of time when the emergent organization overcomes our design (Owen, 2008, p. 128).

Open Space small groups are analogous to Ashby's intelligent organisms adapting to and from their environments. The principles of dialogue are not entirely self-organizing however. While groups may form an emergent organization, that organization will not be an ideal form for effective action. While each and every dialogue may reveal self-organization, the self-organizing is not an experienced quality of the process. The quality and outcome of dialogue requires a conscious process of initiating and coordinating the flows of conversation. Numerous social research observations (Christakis & Bausch, 2006; Warfield, 1995) have demonstrated the pathologies of within-group behavior. Within-group dialogue requires a designed structure and design process to enhance variety, facilitate agreements and mitigate the selection of power within groups.

As a *design* principle, self-organization reminds us of the limited capacity of the individual designer as a formative agent, or an instrumental first-actor toward progressive action. Higher complexity social projects require cooperative organization among multiple actors; indeed some social systems theories (e.g. Christakis & Bausch, 2006) consider all stakeholders as relevant *designers*. The social design practices of dialogue and generative facilitation may be considered self-organizing in principle. Still we acknowledge the particular need for "designerly" actions in material and composition required to realize desired organizational outcomes. Such projects require the skillful means of system ordering, information design, sociotechnical design, and designed communications strategies.

Discussion

Systems theory and design thinking both share a common orientation to the desired outcomes of complex problems, which is to effect highly-leveraged, well-reasoned, and preferred changes in situations of concern. A central difference in perspective is that systems thinking (resulting from its theoretical bias) promotes the understanding of complex problem situations independently of interventions or solutions. The primary systems science disciplines manifest an analytical bias. Design thinking, while not overlooking the imperative toward understanding, prefers an action-first generative bias. Traditional design history, until the most recent (fourth) generation of design methods, presented design as a planning process, oriented to industrial design, where (analytical) problem definition preceded solution.

Systems theories are formulations of frameworks, models, and reasoning practices intended to enable effective problem solving at the systemic scale of application. Systems thinking has emerged as a perspective toward effective problem solving and associated reasoning patterns for complex interconnected (wicked) problems. Design thinking, on the other hand, can be considered a continuously interpreted perspective toward action on intended outcomes, using iterative, successive approximations with highly differentiated artifacts. While these perspectives may be seen as compatible, their co-development and practice presents a contemporary challenge.

Current models of design thinking have overemphasized the generative impulse, to a great extent resulting from the decreased costs of virtual invention and software production. Technologies greatly influence the preference of process and theories—for instance, the hard science approach of simulation modeling has strongly influenced the system dynamics school of systems thinking.

Design thinking has been influenced by rapid prototyping culture. When virtual trials and failures are cheap, multiple prototypes are less expensive than in-depth analysis and research. However, this design thinking bias leads to a short-term bias that rewards immediate responses to prototypes. For industrial products, those bias' risks are minimal. However, for complex social systems a prototyping mindset evaluates component subsystems (at best) selected by a saliency bias. This bottom-up approach fails to acquire a system-level understanding and even erodes a holistic view. New system relationships are formed through iterative trials and informal sample evaluations, but current relationships are not necessarily discovered, leading to significant gaps in systemic understanding.

Systems Thinking about Design Thinking

A contemporary viewpoint encouraged by the participatory viewpoint of multidisciplinary design is that "everyone is a designer now." The fourth generation of design methods promotes generative and participatory tools and mindsets. Pourdehnad et al. (2011) note that a key difference between systems and design thinking is that, for social systems practices, the stakeholders are the designers. The stakeholders in design practices are observed and engaged by designers, and designers retain the judgment and decision rights for the artifacts or services being designed for stakeholders. They recommend an integration of viewpoints toward the ideal of co-creative practice.

Unlike previous stages of design methods, the fourth generation has not accepted a leading systems theory influence. Rather, design studies today tend to follow an ambiguous version of complexity theory, rendered without citations or methodological influence. Due to the implicit skepticism toward methods from previous generations, the previous systems influences associated with design methods have become ignored and underused, leading to insufficient competency to evolve or reconfigure these rigorous systems methods with new practices.

Yet even professional design practice struggles with learning the current profusion of design and organizational methods, as a confusing diversity of approaches is apparent. The codified meaning of "design thinking" ranges widely between the domains of design education, business design, design consulting, and systemic design. Without guidance from some systemic rigor the new schools of design thinking are vulnerable to current management trends as well as market-oriented practices such as *agile* and *lean development*.

Design thinking has been promoted as a powerful practice for aligning organized action with social goals, including social innovation (Brown & Wyatt, 2010) and business management and education (Dunne & Martin, 2006). For nearly a decade, hopes have been high for the results of this contemporary change in mindset, organizing, and pedagogy. Yet current institutions and corporate practices have not demonstrated significantly novel evolutions in policy or business that have benefitted the acknowledged socially complex problems. Traditional financial and market measures of value continue to drive most organizational performance, employment, and the real economy. There may be a significant mismatch of problem scale and design method and practice that design thinking fails to address. Yet this very gap (between problem and practice) is within the understood domain of systems thinking.

Systems thinking enjoys over half a century of intellectual development, and while inclusive of a diverse range of scholars and practices, its solid founding in systems theory guarantees its authority and maturity as an intellectual platform for problem solving. Design thinking shows a robust history (either roughly 20 years of 50 years, depending on definitions), yet the lack of scholarly follow-through in the field has left its intellectual development wanting. Whereas systems theories were developed in keen awareness of the relative contributions from the scientific community, presentations of design thinking, perhaps due to its genesis in design traditions, rarely cite any precedent or theoretical influences.

The possibility exists that design thinking will fail to meet the scope and magnitude of the social and systemic issues facing humanity and societies today. Two Greek terms, *hubris* and *panacea*, might be chosen to characterize the earlier attempts to navigate understanding and effectively intervene in complex social systems. Hubris fits, because many are led to believe that design thinking and methods are sufficient for a problem complexity that cannot be comprehended individually. Panacea, because design thinking risks becoming a cure-all methodology adopted not only by design disciplines but by business, information, and technology disciplines with unrealistic expectations for results.

Without a significant basis for theoretical support, such as systems theory, design thinking is at risk of becoming a management fad, (Bendor et al., 2009) especially as it becomes widely adopted as a strategy for creative inspiration and innovation by mainstream corporate organizations. A major difference with systems thinking is revealed in this comparison. Systems thinking claims a clear theoretical base from a 50 year or more history of systems theory development in the literature. Yet it remains a complex soft technology and generally is not considered a tool for competitive advantage, as it cannot easily be converted to instrumental methodology or business strategy. Design thinking has minimal support from scholarly research and a shallow literature, yet it has become readily adopted in all sizes and types of firms, often explicitly in search of competitive advantage. The adoption of management practices, because of their novelty or visibility in reference groups, is indicative of management fashion (Mol & Birkinshaw, 2009).

Design thinking may succeed as a management innovation because it is presented in terms of practices that yield deliverable representations that serve as boundary objects (Star & Griesemer, 1989). Boundary objects are artifacts that can be claimed and appropriated by participants in adjacent or overlapping disciplines, and therefore aid organizational learning by transferring knowledge and ideation across boundaries.

Systems thinking has not produced a body of artifacts or practices adopted widely in organizations. There are few acknowledged boundary objects, or shared representations, recognized as useful across disciplines in organizational settings. This gap reveals a significant opportunity for promoting practices for systems-oriented artifacts such the Gigamap (Sevaldson, 2011) and the influence map of systemic relationships (Christakis & Bausch, 2006). Such visual models represent many of the systemic design principles and are formulated for strategic contexts that lend credibility and meaning to their adoption.

Conclusion

The systemic design orientation enables a complementarity of design and systems theory for complex social and service systems, the domains identified for Design 3.0 and 4.0. As research and practices develop, the influence of this generation should diffuse into products and services design. A handful of books and articles have excavated this emerging territory, but it would be premature to indicate that a recognized interdisciplinary field has taken hold. While several graduate courses and programs exist, they have not yet yielded definitive research streams.

The design principles representing the complementarity of essential systems and design axioms are judgments based on perspectives of theory, practice and literature, and are not ultimately definitive. They are descriptive guidelines to orient designers toward an awareness of systemic principles in the more complex problem areas being faced by clients and design teams. They are also meant as guidelines to systems theorists to intimate or provoke more powerful theories of systemics and complexity for design, management, and other reflective practices.

An earlier presentation of systemic design concepts (Jones, 2012) described a similar basis of principles for systemic methods. A design language provides a framework and taxonomy guiding the placements of information, objects and meaning in a given domain, in this case, service design in healthcare. These principles combined system functions with human-centered design methods for social systems, integrating system principles with design methods. Five design methods based on systemic practice were suggested, which enable design interventions within a complex (Design 3.0–4.0) domains. To summarize, these include:

- Human-centeredness: Design in social systems requires research and design methods that contribute understanding of human activity and human concerns.
- Convening stakeholders: Design participants must have a personal stake in the outcome of the intervention, or the resulting products will fail from lack of resonance to authentic stakeholder commitments.
- Dialogic process: Dialogic processes enable the connection of diverse stakeholders to the joint processes of inquiry and design. Higher complexity problem areas demand structured approaches to dialogue that enable participants to achieve a collective systems view.
- Iterative inquiry: Systems inquiries require the learning and re-integration of new thinking that occurs over successive explorations and exchanges.
- Multiple design actions over time: As with research and inquiry, design and interventions require multiple methods that explore the full dimensionality of a problem over the period of inquiry.

This chapter has focused on the systemic principles to the exclusion of methods. Further work is called for in developing the design languages and next-generation systemic design methods consistent with the design principles. Further research should also evaluate the principles against other design situations and systems theories. There may be other formulations of principles more generally advantageous to complex design problems, discovered through application and practice research. The current chapter provides a series of principles which serve as guidelines for systemic practice. It outlines a framework of principles that can lead practitioners toward effective and new research and design approaches. Finally, these principles are pointers toward further research and inquiry into systemic design as a developing disciplinary area.

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The Theory and Practice of Third Phase Science

Kenneth C. Bausch

Abstract Systems thinkers often regard groups and communities as collective thinking entities. And collective thinking itself is layered upon a social fabric of norms and traditions. The ways that groups and communities think and make decision together is closely linked to their group identities, and change is difficult. Sometimes, however, innovation in the deep structure of collective thinking becomes essential. This happens when complexity reaches a threshold beyond which informal deliberations fail to produce effective understandings and collective action. Gerard de Zeeuw advanced the understanding of collective thinking when he introduced the concept of *Third Phase Science* in 1997. His thought was summarized in non-specialist language by Bausch and Flanagan. In the Western world view, we have come to see things as well-defined objects that are separate from us. In Indigenous and Eastern cultures, the separation is more subtle. These cultures see human beings as being enmeshed in a universal web of life. This article presents the bare bones of De Zeeuw's thought, describes some of its roots, and shows some applications that (perhaps unconsciously) illustrate is use. It traces these applications as art and as science.

Keywords Contextualized object • Dialogic design • Domain of science model • First, second, and third phase science • Immersed observer

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Large Historical Background

Our understanding of the ways individuals and groups think has been influenced by profound philosophers throughout history. Plato solidified the Western concept of an objective world. He posited a *world of forms* that contained the blueprints for everything in the world. For him, a thing was a dog if it had the *form* or *essence* of a dog. Aristotle placed the essence of *dog-ness* into the physical nature of a dog. For him also, a thing was a dog if it had the essence of a dog. Subsequent Greek, Arab, and Scholastic (medieval) philosophy expanded on this notion in the context of Scriptural/Aristotelian myth.

By the time of Rene Descartes (1596–1650), this all-encompassing mesh of myth was frayed and no longer up to the tasks of explaining the physical realities unearthed in the Age of Discovery and Enlightenment. A new perspective was needed. Descartes supplied it. In his "Discourse on Method" (2007), he laid stress upon objects that could be observed and disputed outside the presumed infallibility of myths.

Contemplating his individual situation and declaring "*cogito ergo sum"* (I think therefore I am), Descartes created an enduring rigid mental separation between an objective world *out there* and the subjective world *in here*. He envisioned a detached observer viewing an objective world. This viewpoint and the contemporaneous work of Galileo initiated the surge of First Phase (classical) science, which was accelerated by the work of Isaac Newton later in the seventeenth century.

Earlier science had interpreted the world with stories and elaborate myths. The new science broke the stories down and focused on the *objects* that were talked about in those myths. Breaking the myths down in this way vastly increased our ability to comprehend new and strange information. With this new science we could take in and categorize information without the need to spin numerous new myths. At the same time, we unraveled the fabric. Man was no longer held in place within his myths.

It should be noted that the ideas *detached observer* and *object* are imaginative constructs that really do not adequately describe either the existing observers or the objects of observation. We are, in fact, bodies enmeshed within a system of other bodies observing a world of which we are a part. The Industrial Revolution over later centuries presented itself as a validation of first phase science in the form of discovered rules for harnessing the powers of nature. For three centuries, technology followed on this model to create advances in areas such as energy, chemistry, and electronics.

First phase science stripped anthropomorphic urges from objects and applied the human eye to look upon all objects from the distinct sphere of human perspective. First phase science fostered confidence in objective observations as a means of refining and even dislodging myth while still contributing to a sense of preserved social order.

Second Phase Science

At the turn of the last century in the *Second Industrial Revolution*, industry started to direct what science studied. It sought to harness and systematize the essence of science itself—its creative power. After the Second World War, industry required information and guidance in increasingly complex areas. It turned to Operational Research—a fusion of engineering and business management—to discover rules for improved leadership, marketing, and production. Science responded by giving birth to new academic fields.

Beyond the similarities between these movements in the beginning and middle of the twentieth century, there was an importance difference. In the Second Industrial Revolution industry had taken command over what was to be studied, replacing science as a decision maker concerning what to deliver and what to study. However, it had not changed the nature of science, which thus could maintain its characteristic disinterest in the users of its results. After the Second World War this attitude was challenged.

In the postwar era, management scientists began to notice that answers to their research surveys were often swayed by the wordings of their questions. In this and many other situations, the *act of observation* was detected as an input by the system under study, and the system under study *reacted* to the observation confounding the observation that was the object of the study. Objects could not be fully known using First Phase Science traditions. First Phase Science was in crisis.

To minimize the effects of self-fulfilling prophesies, placebo effects, and other observer/observed effects, the social and biological sciences devised the double-blind procedure in which neither the subjects nor the researchers know which group is receiving the treatment.

Unfortunately, this approach limits our ability to understand an object by *touching* or *manipulating* it. Research on sentient objects must include evaluating the way that the objects respond to an input, including the source of the input. The presence of sentient objects—both organisms and systems—turned out to be far more pervasive than researchers initially expected. The introduction of new demands into the domain of science—along with continued requirements for experimental objectivity—strained traditional science to the breaking point. Science could no longer assume simplistic definitions for whole classes of *object*. A scientific consensus needed to be agreed upon to specify a specific frame for understanding a specific type of observation.

Second phase science objects are themselves constructed; and they are generally useful in guiding plans for constructing the future. Such objects differ greatly from first phase objects because they are not tightly (i.e. intrinsically) defined in the way a stone is defined; instead, they are a spread of preconditions or effective uses identified by a mathematical average or a range of probability. One way of making the comparison to first phase science is to consider second phase science as a means of transferring a context along with a target object. Unlike the situation in first phase science, however, this larger context is more arbitrary and dependent upon the goals of researchers. It is largely a narrative that mixes some well-founded objects and theorizes connections with other less well-defined ideas. The resulting collage has the flavor a mythical narrative.

The focus of this chapter is *observation*. The type of observation used by traditional science is a concept based upon a detachment between observer and object, and the fixed unbiased perspective of the observer posited by Descartes. This concept defines a frame for freezing an observation from its mythological embodiment and defining it in an otherwise undefined context. In actual practice, scientists needed to create frameworks (contexts for making an observation). This led to a potentially biased choice of one framework from among a plurality of alternative frameworks. Each framework constitutes a *theory*—or story for how things work—and the context for scientific truth moves to a sometimes incommensurate contest among competing theories.

In this context, a definition of a *thing* is *better* if it minimizes *unintended effects*, *mistakes*, or *mishaps* in action more than other proposed definitions. Finding such objects usually involves repeated observations. The search tends to close when a distinction between a *thing* and a level of sameness are perceived to be satisfactory—for present predictive purposes.

Science ran into difficulty when it "tried to apply science's device [i.e. the *object*] to what had been left out in the first phase—when it was tried to deal with the *in there* as if it were the outside of the Cartesian 'out there'" (De Zeeuw, 1997, p. 13). "'Second phase' science aims to resolve the 'overload' that derives from using the Cartesian form to study the 'in there' *as if* it is the 'out there'" (p. 19). The domain of second phase science is goal oriented. It aims to identify qualifications that lead to some desired behavior. Second-phase *objects* for the goal of graduating with a high grade point average, for example, might be getting enough sleep, regular study habits, and taking good notes.

Second phase science has difficulty in defining its objects. Someone has to devise a definition that distinguishes one object from other objects. If one prepares explicit definitions for these objects in order to improve observations, one will find that necessary participants may disagree and refuse to participate in the discussion. Efforts to prevent their defection (i.e., their dismissal of an interpretation that seeks to be recognized as a shared view) may be at high cost and may involve negotiation, teaching, priming, or even scrapping a study if compliance is not achieved.

This resistance to prescribed and often arbitrary objects is especially critical in efforts to influence social behavior. When people feel coerced by physical force, law, or propaganda, they tend to rebel. This resistance may easily be provoked when one's activities may be defined in different terms ('objects'), such as: *sin*, *crime*, *error*, *cultural expectation*, and *heresy*.

The limitations of second phase objects are very painful when dealing with efforts for social *improvement*, for instance, in the realm of business practices. Improvement might be defined as corporate profits, respect for property, privileges of wealth and position, or alternatively as sustainability, social justice, equal opportunity, human rights, safe working conditions, fair wages, etc. A similar divergence can be observed regarding the *responsibility* object. Generalized top-down *objects* may have been satisfactory as proposed by canon law in the eleventh century, but they are simply not up to the task 1,000 years later.

Third Phase Science

Third phase science resists the impulse to reduce contextualized objects to a single essence. Instead, it accepts the legitimacy of observations from many perspectives and so places the object in a rich contextual understanding. From this multidimensional understanding, the object is accepted by a diverse group trying to understand the object. The expansive definitions of third-phase objects include all stakeholder perspectives; they aim to be comprehensive. In this way, they secure support of all stakeholders and generate momentum towards the eventual actions which are the purpose of Third Phase deliberations. It reduces objections to this understanding because it includes those alternative understandings. It should be noted that this multidimensional understanding applies only to the situation in which it was generated. Generalization to similar situations should be done with great care.

Third phase science assumes that our many individual subjective, bodily experiences generate valid viewpoints on what we are collectively observing. Therefore, it does not accept the Cartesian assumption of a generic, detached observer of material things (first phase science). And it does not try to reduce contextual observations to some single, universally-acceptable mathematic or probabilistic essence (second phase science). Instead, it believes that the observations of all stakeholders are authentic from their point of view. Therefore, it welcomes diversities of viewpoint and seeks to increase them in order to get a more complete conception.

This approach encourages the use of a plurality of high quality observations to construct objects that increase the quality of actions directed toward a desired goal. Third phase objects differ in content from objects in first and second phase science. They are collections of diffuse observations that offer a comprehensive portrayal of the topic at hand. Its objects are collaboratively constructed to deal with a problematic situation. They need to be used to achieve their desired goal. These objects are created for a purpose. Constructing objects that are not accepted ultimately as useful by the stakeholders defeats the very purpose of constructing those objects

Where statistical science seeks to make an observation understood in terms of its centrality and the patterns of variance around that center, third phase science seeks to make the *meaning of an object* understood in terms of its assimilation into a multitude of frameworks for understanding the observed world. Theories which seek to reduce variability in predicting a central value for an object in phase one science find their parallel in frameworks which seek to accept understandings for an object in third phase science.

One can look at third phase science as a technology for reducing errors in contextualizing an object under study, rather than in reducing the error in objectifying the object under study. In this way, third phase science is meta-objective, and holds as its central focus the validity of the context centered around an object rather than the agreement on singular essence of an object.

Lenses of Observation

A community of science is any group of observers that uses a consistent lens (or theory) to make observations of increasingly reliable quality. The community works to polish and extend the lens with respect to its utility in observing the objects under study.

First, second, and third phase science are expressed in terms of lenses in Figs. 1, 2, 3, and 4.

Observer-independent observations (Fig. 1) use the individual observer's lens or theory for understanding the world. In first phase science, this lens is polished and its focus is sharpened so that many scientists can see the object more precisely. First phase science assumes an immaterial observer and material world that can be understood in terms of essences.

These assumptions are to a large extent non-problematic for routine physical, chemical, and biological science. They cause consternation, however, in deeper research where it is often found that "It is the hallmark of any deep truth that its negation is also a deep truth" (Bohr, as quoted by Delbrück, 1986, p. 167). In subatomic physics, for example, while looking at the same phenomenon, one observes a particle if one looks at it in one way, but a wave if one looks at it in a different way (Fig. 2).

Observer-dependent observation also uses a single observer and that observer's lens, but recognizes that the observer and the object are embedded in the same overall reality. Second phase science continues to view reality through a single lens and strives for a single abstract definition of its objects, but with a realization that its descriptions are constructed. Often the manner of this construction can be indicated by Fig. 3.

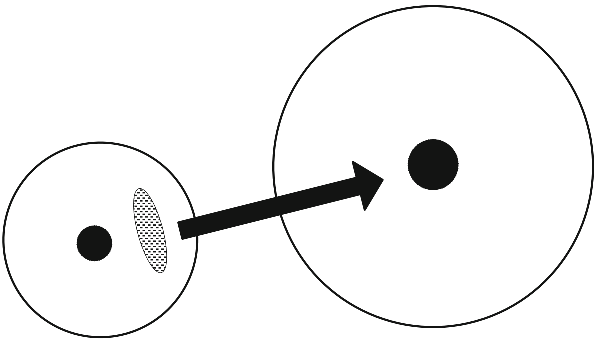

Fig. 1 First phase, immaterial observer

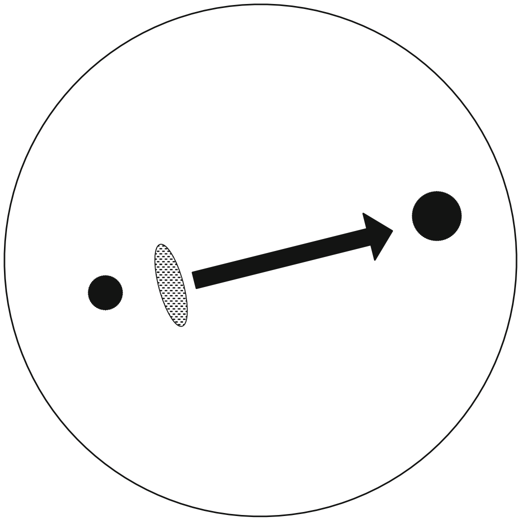

Fig. 2 Second phase, immersed observer

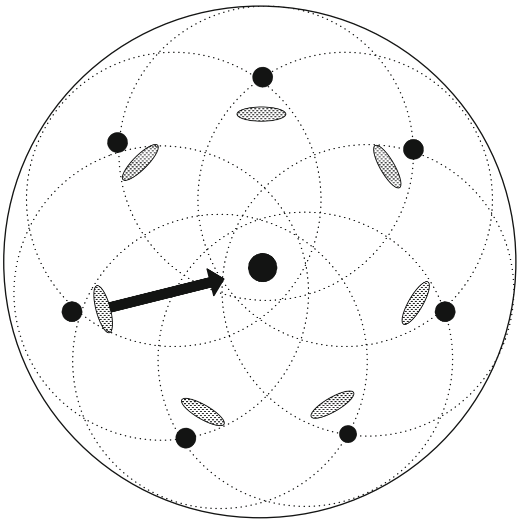

Fig. 3 Second phase, plural observers

Figure 3 indicates a plurality of distinct observers using their individual lenses to understand an object. Efforts to sharpen the focus of any lens and create a consensus definition can lead to conflict over the quality of lens in use as well as to disagreements in the nature of the object under study.

As indicated earlier, these disagreements can often be successfully glossed over by a relatively homogeneous group of scientists, sharing a research agenda, and

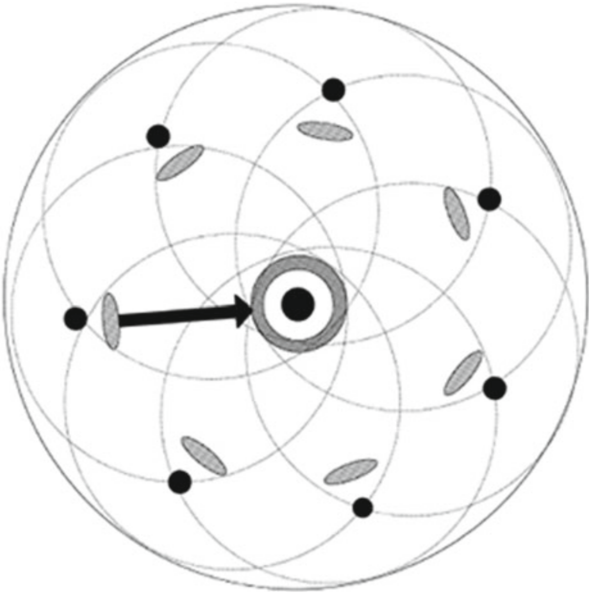

Fig. 4 Third phase, plural perspectives, contextualized object. Graphics supplied by Thomas Flanagan

using probabilistic methods to describe social and cultural situations. The disagreements can be enormous, however, when heterogeneous researchers with diverse agendas attempt to describe cultural realities. Difficulties can be insurmountable if experts attempt to *prescribe* solutions for social and cultural problems.

Figure 4 portrays a different way of constructing an object, by way of *observer-interdependent observation*. As several observers share their perspectives, they build a shared context (represented by the inner circle) that constitutes the object of their deliberations. This is the method of third phase science. It honors the views from every lens and uses them to construct a compound lens (or meta-lens) which is shared by the group as they examine the object that is at the center of their inquiry. Through this meta-lens a group gains a community understanding of the situation they are in and collectively decides what they want to do about it.

Third phase science seeks and respects frameworks for making observations from multiple and distinct observers in order to more fully understand the inclusive context of an object. The language that determines the object of discussion is established through the interaction of the involved observers. Science in this phase deals especially with desired behavioral and social change, such as self-improvement or organizational change. Third phase science does not seek to give a researcher more control over human variables; it thereby does not manipulate and antagonize its users and participants.

> It allows one to meet the demands of people that act as interactive users. It allows them to learn collectively, and to systematically develop the resources needed to improve their own development. It makes it possible to increase differences between individuals, and to use these differences as a resource (De Zeeuw, 1997, p. 27).

Third Phase Science Emerging to Address Engineering Challenges

Following World War II, and in tandem with the rise of industrial and political complexity, a crisis in *planning* was broadly sensed as a leadership challenge. Planning, however, was insufficient. Planning had extrapolated trends and past performances as a forecast into the future. Futures began to be recognized as manifestations of unintended consequences resulting from newly expressed aspirations and reactionary desires. Planning lacked essential features of design because planning tended to be driven by past experiences and by historic data. The term *strategic planning* emerged to capture a distinction between routine planning and planning that was intended to capture emerging opportunities and mitigate evolving threats. Strategic planners thus emerged as a class of experts equipped with design tools and ordained with special status for looking into the future.

The individual experts, however, still remained hostage to their own past experiences and emergent hopes, and thus unavoidably carried their biases into their designs. The notion of moving strategic planning into a practice of collective design was revolutionary in the command-and-control world that lingered as an enduring wound for many nations following the world war. Into this civic environment, many prominent social philosophers planted the seeds for the emergence of third phase science. Landmark contributors include Ozbekhan (1969, 1970), Warfield (1994, 2006), Christakis (2006), Christakis and Bausch (2006), Flanagan and Christakis (2010), Bausch and Flanagan (2013), Churchman (1968, 1979), Checkland (1981), Jackson (1992), Flood (1990), Flood and Jackson (1991) (each discussed below, in context with their primary contributions.)

Design **Hasan Özbekhan** in the 1970 "Report to the Club of Rome," strongly argued that "*the first step is to proceed from a general, agreed upon image. And what makes agreement possible is a shared value-base*." He advocated a heuristic approach "*in which the greatest freedom of action and sensibility of invention must be preserved … starting within the given value-base[s] that lead to the creation of a normative image of the future*." He further recommended that the design work be led by a diversified steering group composed of a mathematician, a statistician with an operations research background, a computer programmer, a social scientist, an economist, and a political scientist with experience in international relations.

Complexity **Aleco Christakis**, who collaborated in the Club of Rome report, drew experience from his training as a physicist and from his immersion in Constantine Doxiadis's world. Doxiadis, a renowned architect and city planner, engaged Christakis to provide rigor for *Ekistics* (1963), an emerging science of human habitations. During the late 1960s, Doxiadis convened celebrated contemporary thinkers—including Arnold Toynbee, Buckminster Fuller, and Margaret Mead—to deliberate on approaches for addressing pressing world issues while cruising the Greek isles on his yacht. On the island of Delos they routinely combined their reflections ("Planners: Oracles at Delos", 1969).

Christakis, as a member of this community, was profoundly impressed by the diversity of the perspectives and the need to include these distinct views into a holistic understanding. He recognized that this was not easy to do. Brilliant minds, fluently discussing complex issues with thinkers in their fields of study, had great difficulty discussing these issues with a diversified group of experts from many other fields. One-on-one, some sense of agreement could be negotiated, but in a larger and more inclusive deliberation, the threads did not converge into a clear view of a shared understanding. Christakis felt that even a science as expansive as physics was not up to the task of the many essential experiences and aspirations that were needed to design thriving human habitations.

For years, Christakis and Özbekhan reflected on the need for a new approach in planning. A breakthrough occurred when Christakis was presenting a seminar on use of engineering matrix analysis in the design of complex systems while John Warfield was sitting in the audience. Warfield had independently developed a method which could simplify the matrix analysis task, and Christakis immediately recognized that Warfield's work has profound implications for enabling a new approach to group deliberations. Together Christakis and Warfield refined the mathematical and the social dimensions of collaborative design and began validating the approach in the form of Interactive Management (IM) for system planning. (Christakis expands on the evolution of this approach in the second chapter of this book.)

Merging "Soft Systems" with "Hard Systems" to Establish Third Phase Science

Christakis came into the practice of Third Phase Science from the *hard systems* tradition of the physical sciences. Within hard systems, a problem is named, options for response are gathered, preferred options are deliberated, a most preferred option is selected, and the selected option is implemented and evaluated. This is an approach traditionally used in engineering arts. Hard systems approaches require accurate descriptions of problems. They work well to optimize results when a problem can be well defined—but they poorly suited for resolving ill-defined problems or uncertain opportunities.

In the 1950s and 1960s, systems theorists began to engage ill-defined problems, which were perceived as uneasiness in organizations. They used the problem solving tools that had worked in the past while also looking for new approaches. System consultants and theorists like C. West Churchman, Russell Ackoff, and Peter Checkland converged on an approach which would become known as *soft systems*—a method specialized for use with ill-defined situations and geared to promote organizational learning.

Soft systems approaches help organizations open themselves to a variety of viewpoints. They encourage diverging views in order to clarify goals, objectives, and procedures through cycles of examining practice, theorizing, applying theory, examining results, re-theorizing, and reapplying theories.

Inclusiveness **C. West Churchman**, a contemporary of Özbekhan and Christakis, emerged from the field of operations research—a "hard systems" practice—and later forged the foundations for soft systems thinking. Churchman defined his moral imperative for soft systems as:

> The design of my philosophical life is based on an examination of the following question: Is it possible to secure improvement in the human condition by means of the human intellect? The verb 'to secure' is (for me) terribly important, because problem-solving often seems to produce improvement, but the so-called 'solution' often makes matters worse in the larger system" (as quoted in Ulrich, 1999).

In a book titled *The Systems Approach and Its Enemies*, Churchman (1979) portrayed himself as the systems hero who had designed an inquiring system as comprehensive as he can make it. He had a clear idea of his own ethics, but found that many people did not share his concerns. To eliminate this dissonance, he first tried to incorporate into his approach the insights of groups that he calls *enemies of the systems approach*.

These enemies, who share many of his convictions, defend preconceived convictions. They think and feel *issues* dealing with topics like conservation, morality, religion, and aesthetics and do not see facts that might undermine their rectitude. When he tells conservationists that conservation has to be seen in the context of the larger system, they think he is trying to co-opt them. Moralists resist any attempts to rationalize or make dialectical decisions. Religionists maintain that God needs to be worshipped by humans who are to obtain their direction from revelation. The aesthetic person insists on the individuality of every person and his/her viewpoint, and therefore rule out tradeoffs. "Gone is adding up values. Gone is any sensible way of assessing change" (Churchman, 1979, p. 199).

To deal with this quandary, our hero offers himself the prescription: *Be your enemy*. As he steps out of the body of rationality into the bodies of his enemies, he sees that rationality is a tool, an expression (among other expressions) of what it is to be human. In this, he does not lose his identity; he continues to operate as a deeply involved rational planner. He embraces the kind of *sane schizophrenia* that Rank (1932) offered to visionaries: "at one and the same time… [to live] visions and the reality of the collective consciousness" (p. 213).

In stepping out, he gains objectivity about his rational self and leavens it with some humor. In looking at himself *as his enemy,* he begins to see how foolishly he pushes "one point of view, of model building, statistical analysis, game theory, ethics, or holism" (Churchman, 1979, p. 214). He realizes that he has quirks like everyone else and finds deep satisfaction in this realization and the understanding that it brings.

Structure **Peter Checkland** was working as a university-based management consultant during the 1970s. He experimented with systemic approaches to problem-solving following the logic of his problems and the leads of other scientists, notably Churchman and Ackoff. He eventually devised the Soft Systems Method (SSM) as a generic approach to the kind of problems he was facing.

SSM is a progressive learning cycle with five stages (in its simplest form). The cycle can begin at any of those stages. Three of the stages concern events in real time, and two involve abstract systemic definitions and models. The first (real world) stage is the gathering information and viewpoints about a problem situation.

The second (thinking) stage is the formulating of critical core definitions. The formulation of these definitions requires abstract thinking about delivery systems, coordination systems, and so on. At this stage, one develops several definitions. Each of these definitions explicitly identifies six elements about the problem situation.

These six elements are identified by the CATWOE acronym. They are: Customers, Actors, Transformation process, Worldview (Weltanschauung), Owner, and Environmental constraints. Customers are those "who would be victims or beneficiaries of this system were it to exist." Actors are those "who would carry out the activities of this system." Transformation process answers the question: "What input is transformed into what output by this system?" Worldview answers "What image of the world makes this meaningful?" The Owner is the one "who could abolish this system." Environmental constraints answer the question: "What external constraints does this system take as given?" (Checkland, 1981, p. 69). Each of these elements is carefully integrated within its worldview. Each Worldview is assessed for its theoretical and ethical relevance.

The third (thinking) stage is also critical. It develops conceptual models based on these root definitions. These models explore the theoretic and practical consequences of the root definitions. They abstractly point out elements, viewpoints, and consequences that are not part of real-world awareness.

The fourth (real world) step compares these systemic models with existing perceptions within the problem situation. This step brings together real life perceptions with abstract perspectives and novel recommendations. It leads to a real life decisions about what will be done to address the organization's problems.

The fifth (real world) step is the taking of some action in the problem situation and the monitoring of the resulting patterns of behavior. Hereupon the stage is set for renewing the process.

Clearly, SSM is a learning system. Organizations use it to clarify their viewpoints, examine theoretic consequences, confront their perceptions with novel schematic possibilities, and use those insights to intervene into their problem situations. They then monitor results and reiterate this process in an upward spiral of organizational communicative improvement.

Checkland also sketched the phenomenological and social bases of SSM. He thought SSM was applicable by anyone to any organizational problem in a value-free manner. He saw compatibility between SSM and critical theory, and noted the similarities between SSM and Habermas' *ideal speech situation* (Checkland, 1981, p. 283). SSM achieved rapid acceptance as a management tool in the 1980s because it offered systematic approaches to real-life situations.

Synthesis **Ramsés Fuenmayor** explored the cross-implications of holism and worldview as they are used in SSM. He interprets soft systems as interpretive thinking because it recognizes that social facts depend upon the point of view of their interpreters. He argues that … "the facts do not exist in themselves; they are things that cannot be without an interpretive context" (Fuenmayor, 1991, p. 236). If we are to agree with respect to what *is*, then we must understand the different ways with which we interpret what *is*. Such clarification is essentially a matter of *filling the gaps* in the different ways that a situation is perceived. It is a search for an inclusive context for understanding. Such an inclusive context is, of necessity, more than an individual context, so it also is different from any individual contextual understanding. To establish this contextual understanding, individuals must agree to legitimize all sincerely expressed distinct, individual perspectives.

Power **Michael Jackson (1992)** perceived a weakness in soft systems methodology with respect to its adequacy for dealing with imbalances in the power distributed among participating deliberators. SSM requires stakeholders in a decision-making process to enter into free and open discussion of proposed changes. Untrammeled communication, however, cannot be easily or frequently met because powerful individuals are not likely to undercut their dominant positions. In contested situations, dialogue must be structured and managed to assure power equality. Jackson contributed insights for improving systems practice and balancing power relations.

Interpretation **Robert Flood (1990)** drew attention to how paradigms enter into the definition of any system. Paradigms provide the underlying metaphors upon which particular systems are built. The idea of what a system *is* has been continuously redefined through analogical reasoning drawn not only from the organic world (e.g. feedback, autopoiesis, feed forward), but also from mechanisms, culture, politics, and psychic prisons. Each underlying metaphor of systems thinking rests upon a basic normative theory of how the social world is put together: mechanically, organically, or communicatively. Each metaphor also reflects an objectivist or subjectivist viewpoint and an attitude about the possibility and desirability of social change.

Reflections

Systems thinkers who engage communities as collaborative designers must manage both information complexity in a design context and information exchange complexities in social contexts. Practitioners working in such an arena merge the art and science of dialogue with an evolving technique of design. The challenge in supporting a continuous and coherent evolution in what we might call *dialogic design* is fundamentally aligned with the need to close the loop from the arena of practice back into the corpus of theory. John Warfield (1994) graphically described this challenge in a circular model that he called the Domain of Science Model. The challenge is very real because individualized practices for implementing the theoretical understanding of systems science give rise to individualized outcomes. Without a coherent contextualized frame for carrying these experiences back into the corpus of theory, meaning will be blurred and understandings will be lost. Here then is a profound example of where third phase science can and must be used reflexively to advance the field of dialogic design which, in turn, enables and advances the practice of third phase science.

Stepping back to see the big picture, Russell Ackoff makes a distinction between *doing things right* and *doing the right thing*. Doing things right is largely the domain of designers (e.g., practitioners) who produce practical, elegant, and appealing products and campaigns. Designers with a stronger systemic base have principles beyond their artistic sensibility for choosing the right thing to do. Theory can also be used to guide choices with respect to the *right* way to engage the design challenges under a range of contextual situations. In this chapter, I seek to make the point that designers who have a conceptual awareness of third phase science may be better able to recognize when third phase science is applicable to a given design situation. In highly complex human system design situations, specific methodologies for implementing third phase science may become recognized as being the *right* approach.

In highly complex situations, the third phase science methodology refined and validated by Christakis has specific advantages of which designers should be aware. This methodology—which is currently known as Structured Dialogic Design (SDD), Structured Democratic Design, or the Structured Dialogic Design Process (SDDP)—continues to evolve. As it is being integrated into social system approaches, it builds a will to design collaboratively and to translate inclusively diversified design into a program of collective action.

Seven Principles Embodied Within Structured Dialogic Design

The Law of Requisite Variety (William Ross Ashby, 1958)
The Law of Requisite Parsimony (George Miller, 1956 and John Warfield, 1988)
The Law of Requisite Meaning (Charles Sanders Peirce)
The Law of Requisite Saliency (Kenneth Boulding, 1966)
The Law of Requisite Autonomy and Authenticity (Ioanna Tsivacou, 1997)
The Law of Requisite Evolution of Observations (Kevin Dye and Diane Conaway, 1999)
The Law of Requisite Action (Laouris et al. 2008)

Third Phase science requires multiple points of view and a diverse context for understanding complex social situations. Engaging multiple stakeholders in deliberations is essential, but unless the stakeholders represent a balanced view of the diversify in the community affected by the design outcome, the design product is likely to be defective. Designers must take care to draw a fully diversified assembly of perspectives representing the experiences and aspirations of the community. Within SDD, this is stated axiomatically as the need for requisite diversity.

In complex deliberations, high diversity can push the stakeholder/designers into cognitive overload. Deliberations must be structured to manage this overload. SDD structures idea gathering, posting, clarification, sorting, and relationship mapping. Decisions made by the community of designers are captured in a software tool which supports the group in two additional ways: (1) it prompts the group to consider relationships which they need to consider in order to provide a comprehensive understanding of their design challenge, and (2) it presents the results of their decisions to the group in the form of an easily read tree. Axiomatically, the structuring that is implemented through SDD assures requisite parsimony for each decision making event, and assures requisite meaning and wisdom for understanding ideas in a contextual form before decision are made.

When participants in a complex design challenge are asked to contribute important ideas in efforts to meet the design challenge, there is a natural tendency to bring forward as many ideas as possible. SDD does not impose limits on the number of ideas brought into a design consideration; however, SDD does recognize that some ideas are more relevant—and more salient—for the design challenge than other ideas. SDD addresses the axiomatic requirement for requisite saliency by applying reflective use of the Nominal Group Technique during idea elicitation.

As meaning unfolds in a complex deliberation, design groups can become confused with respect to the meanings of ideas that were expressed earlier in the design process. To maintain coherence with respect to each individual idea, SDD applies an axiom of requisite autonomy for authorship of each idea. In this fashion, if there is ever a question about what an idea means, the original author of that idea is the sole authority for that idea's meaning. If a new meaning is discovered by the group, then a member of the group is invited to author an idea that carries that new meaning. At all times, each distinct idea has an individual owner who speaks authoritatively for that distinct meaning. The idea is authenticated through the experience of its author, and the coherence of the idea is preserved through the autonomy with which that author speaks for the idea. This concept is the axiom of authenticity and autonomy of ideas.

Meanings emerge at both individual and collective levels. As individuals in a group come to understand the ideas that are brought into the design by other design participants, the emerging understanding evolves in depth and richness. This concept is represented as the evolution of learning. Ideas take on enhanced meaning as they increasingly take informed positions in relationship to other ideas. The evolution of this contextual understanding—this meaning—is supported by the graphic language of SDD. It is also signaled by the axiom of evolutionary learning during authentic collaborative design. To illustrate this point in more detail, SDD extends the evolution of meaning by specifically applying a systems design tool to *map* ideas to reveal their recognized strong influence upon each other. This step goes beyond the conventional stopping point in many group design processes where, following deliberation, priority voting is taken to rank ideas and reveal preferences. Because SDD goes beyond this point, SDD reveals that priority voting in the absence of influence mapping results in priorities which are inconsistent with the group's systemically reasoned preferences. Premature termination of the evolution of meaning in collaborative design for complex situations invariably results in erroneous priorities.

SDD's seventh and final law predicts that any action plans to reform complex social systems designed without the authentic and true engagement of those whose futures will be influenced by the change are bound to fail. And as a corollary designs generated by stakeholders are likely to succeed because of stakeholder commitment. When a community of stakeholders is also the collaborative decision maker, knowledge of what is agreed to be in the best collective interests of a community carries an ethical and emotional imperative for implementation. In this sense, SDD is not simply a descriptive application of third phase science, but is also a normative vehicle for collective action.

Conclusion

Third phase science is a theoretically reasoned approach for developing shared understandings and collective responses to complex situations. The application of the science is illustrated with reference to Structured Dialogic Design. The evolution of this particularly methodology and its social transformational practice are being advanced and refined as a science of dialogic design. Third phase science need not be limited to face-to-face dialogue realms, and to this point we acknowledge that the Carnegie Foundation for the Advancement of Teaching is currently leading a new online effort for the emerging science of improvement practice. This is a deep and long-term exploration into the effectiveness of the tenets, tools, and methods of improvement research. It seeks to develop a science of performance improvement in education (Bryk, Gomez, & Grunow, 2011). Third phase science can be expected to emerge in multiple arenas and through multiple engagement approaches and management methodologies.

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Designing the Means for Governing the Commons

Thomas R. Flanagan

Abstract Empirical studies of emergent democratic social systems reveal elements which consistently are evoked during the design phase of the new institutions. Considerable scholarly work has been invested in understanding these elements and rationalizing how they collectively represent a precondition for building stable new democratic structures. Less attention has been directed at this time to optimizing this process by considering sequences with which the design elements might be evoked within specific civic contexts. This chapter represents a contribution to our thinking about possibilities for optimizing democratic emergence with enhanced collaborative design methodologies.

The design methodology illustrated is called Structured Dialogic Design in the United States and Structured Democratic Dialogue in Europe. It is a derivative of Interactive Management co-invented by Alexander N. Christakis and John N. Warfield in the 1970s. The method applies the engineering tool of Interpretive Structural Modeling within a soft systems context so that citizens of greatly varied levels of technological capacity can contribute equally in complex systems design. In its various forms, the design method has been used most consistently and extensively in the nation rebuilding efforts of the citizens of Cyprus over the past 20 years. The generic use of this method to design contextually-tuned pathways for democratic emergence has not previously been reported.

Keywords Collaborative design • Democratic design • Large group design • Social systems design • Systemic design

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Introduction

> If the 20th century was the era of the administrative state, then the 21st century may be the era of the collaborative state. This seems particularly true for environmental issues, where decision-making processes have increasingly shifted from public hierarchies to multisector collaborative arrangements (Koontz & Thomas, 2006).

As complexity continues to rise, decision-making must move closer to the point where decisions have their greatest impact. This decentralization of decision-making has already been embraced in highly command-and-control systems such as the U.S. military under the rubric of battlefield-centric and network-centric decision making. Management science has long recognized the benefits of employees who are both informed and empowered. And consistent with the theme of this volume, design practice recognizes that centralized design principles offer guidance only, and that design elements emerge in finished designs through a multiplicity of local paths. This chapter considers the relationship between essential design elements of self-organized democratic systems, generic principles that guide democratic design, and an overarching design management mechanism for significantly enhancing the success of locally constructed complex systems.

Requisites for Communal Governance

There are generally accepted prerequisites for communal governance. Primary among them are the actual existence of formal and informal levels of governance and the autocratic and democratic levels of governance. The relationships between these two are represented in Table 1.

In both extremes, systems science offers tools for the designer. Formal and informal governance systems work together to constrain or liberate individual citizens and groups of citizens as they might seek to make and apply new designs—and they also erect barriers for the exchange of information due to fragmentation of norms

Table 1 Governance forms and styles

Autocratic governance	Democratic governance
Formal governance (mainly a closed system resistant to change)	
Strongly resistant to any change	Open to democratic approaches that follow defined rules
Informal governance	
Follows rules	Bends the rules
Resistant to change	More open to change
Efficient for dealing with understood situations	Efficient for framing unfamiliar situations
Based on a deeply expert (and possibly forensic) view	Based on a broadly embedded (and inescapably collective) view

and habits as groups differentiate. Individual autonomy in thought and expression can be constrained by requirements for group conformity, thereby putting limitations on unassisted collective learning.

This chapter provides an illustration of a systems approach that can pool expert and embedded views of context through the task of collaborative design. The design task involves assembling a map connecting essential design elements that elsewhere are known to naturally combine and result in an innovative democratic social institution.

The Natural Emergence of Democratic Governance

The body of economic scholarship for which Elinor Ostrom and Oliver Williamson were awarded the 2009 Nobel Prize is embedded in the practice of large-group decision making and emergent governance. Ostrom (1990) focused on governance of common pool resources in the public arena, and her empirical fieldwork has received considerable attention because it overturned a long held assertion that people simply are incapable of self-governance when they share equal access to essential assets. The details of this work are captured in encyclopedic fashion in a monograph titled "Governing the Commons: The Evolution of Institutions for Collective Action" (Ostrom, 1990).

Ostrom's work responded specifically to a brief but enduring essay that introduced the onerous concept of "The Tragedy of the Commons" (Hardin, 1968). History points to many instances that affirm Hardin's view. Ostrom's work makes clear that while the tragedy is an authentic possibility, it is not inevitable. Informal democratic self-governance can give rise to durable forms of formal governing institutions; and, indeed, nothing else has.

Ostrom's field research provides evidence that democratic self-governance can arise "spontaneously" when a set of essential design elements are able to productively connect. Unfortunately, the case data Ostrom has gathered affirms the emergence of a design element only when the design element has been discovered in the finished product. Its pathway to emergence is obscure.

The contextual information underlying the emergence of a *natural* system is tacitly embedded within the system (culture) that creates the design. In human systems, designers use tools to elicit and structure that tacit knowledge. They can identify locally preferred ways for connecting essential design elements. The resulting design informs the community of intentions behind the design, and this information may alter behaviors within the community. Information shapes action, which shapes context and, in turn, shapes futures. The formation of democratic institutions is an iterative, emergent process.

Hypothetically it can be asserted that democratic institutions may only emerge as a consequence of democratic processes. The predisposition for democracy must emerge culturally before this ideal can emerge physically as a community institution. Iterations of democratically sourced and communicated understandings vibrate through social systems, and as they reverberate they create a form of friction. The speed, tempo and depth of cycles of this evolving contextual information can warm or inflame the community, depending upon contextual (cultural) factors. Herein researchers might seek to discover design constraints for the "natural" emergence of democratic systems: crisis, habits, complexity, time and fatigue.

Catalyst for Democratic Design

Perception plays a catalytic role in collective action, and, according to Ostrom (1990):

> Individuals who do not have similar images of the problem they face, who do not work out mechanisms to disaggregate complex problems into subparts, and who do not recognize the legitimacy of diverse interests are unlikely to solve their problems even when the institutional means to do so are available to them (p. 149).

Perceptions thus kindle and then build the political will that shapes our emerging realities.

In reflecting back over the decade after his 1968 article first shook the public conscious, Garrett Hardin offered the dismal appraisal that we are enveloped in a "cloud of ignorance" about "the true nature of the fundamental political systems and the effect of each on the preservation of the environment" (Hardin, 1978, p. 310). In short, Hardin felt that humanity lacks the means needed to see the system as an interconnected set of essential design elements and therefore humanity cannot design implementation pathways for promising resolutions to the challenges that we face. This is perhaps a central crisis; however, beyond a circle of policy scholars, it fails as a catalytic crisis.

To catalyze a community to engage a challenge or opportunity, that challenge or opportunity has to have clear and immediate survival *meaning*. Individual planning horizons tend to focus on the present. Remote effects have lesser meaning. Natural and man-made ecological disasters do throw the future into question … except for different moments in time for different citizens. Those citizens who lean most deeply into the future sense the harbingers of pending crisis, and their ability to rally other citizens to sense their joy or terror creates the political will that is needed for citizens to engage in collaborative design.

If crisis, real or imagined, is the essential catalyst, must human systems wait until the crisis is physically manifest? What contextual factors will provide meaning and the conceptual spark needed to kindle the collective response? Is the crisis unheard—or is it simply drowned in a sea of alternative, competing crises? From an embedded perspective within a human system, cultural attitudes toward futurists, alarmists, eschatologists, and anointed leaders shape capacities for groups to focus their collective attention. There are channels through which individual ideas become collective concerns. And there is an inertia with which all new ideas must contend. Cultural attitudes toward preserving the status quo, returning to the past, or transforming into the future welcome or hinder the perception of crisis. Crisis is a catalyst for collective response, but only if the crisis is perceived to be sufficiently strange or mysterious or complex to warrant collective (democratic) engagement in devising a response.

Social Context for Democratic Design

Stated most simply, governance is a systemic practice that regulates decision-making; systems science is a formal practice that creates contextual understanding from which rules can be rationally formulated. In governance, the question is rarely a matter of whether systems thinking is being used: the question is, *whose* system thinking is being used.

Autocratic governance uses an authoritarian perspective; democratic governance uses a pluralist perspective. These approaches are complementary more than they are contradictory. Autocratic governance is efficient for dealing with understood situations; democratic governance is efficient for framing unfamiliar situations. Excesses can exist at either extreme and so much of effective governance results from the business of entering and managing the middle ground. This middle ground is shaped by factors that contribute both substance and fluidity.

1. *Traditions of Pluralism*. Pluralism and pluralistic design reflect processes of contributing from distinct perspectives to jointly authored outcomes. As systems embrace more and more social, demographic, and economic diversity, pluralistic design becomes progressively more challenging. Part of the governance challenge is due to complexities arising from differences in interactions among groups and part of the challenge is due to the potential for differences in the cognitive approaches for exploring and understanding complexity within the different groups themselves.
2. *Prevailing Mental Models of Governance*. Governance is a process that most citizens in large complex systems experience through metaphor. Military models, corporate models, sports team models, civic association models, all rise to capture aspects of governance structures. Preconceptions for the "proper" nature of a desired governing institution can hinder the emergence of a structure which could be most adaptive for a specific local circumstance.
3. *Existing Structural Hierarchy*. Governance structures have an upper level of rules that assure unifying constitutional choice mechanisms. Between the citizen and the constitutional structure, governing institutions define *collective choice rules*. Citizens then make their individual choices either to conform to the rules or to defy the rules, often with reference to the informal governance culture that they experience. Ostrom (1990) writes:

   > The basic alternatives available to an individual are (1) to support the continuance of the status quo rules or (2) to support a change in one or more of the status quo rules. … The

> strategies available to an individual are "to support" rather than "to choose" because no single individual makes institutional choices in other than totally monochromic systems (p. 192).

4. *Interdependencies Across Silos and Scales*. Silos are cultures of technical language, administrative habits, and codes of conduct that relate to specific missions. As silos harden around specific missions they compete as status block groups for resources. In corporate settings, designers have created democratic bubbles—workshop colaboratories—where participants shape understandings and rules that can be applied across departments and throughout chains of reporting structures (see Christakis & Bausch, 2006). Management science calls these cross-cutting governance systems *matrix management* and recognizes them as special challenges.

Prerequisites for Democratic Collaborative Design

For democratic design to occur, people must show up for the deliberations. For some, the purpose for a collaborative design will be compelling in itself. When properly communicated, purpose becomes an incentive. If the demand for deliberations does not arise organically from the populace, however, some sponsoring authority may need to invest in facilities and amenities, including payments on occasion, to identify, engage, and recruit citizens into a collaborative design. Investments should be limited to getting the group together in an appropriate design context because the process of design will foreshadow the democratic institution under design.

The mechanics of collaborative design involve iterations of idea-gathering and idea selection where preferences are expressed through deliberation or through votes. This expanding and contracting pulse occurs within individuals and within groups. The challenge in working within groups results from the fact that some individuals have rapid pulses while others have slow pulses. Working inclusively puts cycle time constraints on the rapid pulses and puts corresponding performance pressures on the slower pulses. As groups become large, the gathering-selecting cycle is burdened with information overload. Collaborative designers recognize that there are costs in managing the heavy lifting, and when deliberative styles differ, managing the friction among thinking styles. Several cultural factors contribute to the success of inclusively diversified collaborative design:

1. *Respect for Covenants.* A covenant is a win–win agreement expressed in terms of purpose but not in terms of specific performance. For example, if a community agrees to work together, a shared problem can be resolved, a broad opportunity can be captured, a disaster can be diverted, etc. This is not a superficial agreement. It is entered into in spirit, and it binds in spirit. It has its roots in the informal governance structure of a community. Citizens gathered for common purpose under a covenant carry an obligation to engage each other respectfully.

"All too many formal constitutional documents have been little more than words on paper, without any impact on the political and social order that follows their pronouncement" (Ostrom, 1996, p. 23). Commitment to agreements for collaborative action will be weak if participants don't "feel" the rationality of the explanation of the situation and the urgency for the proposed action (Thomson & Perry, 2006).

2. *Capacity to Make Clear and Credible Statements.* Clarity is essential for making credible promises. Individuals must be able to understand situations, honestly express their views, and bind themselves to the truth of a collective understanding. Unlike a covenant, a negotiated understanding of a shared situation conveys obligations for specific performance, and carries implicit or explicit penalties for a breach of the contract of trust.
3. *Capacity for Social Learning*. Formal and informal governance structures periodically change through co-evolution or revolution. Evolutionary change retains many of the core institutions of the old structure; with change occurring through changes internal to the institutions or with the substitution or inclusion of new institutions (see Sharp, 1993). Much of the fabric of civic interdependencies is preserved. One strategy for cultivating evolution of an overly authoritarian governance system is to introduce inclusive system-thinking events in a non-threatening application into the informal governance structure of the social culture. Ostrom's field studies find evidence of this approach: "Success in starting small-scale initial institutions enables a group of individuals to build on the social capital thus created to solve larger problems with larger and more complex institutional arrangements" (Ostrom, 1990, p. 190).
4. *Capacity to Express Reasoning*. Average individuals, regardless of their station or social status, follow four specific rules when they make decisions (Ostrom & Ostrom, 1971):

   (a) Individuals have contextual self-interests (e.g., their values are anchored to their own experiences);
   (b) Individuals are rational (e.g., they rank choices to reflect transitive preferences);
   (c) Individuals adopt maximizing strategies (e.g., they consistently choose an option with the greatest probable outcomes);
   (d) Individuals make choices under conditions of uncertainty (e.g., they consider the probability of an outcome when they estimate its present value).

   Most individuals facing an important decision will seek input from individuals who they feel are most like themselves rather than from individuals who are likely to have radically different perspectives. When decision-making moves from deliberation to the choice phase, some individuals consciously model their decision using some form of systems thinking while others are intuitive decision makers. Considerable individual identity becomes invested in clinging to a specific style for thinking and making decisions, and for this reason, strongly contrasting thinking and deciding habits can create friction during collective design efforts.

5. *Capacity to Restrain Self-interest*. Collective action typically requires that individual self-interest must be moderated to accommodate collective interests. Perfect preferences that might be beyond reach need to be substituted for preferred preferences that seem to be within reach. Individuals who feel threatened or who see themselves as historically abused can be reluctant to relax their self-interests. Collaborative design, therefore, cannot be launched directly from within a state of highly polarized conflict. Ironically, perhaps, collaboration can be fostered from states of highly diffuse confusion. Before win–lose partisanship emerges, groups can commit to collectively discover their situation and design their preferred alternatives to individually perfect solutions. The capacity to restrain self-interests and design together is enabled by discovering a capacity to discover together. In 35 years collaborative design using the Structured Dialogic Design© process, Christakis and Bausch (2006) have consistently found participants willing to suspend their self-interests for the benefit of deep learning achieved through the group.
6. *Capacity for Making Commitments*. Scholars of sociology recognize two fundamentally distinct mechanisms for making commitments: based on an agreed course of action (*a rational choice*) and; one based on traditional institutional affiliation (*an organizational choice*). Agreement, when it might be reached, exists in one of four forms (Mansbridge et al., 2010): (1) fully cooperative distributive negotiations (where participants are in conflict yet still agree to deliberate without threats hoping to reach a new resolution that minimizes lose–lose outcomes); (2) integrative negotiations (where participants are confused yet not in conflict and seek a win–win resolution); (3) incompletely theorized agreements (where individuals agree with respect to a proposition yet do so using different reasons); and (4) convergent agreement (where the same reasons for agreeing are held by all who agree). While working through complexity in large diverse groups is technically challenging, agreements that result through such efforts raise confidence the plan has been considered with such depth that has less room for errors of omission (Wondolleck & Yaffee, 2000). Conversely, agreements which lack the strong *feel* of rational systems thinking result in weak commitments for future action (Thomson & Perry, 2006). Osborn's studies of self-organized democratic structures reveal the need for a single, shared, authoritative and rational *image* of the problem as a requirement for collective action (Ostrom, 1990, p. 112).
7. *Time for Deliberating Inclusively*. Time is a cruel arbitrator. Deliberation involves understanding shared goals, collecting and clarifying ideas, and structuring information into decision packages. Failure to appropriately conclude each step in the sequence raises the risk of the ultimate failure of the design project. Design management approaches seek to assure that deliberations reach essential pause points. Reflection, which occurs outside of formal design sessions, contributes to the evolution of deeper individual meanings, some of which will require reconsideration as the design project resumes in its next session. At the same time, design participants are at risk of forgetting elements of the deliberations in the gap between design sessions. The alternative of sustaining a

continuous design task, if this were to be feasible, risks weakening the design product due to fatigue of the design team. Spontaneous or unassisted emergence of democratic institutions observed in Ostrom's field studies results from uncharacterized time and information management processes. Says Ostrom: "I presume that individuals have very similar limited capabilities to reason and figure out the structure of complex environments" (Ostrom, 1990, p. 25) and "Instead of presuming that optimal institutional solutions can be designed easily and imposed at low cost by external authorities, I argued that 'getting the institutions right' is a difficult, time-consuming, conflict evoking process" (Ostrom, 1990, p. 14).

Special Challenges for Designing Within Twenty-first Century Human Systems

The twenty-first century is differentiated by prior centuries through its complexity. As Margaret Wheatley (1999) has said of rapidly changing management traditions: "Participation and relationships are only two of our present dilemmas. Here we sit in the information age, the knowledge age, meaning age—whatever it's called—we all feel besieged by more information than mind can handle" (p. 166). Managing complex design challenges is discussed elsewhere in this volume (see chapters in this book by Bausch, and Christakis, respectively). Parallel consideration should be given to contemporary issues of dealing with accessing limited deliberative bandwidth, navigating waves of cultural shock, and building collective will for large scale democratic action.

1. *Working with Limited Deliberative Bandwidth*. The public sphere, in its various understandings, is a realm where issues are brought forward, deliberated, and assessed for action. This is, however, an ungoverned realm. Yes, airwaves are regulated in terms of electromagnetic wavelength use, and media is regulated in terms of prohibiting certain forms of obscenity, violent incitement, and, to a lesser degree, character attacks and slander. The public realm is regulated by content exclusion rather than by content use. Abuse of the public sphere as a deliberative forum exists when the space is overtaken by entertainment. Such use parallels paving grazing land for parking spaces. No governance structure exists to assure bandwidth for democratic deliberation, and this reflects a tacit assumption that democratic deliberation is of small consequence—and may be undesired—by and for the masses. A cultural trend which makes thoughtful deliberation fashionable may retake some of the turf from current entrainment uses. Richard Saul Wurman is experimenting in this fashion with a project that is being called "reinventing the art of conversation" ("Esri Hosts WWW Conference" 2012). Observing democratic deliberation is still a far step from practicing the art sufficiently to bring it back into the cultural mainstream. The dominant model for deliberation is debate, an art wherein individuals seek to avoid discovering an accommodation by jousting at each other's assumptions in

a win–lose contest. A culture that is built upon its passion for conflict develops a language that richly describes conflicts and a predisposition to apply rules of conflict in its deliberation. The status awarded to debate as a means of building critical thinking skills unintentionally consumes and erodes the residual space in the public sphere that might otherwise be reserved for pluralistic democratic deliberations. To counter the extinction of democratic deliberation from the public sphere, a new form of civic institution is needed wherein such deliberations are fostered and celebrated.

2. *Navigating Waves of Cultural Shock*. The world is experiencing numbing shocks in terms of global warming, economic inequity, and governing capacity. Individuals feel the rising crises but governing institutions seem to ignore them. Part of the reason for this is that governing bureaucracies have mechanisms which immunize them from sensing disquieting changes in their environments. In the worst of cases, such institutions become sources of skewed information that renders them progressively less relevant during times of major change. The spiral is explained this way Ostrom and Ostrom (1971):

> Rationally behaving, career-oriented public servants within a bureaucracy will act to please their superiors. This means that on balance favorable information will be forwarded while unfavorable information will be repressed. This distortion of the information flow will diminish the capacity of the bureaucracy to control and generate public projects. Thus, large-scale bureaucracies will become error prone and ineffective in adapting to rapidly changing civic conditions. Efforts to correct the malfunctioning of bureaucracies by tightening control will simply magnify errors (p. 209).

We are facing a time of change. When governments are attentive to the need for change, self-imposed shocks, such as emancipation in the United States and the end of apartheid in South Africa, alter the constitutional rules for inclusion into the rule crafting community. The result of such changes leads to broad adjustments in formal collaborative choice rules and informal compliance norms. Properly scheduled and systemically introduced change can be a good thing, but without democratic civic institutions that deliberate visions for the future, citizens become radicalized. The resulting willingness to be agents of a feuding governance system rather than owners of a democratic governance system in our day even presents a crisis in national defense for the United States. Secretary of Defense Leon Panetta has said as much in his recent comments to the Center for a New American Security:

> The issue of whether our democracy can truly function … can have leaders that are prepared to make the decisions that need to be made … in order for this country to govern itself is, I think, the issue that will determine if we have national security [and furthermore] … if this country is to provide leadership in the 21st century, if we are to do what we have to do to guide countries so that they are in fact able to protect their interests and to engage in the kind of commerce and economic development that is important for the future, if we are going to be a part of that, then we have to be credible (“Secretary Panetta on Defense Priorities - C-SPAN Video Library,” n.d.)

Responding to the essential need to practice pluralistic systems thinking and democratic deliberation as a social norm will require us to be creative.

> It requires substantial ingenuity to design institutions that cope effectively with attributes of a particular resource given the larger macro-political institutions, culture, and economic environment in which that resource is embedded. With improved understanding, it may become possible to diagnose resource use situations well enough to separate promising institutional forms from those unlikely to achieve desired goals … (Ostrom et al., 2002, p. 25).

3. *Building Collective Will for Large Scale Action*. Deliberation as a spectator sport requires the acquired taste of a cricket fan content to forgo the drama. This is to say that deliberation itself doesn't sell well to mass audiences. Deliberations do need to be interpreted, but if they are to lead cultures to new horizons, they need to be interpreted in forms other than traditional win–lose contests. Preferred interpretations will present artistic challenges—to storytellers, graphic artists, and filmmakers, poets and humorists. The power of a democratic deliberation will be found in the reflections generated as the voices of the community reports on those deliberations. Scholarly appreciation of art as an instrument for sharing important civic understandings focuses specifically on subjects that are difficult to bring into casual discussions, such as, sexually transmitted disease, violence toward women, and minority oppression. The anti-apartheid movement in South Africa used the powerful narratives of Nelson Mandela. The civil rights movement in the United States carried the "I have a dream" narrative through the voice of Martin Luther King. Both leaders emerged as cultural symbols for freedom and justice. From graffiti to grand opera, visual and performance art have carried messages from within communities forward into the world (Rader, 2011).

Modern societies need to create links that open spaces in the commons of the public sphere, sensitize us to pending cultural shocks, and engage us artistically. It's a tall order, but it begins with the effort to use a democratic deliberation as a script for artistic interpretation (see Flanagan, 2008). Changing our situation involves changing our narrative. We become socialized and we socialize others through the stories that we tell and retell (Robertson & Tang, 1995), and we cling to a favorite story because at its heart we find a shared truth. Precedents for linking deliberation to commitments for civic action are reported from communities of faith (Golemon, 2010; Hester & Walker-Jones, 2009) as well as corporations (Denning, 2011; Gabriel, 2000; Simmons, 2006). In communities where we hold shifting affinity with many civic groups (Putnam, 2000), the role of a unifying community narrative is to provide us with the evolving sense of identity we need to solve difficult problems together. As social institutions bend and stretch under pressures for change, our connection to a felt sense of civic leadership can get lost in the cracks of alienating governance structures (Bovens, Schillemans, & Hart, 2008). Leaders in our communities can reconnect us through the wise use of the arts (Trice & Beyer, 1993).

Essential Elements of Democratic Governance

Elinor Ostrom's work leads to a set of eight elements which were empirically found to exist in all successful democratic institutions (see Ostrom, 1990, p. 90). From a design perspective, the questions that we address in an effort to mimic nature are: (1) how did the design elements emerge and entwine into new governance structure, and (2) how can we identify an appropriate sequence for recruiting the design elements into a new structure within a new civic context. The design elements are as follows:

1. *Clearly Defined Participant and Resource Boundaries*. This design element addresses the identity issue where boundary conditions and access rights for the system under governance are negotiated. Establishing this design element is problematic when the resource in question is intangible, invisible or otherwise not attached to specific and easily identified landscapes. Likewise, deciding who does and does not warrant access to the resource is politically problematic and the element does not include any internal provisions insisting that the distribution of access rights need be equitable beyond the inclinations of the local powers granting the access and defining the boundaries.
2. *Congruence between Appropriation and Provision Rules and Local Conditions*. This design element aligns rules for distributing and conserving the resource in harmony with specific local understanding of local conditions. The environmental and social sustainability of the governing entity requires that designers do estimate correctly. In New England, as elsewhere, local hydrological conditions specify what loads of wastewater can be accommodated within specific natural microenvironments; however, local knowledge is often unprepared to accurately estimate the future sending and receiving loads, and thus the future adsorptive capacity of the resource, though geographically bounded, represents an insufficiently defined—and potentially changing—local use conditions that can be the focus of dispute between conservationists and developers.
3. *Collective-Choice Arrangements and Modification Rules*. This design element relates to legislative process, equivalent to setting laws, policies and regulations: specifying who gets to change rules and how the rules are changed. This is where rights are assigned for challenging rules too. If one family has many members, if rules are changed through voting, and if all family members can individually vote, then large families might always dominate the governance structure.
4. *Monitoring the Resource and the Participants*. This design element relates to reporting on the effectiveness of the governance structure. Feedback systems must be designed so that they can be trusted. Provisions to control for corruption and assure accuracy must be considered. Moreover the cost for monitoring must be allocated within the community.
5. *Graduated Sanctions for Incremental Infractions*. This design element relates to the community's sense of justice. Disincentives must be practical and predictable. Graduated, fixed size fees will also have different motivational impacts on

individuals with different levels of wealth, and individual wealth may not be transparent.

6. *Conflict Resolution Mechanisms for Individuals and Institutions*. This element relates to the right to appeal perceived miscarriages of justice. Rules can specify who has the right to raise objections, what forms of redress are allowed, and what actions can be taken to assure resolution.
7. *Minimal Recognition of Rights to Autonomously Organize*. This element relates to legitimacy to self-govern. The presumption of an enduring autonomous authority can lead to can lead to conflicts while the presumption of persistent subordination can prevent communities from coming together to see if they might solve problems that are within their capacity to resolve.
8. *Nested Enterprises.* This element represents integration and inclusion in larger scale governance structures. Integrating assures information exchanges to provide advanced notice for changing external political conditions, and for representing local political conditions to external policy makers. If this element is missing, local democratic institutions can be displaced incidentally by plans made external to the community.

If the community environments and design management approaches that give rise to new democratic institutions themselves carry features that foreshadow the emerging governance systems, one might be able to identify design elements such as those reported in Ostrom's work. Stated another way, it is possible that a democratic design approach must be used to design democratic systems. To test this idea, elements of the Structured Dialogic Design™ (SDD) process that seem to correspond to Ostrom's design elements are listed below:

1. *Stakeholders Comprise an Inclusive and Relevant Body of Decision-Makers*. The resource that is being managed during design is the design environment itself, and the participants are identified individuals who carry a distinct voice into the design environment from among all of the parties who will be impacted by the results of the design project.
2. *Stakeholders Define the Design Situation from Their Own Experiences*. Design activities remain congruent because statements are grounded in local experience and because the authenticity of individual expression is preserved throughout the design project.
3. *Stakeholders Agree to Work Within a Codified Design Process*. Rules for contributing to the design are validated through democratic review of their effectiveness in design practices and are continually evolving with the democratic practice of dialogic design science.
4. *Stakeholders Generate Transparent Records of Their Deliberations*. Progress of the design activity is captured and reported in real time to all of the participants. Records of contributions from all participants are presented to all participants for confirmation or for refinement.
5. *Stakeholders Support Collective Compliance with Design Tasks*. Participation in dialogic design is normative in that the sequence and scale of contributions and the means of clarifying ideas without expressing judgment are modeled by the

Table 2 Comparison of Ostrom's eight essential elements with SDD's elements of democratic design

Ostrom's eight elements of democratic institutions	SDD's elements of democratic design
Clearly defined participant and resource boundaries	Stakeholders comprise an inclusive and relevant body of decision-makers
Congruence between appropriation and provision rules and local conditions	Stakeholders define the design situation from their own experiences
Collective-choice arrangements and modification rules	Stakeholders agree to work within a codified design process
Monitoring the resource and the participants	Stakeholders generate transparent records of their deliberations
Graduated sanctions for incremental infractions	Stakeholders support collective compliance with design tasks
Conflict resolution mechanisms for individuals and institutions	Stakeholders accept the management team's constitutional authority to guide the design process
Minimal recognition of rights to autonomously organize	Stakeholders recognize the collective right of all participants to construct design statements
Nested enterprises	Stakeholder design work is available for communication with constituents beyond the design table

dialogue managers and replicated by participants. Sanctions exist in the form of intervention by dialogue managers, and care is taken to intervene through coaching and only then through more invasive means.

6. *Stakeholders Accept the Management Team's Constitutional Authority to Guide the Design Process*. Conflicts with respect to tasks and processes are resolved through appeal to the collective acceptance of the agenda for the activities introduced at the start of design.
7. *Stakeholders Recognize the Collective Right of All Participants to Construct Design Statements*. A clear and solid line is drawn between the role of dialogue managers to guide the process but never to interject or alter any contributed content. Participants retain full autonomy over what is included in or what is not added into the design work.
8. *Stakeholder Design Work is Available for Communication with Constituents Beyond the Design Table*. Because participants in SDD colaboratories represent community perspectives held by others in the community, the design product is organized for ease of sharing elements of the design to individuals and groups who have authority to ratify or veto the design product.

The close correspondence Ostrom's eight essential elements and the design elements of SDD are portrayed in the Table 2.

While the concurrence of design elements within SDD and with Ostrom's list of essential design elements may be coincidental, approaches for fostering the emergence of new democracies may, themselves, have an essential requirement to possess certain features that are sought in the intended design construct.

Methodologies—and local cultures—that construct democratic institutions may themselves have requirements to operate with specific democratic principles.

Sequential Implementation of Essential Design Elements

Project managers are keenly aware of interdependencies in the implementation of complex plans. Some implementation tasks must be started before or after others, and completing the initiation of some tasks can profoundly affect the ease with which other tasks are implemented. If a task involves building a house, and the lot is in a forest, then deciding upon the finished area of the building and clearing the land takes precedent; however it the land is already clear, the task of clearing the land is irrelevant and decisions about the finished area of the building can be determined at a later date. The point here is that local conditions in the environment with which the project is implemented do shape the sequence within which tasks are ideally performed.

In natural settings, stable democratic institutions may or may not come into existence. Factors that are included in successfully launched institutions have been identified. Data does not yet exist to identify the extent to which success is assured (or even accelerated) by virtue of the sequence with which design elements are introduced into the work plan. Given that catalytic events must occur to initiate design, social contexts need to be navigated, and collaborative design capabilities need to be in place, the sequence with which work begins on each of Ostrom's design elements can be expected to reflect and aggregated complex of local environmental considerations. In other words, the sequence with which design should proceed cannot be universally prescribed but rather must be locally discovered. Ostrom herself does offer hints for where she feels the design process might frequently begin: "designing the boundaries of the CPR and specifying those authorized to use it can be thought of as a first step in organizing for collective action" (Ostrom, 1990, p. 91).

The assumption underlying first steps taken to define (design) boundaries and identify (specify) users carries an implicit belief that starting at this point requires a small investment of time and resources. It is possible to imagine a situation in which community members are unsure of their legitimacy to design a system for managing a situation. In such a case, establishing the legitimacy for constructing a system to manage a situation might be a prerequisite for defining boundaries and identifying and convening stakeholders. If local knowledge plays an important role in determining how the design for a democratic governance structure is to emerge, then a mechanism for working with local knowledge and extracting tacit wisdom can contribute to superior strategies for design.

In a preliminary approach to the design challenge, a representative group of informed citizens can jointly map a sequence for implementing Ostrom's design elements. Using SDD as a design methodology, citizens will be asked if implementing design element "A" will significantly enhance the ease with which design

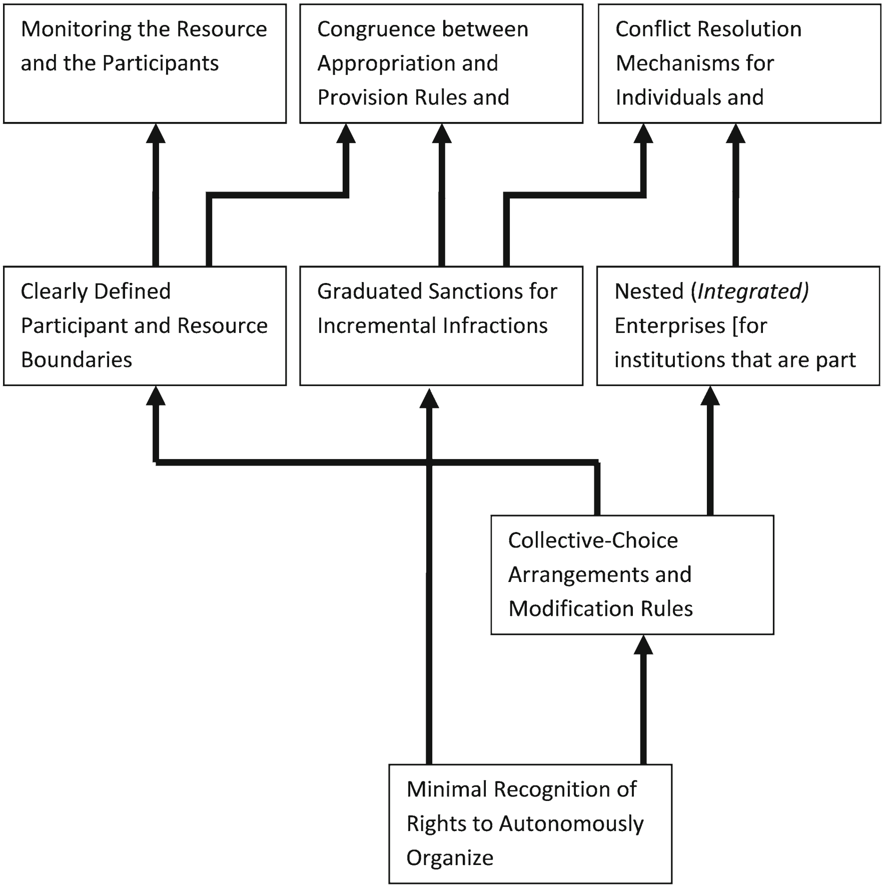

Fig. 1 A hypothetical ISM map of influence among the Ostrom design principles for a unique community

element "B" can be implemented. The group will deliberate interdependencies that can influence a sequence of implementation, and strongly held agreement for significant influence will be recorded. After considering the relationship of influence among all of the essential design elements, the graphic conversion tool within the SDD approach will report out the identified strong influences in the form of a tree (see Fig. 1).

Figure 1 illustrates a map which is read from the bottom to the top. The bottom most elements are 'deep drivers' of influence—they can also be thought of as the root causes of efficient performance. While the map does not report the arguments that were raised to support assertions of influence, the structure invites informed observers to guess as to what local conditions might be responsible for specific patterns of reported influence. The map also shows aspects of design which are thought to benefit most from the completion of prior design tasks, and in this sense the map cautions design managers in a specific community to delay initiation of certain tasks until progress has been made in other areas. While Fig. 1 is hypothetical, the reasoning that happens to put discussions of monitoring, rules, and conflict resolution at the top of the map was based on this author's belief that resolving access rights, defining types of sanctions, and identifying relations with overarching governance systems will significantly ease the design burden in the author's individual experience with organizational design.

The map shown in Fig. 1 can be expressed also as narrative:

> Our community shares a problem that requires our collective action. To respond, we will need to develop a governance structure that will serve our needs as we struggle with a resource upon which we critically depend. Developing this governance structure will require us to invest time and energy. If we are to do this, we first must consider the set of design principles which have been empirically determined to be required for democratic governance of shared essential resources. We have considered our situation and the requirements of the design that lies ahead and we have agreed that we must first convince ourselves that we are recognized as having legitimacy to design and apply a governance system for the essential resource (#7). When we are agreed that we do have the authority to design a solution for our community, then we will invest our energies in exploring rules that we feel might improve the management of our situation (#3) and the nature of penalties that we feel might be appropriate for first and for recurrent rule breaking. As our understanding of rules that we feel we would like to see in place, we will consider the participants in our community who will need to join us in exploration of rules for governing the resource, and to help us establish boundaries where our rules can extend and beyond which they will no longer apply (#1). At the same time, we will consider how our local governance structure will have to connect to larger regional, state and federal regulatory systems so that plans which evolve over time are communicated to us for our input (#8). Our understanding of sanctions which we feel are appropriate for rule breakers (#5) and our understanding of our fit within hierarchical regulatory systems (#8) will help us to identify options for conflict resolution, when conflicts in our governance model will periodically emerge. Our evolving understanding of participants and boundaries (#1) will help us design monitoring strategies for the resource and its users (#4). And our understanding of participants and boundaries (#1) in combination with our proposed sanctions for rule breaking (#5) will help us assure that our rules for using and for evolving rules for using the resources are congruent with our community needs and capabilities. The design process will take time, and we cannot afford the confusion of muddling through, so we have constructed a map that provides us with the most efficient cascade of activities that must undertake together in the coming months to allow us to resolve a critical situation that we share.

The graphic view and interpretive versions of the narrative can be used by the design manager in the community to help a community focus on a sequence of tasks that can improve efficiency and speed with which a design is collaboratively constructed. Project managers can use such a map and work products reflecting a current positing within the map to communicate progress visually. Harold Lasswell, a brilliant social scientist, had envisioned sharing such information in an exhibit that he called a 'social planetarium'—a vehicle for linking knowledge users in the public sphere to visualize emerging designs and thereby expand inclusion into the design process (Lasswell, 1963).

Beyond Democratic Design of Pathways for Design

Tools which help us decide how to improve the management of our design processes can also be used within our design processes. Each of the Ostrom's elements in self-governing democratic systems must be designed for the local community that will use it. Capturing these designs and exhibiting them in a public observatorium helps expand inclusion into the design activity as the activity proceeds. At some points, explicit graphic representation of design elements may play a critical role in communicating an understanding of that element to broader public audiences. Consider, for example, the challenge of discussing the boundaries around a common pool resource for philanthropic funding (see Romzek, LeRoux, & Blackmar, 2012). Funding resources cannot be seen using direct observation. Standing stocks and flows of philanthropic resources can be graphically represented; however, the web of community relationships that depend upon funding for their operations—and that depend upon tasks performed in the community by partners who are also dependent on such funds—quickly becomes too complex to communicate using conversational means.

Conclusion

Democratic design requires collaborative deliberation that results in both a cognitive experience and a felt experience (Christakis & Bausch, 2006; Flanagan & Bausch, 2012; Flanagan & Christakis, 2010). Multiple dialogue methods—naturally to humanity as well as designed by science—can support the design of democratic institutions under appropriate cultural conditions and with appropriate decision making capacities. From the traditions of the tribal council to the evolution of Structured Dialogic Design, methods differ with respect to their capacity to perform under demanding time constraints and in the burden of information overload (see chapters in this book by Bausch, and Christakis, respectively). This chapter seeks to identify some of the dimensions of complexity in social system design and some of the capacities that can and must be used to offer realist hopes for enhancing the emergence of new democratic institutions of governance.

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Co-laboratories of Democracy: Best Choices for Designing Sustainable Futures

Yiannis Laouris, Kevin M.C. Dye, Marios Michaelides, and Alexander N. Christakis

Abstract This chapter frames one of the greatest challenges of our time: the invention of methods and technologies that harness the collective intelligence and wisdom of thousands of stakeholders working together on a complex societal systemic problem. The worldwide failures of democracy to respond to global challenges, especially in the domain of governance, call for such massive but still authentic and democratic participatory systems. The authors assert that the need to reinvent democracy is urgent and that it can be done using co-laboratories of democracy. It concludes with a presentation of key findings of co-laboratories that aim to reinvent democracy using structured dialogic design methodology applied in small group settings and an introduction into the challenges of scaling up this process to engage thousands.

Keywords Digital democracy • Reinventing democracy • Stakeholders • Structured dialogic design

Introducing the Greatest Challenge of Our Time

Humans continue to survive because we are able to solve problems. Every problem we encounter is a new challenge to which we apply our brains until we discover a reasonable resolution. When we cannot do it alone, we compromise; we give ourselves more time allowing nature to solve it for us, call others for help, or team up to tackle problems collectively. Humans are fairly adept at working together, especially when we face a common threat. We have survived so far on this planet

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because, no matter how complicated the problems we may face, we have always managed to solve them and triumph.

However, the dawn of the twenty-first century has marked an unprecedented paradigm shift. The challenges we face are far too complex for any single human to tackle them alone. At the same time, we have discovered that the methods and tools we have used in the past seem to be failing when applied on today's highly convoluted wicked problems. We have come to realize that we lack scientifically or empirically validated tools or methodologies to help us manage results-oriented collaboration that is at the same time also authentic and democratic. In an attempt to address the complexity of this challenge, we have begun to rely enormously on computers to collect, analyze and present data in forms that help us make sense of the world. In order to begin harnessing our collective intelligence and wisdom, we have discovered and have started to experiment with new approaches such as parallel processing, distributed research and crowd sourcing.

Nevertheless, despite all technological progress, no one has yet found a way to combine or to sum up the brainpower of even two individuals and use the resulting intelligence to tackle a problem. The fundamental obstacle is that when more than two people engage in some form of communication, their combined intelligence is far less than the sum of their individual intelligences (Malone, 2006). The same holds true for their collective wisdom. On a larger scale, a group of people can reach solutions that are often inferior to those that any single individual in the same group would have discovered by himself or herself (Albrecht, 2003). To make things even more complicated, we do not have generally accepted definitions of either collective intelligence or collective wisdom, to say nothing about the debate regarding definitions for individual intelligence or wisdom. Since collective intelligence is usually defined as "the ability of a group to solve more problems than its individual members" (Heylighen, 1999), and because we lack a way to exploit the total intelligence of a group of individuals, we can deduce that there are certain obstacles that make it hard for members of a team to coordinate, align and/or process their thoughts. Group deliberations, for example, usually suffer from certain pathologies such as Groupthink (Whyte, 1952), Spreadthink (Warfield, 1995) and Clanthink (Warfield & Teigen, 1993). Other barriers include individual cognitive limitations and the lack of functional connections and communication among collaborators. Evidently, we need to devise new strategies and approaches to collaboration in order to overcome these limitations.

Crowdsourcing has generated some impressive and successful applications that harness the collective abilities of the crowd. Amid concerns and disputes, Wikipedia™ has won its place as the first collective mind, or at least as the memory and reference module of a *world brain*. The model of crowd sourcing applied by the creators of Wikipedia™ proved useful for facilitating system evolution, resolving disputes, and reaching equilibrium. But can anyone imagine using crowdsourcing to make decisions at national or international levels? That would be analogous to applying a model of direct democracy to governance. Most would agree that substituting the council of the captain of a ship with the collective opinion of his passengers would probably not be the wisest course of action. If this decision-making model were applied to the governance of a country, the results could be devastating.

The ensuing chaos might be analogous to that of the Tower of Babel, as described in the Book of Genesis, in which God supposedly stated "that as one people with one language, nothing that they sought would be out of their reach," (Genesis) underlying the importance of developing a *shared language* as a major step towards solving complex problems. According to Genesis, if we were to invent ways that allow us to put our minds to work together on a single problem, "nothing would be out of reach!"

Most of the crowdsourcing models we have seen so far focus on addressing the quantitative rather than qualitative aspects of problems. For example, MediaWiki™ (the engine behind Wikipedia and thousands of other similar applications) or CAPTCHAs (Completely Automated Public Turing test to tell Computers and Humans Apart; used to prevent unwanted internet bots from accessing websites) are effective at distributing modest tasks to millions of people, but are less effective at addressing and solving complex problems. Therefore, the difficulty in harnessing collective intelligence and wisdom might owe less to our limited cognitive abilities and more to a lack of methodologies and tools necessary to consolidate these collective resources efficiently in order to solve irreducibly complex problems.

For example, when IBM's super computer Deep Blue beat world chess champion Garry Kasparov in 1997, many philosophers were convinced that we had reached the tipping point at which machines would become more powerful than humans (King, 1997). Then, in 2005, two amateurs, Steven Cramton and Zackary Stephen, shocked the world during the first Freestyle Chess Tournament by defeating teams of strong grandmasters using three ordinary computers. How did that happen? As Sankar (2012) noted during his 2012 TED presentation, "The Rise Of Human-Computer Cooperation:" "Their skill at manipulating and coaching their computers to look very deeply into positions effectively counteracted the superior chess understanding of their grandmaster opponents and the greater computational power of other participants." In other words:

> Weak Human(s) + Week Machine(s) + Better Process(es)
> Is SUPERIOR TO
> Super Computer + World's Grandmasters

What can we learn from this? It is unlikely we will manage to increase our biological intellectual capacity significantly in the foreseeable future. Therefore, we should focus on improving methodologies and tools to enable more efficient human–human and human–machine interactions.

The science of dialogic design (SDD), as originally proposed in the legendary Predicament of Mankind within the context of the Club of Rome by early pioneers such as Warfield, Christakis and Özbekhan (Özbekhan, Jantsch, & Christakis, 1970) and further developed by the Agoras Group (Christakis & Bausch, 2006; Flanagan & Christakis, 2009; Laouris & Christakis, 2007), has managed to address sufficiently most challenges of implementing efficient dialogues in small-to-medium human-to-human communication groups through technology (e.g., ISM Software or Cogniscope™) to facilitate interactions and processes. For example, the Structured Democratic Dialogue Process (SDDP) manages to counteract phenomena such as Groupthink (Whyte, 1952) and the Erroneous Priorities Effect (Dye & Conaway, 1999). The implementation of a successful SDDP is not mired in obscure science. Indeed, its key fundamentals have been re-discovered and underscored in repeated two- to three-hour co-laboratories in which participants were asked to identify the basic obstacles to harnessing collective wisdom during a dialogue (Christakis & Laouris, 2010; Laouris, 2012a). The basic principles of a good dialogue and their formulation into scientific axioms and laws are exemplified in "The ABCs Of The Science Of Dialogic Design" (Laouris, 2012b).

While the science of dialogic design was established almost four decades ago, the number and spread of SDDP applications has not yet reached the necessary threshold to make it into the mainstream. The authors assert that this partially explains why political systems of governance fail to respond to people's expectations and contemporary societal, environmental, and philosophical challenges, because harnessing the collective wisdom of people demands strict adherence to the laws and processes of the science of dialogic design.

Europe at the Crossroads

The European Union currently faces what are likely to be the most difficult challenges since its formation. Several countries in the south of the Union are close to financial default, Euro-skepticism is rising, and unemployment has reached a seven-year high. Croatia is joining the Union, Latvia is entering the Eurozone, and pro-Europeans support further *deepening* of European integration. George Papandreou, ex-prime minister of Greece, argued in his recent TED Talk that, "while Europeans have to live with the benefits and challenges of a global economy, our territory itself has not been globalized: our democracies are weakened by players who can evade laws, taxes, and environmental and labor standards" (Papandreou, 2013). He argues that, while our markets have been globalized, our democratic institutions have not; therefore, politicians' power is limited to local borders, while citizens are prey to forces far beyond their control. Papandreou suggests experimenting with new kinds of democracy that respond to these global challenges.

More significantly, the European Commission has launched *Digital Futures* (Digital Futures Task Force, 2012a), a foresight project that taps into the collective wisdom and creativity of stakeholders to co-develop long-term positive visions (*futures* is their term for positive visions) and policy ideas far beyond the Digital Agenda and Europe 2020 (European Commission, 2010). During the first participatory "Core Foresight 2050" workshop that the Digital Futures Task Force organized in March 2012 (Digital Futures Task Force, 2012b), 60 experts from across Europe proposed over 100 *futures* for the world they envision in 2050. The Task Force aims to *create* rather than *anticipate* the future, to envision and to design rather than react to potentially negative future outcomes. In this sense, the initiative of the Digital Futures Task Force is probably the first open recognition of the underlying philosophy of SDD. The initiative is also likely to be one of the most significant implementations of SDD, even though some important aspects of the methodology have not yet been realized, and others have deviated from historically validated standards. For example, after the generation of *futures*, participants in the Digital Futures participatory workshop were asked to score ideas not according to importance, but according to three other characteristics: societal impact, desirability, and the probability that the vision would come to fruition without political or financial intervention. This novel scoring approach, which has roots in the DELPHI Method, was applied in the context of experimenting with new features, and in collaboration with members of the Institute for 21st Century Agoras to identify research and technological priorities that are important for positive societal change, but would require policies and research grants to support them. The same scoring system has also been used in one of the largest structured dialogues in Europe, which aimed to highlight research priorities for consideration by the European Commission when developing calls for proposals (CARDIAC Consortium, 2012). In the Core Foresight 2050 workshop, the *future* with the greatest gap between *impact as well as desirability versus probability of happening without intervention* was the idea of structured democratic participatory democracy as proposed by the science of dialogic design (Digital Futures Task Force, 2012b). The formulation of the accompanying envisioned technology was:

> By 2050 there will be new network technologies that will allow ideas of people to be connected and therefore ideas will be able to interact, fight with one another for survival in a way that will help us converge to some consensus, harnessing the collective wisdom of the people (Digital Futures Task Force, 2012b).

In other words, 60 experts agreed that a new system of democratic governance that harnesses the collective wisdom of the people will have a significant positive impact in creating a sustainable, humane future, and is therefore very desirable. Sadly, they have also agreed that such a system is not going to emerge by itself. The questions we ask in this chapter are first, “Why not?” and second, “What would it take to make it happen?” The next section presents some of the underlying reasons responsible for the failure of contemporary systems of governance. Corporate control of the means of democracy, absence of participatory systems and the non-development of the political system, along with corruption and lack of accountability are among the key root causes.

The authors of this chapter assert that the next evolution of the science of dialogic design, which is expected to address the challenge of scalability (i.e., engage thousands in meaningful authentic structured democratic deliberations), in connection with the recognition that the global demand for new models of democratic governance will underscore that mass-scale Co-laboratories of Democracy are not only the best choices for designing sustainable futures, but they are probably the only choice available.

In the following sections we present and discuss the key findings from five Co-laboratories of Democracy that aimed to identify shortcomings of current models of governance and explore characteristics of future ideal systems.

Reinventing Democracy

Over the past few years, the organizations of the authors have been facilitating Co-laboratories of Democracy with an intention to identify the greatest shortcomings of current models of governance, and to encourage different groups of stakeholders to envision future ideal systems.

The first Co-Laboratory has been implemented completely virtually, i.e., without any face-to-face interaction between the participants. It was organized in cyberspace, in 2008, shortly after Barack Obama had first been elected president of the US. The goal was to identify possible roadblocks he would be facing in realizing his vision for open government and public engagement implementing a bottom-up model of democracy (Global Agoras, 2008). The next four examples summarize findings from a series of Co-Laboratories, which aspire to reinvent democracy. The latter two were conducted face-to-face, but they were implemented by testing adapted- and/or new technologies and methodologies which lay the groundwork for the next step in the evolution of the science: scaling up such dialogues to engage hundreds or even thousands of participants simultaneously. The last case had a particular focus on reinventing democracy by harnessing the power of the digital era.

The following two tables summarize the factors that following the SDDP methodology emerged as the most influential. Table 1 documents Obstacles, and Table 2 documents Actions.

Barack Obama's Vision for Open Government and Public Engagement

In 2008, when Barack Obama was elected President of the US, members of the Institute of 21st Century Agoras from across the world engaged in one of the first ever virtual structured democratic dialogues (Global Agoras, 2008). They used the

Table 1 Shortcomings and/or obstacles that emerged at the root of the influence trees in three SDDPs

SDDP	Factor	Shortcomings/obstacles
BOOG	22	Corporate control of the means of democracy
	14	Insufficient attention given to facilitator capacitation
GCRD	32	The repletion of the Paleolithic system
	40	The non-development of the political system
YEIF	84	Lack of accountability
	31	Conflict between personal job and parliamentary duties
	9	Personal relations
	13	Lack of participatory democracy

BOOG Barack Obama's vision for Open Government and Public Engagement, *GCRD* Greek Cypriots Reinventing Democracy, *YEIF* Youth Envisage their Ideal Future

Table 2 Ideal characteristics and/or actions that emerged as the most influential root drivers in three SDDPs

SDDP	Factor	Ideal characteristics/actions
GCRD	34	The laws are voted directly by people
	19	Inclusiveness, dialogue, co-decision in local communities and their representation in decision-making
	15	Direct democracy
	8	An ataxic–progressive society
	6	Inclusive system that revises the current understanding of "success"
	35	"Collectives"
RDDE	89	End of political parties as institutions
	105	Technology for time management for active participation
	93	Redefining the Universal Declaration of Human Rights in the digital Era
	13	Continuous passive and active participation in the political process via an online platform
ECRD	26	Independent interactive media created by citizens for citizens

BOOG Barack Obama's vision for Open Government and Public Engagement, *GCRD* Greek Cypriots Reinventing Democracy, *YEIF* Youth Envisage their Ideal Future

following "Triggering Question[1]" to stimulate and collect potential inhibitors to the actualization of his vision:

> In the context of Obama's vision for engaging stakeholders from all walks of life in a bottom-up democracy employing Internet technology, what factors do we anticipate, on the basis of our experiences with SDDP, will emerge as inhibitors to the actualization of his vision?

The two factors that emerged as the most influential were Inhibitor #22: Corporate Control of the Means of Democracy and Inhibitor #14: Insufficient attention given to facilitator capacitation (Christakis & Underwood, 2008).

Greeks and Cypriots Reinventing Democracy in the Twenty-First Century

The "Greeks and Cypriots Reinventing Democracy in the twenty-first century" (GCRD) SDDP (Future Worlds Center, 2012a) was organized by a number of Cypriot and Greek NGOs in the context of a nine-month (3rd January to 30th October 2012) Youth in Action, European-Commission-funded project (Future

[1] The term Triggering Question is used by practitioners of the SDDP methodology to describe a question formulated by the Knowledge Management Team of a particular dialogue with the aim to trigger short and concise responses by the participants.

Worlds Center, 2011). The idea was to take apart and reconstruct the concept of democracy—an EU founding principle. The seven-day SDDP took place in Pafos, Cyprus, between 28 June and 3 July 2012. The participants invested more than 1,450 person hours in identifying the root causes of the failure of current political systems and in coming up with the most influential options to achieve positive change. They worked with the following Triggering Questions:

> What are the failings of our current political system?
>
> How could we re-design modern society by envisioning a New Democracy?

They identified "Shortcoming #32: Repletion of the Paleolithic system" and "Shortcoming #40: The non-development of the political system" as the most influential root causes of failure in modern political systems. In their dialogue, which focused on actions, the factors that emerged as the deep drivers were: "Characteristic #34: Laws are voted for directly by people," and "Characteristic #19: Inclusiveness, dialogue, co-decision in local communities and their representation in decision-making."

Youth Envisage Their Ideal Future

The Youth Envisage their Ideal Future (YEIF) co-Laboratory was organized in the context of a Youth in Action, European-Commission-funded project (1 March 2012–31 August 2012). Two SDDPs took place in Pafos, Cyprus (18–22 July 2012), one focusing on the diagnosis of obstacles and one on the exploration of characteristics of ideal future systems of governance.

The respective Triggering Questions were:

> Which are the disadvantages or obstacles of the current socio-political system that discourage youth participation?
>
> What are the characteristics of the ideal socio-political system that would encourage active youth participation?

Following a time investment of more than 750 person hours, the participants concluded that the root obstacles of the current socio-economic-political system that discourage youth participation are: "Obstacle #84: Lack of accountability of those in power; Obstacle #31 Conflict between private profession and parliamentary duties of people elected for office; Obstacle #9: Personal relations between those in power; and Obstacle #13: Lack of participatory democracy." In other words, three out of four deep drivers are related to conflicts of interest and corruption among those who serve as peoples' representatives, while the fourth obstacle can be seen as a demand for participatory systems, probably in the hope that that such systems might serve as better controls against corruption.

Another 750 person hours were invested in the second Triggering Question, aimed at envisioning an ideal socio-economic-political system that would encourage active youth participation. The most influential factors were: "Characteristic #15: Direct Democracy; Characteristic #8: An Ataxic—progressive society; Characteristic #6: Inclusive system that revises the current understanding of "success"; and Characteristic #35: Collectives." Again three out of the four most influential descriptors envisage participatory, direct democratic, even ataxic societies based on a revised formulation of the early twentieth century collectives. This probably underscores the disappointment of the younger generations, which is a result of the failure of current models of representative democracy. The fourth factor calls for re-considering our values and particularly revisiting our definition and understanding of success.

Reinventing Democracy in the Digital Era

Reinventing Democracy in the Digital Era (RDDE) (Future Worlds Center, 2012b) was a highlight in the above series of SDDPs aimed at exploring ideas for reinventing democracy. It formed part of the activities carried out under the auspices of the Cyprus Presidency, and it was co-organized with the Digital Futures Task Force of the European Commission (Digital Futures Task Force, 2012a). The co-laboratory took place in Lefkosia on the 14th and 15th of September, 2012 (full days) at the Cyprus Community Media Center (Cyprus Civil Society, 2009), in the Buffer Zone next to the Ledra Palace Hotel. The participants were asked to respond to the following Triggering Question:

> What are the features of an ideal future system of governance that fully utilizes innovative emerging technologies?

Probably not surprisingly given the global international crisis, one most provocative factor made it to the root of the tree: "Characteristic #89: End of political parties as institutions" (Petridou, Michail, Georgiou, & Psilla, 2012). Two factors pointed towards the urgency of developing technologies that would enable massive and active participation as well as respect for and support of our cognitive limitations: "Characteristic #13: Continuous passive and active participation in the political process via an online platform; and Characteristic #105: Technology for time management for active participation." Finally, one factor highlighted the need for re-engineering human rights: "Characteristic #93: Redefining the Universal Declaration of Human Rights in the digital Era."

Engaging Citizens to Reinvent Democracy

In this single-day SDDP, taking place on September 19, 2012 in Nicosia (Future Worlds Center, 2012c), participants representing a wide spectrum of stakeholders ranging from unemployed youth to top-level government executives explored the characteristics of an ideal future system of governance.

Out of a total of 54 characteristics submitted, "Characteristic #26: Independent interactive media created by citizens for citizens," stood out as the most influential in terms of its capability to leverage change.

Reflecting on the Findings from the Four Co-laboratories

Out of hundreds of ideas submitted by the participants of the above four co-laboratories, the SDD process supported them to consensually agree on those that are root causes and/or are deep drivers in their potential to achieve change. Even without any deeper analysis, the root problems of the current systems of governance as they surfaced using SDDP with about 80 participants who have invested more than 4,000 person hours in their deliberations can be reworded from Table 1 as just a few guidelines:

1. Address issues of corruption, conflict of interest and accountability
2. Take measures to ensure that the system of governance evolves and meets the standards of today's citizens exploiting and taking advantage of emerging technologies just like in all other aspects of life
3. Promote proper and practical policies to control and regulate the power of companies on defining and determining developments, lifestyles etc.

It is therefore evident that the application of SDDP in co-laboratories of democracy can equip citizens across the globe discuss and reach consensus as to the most influential leverages that need to be addressed in our endeavors to reinvent democracy.

Discussion

We have been analyzing and trying to make sense of the world for centuries. The time has come for us to dare to design the world in which we would like to live. While the past has passed, the future is open for us to make a difference. Globalization, in connection with global access to information, goods, and knowledge, shapes a new world in which billions could, at least in theory, live in prosperity. However, for our increasing population to be able to benefit from every new opportunity we as humans have managed to create, we must also learn to live in harmony with one another and with our environment. The greatest challenge we face is how to reconcile our wishes, our desires and our demands, with those of others around us and with those of the animate and inanimate world in which we live.

The emergence of the digital era has also signaled a paradigm shift in how we manage information, money, and goods, but also ourselves. Maybe the day is not that far off when we will learn how to live together in harmony without relying on talented leaders, laws made by representatives and states managing our lives. "In fifty years, our grandchildren may look at us as the last of the historical, State-run generations, not so differently from the way we look at the Amazonian tribes, as the last of the pre-historical, stateless societies" (Floridi, 2012).

Barack Obama (Obama, 2006) wrote in *The Audacity of Hope: Thoughts on Reclaiming the American Dream*:

> What the framework of our constitution can do is organize the way in which we argue about our future. …, a "deliberative democracy" in which all citizens are required to engage in a process of testing their ideas against an external reality, persuading others of their point of view, and building shifting alliances of consent (p. 92).

Barack Obama, just like George Papandreou, shares the dream of change and encourages bottom-up democracy. They both also recognize the dynamic character of the underlying processes and the requirement that alliances of consent might be continuously shifting. However, while both men appreciate how important it is to put a proper system of dialogue management in place, they both underestimate the fact that such a system is not straightforward, not to mention that it also does not exist yet. The Core Foresight 2050 workshop has exposed that although a new system of democratic governance that harnesses the collective wisdom of the people is imperative for creating a sustainable, humane future, such a system is not going to emerge by itself (Digital Futures Task Force, 2012b). In the spirit of our conscious evolution, we humans have to invent such systems. As the Obama vision SDDP has revealed, properly qualified and trained facilitators are a fundamental requirement of such dialogue management processes. But, also, as Tom Flanagan, President of the Institute for 21st Century Agoras, stated after the Obama Vision SDDP,

> It is perhaps no great surprise that when a panel of systems scientists from across the globe pull their heads together around challenges that President Elect Obama is likely to face … the most influential factor underlying the success of such an outcome was judged to be the commitment that government leaders and agencies actually hold in supporting a grassroots effort.

What if governments and leaders do not have this commitment? The participants of the other four co-Laboratories of democracy provided the answer in a number of distinctive ways. The deep drivers of all dialogues reveal that the current system of representative democracy is obsolete and that sooner or later it will give its place to more participatory and more direct systems of governance.

Co-laboratories of Democracy Make Better Citizens

Epistemic democrats believe that the aim of democracy is to track the truth (Estlund, 1997). In contrast, procedural democrats claim that the aim of democracy is instead to embody certain procedural virtues. Even though they might express different opinions as to what those virtues might be, and which procedures best embody them, procedural democrats agree that democracy is not about tracking any "independent truth of the matter"; but instead, the goodness or rightness of an outcome is wholly constituted by the fact of its having emerged in some procedurally correct manner (Coleman & Ferejohn, 1986).

Within this taxonomy, the SDD process supports procedural democracy, because it is grounded on the premise that "the capacity of a community of stakeholders to implement a plan of action effectively depends strongly on the true engagement of the stakeholders in designing it. Disregarding the participation of the stakeholders the plans are bound to fail" (Laouris, Laouri, & Christakis, 2008, p. 341). Christakis has further proposed the expansion of the "Tree of Meaning" to incorporate this law as well as the "Engagement Axiom", attributed to Özbekhan: "Designing action plans for complex social systems requires the engagement of the community of stakeholders in dialogue. Disregarding the participation of the stakeholders is unethical" (Christakis, 2010).

The type of co-laboratories described here require strict adherence to the engagement process. Furthermore, in all co-laboratories of democracy we have facilitated, the learning that took place among the participants [see also (Fung, 2003)], the sharpening and deepening of their understanding of the problématique as well as their evolving views regarding the prioritization of their ideas using relative influence rather than subjective importance has been remarkable. In this sense we claim that the SDD process contributes not only towards exploring, designing and implementing ideal future worlds, but moreover it creates better citizens. We furthermore assert, like other authors (Luskin & Fishkin, 2002), that if the SDD process were embedded within public structures that take decisions engaging technocrats, politicians, citizens and in general all relevant stakeholders, a new type of deliberative democracy could emerge; one that would be *talk- and argument-centric*, and not *vote-centric* (Chambers, 2003); on that would give citizens a *voice* rather than just the power to vote once every four or five years.

In an excellent review about citizenship and democratic deficits in which Nabatchi (2010) explores the potentials of deliberative democracy for public administrations she underscores the need to refocus our attention on the role of citizens in the work of governments. After all, we also know that participation is a circular causal process (Finkel, 1985) in the sense that "the more individuals participate, the better able they become to do so" (Pateman, 1970, pp. 42–43). However, what makes the SDD process unique when compared with any other participatory process is that it is grounded on laws repetitively validated empirically and scientifically in the arena of practice.

A powerful example is the requirement for engagement of all relevant stakeholders and diversity of points of view, which is grounded on Ashby's Law of Requisite Variety (Ashby, 1958). The protection of every author's contribution with redistribution of power is imperative, because as Arnstein (1969) notes, participation without redistribution of power is an empty and frustrating process that simply maintains the status quo (captured by Tsivacou's (1997) Law of Requisite Autonomy in Decision). The recognition of our human limitations (i.e., Miller's (1956) Law of Requisite Parsimony) by focusing on one simple question at a time and using technology to support the process is another great example that is repetitively empirically validated in the arena.

Avoiding premature conclusions that are almost always grounded on *erroneous priorities* [i.e., Dye's Law of the Requisite Evolution of Observations (in Dye & Conaway, 1999)] surprises participants of SDD co-Laboratories every time. Moreover, participants are astonished to discover at the end of the process that meaning and wisdom are produced in their dialogue only *after* they search for relationships of similarity, priority, influence, etc., within a set of observations and not simply choose using popular voting [i.e., Boulding's Law of Requisite Saliency (Boulding, 1966) and Peirce's Law of Requisite Meaning (Turrisi, 1997)]. It is through the strict adherence to the laws of structured dialogic design that we set up the stage to compel parsimony, autonomy, evolutionary learning and assist participants to achieve meaning and wisdom. Out of these, largely cognitive processes, action emerges as a natural consequence [i.e., Laouris's Law of Requisite Action (Laouris et al., 2008)].

Is Democracy the Path to Freedom?

Democracy is not same as freedom. Democracy does not even guarantee freedom. Characteristically, the word "democracy" does not appear in the *liberté, égalité, fraternité* (French for liberty, equality, fraternity-brotherhood) slogan of the French Revolution (Laouris, 2014). Indeed, democracy and freedom are not only two independent things, but they can even work against each other. Fareed Zakaria warned that equating the two concepts is dangerous and provided examples how democracy can lead to erosion of freedom even unintentionally (Zakaria, 2007). In the US constitution, the Founding Fathers have set limits in which democracy can operate in order to protect peoples' freedoms from democracy. Why is this so? The reason is that we always struggle for more, for growth, for better lives. But, naturally, as soon as our standard of living reaches a certain level, we become anxious to lose it and make laws to protect it, which often means voting freedoms away. Ultimately, though, we still want our freedoms. For that reason, if we wish to retain democracy we must become aware of the negative aspects of the current model of democracy and dare re-invent it.

The Challenge of Scalability

The problem we describe here, i.e., the vision to reinvent democracy, is one of a very large scale; even that of a single nation state. However, the science of dialogic design in its contemporary form has been applied only in small groups of typically much less than 100 people and in most cases less than 30. We are therefore in urgent need of technologies that would enable massive collaboration (Laouris, 2014), if we wish to accelerate decision making and, consequently, positive social change. While there are some examples of mass collaboration (mainly based on crowd sourcing), we need to build bridges between the scales as well as to introduce the laws of structured democratic dialogue in the large-scale cyber spaces. There is emerging evidence about the quality of online deliberation, which indicates that this challenge would be easy to address. Our struggle to extend public spaces, in which humans interact and increase affordances and freedoms, must be accompanied by parallel developments in methodologies and technologies that can effectively guarantee that wisdom will always prevail in our choices and actions.

Our group has begun to address the challenge since 2005, by introducing for the first time the concepts of synchronous vs. asynchronous and of face-to-face vs. virtual SDDP (Laouris & Christakis, 2007). In the context of the COST 219ter project (COST Action-219ter, 2010) we have collected ideas from the participants using email communication ahead of the co-laboratory. The process, which engaged 26 experts from 15 countries, was spread both chronologically (2005–2006) and geographically (Ayia Napa, Cyprus, Seville, Spain) (Laouris & Michaelides, 2007). The synchronous meetings lasted 570 min, while the asynchronous reached 100 min. In the next experiment, which took place in the context of another European Commission COST Action (COST Action-298, 2007), we decreased the total duration keeping the relation between synchronous and asynchronous phases more or less the same (429 min vs. 80 min) (Laouris, Michaelides, & Sapio, 2007).

In this co-laboratory we performed the voting process in an asynchronous mode. Next, in a philosophical dialogue with experts across the globe, we attempted a further reduction in the proportion of synchronous interactions (180 synchronous vs. 120 asynchronous minutes) and implementation of the clarifications fully through email communications (Schreibman, 2007). Finally, we attempted to introduce these concepts in a politically sensitive set-up, that of the Cyprus problem (Laouris et al., 2008). The collection of ideas, clarifications, clustering and voting were performed asynchronously and virtually with the exception that a few synchronous hours were devoted to an extensive discussion and revision of all ideas and clarifications to ensure that all participants understood and agreed on the meaning of every contribution. This led also to addition and deletion of factors.

In all trials described above, we have experimented with the reduction of the total time required for a co-laboratory and with the replacement of selected (non-sensitive) phases of the process with asynchronous or virtual meetings. Nevertheless, a number of shortcomings still came up, which are briefly discussed in a 2007 publication (Laouris & Christakis, 2007). The most significant are: (1) the fact that virtual SDDP deprives participants of the option to listen directly to the author clarifying his or her idea and (2) clustering in smaller groups or using virtual communication technologies affects the quality of the outcome because participants do not cluster the factors truly consensually as in the case of face-to-face meetings. Finally, (3) the structuring of the influence map can be done quite effectively, but it is more the result of a cognitive exercise than a process of debating. In the latter case, a good argumentation might not only change the voting outcome, but it also contributes significantly to the learning process as well as to change of beliefs and abortion of stereotypes.

More recently, we have launched a web-based (Laouris, Christakis, Dye et al., 2012) system to enable the participation of people from across the world, enabling the whole process to be implemented on line, with asynchronous and synchronous events taking place on the same platform. The system provides functionalities such as video recording of the clarification, sending of requests for further clarification, various ways of evaluating statements (ranging from “likeness”, to “nominating for deletion as irrelevant to the Triggering Question,” etc.), a sophisticated notification system, and others. It is however still very early to discuss the cons and pros of such an approach.

In closing, we suggest that the challenge of scalability should be accompanied with more research to explore not only the scientific implications of making it possible to harness massively collective intelligence and wisdom. More importantly, what is needed is to investigate whether such participatory systems could affect an individual’s understanding of his or her own roles in governance, change his or her perceptions regarding the concept of governance, and ultimately *make* better citizens who would support their governments take better decisions.

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Better Late than Never: Open Systems Theory's Plan to Deal with Climate Change

Merrelyn Emery

Abstract Using Open Systems Theory's comprehensive, internally consistent conceptual framework, this paper analyses the world's inadequate response to increasing anthropogenic global warming. The full diagnosis involves a motivation deficit born of a cultural malaise that has its roots in the industrial revolution and later, in the failure of the wave of social change in the 1960–1970s, that wave which precipitated a backlash from elites. The third major element is a pernicious economic system based on dysfunctional values where the planet has no intrinsic value. At the heart of the diagnosis lies the first *genotypical*, organizational design principle which produces hierarchies of dominance, of one person over another, and of people over the planet. The paper describes a plan to cure the motivation disease in Australia which can be adjusted for any country's circumstances. It shows the logistics and design of the two-stage model, Search Conference plus Participative Design workshop, applied across the country such that the people of every region would participate in "The Future of Australia," taking climate change into account. The design would revitalize communities, organizations and individuals. The paper also outlines how the United Nations would successfully deal with climate change if it functioned as an organization built on the second design principle, a non-dominant hierarchy based on collective work and negotiations between peers. Finally, it provides some data on why the designs would work. The scope of the paper limits consideration of the economic changes required.

Keywords Active adaptation • Climate change • Genotypical design principles • Open systems theory • Social change

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Introduction

We seem to believe that we can create a better world, if we pay attention to the right things. We have been talking about this on a global scale at least since the Club of Rome raised its concerns in the late 1960s. It appears that we have continued on the same general trajectory since then, though. What can we learn from where we've been, and is there really any effective work that we can do to make things different; not just ideally, or in theory, but in reality (Metcalf, 2012)?

Gary Metcalf is correct. We have indeed been fiddling while the planet roasts, toasts, fries and grills (Lagarde, in Romm, 2013a). Scientists have been warning us for more than 40 years that not only must we exchange fossil fuels for renewable energy but we must also totally redesign our Western industrialized way of life if we are to avoid catastrophic climate change, and possibly the extinction of our species. The predictions and warnings have become direr as time has gone by, and as our emissions of greenhouse gases (GHGs) have risen steadily. Now the warnings are coming not only from climatologists but from Munich Re (2010), the World Bank (2012) and most recently Christine Lagarde of the International Monetary Fund (IMF) (Romm, 2013a). We are now witnessing climate disasters such as record floods, drought and fires as well as record high global temperatures; extreme weather of all kinds and sea level rise. Some island communities are already in their death throes. And still, there is no international agreement on action and no sense of urgency in most of our communities.

Some countries have been wracked with conflict because a concerted and relentless campaign by climate change deniers has cast doubt on the science. These deniers have targeted the scientifically illiterate and the poorly educated more generally with nonsense about carbon dioxide (CO_2) being plant food, the power of natural cycles relative to CO_2 and carefully, politically calibrated messages about reducing fossil fuel usage destroying jobs and the economy, as if ecology and economy could be separated. Many countries are already suffering from the huge hits their economies have taken from climate disasters with many, many more on the way.

Diagnosis of the Problem

So we have a problem, one which needs an accurate diagnosis and from there, an urgent remedy. I will leave it to my colleagues in the physical sciences to argue the relative merits of the technological benefits of various renewable sources, albedo restoration in the Arctic and carbon recovery from oceans and atmosphere alike. From the social science perspective, the problem is simple: despite crystal clear and agreed knowledge of cause and increasingly tangible effects, neither national politicians nor the great mass of citizens have found the motivation necessary to address this climate emergency with the global wholehearted cooperation it is going to take to stop any further escalation of the problem, and start repairing the damage already done. Fortunately, most climatologists agree that while we cannot now escape a lot of damage, we can still avoid the very worst effects (Koronowski, 2013; Romm, 2013b).

While the problem is simple, the diagnosis is a little more complex in that there are historical dimensions as well as the role played by such as the media in our increasingly high tech societies. Even the problem caused by the deniers suffers from these complications. While it is easy to say the schools should be doing a better job at educating children in the basic physics and chemistry involved in the absorption of infrared energy by greenhouse gasses (GHGs), questions then arise as to why schools are still predominantly using ineffective approaches like *one-to-many knowledge transfer* (teaching), when alternatives that generate more learning have been researched and known for a long time (Emery, 2006). These questions are systemic and require systemic answers.

So while the primary diagnosis of our failure so far to effectively deal with climate change is that we have a cultural malaise born of a deficit of purpose and motivation, we may also ask what exactly has contributed to this deficit. Getting cancer involves a cell mutation but the mutation is a product of all factors, individual and environmental. We are always dealing with whole people-in-environments, and the same logic applies to social and cultural problems as it does with medical problems. In the following sections, we take a systemic look at the cultural malaise, the motivation deficit and the factors that contributed to it, and then, at what we can do to change the critical anchors. But before we attempt that, we must revisit some basic concepts we will need to accurately spell out the diagnosis and the cure.

Open Systems Theory

Thinking in terms of material rather than abstract universals, *realism* rather than *idealism* has a history as long as thinking itself. Rather than ask "What is it?" realism asks "What does it do?" This leads to serial genetic or functional constructs rather than generic things or nouns. Rather than assuming, as idealism does, that the sufficient conditions for behaviour lie within the organism or social unit, realism assumes that the conditions exist within system-in-environment. It also emphasizes synthesis rather than analysis. Open Systems Theory (OST) uses material universals with some of its more recent history documented directly (Emery, 2000a, 2000b). That history is also documented through the key papers published in the Tavistock anthology (Trist, Emery, & Murray, 1997; Trist & Murray, 1990, 1993), an invaluable starting point for understanding both the scope and depth of Open Systems Theory. OST in its current form embodies the work of some of the best minds to work in the social and other sciences, with that work welded into a comprehensive conceptual framework that continues to successfully address the big conceptual *and* practical challenges of our times (Emery, 1977, pp. 198–206). I introduce in this section only the big concepts that provide an essential foundation for the plan that

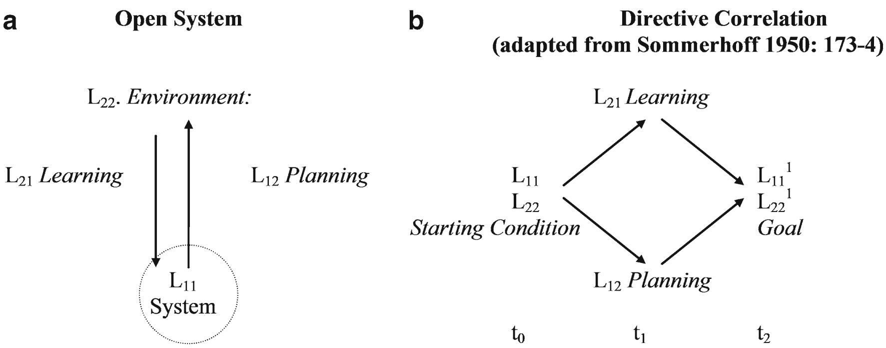


Fig. 1 The basic models of open system and directive correlation

follows. There is a host of supporting concepts and principles all intermeshed into the framework (Emery, 1999, 2012a) and introduced into this discussion as relevant.

The Open System and Directive Correlation

The accelerating speed of effects and disasters from our emissions of GHGs exceeds every scientific prediction, showing that the Earth is responding systemically as the open system she is, in the same way that the most humble organism is an open system (Rayner, 1997). The radical shift from a closed systems perspective of human behaviour to an open systems one that honoured the reality that our world is composed of open systems, including us, came with the publication of Emery and Trist (1965).

That citation classic outlined the concept of an extended social field of directive correlations (Emery, 1977), a social environment with which people transact on a daily basis. It was the point at which we broke free from the closed systems analysis of von Bertalanffy, (1950) which subsumed people into the class of animals with bodies and awareness but without awareness of awareness (Chein, 1972).

As Fig. 1 shows, the most fundamental concept of OST, the mutual determination of system and environment, comes in two forms.

Figure 1a shows a system with permeable boundaries where system and environment are mutually determining and governed by laws (L) which are able to be known. When the system (designated "1") acts upon the environment (designated "2") we say the system is planning (L_{12}). Environment acts upon the system and is known to us through ecological learning (L_{21}) (Emery, 1980). L_{11} and L_{22}, express the intrinsic natures of the system and environment respectively. The laws that govern them are implicitly learned about in the Search Conference.

The environment, the L_{22}, is defined as the extended social field of directive correlations where the nature of that field affects the behaviour of all systems within it

(Emery, 1977). This conceptualization provides a conceptual, historical and practical framework for cultural change and its fluctuating adaptivity.

The social field is a directly observable, objective entity in its own right. As a field, not a system, its laws are very different from the laws governing systems. The inclusion of a discrete social environment is the major defining difference between an open and closed systems social science. What Emery and Trist achieved in 1965 was the completion of the conceptualization of the open system that von Bertalanffy began.

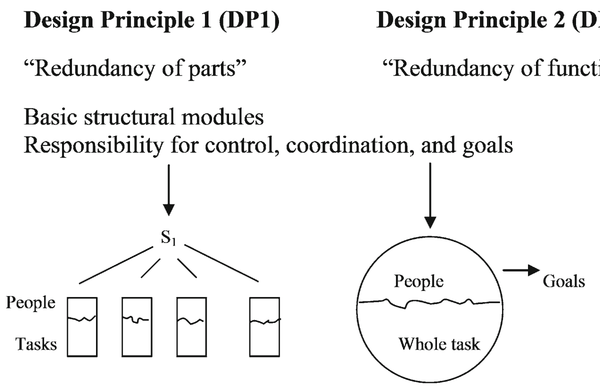
Directive correlation expresses the mutual shaping of a system's behaviour and its environment towards a goal. In the directive correlation mode1 (Fig. 1b), it is a necessary condition for the subsequent occurrence of a certain event or goal that two or more variables, environment and system, should at a given time be in exact correspondence to be in an adaptive relationship. The environment and system are directively correlated with respect to the goal and the starting conditions (Sommerhoff, 1969), that is, system and environment are correlated in terms of direction. They are both acting to bring about the same state of affairs from the same starting point.

From the original condition at t_0 which consists of the system and its environment, both system and environment are making changes at t_1. These result in a new set of conditions consisting of a changed system and a changed environment at t_2. In the case of Fig. 1b the changes are directively correlated and, therefore, adaptive. There are of course, an infinite number of cases in which system and environment are not directively correlated and, therefore, stand in a maladaptive relationship.

The Genotypical Organizational Design Principles

The genotypical design principles were discovered during the Norwegian Industrial Democracy program (Emery, 1967). The first design principle, DP1, (Fig. 2) is called *redundancy of parts* because there are more parts (people) than are required to perform a task at any one given time. Individuals have fragmented tasks and goals: one person, one job. The critical feature of DP1 is that responsibility for coordination and control is located at least one level above where the work, learning or planning is being done. A DP1 system is one governed by asymmetrical dependence. Therefore, the DP1 organization is autocratic or bureaucratic; it is the master-servant relation in action. In other words, in DP1, those above have the right and responsibility to tell those below what to do and how to do it. It is a structure of personal dominance, a dominant hierarchy. Controls might be sloppy or tight but the principle is the same. DP1 enshrines inequality.

Control (vertical) and co-ordination (horizontal) are the two dimensions of organization and responsibility for both are vested in the supervisor. She/he controls subordinates by specifying what the individuals will do, vis-a-vis the jobs allotted to them. She/he achieves coordination across the section by manipulating the work loads of individuals to take care of the interdependencies between individual jobs.



Note: S_1 = first-line supervisor.

Fig. 2 Genotypical organizational design principles

When we analyse this structure, we see immediately that it produces competition. At the most trivial level, there is only one supervisory position and individuals are in competition for it. As soon as people are forced to compete, they have to look after their own interests and so self-interest comes to dominate life in a DP1 structure. All the team building in the world cannot change this dynamic.

The second principle (DP2) is called *redundancy of functions* because more skills and functions are built into a person than that person can use at any one given point in time. In DP2, responsibility for coordination and control is located with the people performing the task. The self-managing group works to a comprehensive set of agreed and measurable goals. Large DP2 structures are non-dominant hierarchies of function where all change is negotiated between peers. A DP2 system is one governed by symmetrical interdependence.

DP2 has markedly different potentials to DP1. The first and obvious feature is that there are no individual jobs or positions. People in a designated group are now jointly responsible for all the tasks and all the inter-dependencies they involve. They are also responsible for monitoring and controlling the contributions of members, organizing themselves to cope with individual and task variations and meeting their agreed group goals. Because in DP2, people are working together to achieve agreed goals for which they are collectively responsible, it engenders cooperation.

In a DP2 systems, change can be initiated anywhere and all change is negotiated between *equals*.

Laissez-faire (Lippitt, 1940), not shown in Fig. 2, completes the set. It is defined as the absence of a design principle and, therefore, the absence of structure and the absence of responsibility for coordination and control. In its pure form, it is just a collection of unrelated individuals each doing *their own thing*. Laissez-faire today commonly takes the form of organizations where the structure on paper is DP1 but the controls have been loosened to the point that there is widespread confusion about where responsibility for control and coordination are located. These forms of organization are increasing in North America and now elsewhere: they are attempts to accommodate the increased call for participation. Most involve the change of name of the first line supervisor to Team Leader or Coach (TLC) and have mistakenly been designated as empowered workplaces (deGuerre & Emery, 2008).

We recently worked with one of these organizations and it was an extraordinarily troubled workplace with very high levels of fight/flight, dependency and negative affect, much higher than you would expect in your run-of-the-mill DP1 structure (Emery, 2012b), confirming the original conclusion that laissez-faire produces as much if not more distress than DP1 and similarly produces low productivity (Lewin, Lippitt, & White, 1939; Lippitt & White, 1943).

These design principles have been discovered independently by Eisler (1995, p. 105) who also recognizes that they are extremely powerful and affect most aspects of life. Over time DP1 actively deskills and demotivates, DP2 skills and motivates (Emery & Emery, 1974). Many common organizational phenomena such as communication problems and personality conflicts flow from the nature of the design principle (Emery, 2004; Emery & Emery, 1976). So, too, do Bion's group assumptions or organizational dynamics of dependency, fight/flight, pairing and the creative working mode (Bion, 1952, 1961; Emery, 1999). These genotypical organizational design principles also appear to operate across the animal, biological, cellular and mechanical realms (Emery, 2003).

The genotypical organizational design principles are correlated with the psychological requirements for productive work, called the *six criteria* for short (Emery & Thorsrud, 1969). It is difficult to get good scores on the six criteria from DP1 structures even when management has gone out of its way to attend to all hygiene factors (Herzberg, 1987) and such efforts are appreciated. The six criteria are the *intrinsic motivators* and are independent of the hygiene factors, or external motivators. The nature of the relationship between design principles and six criteria has held in every country and culture studied so far. They are very good examples of species or human laws. If an organization genuinely wants high levels of intrinsic motivation or engagement, it appears to have no choice but to change the design principle that underlies the structure.

The six criteria are:

1. Elbow Room, optimal autonomy in decision making
2. Continual Learning for which there must be
   (a) some room to set goals
   (b) receipt of accurate and timely feedback
3. Variety
4. Mutual Support and Respect: helping out and being helped out by others without request, respect for contribution rather than IQ for example
5. Meaningfulness which consists of
   (a) doing something with social value
   (b) seeing the whole product or service to which the individual contributes
6. A desirable Future, not having a dead end job.

There are variations of DP2 structures depending on whether there are specializations or project work and all variations have proven to be able to work together as do the multi-skilled version shown above (Emery, 2012a).

Within DP1 structures, errors amplify (Beer, 1972; Emery, 1977). People are not able to set their own goals and challenges and the structure also militates against them getting accurate and timely feedback on performance. These organizations cannot, therefore, be environments for learning. DP2 structures, however, provide for all basic psychological needs including being able to learn and go on learning. They attenuate error over time and, therefore, only DP2 produces a *learning organization*, an organization "structured in such a way that its members can learn and continue to learn within it" (Emery, 1993, p. 2). There is no implication here that organizations can learn.

The design principles operate at all levels and sectors of society. They underlie the nature of political or governance systems in the same way as they underlie structure of single organizations of all types. Representative political systems derive from DP1. DP2 alternatives have existed and currently exist (Emery, 1974, 1976a, 1989).

People as Open Purposeful Systems

People "can produce (1) the same functional type of outcome in different structural ways in the same structural environment and (2) can produce functionally different outcomes in the same and different structural environments" (Ackoff & Emery, 1972, p. 31) They display *will*. By constantly acting as active, responsible agents, not simply helpless, powerless reagents (Chein, 1972, p. 6), they change the environment. The current environment is a result of the will and power of the people (Emery, 1977). You will note that this definition of people is a serial genetic one: it bears no relation to any of the infinitude of definitions of *human nature*.

While people as one arm of the basic directive correlation display will and act on their environment, they are also acted upon by that environment. They are part of the whole whether they like it or not. *Autonomous* means governed from inside. It is a concept of purposeful activity, a general systemic direction towards expansion through coherence. The trend towards *homonomy* is "a trend to be in harmony with super individual units, the social group, nature ...." etc. This penetrates "the whole realm of human life" (Angyal, 1965, p. 173) and is visible through moves towards sharing, participation and union. "The homonomous tendency is the dominating factor in forms of inter-human relationships where the other person is recognised to be a value in himself" (Angyal, p. 202). "Life is an autonomous dynamic event which takes place *between* the organism and the environment" (Angyal p. 48, emphasis added). Mental health is "the capacity both for *autonomous expansion AND* for *homonomous integration*" (Angyal, p. 254). Autonomy without corresponding homonomy actually restricts and inhibits personal growth.

Changes in Causal Texture Over Time

Emery and Trist (1965) also documented social fields as they have changed their causal texture over human history and this analysis has been validated and elaborated several times by supporting evidence from sources such as historical and anthropological studies (Emery, 1977, 1982). Summaries can be found in more recent publications (e.g. Emery, 2012a). The significance of this work lies in its analytic power to guide decisions about the adaptivity of various actions and strategies in our current environment technically known as the Type IV and colloquially, if somewhat inaccurately, as *turbulent*. It is an environment characterized by relevant uncertainty.

This uncertainty is not caused by rapid technological or physical environmental change but by the fact that people are still changing their minds about what they really value. Previously stable value systems were thrown into chaos at the end of World War II. The immensely high rate of productivity during WWII and the strategy of mutually assured destruction initiated by the detonation of the atomic, followed by thermonuclear, bombs pulled the rug out from under the two assumptions that had governed the people's voluntary subservience to the state (Emery, 1978). With the foundations of that authoritarian value system destroyed, people were left with no option but to decide for themselves what they valued. That process is not yet complete.

To change this type IV environment, which is itself maladaptive, requires the creation and maintenance of an *active adaptive culture* described as *associative, joyful and wise* (Emery, 1999). Within this culture, people are creative and motivated to diffuse their culture. To do this, they require conscious, conceptual knowledge of the genotypical design principles discussed above. We are aiming for an end state, *participative democracy* where *all* entire human systems are and want to be purposeful and responsible, continuously learning and practicing active adaptation within this more stable environment. That means the creation of a modern form of Type II environment.

The Type II lasted longer than any other environment we have created, at least 60,000 years, and the cultures that created it remain in remnant form throughout the world. This itself is a testament to their resilience in the face of everything the ruthless, brutal mechanistic cultures of the Type III subjected them to. Those Type II cultures were based on respect for, and cooperation between, the people and the planet, that is on DP2.

The Type III born of the industrial revolution replaced respect and cooperation with disrespect and competition as the factory system gradually forced the mass of people to abandon their DP2 forms of organization and living. To obtain reliable systems from unreliable parts (people), organizations brought in DP1, for the first time in the West on a large scale. These ever growing bureaucratic structures began to compete in earnest for the world's resources, the results of which are highly visible as today's ecological destruction and climate emergency. It also pitted person against person initiating the maladaptions that beset our societies today (Emery, 2013, and see below).

The Type III contained the seeds of its own destruction as people finally rejected their subservience but many remain trapped, their word, in vast bureaucratic structures which have become so ubiquitous that many now believe, wrongly, that there is no alternative. So at this moment in time we have neither the majority of adaptive, cooperative, socially responsible organizations nor the vast majority of active adaptive citizens we need to globally mobilize to deal promptly and effectively with climate change. Nor do we have the participative democratic governments that are relatively immune to corruption by the power of money. That's the bad news. The good news as we see in the next section is that there is a new wave of social change rippling around the world challenging the elites everywhere with the power of spontaneous DP2 organization and the release of the ideals we all share.

The New Wave of Social Change

The new wave of social change began in Tunisia, spread through many countries and morphed into the Occupy movement in many other countries. Many commentators treat the period or even each episode as an isolated event, isolated in historical time and isolated from similar events in different global and cultural contexts. At best, a very few reasons or causal factors are cited for the unrest. But the current wave cannot be fully understood in isolation. It is not the first such wave in history and to comprehend it, it must be placed within the broader landscape of social change.

The analysis of the new wave cited here (Emery, 2013) puts lots of meat on the bones of the diagnosis of a motivation deficit with complicating factors, and also points more compellingly to the solution, the cure. The analysis is based on well documented historical sources and data obtained from the first hand perceptions of hundreds of people around the world who attended Search Conferences (Fig. 3) in 2004–2009. Their perceptions, elicited by the question, "what have you seen happen in the last 5–7 years around the world that has struck you as new or novel?" are a record of the changes in the L_{22} that took place during that period. In other words, they are a record of the significant and indicative changes of recent value shifts and social change. These perceptions were recorded verbatim and coded according to the OST taxonomy of ideals and maladaptions (Table 1).

As Table 1 shows, the human set of ideals is a subset of human choice where making a decision, conscious or unconscious, involves all the parameters of choice (Ackoff & Emery, 1972). These parameters are themselves drawn from the parameters of the open system. As such, the ideals and the maladaptions, form logically exhaustive and mutually exclusive sets.

Ideal seeking is a potential in all people but can be elicited only in certain circumstances – it is only in group life (DP2 structures) that ideals can emerge. It also emerges only when people must choose between purposes, all of which are important to them. The collective task of outlining the most desirable future for a system that participants are vitally concerned about and responsible for, e.g. their

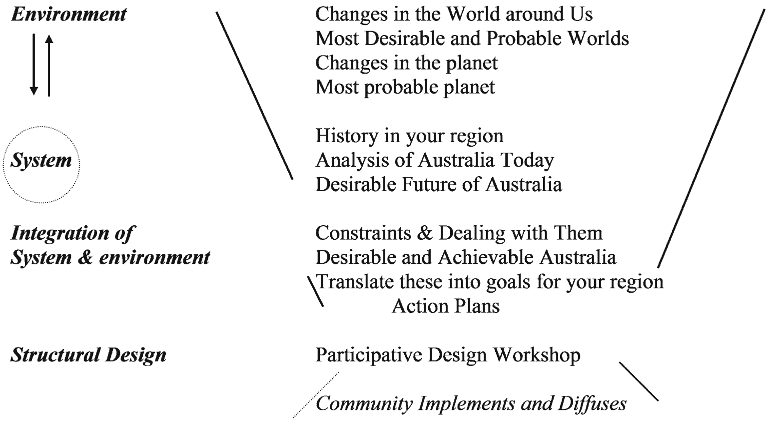


Fig. 3 The future of Australia 2020 (Two-stage model)

Table 1 The classificatory system (adapted from Emery & Emery, 1979, p. 338)

		Possible scenarios		
			Maladaptive	
Parameters of open systems	Parameters of choice	Adaptive (ideals)	Passive	Active
L_{11}-system	Probability of choice	Homonomy (sense of belonging)	Segmentation	Law and order
L_{21}-environment acting on system learning	Probable effectiveness	Nurturance	Dissociation	Evangelicism
L_{12}-system acting on environment	Probability of outcome	Humanity	Doomsday	Social engineering[a]
L_{22}-environment	Relative intention	Beauty	Superficiality	Synoptic idealism

[a]Previously called eugenics

community, is such a task and reliably elicits ideal-seeking. However, only individuals can be ideal seeking systems. For sustained active adaptation, the ideals must be pursued as a set. The pursuit of less than the full set would lead us into paths of maladaption (Emery, 1977, pp. 67–80). As ideals can be approached but never reached, they are motivators and the experience of ideal-seeking is exciting and energizing, one that people strive to re-create.

- The first ideal is *Homonomy*, the being with others in a sense of belongingness and interdependence. It relates part to part within the whole for the benefit of the whole and all its parts. It is the opposite of selfishness.

- The second is *Nurturance*, cultivating and using those means which contribute to the health and beauty of the whole and all its parts. It is the opposite of exploitation.
- The third is *Humanity*, expressing what is appropriate, fitting and effective for us as people; regarding people as superordinate to institutions and putting their wellbeing and development (spiritual as well as physical) above bureaucratic and/or material criteria of progress. It is the opposite of inhumanity.
- The fourth is *Beauty*, expressing that which is aesthetically ordered and intrinsically attractive; moving within the social and physical environments so that they become increasingly desirable, more dynamically balanced. It is the antithesis of ugliness (Emery, 1977, 1999).

But obviously, not everything that happens in our world is adaptive, indeed as we see, our world is full of very serious maladaptions. In the OST framework, for every ideal, there is a passive and an active maladaption.

> The quality and complexity of a social field is determined by the purposeful choice of co-production with others for mutually agreed ends. Where choice…becomes too difficult and too anxiety laden, and yet choice is unavoidable, we can expect the effects to be manifested on one or more of the…dimensions of purposeful choice (Emery, 1977, p. 31).

The first set is called passive because they are directed only at reduction of the immediately confronting uncertainties. They are most usually seen as the behaviours of the people at large, the masses. The second set is called active because when the elites perceive a social breakdown or a way to effect an improvement, they seek to initiate strategies to achieve those ends.

The first passive maladaption is *Segmentation:* in and out-group prejudices are amplified as people attempt to simplify their choices and reduce their relevant uncertainty. Coproduction is restricted to those who are known and trusted so the whole social field is degraded into a set of fields.

Dissociation is denial that coproduction with others could be more effective in reaching desired goals than acting alone or selfishly. It is an anomic response characterized as a withdrawal into *The Private Future* (Pawley, 1973) and *Bowling Alone* (Putnam, 2000). It is to keep oneself to oneself and not get involved with others: the classic leisure pursuit is watching television which is the ultimate in dissociative media (Emery & Emery, 1976). It is essentially a denial of responsibility for the public space and the common good.

The *Doomsday* response is the denial that an outcome is possible: it expresses hopelessness that action can be effective or that active adaptive behaviours are even conscionable. Doomsday scenarios see our future as shaped by biological, technological and economic processes that have gotten out of hand and which we can no longer control. It is this quality of lost control that produces the hopelessness that leads to quietly awaiting *the end* or *heading for the hills* or the psychological equivalents of these, depression and suicide.

In *Superficiality*, the relevant uncertainty is reduced by lowering the emotional investment in the ends being pursued whether they be individual or shared. "This strategy can be pursued only by denying the reality of the deeper roots of humanity that bind social fields together and on a personal level denying the reality of their own psyche" (Emery, 1977, p. 32). It is a loss of meaning in life and can frequently be seen as permissiveness accompanied by a superficial conformity.

These strategies are called passive because they aim only to reduce the immediate uncertainties. They are maladaptive because they reduce the probability of changing the source of those uncertainties. But these maladaptions are dualities; for each passive strategy it is possible to discern an active counterpart. The *active* maladaptive strategies are those open to people who can influence or order changes in social arrangements, the elites, while the *passive* maladaptive strategies are what people can try to do to adjust to situations that are not of their own making.

The active counterpart to segmentation is *Law and Order*, the effort by the elites to reduce or remove the divisions and restore the whole by the application of strict rules that must be obeyed and if not obeyed, must be enforced. As communities and societies fracture, threatening the order and good function of the whole, the elites respond to *keep the peace*.

The response to dissociation is more complex as "dissociation induces, almost creates, its own active maladaptive response; it does not just stimulate others to act against it" (Emery, 1977, p. 44). Using the analyses of Erich Neumann, Eric Fromm and Norman Cohn, Emery identified the evangelical response, the revolutionary millenarianism and mystical anarchism that have surfaced regularly throughout human history, as the alternative dynamic of dissociation. The focus of *Evangelicism* may be a person or an idea, a focus for concerted action or emotional support that replaces the psychic pain of isolation endured in dissociation. Such a recent example was the extreme display of global identification and grief following the death of Diana, *the people's Princess* (Emery, 1997).

As *Doomsday* expresses the belief of the people that any further action is hopeless and an adaptive outcome cannot be achieved, so the elites move to manufacture or engineer an outcome. These efforts at *Social Engineering* are designed to reassert the possibility if not probability of an outcome. If the people are not psychologically prepared to work for an adaptive outcome, one must be provided for them in the interests of the continued existence and stability of the whole. Never mind that the outcomes so engineered may be rejected by the population; it is simply inconceivable that the pursuit of outcomes could be abandoned. If the people refuse to be their normal purposeful selves, so they must accept the purposes of the elites.

The active response to the passive maladaptive behaviours of superficiality is that meaning can be brought into being by the exercise of far reaching policies and plans that encompass the whole and govern the behaviour of all those touched by those policies and plans. These plans for comprehensive, long term social change are of course based on the planner's dreams of the ideal society. This active maladaption is called *Synoptic Idealism* (Crombie, 1972). It expresses the reality that that the dreams of these centralized and specialized planners who exist at the higher reaches of our hierarchical societies are unlikely to coincide with the dreams and realities of the population at large. The planners are unlikely to enjoy the commitment of those planned for. After all, the planners are substituting for the perceived inability of the people to plan for themselves. The other major problem is that as social change proceeds rapidly and in unpredictable ways, the plan will always to be subject to the vagaries of that change and will rapidly find itself out of kilter with new realities, generating unintended and often, unfortunate consequences (Emery, 2013).

Some categories in Table 1 have been elaborated since the 1970s study (Emery & Emery, 1979) to cover the range of phenomena encountered and recorded. Using this foundation, a 2013 study investigated the wave of the 1960–1970s, also employing the data from the first study to use L_{22} data, the major events and trends in the interval between the last wave and that underway today, and the L_{22} data for the period 2004–2009. That period immediately preceded the outbreak of the new wave.

One of the findings of the 2013 study most relevant here is that there were increases in all categories of ideals and active and passive maladaptions from the period 2001–2003 to that of 2004–2009: 80 % for passive, 50 % for active maladaptions, and for the ideals, 62.5 %. Not only do these figures indicate that tensions between the elites and the people had grown to the point where something had to give, they also tell us a lot about why in general, there has been so little noise and highly visible public concern, and action about climate change.

Approaching the Full Diagnosis

We have most of our people worldwide working in DP1 structures which cannot provide even adequate levels of the intrinsic motivators, and which are fundamentally out of kilter with our primary characteristic of purposefulness. We also have the great majority of our people living in representative democracies, or dictatorships, both DP1, where over time, the psychological distance between the representatives and the represented, or the autocrats and the unrepresented, grows. This shows up as apathy, cynicism and distrust.

Since the industrial revolution, and certainly since the crackdown of the elites following the last wave of social change in the 1960–1970s, the rapid economic globalization and the tightening up of top-down structures and the growth of inequality (Emery, 2013), we have seen the commensurate growth of passive maladaptions. Dissociation did not even show up in Australian records until the period 1977–1978 (Emery & Emery, 1979).

In addition we have most of our organizations and governments dutifully doing their strategic plans in a non-participative fashion and without awareness, let alone monitoring, of the L_{22}. Such lack of awareness or hubris ("build them and they will come") led to spectacular failures of the USA auto giants who kept building gas-guzzlers while consumers worldwide kept buying smaller, more fuel-efficient cars. Tax payers bailed them out. Bailing out financial institutions *too big to fail* coupled with austerity is currently fuelling social unrest born of an inbuilt sense of fairness (de Waal, 2009) and the purpose of lower income purposeful systems who know that this dooms their future.

The elites have adopted economic philosophies, theories and practices born of the total internalization of dominance-subservience, such as economic rationalism (Quiggin, 1997), where public assets are privatized and users pay for services whose quantity and quality are determined by profit margins rather than human need. They have installed the value of money as the sole determinant of value where nature is discarded as an externality. This exercise of dominance over the planet demonstrates DP1 in action in the same way we have enshrined some people over others.

Economic rationalism plus DP1 fuelled the growth of corporations whose single goal is the maximization of shareholder value where the remote shareholders, directors and CEOs take the winnings and the community and environment pay the costs. As economic globalization has spread across the world, corporate influence on representative (DP1) democracies and societies has increased to the point of the almost laughable 2010 declaration by the US Supreme Court that corporations are people (Corporate Personhood, 2013). Then we have the growth of the stock market, driven in part by the huge contributions from pension and superannuation funds which to some represents the democratization of the economic future but which rises and falls in tune with human affects. It has long lost any connection with the real substantial value of the assets it purports to represent as many retirees have discovered to their cost as the global economy teetered during the global financial crisis and still teeters on the brink. The reality is of course that economy and ecology are not separable entities and as we slowly destroy our biosphere, so we destroy our economy. As the climate disasters escalate, so the costs will eventually exceed every nation's capacity to deal with and pay for them. When you boil it all down, our only capital is the planet and our only income is sunshine. Reification, and pursuit of the growth of the *economy* which is simply a human construct, is a serious problem in its own right.

These multiple and interrelated factors contribute to an accelerating problem of inequality, of status and power: social, political and economic. Many around the world have noted that the social tone has changed, becoming less generous, more nasty (Emery, 2013). No wonder there has been an increase in doomsday scenarios!

Now in 2013 we do stand on the brink of planetary disaster, a brink of our own making (Romm, 2013c) with most of the warming going into the oceans (Masters, 2013) with the carbon dioxide also increasing acidification which is destroying the substratum of the food chain. But all is not lost. Science tells us we cannot escape terrible suffering as sea level rises, droughts and floods ravage our lands and crops fail. But we can still avoid the worst, the runaway Venus greenhouse effect (Hansen, 2009) that would guarantee a dead planet. This is no time to cry over spilt milk, it is the time for effective action, action that goes to the heart of our problem and does not fiddle around the edges.

The other side of the story is that amongst the growth in ideals, three of the biggest increases were in Nurturance, that sub-category of looking after and working towards a healthier physical environment (108.6 %), Humanity, the sub-category of a non-discriminatory multiculturalism and diversity in all its guises (134.6 %), and of course Humanity, the sub-category of technology for people because of the huge explosion in cheap, electronic communication devices (146.0 %), (Emery, 2013). Many are exercising their purposefulness plus ideal-seeking and it is on this set of trends that we must build.

Curing the Disease

It is outside the scope of this chapter to address the economic issues but there are tried and true alternatives to economic rationalism. While there will be some pain as we dismantle mechanisms such as the stock market, we must return to genuine measures of substantive value rather than GDP.

We can immediately go to the core of the problem by remembering that it is only in DP2 structures that ideal-seeking is elicited and it is only when people do a scan and analysis of the L_{22} that they can really understand what is going on around the planet. The methodology that combines both these key concepts, and more, is known as the *two-stage model for active adaptive planning and design* (Emery, 1999).

The *two-stage model* consists of a Search Conference (SC) followed by a Participative Design Workshop (PDW) for design of a DP2 structure to effectively implement the plans arrived at during the SC (Emery, 1999). The first SC was held in 1959 (Trist & Emery, 1960) and has been developed since then, by carefully tested and integrated theory and practice, into a reliable and highly adaptable method of participative strategic planning. It is based on the concept of the open system itself (Fig. 3) and many interlocked concepts and principles which underlie its reliability. Its ability to elicit intrinsic motivation, ideals, energy and diffusion derives from its DP2 structure which means that the participants accept the responsibility for the content of the work, the plan and its implementation (Emery, 1999). It answers the questions, "where do we want to be and what do we want to be in year X?"

But these answers are, on their own, inadequate. We also need to ensure that we have the most effective form of organization through which to implement the plan. All practitioners had experienced highly successful SCs only to see them fail during the implementation. It became clear that these failures occurred because while SC participants work in a DP2 structure, they did not get conscious, conceptual knowledge of the design principles. Consequently, they set up structures such as committees (DP1) for the implementation. Hence the failures, as DP1 structures demotivate and de-energize (Emery & Emery, 1974).

To prevent these failures, a Participative Design Workshop, modified from the original for design rather than redesign, is hung on the end of the SC. As in the original PDW (Emery & Emery, 1974), participants receive full briefings on the design principles and their effects and learn how to use them by designing their own effective organization for implementation (Emery, 1999). Right from the earliest examples, we have seen successful implementation, e.g. Paton and Emery (1996). But it has other desirable flow-ons as we see below.

Dealing Effectively with Climate Change at the National Level

In the following plan, the example is Australia, but there is nothing to stop any country developing such a plan adjusted to its circumstances. From 1st July, 2012, Australia has a 3-year fixed period of a carbon price of A$23.00 per tonne, imposed on the biggest emitters. It serves as an introduction to a carbon trading scheme, supplemented by a complex set of legislation for carbon farming, the development and financing of renewable energy projects and technologies and a host of others plus means tested compensation to citizens. Emissions dropped 8.6 % in the first six months. These actions can be escalated as need be so we may consider that there is an adequate government response. Whether the carbon price will function quickly enough to close the fossil fuel industries in the near future is an open question.

We also know that over 62 % of Australians are recycling more, making sure to turn lights and appliances off, using green bags rather than plastic and have changed to more efficient light globes. The group most motivated and taking most action were mature aged, higher socio-economic status women (Emery, 2009). Since 2009, there has been a tenfold increase in PV installations (Solar power in Australia, 2013). Solar hot water systems have been increasingly popular since the early 1970s. The disastrous consequences of climate destabilization have become more visible and more broadly experienced first-hand, as in the summer of 2012–2013. Raging fires and floods crossed the whole continent, resulting in more individuals and households taking action.

The missing ingredient in the Australian recipe is the community. All communities are at risk in this land of extremes but the majority of the population lives around the coast, which is increasingly subject to the rise of sea level fuelled by the melting of both the Arctic and Antarctic. There is a desperate need for both mitigation and adaptation at the community level but many Councils and Shires are short on funds as a result of lower taxes, following the economic rationalist doctrine. They are also short on ideas. Add in the effects of dissociation and the whole idea of a *community* has been effectively disabled.

But while the means may be missing, the will is still there. While maladaptions are rife they are not the whole story, as we saw from the 2013 L_{22} data. This is confirmed by tests my colleagues and I have conducted over the last few years in piloting a one day workshop for communities and organizations to get to grips with climate change. The one day design is not a SC but a Unique Design (Emery & de Guerre, 2007) including a briefing at the end outlining the concepts and practices that enable a couple of community members working together to replicate the event in another community or group.

However, the hour is now late and we need the major spin-offs that accrue from a community really welding itself into a genuine community. That takes a bit longer than a 9–5 day. It involves all the elements required for the building of trust between diverse and disparate members of a geographic community (Asch, 1952; Emery, 1999). The design goes beyond a single two-stage model to a national campaign based on a series of them across the country, all with the same internal design and integrated at the local, state and national levels.

The great spin off from the two-stage model is that because the Community Reference System (Emery, 1999) inevitably results in the participation of employees and managers from local businesses, these participants prick up their ears and think about the benefits of DP2 for them. Not every business has to change immediately. Once the message gets around that "our place has changed, I helped make it happen and it's fantastic for everyone," who is going to want to work for the competition where you are treated as a stupid, irresponsible child?

When an integration event is required, the SCs finish after the community has decided on its most desirable and achievable community (strategic goals). Each SC selects the required number of participants for the integration event. In the integration, they simply put up their strategic goals, discuss and integrate them in exactly the same way they learned to do in their SC when they used the rationalization of conflict (Emery, 1966, 1999). They group up those that are the same in meaning or a part of another and keep the stand-alones, so that nothing gets lost. The integrated list can then be discussed and sorted into which are unique to a particular section or area of the community and which are common to all. (Where there are many SCs in series, there may be two or more stages in the integration. This presents no difficulties, just takes a bit more time.)

Participants from all SCs then meet again and self-select around a goal. They then do action planning in the normal way and meet again in the modified PDW. This ensures cooperative work across the whole town or city.

The following plan, called "The Future of Australia," was originally designed for a submission to a government enquiry into increasing innovation. It began, "we know that until ordinary Australians across the nation are given an opportunity to create their own future, we will continue to see unnecessarily high levels of social maladaption and unnecessarily low levels of innovation and productivity." Here we present a plan to involve the people of Australia in her future leading to:

- A revitalization of communities, regions and the people generally, with
- An increase in energy levels, cooperation and creativity, and
- A decrease in maladaptive behaviours as more people recover their sense of belonging.

It will also produce:

- a picture of the most desirable and achievable Australia as agreed across the country, and
- a huge amount of action on the ground to make that Australia happen.

Australians will jump at this chance and as usually happens with such operations, there will be spin offs in many directions. Once people are motivated and energized, bright ideas and collective action can spring up from anywhere.

This plan asks people in every region of the country to create The Future of Australia in much the same way that the basic SC design addresses The Future of Our Community (Emery & Aughton, 2008). Because we are now all addressing climate change as *the* issue around the planet, we need a task environment, a ring of the onion between the L_{22} and L_{11}, appropriate to the task at hand (Williams, 1982) to ensure that when regions discuss how to improve their futures, they do it in light of the effects of climate change that are already upon us, plus their implications for the future. As Fig. 3 shows, the task environment in this case is the planet. It is basically a top-up as we know from the last few years that the L_{22} scan will contain many embryos of social change that indicate climate destabilization and environmental destruction. By collecting a full range of data and putting it together into a scenario for the most probable planet, we will get not only the creativity, we will also get practical, collective efforts that mitigate the cause and adapt to a radically different climate.

The overall design uses the term *region* to cover all cases where each region has a SC (two-stage model) addressing the future of Australia.

Usually, the strategic goals listed under their most desirable and achievable Australia are integrated by participants selected from the SCs by their peers. In this case, the distances, and therefore, costs necessitate integration by the relevant managers. The managers will also sort the goals into those that are the responsibility of citizens and their local governments, state and federal governments. These latter two types will be passed to the relevant level of government. After integration, participants will translate each of the strategic goals for Australia into goals for their region and then do action planning for them.

[There will actually *not* be an extremely long list of goals for Australia despite the size of the country, as experience shows that there is a massive degree of commonality in the strategic goals that people produce. This is because the SC elicits the set of ideals during the work of designing the most desirable world and they continue to build these into their most desirable system. A lot of differences are semantic.]

The map (Fig. 4) shows that the logistics of this national plan were based on 110 towns and cities with a population of 10,000 or more (ABS, 2008). We have divided the country into regions surrounding these towns to reflect population density and ensure total coverage. The larger town and cities in this case will be broken down into natural geographical divisions recognized by the residents. Each should contain people from the surrounding small hamlets and properties. This guarantees that city people won't forget their regions and the importance of their surrounding physical environments. In the sparsely populated regions, there will just be one event that includes people from all parts of the region.

Each region needs to have two SC designers and managers who make two visits:

- The first visit is preparation, to advertise the event, educate about the process, recruit a small organizing group from the region and get them using the Community Reference System (Emery, 1999) to select their participants, and
- The second to conduct the event.

The first visit will vary in length depending on population, distance and travel—let us say an average of three weeks. The second should need only a week; two or three days for tidying up loose ends with the organizers on the ground, three days for the SC, holding the PDW on the fourth day. The total number of events would be about 290.

Fig. 4 Australian map

With 54 trained SC managers, the country could be covered in a year at the average rate of each pair of managers doing 11 regions in a year.

Australia has people experienced in these methods, but not enough, and many could not leave their normal work or practices for a year. These SC managers, therefore, need to be recruited from all over the country so as many as possible can operate in their own areas and should be multicultural including Indigenous Australians. They will need training, which will take about 10 days. Assuming two training workshops are required, the whole project including a yearly salary and travel would cost less than A$5 million at 2008 prices.

At the end of the year, we will have a set of strategic goals for Australia agreed across the country and about 10,000 people working together and continuously involving others to create this most desirable future Australia in their region. We will also have a fantastic resource in the SC managers, available for future developments in any related field.

Of course, the other thing that needs to happen is that Australia becomes a participative rather than representative democracy, but that may take a little longer.

If many countries were to implement such a plan, we could also integrate the national strategic goals into an international set that could be presented to the United Nations (UN). But let us now consider how the UN itself would work on climate change if instead of a conflict ridden DP1 representative structure, it was a DP2 structure.

Dealing Effectively with Climate Change at the International Level

To make its decisions as a DP2 or participative democratic structure, the UN would use open discursive processes such as the Search Conference that work on commonalities not differences. If the UN Assembly sat around as equals, *Earthlings*, and asked themselves the question "What have you seen happening to the planet in the last 20 years?" it could put up the answers and allow heterogeneous groups to synthesize the data into most probable and most desirable scenarios for Earth in 2020. Inevitably, the answer to the implicit question, "Do we want to save our home?" would be "Yes." They would then integrate the points in the scenarios and rationalize any differences that had arisen. A few differences wouldn't matter to the end result, as the commonalities to work on would be huge.

So then groups based on geographical regions would go and decide what needs to be done to bring this healthy sustainable planet into being. They would do action plans that take into account their local diversity and that would bring about the beautiful and bountiful, healthy planet they want to see.

They would then go into a Participative Design Workshop in which they designed a DP2 structure that ensured that the energy and motivation generated in the process so far would be maintained through the process of implementation. They would include a timetable for progress meetings and solving problems if such arise (adapted from Emery, 2010a).

If the UN had been a DP2 structure and worked with OST methods, global action on global warming, when it first became accepted as a scientific fact, would have solved the problem by now. Now we are running out of time and have no international agreement, as they are sticking to the same divisive structure and methods that have failed so many times before. If we do get an agreement through the COPs by the 2015 date set, it will be one based on the lowest common denominator rather than the highest. That is far from what we need. We need global cooperation to institute emergency action to rapidly reduce emissions and possibly to initiate geoengineering under rigorous, scientific control. Without these conditions for cooperation, ideal-seeking and motivation, we won't make it. We will learn that for all our intelligence, technological prowess and hubris, we have never controlled the planet. And as we have been told in so many ways by those we dispossessed, "you can't eat money."

Why We Know It Would Work

As has been documented since 1939 (e.g. Lewin et al., 1939; Trist & Bamforth 1951; Emery & Thorsrud, 1976; deGuerre, Emery, Aughton, & Trull, 2008), DP2 structures provide the conditions for motivation and cooperative trusting relations, high productivity and mental health through the constructive use of purposefulness and the balance of autonomy and homonomy. About 10 years ago, we began compiling data on the effects of DP2 as the epidemic of depression and mental illness (WHO, 1996, 2008) became highly visible in Australian organizations. Analysis of the total sample data from seven very diverse organizations yielded the following causal path (Emery, 2012c).

Causal paths (Emery, 1976b) are read like road maps (Fig. 5). Start from the left hand side and follow the arrows. We see that DP2, low DP1 and low Laissez-faire lead to perceptions of higher job security which leads to higher positive affect, lower negative affect, higher levels of the six criteria or psychological requirement for productive work, higher motivation and better conditions for innovation. It must be noted that higher job security cannot actually influence such objective factors as the six criteria. They are the result of the design principle and as the secondary (dotted) link shows, there is a significant correlation between the design principles box and that headed up by positive affect. The six criteria are the intrinsic motivators.

The conditions for innovation included here are high mental demand, sense of achievement, being rewarded for innovations and management openness.

The box containing the factors of six criteria, higher motivation and positive affect, etc. leads to higher cooperation and trust, higher levels of the creative working mode (Bion, 1952, 1961; Emery, 1999), lower levels of the basic assumptions of dependency and fight/flight and better organizational outcomes. The outcomes included here are higher levels of accountability, innovation, productivity and quality.

Better outcomes lead to higher IR which consists of satisfaction with pay and working conditions. That is, when a person has a highly satisfying working life they are less inclined to be dissatisfied with their pay and conditions. This relationship has been found in every individual organization so far. However, this should not be taken to mean that people in DP2 structures will tolerate inadequate pay and conditions. Inadequate pay and conditions rapidly increase dissatisfaction with the organization regardless of the design principle in operation.

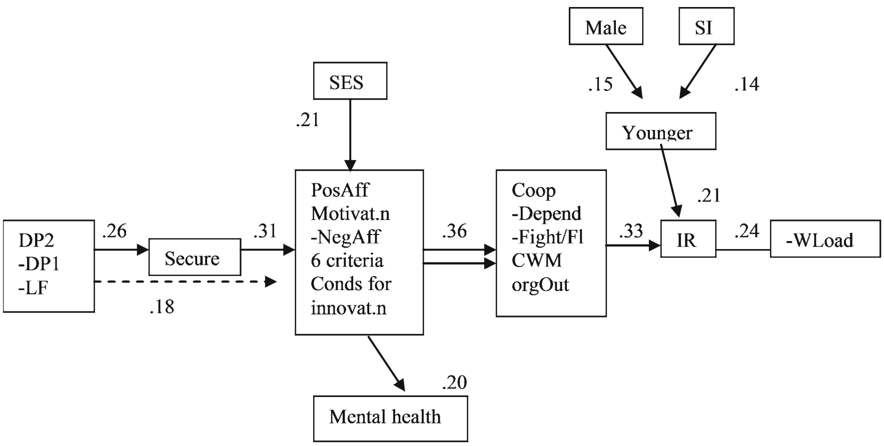


Fig. 5 Causal path for total sample (from M4). Minimum no of respondents = 202; r = 0.14 @p <0.05; r = 0.18 @p <0.01; r = 0.23 @p <0.001. Had all variables had 555 respondents, the r levels would have been much lower so that most correlations reported are very conservative

No arrow has been consigned to the link between IR and lower workload as the relationship could go either way. Until quite recently, there has been a positive correlation between IR and workload in DP2 structures as working hard is a sign of intrinsic motivation, the enjoyment of intellectual challenges and gaining a sense of achievement.

Whether this change is a sign that the organizations recently added to our database have overstepped the mark on expecting fewer workers to do more with less, or is due to the younger workers changing their expectations of a fair days work needs further exploration.

Demographic factors have a small effect on these results. Higher socio-economic status (SES) makes a contribution to the motivation, positive affect cluster, confirming that it is easier to find better quality work as measured by the six criteria as education levels and incomes rise. Gender and personality as measured by behavioural preferences (Subjective Internalizer, SI) (Emery & Emery, 1980) feed into younger age which makes its contribution to IR. These demographic contributions are far less powerful than those of the design principles.

As Fig. 5 shows, mental health is a direct consequence of the cluster containing the intrinsic motivators, motivation, positive affect and low negative affect. This confirms all our previous research and of course as we noted (deGuerre et al., 2008), it confirms the findings of Trist and Bamforth (1951). It is also, of course, exactly what one would expect from the fact that people are open purposeful systems who want to be treated as the responsible adults they are. It should come as no surprise that over time, they react with the maladaptions when expected to act against their intrinsic nature as a social or group species. As these graphs are mathematical entities, the sign of the entire graph can be reversed. When the sign is reversed, the figure shows that it is DP1 and Laissez-faire that lead to organizational problems and mental illness.

Here as in other studies, there is little evidence that increasing external motivators such as pay and conditions will do anything to stem the increasing casualties from DP1 structures. HR policies which revolve around such external motivators have failed spectacularly in the past and continue to fail (Emery, 2010b).

As there is no known case of a two-stage model failing to produce a revitalized community or organization, we can have confidence that a major concerted assault on DP1 at all levels will complete the set of actions necessary to rapidly reduce GHG emissions. We have the technology, the economic theory and the means to change our dominant design principle. We just need to "deploy, deploy, deploy" (Romm, 2011)

Conclusion

The tragedy that began when we adopted the first design principle as the dominant way to organize our human affairs and our relationship to the planet, at the beginning of the industrial revolution, is still playing itself out and will not end well. If down the track, the ruins of our industrialized society lie scattered across the planet, there will probably be a few picking amongst the rubble, trying to eke out their lives. Inevitably there will be a constant theme running through all the discussions as people collect to shelter at night—that theme will be "why?" Let us just hope that enough of these survivors have the requisite knowledge of systems science, the design principles and their consequences, amongst other important concepts and methods, to answer these questions and rebuild on the basis of the only tried and true option humans have devised, that based on respect for and cooperation with Earth.

However, we can do better than that. We have all the tools we need: all we need to do is use them. The hour is late but it is not too late.

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Social Systems Design in Organizational Change

Doug Walton

Abstract The pressing need for the continuous redesign of organizational operating models increases the demand for new approaches to conducting design. To manage this, a new approach must created that embeds the capability to redesign the organization at all levels, not just the in the offices of executives or process experts. Social Systems Design provides important underpinnings for how to architect such collaborations. Inherent to this approach is the realization that designing complex social systems is not just a construction or specification process, but rather a human knowledge development process. This paper outlines a design approach based on social systems design for constructing participatory design on a large scale. The approach shows how interweaving knowledge development, knowledge capture, and the appropriate levels of design can facilitate an evolutionary methodology. A brief case study of how the approach was applied in a major high tech corporation is give to illustrate the approach.

Keywords Large-scale change • Participatory design • Social systems design • Transformational change

Introduction

"The art of progress is to preserve order amid change and to preserve change amid order." This quote by the eminent mathematician and philosopher Alfred North Whitehead nicely captures the situation in business today. The accelerating pace of technical change not only introduces new products and services but also disrupts the organization's operating models. Innovation in operating models—how works gets done—is as important as innovation in what gets produced.

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The interplay of change and order manifests in modern organizations as the pervasive disruption in the stability needed to operate efficiently. That is, on the one hand, being ever more competitive requires designing increasingly sophisticated operating models, automating them, and refining them. On the other hand, the change in operating models causes people to uproot their relationships and mindsets.

The consequent need for continuous change at all levels of an organization pushes responsibility for operating model redesign to lower levels of the organization. In response, leaders often call for greater collaboration. While many people think of collaboration as the sharing of information or consensus on what is to be done, such basic interactions are insufficient for redesigning complex operating models. Rather, a more rigorous, participatory approach is required to facilitate the quick redesign of operating models so they can be quickly institutionalized to maintain the ongoing flow of revenues from products and services.

Substantial underpinnings for such an approach were laid out in the 1990s in the works of Dr. Bela H. Banathy. The core of this work is outlined in *Designing Social Systems in a Changing World* (1996). This approach, usually called Social Systems Design (SSD), offers a unique perspective on the design of human systems. It thoroughly incorporates systems thinking along with the group dynamics of innovation and of making good decisions. It thus offers a deeply systemic form of collaboration.

Over the past 15 years, this work has been used and extended in many ways. In particular, it has been applied in small and large-scale design efforts at several major high-technology companies. This chapter covers certain key learnings gained from those efforts, with the intention of providing valuable insights about developing the organizational capability to redesign operations continuously.

Architecting Design Collaboration

In all organizations, humans work together to execute the operations of the organization. This occurs whether the organization is a corporation, family business, or a nonprofit foundation. The employees, members, or partners organize to achieve the organization's goals and produce the intended value. We can refer generically to the description of the goals, tools, and technology used for these operations as *operating models*.

Operating models, like all models, are human constructions. Thus, they are themselves the product of a human design activity, often in recent years called *enterprise architecture*. However, while the detailed outputs and the logical steps needed to create business architectures are covered in detail in many enterprise architecture approaches, predominately overlooked are the human dynamics of how a good design is reached and agreed on by the community of architects.

Moreover, how the design is accomplished is critical to its subsequent quality and successful implementation. We are not just talking about the sequence of logical steps. We can probably agree, for the most part, that operating models cannot be created entirely by a single individual, and thus they are the product of design collaboration by some community of interested parties. This means, for reasons of group dynamics to be explored later in this chapter, that how design decisions are made and by whom is critical. In short, we will see that, in addition to architecting the operating model itself, we must architect the design collaboration needed.

To explore architecting the design collaboration, we draw on insights from Social Systems Design (Banathy, 1996). The foundations of Social Systems Design were built on concepts outlined in Checkland's (1981) Soft Systems Methodology, Ackoff, Magidson, and Addison's (2006) Idealized Design, and the many works of C. West Churchman. Along the way, Banathy incorporated deep insights about how humans work together to produce a design.

Who Designs?

Design for human systems is the activity of determining how people should relate to each other. It does not specifically include implementation, although participation by stakeholders may influence their readiness to adopt a design. As part of the design, technologies needed to support the new way of working may be also be designed, and a variety of models, goals, requirements lists, and process diagrams might be needed to understand what is to be done or built. But, in essence, design for human systems is fundamentally a decision-making activity to determine how people should act toward each other to achieve specified purposes.

A critical question raised by Social Systems Design was "who designs?" Classically, there are two common approaches to design decision-making. One approach assumes there are people with specialized knowledge who should make the design decisions for everyone else. The other approach assumes the people who will be affected by the change are the experts of their situation and thus should collaborate to design the change together. Both of these approaches have challenges, as discussed below.

The Problem with Expert Design

Historically in organizations, operating models have been most often designed by experts outside the work process. These experts could be senior management, business architects, selected representatives of functional organizations, or software designers. Whoever they are, they are assumed to have specialized knowledge that makes them the best decision maker, and they are charged to make the decision for others.

The challenge faced by expert designers, often noted in Banathy's (1996) work, is there is really no such thing as an expert designer in human systems.

While experienced people can possibly provide guidelines or input about how work in some area of the organization should be accomplished, the exact way a process or organizational activity works is too complex and nuanced for a small set of individuals to determine for everyone else. This issue was dramatically evidenced by the early failures of business process reengineering (Cao, Clarke, & Lehaney, 2001). It is even more true as modern organizations become more complex and need to be redesigned more continuously at all levels of the organization.

The Problem with Group Design

Realizing the issues with expert-driven designs, Social Systems Design incorporated the notion of stakeholders as designers. Such participative group design activities have a number of advantages as listed below.

Better decisions are made by integrating diversity: Research on group decision-making has shown that better decisions are usually made by incorporating a wider range of viewpoints. This counteracts groupthink, and, in complex cases of organizational change, fully understanding the implications and the best approaches lies in the synthesis of the many views. So, skillfully integrating many perspectives tends to create a much richer, more accurate understanding of the situation (Roberto, 2007).

Mental engagement is needed for deeper understanding: Involving the group in design better exposes the real issues. When people are only shown the output of another's work, they often do not engage mentally with it. This leads to many discrepancies in understanding, which ultimately results in miscommunications and missteps down the road (Yankelovich, 1999).

Involvement builds commitment: Not only does discussing the ideas openly build greater understanding, it also deepens commitment. When people invest their own time and energy into the idea, they are more committed to it. Numerous studies have shown once people engage even a little in an activity, they are more likely to accept the next task, even if it increases their involvement (Cialdini, 2001).

Although group discussion has advantages, it also introduces challenges. One problem with group collaboration is that, especially with such complexity as we see in modern business, reaching agreement becomes difficult. The variables can be overwhelming for groups and there are so many factors it becomes almost impossible to sort them out. This can raise anxiety for many people who fear an endless and fruitless discussion often called *spin cycle*. In response, people will often start calling for someone of authority to "just make a decision" and return to an expert or authority decision.

The *spin cycle effect* occurs largely because, at the outset, people are unclear about their own thinking and thus tend to introduce a wide range of concepts that are ill formed, irrelevant, and out of sequence. Further complicating the discussion, there is a tendency to make proposals and statements on the basis of undisclosed assumptions, and this makes challenging those statements in order to think together difficult (Bohm & Nichol, 1996).

The second major problem is that, when people begin working through ideas, certain human dynamics come into play, which creates a situation of smart people making poor decisions. The phenomenon results from the ways in which the decisions are approached. Regardless of intelligence, natural human tendencies cause poor collective decisions to be made, often resulting in the status quo being subtly reaffirmed instead of changed or risky decisions imperiling the success of the program (Roberto, 2007). Yet, the group will feel as if a good decision was made—until reality enters.

Often, when the process of consensus is unstructured and when forceful and opinionated voices are introduced early in the group process, those voices tend to shape the discussion (El-Shinnawy & Vinze, 1998). Members conform by contributing ideas similar to, and not radically different from, what has already been said, for fear of being viewed as unusual or out of step by the other members. This is called *information cascading*. Further, group members then want to make a contribution, so they add to the direction already set, creating a reinforcing loop where the initial position becomes more strongly affirmed by the group than it was at the outset of the discussion. For example, if locations for a leadership workshop are discussed, and the first options proposed entail using low-budget facilities or onsite conference rooms, others in the group may fear that suggesting travel to an offsite conference facility would be viewed as too lavish or not fiscally responsible.

A Middle Way: Social Systems Design

There is a middle ground: architecting an effective collaboration. This is the key insight offered by Social Systems Design. To address the difficulty of reaching an innovative, solid decision on complex issues, Social Systems Design integrated methods of facilitation in addition to steps of developing the design. This facilitative approach contained three key features (a) establishing a truly collaborative design conversation, (b) generating a forward flow of design thought through a series of inquiry spirals, and (c) using systems models to simplify the complexity.

Design Conversation

The established order in an organization is maintained by the unquestioned or unquestionable assertion of what seems to be common sense or obvious decisions. New ideas are shut down because they threaten to upset ongoing operations. When a person suggests a new way, a person with authority says “you don’t understand” or “just do this,” without offering the opportunity for authentic consideration of a new way. Social systems design sought to interrupt this pattern by incorporating the *design conversation*.

The design conversation introduces concepts of deep listening and open questioning of fundamental assumptions. Drawing on forms of dialogue advocated by writers such as Bohm and Nichol (1996), Isaacs (1999), and Yankelovich (1999), Social Systems Design advocated that designers interact to maximize transparency and rationality, rather than using position power or gut reactions. This form of interaction shifted the communication objective from winning the debate to inquiring together to find a deeper truth. Design conversation thus emphasizes exploring, discovering, and building new knowledge. This form of collaboration maximizes the benefits of group participation—incorporating diversity, engaging people mentally, and deepening their commitment.

Critics argue dialogue in organizations is not possible due to the nature of hierarchies and power. While it is true the presence of power tends to inhibit open dialogue, it is also not a reason to refrain from trying. Dialogue is still beneficial in less than ideal conditions. In my experience, although most business people are highly task focused, they find even a little bit of free dialogue both personally rewarding and a door to greater creativity.

Spirals of Design

The second feature of architecting collaboration introduced by Social Systems Design is managing the flow of idea development. Having such a flow is important because it shows the most efficient way to make decisions. It is also a troubleshooting tool if the group seems to get off track—which is often the result of skipping a step.

Different versions of the exact flow in Social Systems Design exist, but the essence is as follows:

- Formulating the Core definition
- Selecting Functions
- Designing the Enabling systems
- Determining the Components

While most design approaches have steps, in Social Systems Design, the steps are called *spirals*. This labeling is a nod to the facilitative aspect, because each spiral involves the purposeful generation of multiple alternatives before making a selection. This correlates with findings by creativity researcher Edward de Bono, who found people often dismiss or accept ideas too quickly based on prevailing assumptions. In that regard, de Bono (2006) recommended the Alternatives, Possibilities, Choices (APC) approach where multiple options are considered before choosing. Social Systems Design incorporated this approach by having the design group work through a sequence of (a) defining success criteria, (b) generating multiple options, and (c) selecting the best option based on the success criteria. This cycle was intended to maximize innovation while also deepening design understanding and engagement among the designers.

Systems Modeling

The third key feature of Social Systems Design was the pervasive and inherent use of systems modeling, both in terms of modeling the future system and modeling the change system that will enact the future system. The value this provides is a rational way to integrate perspectives (Walton, 2004). Because systems models are causal descriptions of the intended system, using them enforces a form of logic discipline as well as an emphasis on documenting truly causal aspects, rather than every detail.

The particular approach advocated in Social Systems Design was the *three-lens method* (Banathy, 1992). The concept of the three lenses was that while all diagrams and models are inherently incomplete, using different types of models (lenses) together to represent the same system provides a richer, more multi-dimensional view. One way to grasp the lenses is to realize that they each have a specific focus. The name of the lens and its associated focus is given below:

Systems-Environment Lens: What is the system of interest? This lens differentiates the system being designed (system of interest) from other associated systems. For example, if the Customer Service function is being redesigned, it is the system of interest. But the system of interest may have linkages with the Sales department or Finance. This lens shows these linkages as well as the inputs and outputs between the interrelated systems. It is similar to a context map.

Functions-Structure Lens: How does the System Operate? This lens depicts the functional structure of the system. It shows the set of ongoing activities and how they are related to each other. These ongoing activities could be functions of an organization, such as Engineering, or process domains, such as Portfolio Management, or even services, such as a Business Development service.

Process-Behavioral Lens: How does the system transform inputs to outputs? This lens shows the sequence of taking inputs, operating on them, and transforming them to outputs.

An under-appreciated aspect of this modeling approach is actually its looseness. The lenses each have minimal required notational conventions except for their intended content and purpose. Although design experts often want greater specificity and rigor in the modeling process to make it more accurate, this introduces difficulty in obtaining agreement across the community of designers. Most key managers and employees are also very busy. They do not have the time or the training to understand detailed notational conventions, and highly rigorous language often causes them to lose interest. At least initially, loosely defined models keep more of a connection with the stakeholders.

Also, excessive detail too early disconnects the model from appealing broadly to all stakeholders. There becomes too much focus on the purity of the drawing and not enough focus on the engagement of people at the right level of design. The beauty of intentionally ambiguous representations is to keep people on the same page with each other, as each can see their role in it. In human systems design, the curious paradox is that, to some extent, because everyone's situation is a little different, the more detailed a model is, the less it fits for everyone.

This is not to say more rigor cannot be introduced along the way. In fact, a useful way to look at Banathy's (1992) three lenses is as types of views or categories of focus rather than single views in themselves. They are open enough to get everyone on the same page, and, over time, they can be refined as the tolerance levels of the designers permit. Moreover, it is certainly possible for a lens to be fulfilled by a more rigorous form of that lens. For example, a process-behavioral lens is essentially a sequence. While this sequence could be represented by a string of boxes with labeled steps, an organization more versed in process modeling might represent the lens using formal flow-charting symbols.

The Right Methodology for the Situation

Social Systems Design is so versatile that it is a methodology for designing a methodology. The approach was intended to address all kinds of systems, from societies to families. Historically, it was often applied to very large-scale systems, such as educational and health care organizations. Its general nature makes it applicable to all design situations, but this in turn means bringing it to the level of action for a specific situation, which requires additional design effort.

When we assume the target is a business or nonprofit organization, we can make certain assumptions that enable us to narrow down the possible approaches. This narrowing is intentional in the methodology. In fact, Banathy (1996) said we should design the change approach based on the characteristics of the human system, and he used a set of ten descriptors to outline the five types of systems. He associated certain types of design methodologies with certain types of systems, as summarize below.

- *Rigidly Controlled systems* are closed, relatively simple systems that are well controlled, having limited interactions with the environment. Examples of rigidly controlled systems are assembly lines and very autocratic organizations.
- *Deterministic* systems have clear goals and objectives. There is little room for personal choice or involvement. Examples of Deterministic systems are governmental agencies, militaries, and centralized educational systems.
- *Purposive* systems have set purposes, but the means for pursuing the purposes are flexible. Examples include public education, many types of corporations, industrial organizations, and multi-level hierarchies.
- *Heuristic* systems have tendencies toward plural goals, so they can co-evolve with environment. They rely on the creativity and participation of people who comprise them. Significant change can happen within the overall policy and structural framework. There is considerable autonomy while maintaining that

some degree of control is retained through the hierarchy. Examples of heuristic systems are research and development organizations, high tech organizations, and nontraditional health care organizations.

- *Purposeful/purpose seeking* systems are ideal-seeking systems guided by images of the future. They are constantly evolving and searching for new and innovative ways to achieve the vision. Examples of these kinds of systems are self-creating systems, wellness systems, some kinds of high tech enterprises, peace development systems, and artistic systems.

While modern organizations vary across these types, and it is probably not necessary to exactly define the type for our purposes, certain characteristics tend to suggest the type of change approaches that will work best. Let us review a few of these key characteristics and their implications.

Hierarchy

For the most part, organizations are hierarchical. That is, there are power relationships formed by who controls the money and the power to hire and fire, which affect what people are motivated to do and how they act in a design activity. In general, people will be more reserved, more compliant, and less likely to challenge assumptions in the presence of people who are perceived to hold power over their pay, promotion opportunities, or performance evaluations.

Moreover, people who can exercise the power to direct others often exhibit certain behaviors, albeit subconsciously, which are counterproductive to participatory design. These influences include the following:

Micromanaging: Sometimes, leaders with positional power believe they have specialized knowledge that others do not, so they make decisions and attempt to enforce those decisions using their positions.

Politics: Certain managers want to maintain their organizations as miniature fiefdoms. Moreover, the typical organizational behavior tends to foster silos and intra-departmental conflict.

Insulation: Managers have a tendency to talk and interact with their peers or with their own managers, creating strata of conversation. Oshry (2007) describes these as the top, middle, and bottom layers of the organization, and he asserts many organizational issues are the result of chronic miscommunications and misperceptions between these layers.

The dynamics of a hierarchy imply an organizational design approach must shape leadership behaviors in addition to determining how a product or service is produced. Also, a workable design will also have to include changes to incentives and priorities.

Plurality of Goals

While members of the management hierarchy do have significant control over the organizational goals pursued, it should be noted that having positional power does not ensure control over the design or change process, as people are not always strictly motivated by hierarchical directive. Numerous studies have shown that other influences come into play (Brown & Duguid, 2000).

In most organizations, there is a plurality of goals people are pursuing simultaneously. These include the following:

- Shareholder expectations for dividends and increases in stock price
- Executives' expectations of pursuing the defined company vision and strategy
- Employee goals of enhancing their own careers

Because the human actors in an organization have many goals, the design effort must have the flexibility to deal with many different situations. This requires understanding and integrating stakeholder perspectives into the design.

Continuous Operation

Unless a company or a division is started from scratch, the environment of any participative design effort occurs while the organization is also maintaining the stability of ongoing operations to keep people employed and shareholders happy. The situation is often colloquially described as, *building the plane while flying it*. It is maintained by people who are skeptical of ideas that disrupt the stability of operations and who make keeping the company running a priority. Of course, these are truly important perspectives, but they also distract from focus that could be applied to the design effort.

The consequence of this limitation is to eliminate any possibility of changing everything in lockstep. There are always multiple priorities, numerous dependencies, and pre-existing commitments. The design effort must evolve the organization while dealing with these realities.

Human Limitations

While it would be ideal to engage everyone in everything affecting them, realistically it is not possible. There a many human limits mitigating the possibilities for a design approach. These limits include

- Cognitive energy to pay attention
- Interest in various topics
- Speed to learn new processes, technologies, and relationships

- Time available
- Effort that can be applied to engage them

As a result, a design effort must resolve many complex local situations. This requires involving large numbers of people. Additionally, it also means the design effort must evolve along with the organization's capability to change.

Systems of Design Conversation

What kind of design effort is needed? Somewhat recursively, the Social Systems Design response was to use Social Systems Design to design it. Banathy (1996) uses the phrase "designing the designing system" (p. 258) which often evokes a reaction from students. While the unusual phrasing recognizes that large-scale participative design is itself a human system, designing such a system can be daunting for the average worker. Thus, given the known and persistent characteristics of organizations as discussed in this section, there are certain patterns of "designing the designing system" which have tended to work. These are described in the material that follows, and can be of value in architecting a large-scale design conversation.

The basic principle of scaling the design conversation is distributing the decision making in the design effort to the appropriate stakeholder groups while maintaining some fidelity to the overall direction of the design. This requires creating a system of conversation where subgroups can design freely yet maintain connection to the larger design concept. This distribution of decision making inherently also means the constituent groups discover things, so their ideas must also be fed back to the overall design and potentially modify it. Thus, the designing system is also a learning system.

This section discusses guidelines for creating such a system of design conversation. The ideas originate from applying Social Systems Design principles to small- and large-scale situations at Lucent Technologies and Cisco Systems. While there are too many variables to specify an exact system of design conversation applicable to every situation, some guiding ideas about how to extend Social Systems Design into these kinds of organizational settings have been learned. The guidelines presented here focus on constructing a learning system based on balancing the development of design knowledge collaboratively and interactively across three dimensions: Knowledge, Artifacts, and Structure.

Knowledge Dimension

In essence, design is about taking the intention and making it more concrete. To do so, we have to develop *design knowledge* of how the intention will be realized as actual behaviors performed by people. This knowledge is not a document. Rather, knowledge is something people have in their heads as a result of experience and study. It is the result of learning.

Normally, the steps in a design methodology are used to develop design knowledge. As discussed, Social Systems Design recognized the output of the step is not an artifact but shared knowledge among the community, so the "steps" in social systems design are *spirals* which are used to create knowledge.

Developing design knowledge in a complex design can always be viewed as having at least four basic levels of development. These levels and associated spirals from Social Systems Design are as follows:

An intention to change or create something: This is usually the vague, undeveloped desire of the originator to create a change.

A concept of what the solution will be: A simple concept of some kind is needed to keep focus so more detailed work required in a complex design can be accomplished. This understanding is the output of the spiral "Formulating the Core Definition."

A detailed framework of the solution: Depending on the nature of the design, rigorous inquiry is needed to determine the appropriate tangible results. When designing a house, this framework comprises the detailed architectural plans; when designing an exercise program, this framework might be the exercise guidelines and schedule of workout days. In designing human systems, it is the functions that must be performed to achieve the organizational purpose, or the operating model. This model must include ways to shape the process of providing the service or product as well as the incentives, priorities, and management style. Thus, this framework is the result of two spirals "Determining the Functions," and "Designing the Enabling System."

The components *derive from the framework*: These are the tangible behaviors and supporting resources or technologies. The understanding of the necessary components is the result of the spiral "Formulating the Core Components."

These basic levels serve well for a simple situation where there is roughly a single group, perhaps of size less than 70 people, who design for themselves. But, when the target population in design is larger, additional challenges are introduced, as discussed in the previous section. These include (a) human limits to how many people can work together meaningfully, (b) many local variations, and (c) differing priorities about what can be accomplished and when.

The solution is modifying our concepts of how design knowledge is developed so we can distribute the design conversation to many groups. This is accomplished by dividing the framework and components into global and local partitions. The global framework addresses what is common to local frameworks, and local frameworks deal with the specific needs of more discrete communities. This is shown in Fig. 1.

Adding different framework levels to the model allows the space for different communities of designers. They can design operating models to fit their local situations but maintain some fidelity to the larger operating model. They work through the spirals of design, each at their respective levels, with some boundaries imposed by the higher level model, as indicated by the bidirectional arrow.

The global level framework is not a specification but rather a high-level function-structure lens (Banathy, 1992) that delineates what I call a *collaboration framework*. This collaboration framework is a systems model purposely showing relationships

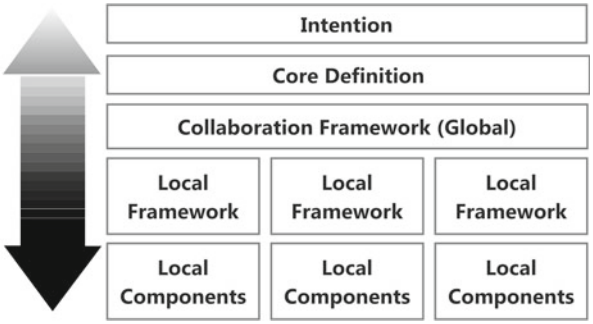

Fig. 1 Extended design knowledge levels

between local entities, but not within the local entities. Each entity on the collaboration model has an owner, and the only requirement is for entity owners to negotiate linkages between themselves—not what is within their assigned local entity. The collaboration framework enables the constituents of the local entity to create their own operating models while maintaining connection to the others.

The usage of the collaboration framework is unique and has certain nuances that make it a powerful tool. As discussed, it is not so much as a specification for the future state as a model for how the local design activities should relate to each other. To understand this more deeply, consider how a large jigsaw puzzle of a detailed farm scene could be assembled. The farm scene shows a red barn, many farm animals, fences, large open areas of a sky and large open fields of wheat. The edges are standard interlocking puzzle pieces in the style of tabs and blanks. One way to build this puzzle would be to take piece at random and start trying to match it to every other piece in the box until finding a match. Then, the process would be repeated with the next piece. This linear approach, while methodical and probably ultimately effective, would likely take an excruciating long period of time.

Experienced jigsaw puzzlers assemble the puzzle differently. They realize the jigsaw puzzle has a certain inherent model. Even without the picture, the puzzle has a border of some kind and has pieces with interlocking edges that must eventually all fit into a unique combination. Further with the picture in mind, it is known the puzzle has zones of similarity—the redness of the barn, the blues of the sky, the parts of the barn animals. Some of the pieces have one tab; others might have tabs on all sides. With this knowledge of the patterns and structure of the puzzle, the experienced puzzler creates categories for the structural areas and begins sorting pieces into them—edges, animals, sky pieces, wheat pieces.

This method is effective not only for one person but for a group of people working on the same puzzle. Other puzzlers can each take a recognizable category of pieces, such as edges, familiar shapes, or similar colors. Each puzzler knows the general categories of others and sorts the pieces relevant to them, while trying to assemble the pieces in their respective categories. Of course, because the categories are fuzzy, there are overlaps—a red piece which is also the edge of a barn. Generally, puzzlers follow the social convention of pulling unassembled pieces into their own pile, but not disassembling another's section to obtain a piece. In this way, the model

Table 1 Design knowledge levels and associated artifacts

Design dimension	Documentation dimension
Intent	Statement of intent or purpose
Core description	Core definition statement
	Systems-environment lens
Framework	Function-structure lens
	Process-behavioral lens
Components	Resource lists
	Role descriptions
	Technologies

of the puzzle becomes a collaboration framework, providing definitions and guidelines as to how to respond to the consideration of each new piece.

Operating model builders work similarly. They use the components and relationships common to all and design their own local operating models in a way they fit with the whole. The frameworks help sequence the conversation by minimizing distractions and creating a focus on the critical topics and issues at the right time.

Artifact Dimension

The ability to think more deeply about the design is constrained by the level of documentation, especially in larger groups. That is, developing greater specificity is difficult without drawings and specifications. Although it is impossible to capture all the design knowledge, especially in large, complex situations, we can capture key artifacts and agreements to keep the design on track.

Documenting the design involves the creation of artifacts that are kept in a common repository, or *knowledge base*, which all members of the team can access. They are called artifacts because they could be drawings, tables, charts, data in software applications, or physical models. This provides the transparency to what has been decided and also facilitates having access to key documents.

In Social Systems Design, the artifacts center around the *three lens modeling system* used by Banathy (1992). Examples of the artifacts associated with different design knowledge levels are shown in Table 1.

The proper application of this dimension requires developing some essential design behaviors. These include the following:

Stewardship of the knowledge base: Artifacts are used to forward the design activity, not just record history. Thus, ideally the knowledge base is kept focused and relevant. While controlling everything going into the knowledge base is probably too constraining, companies who specialize in knowledge management often have a steward who keeps the knowledge base coherent and easy to use.

Accountability to group decisions: Proper use of the knowledge base also requires discipline on the program team. This discipline maintains consistency with the

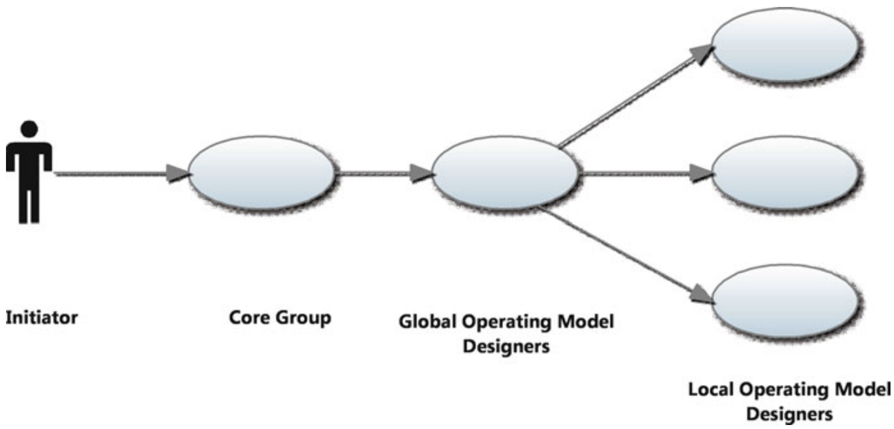

Fig. 2 How the initiator distributes design activities

knowledge base, which is the record of team decisions. So the team must develop the habit of building on, and working from, the knowledge base—not continuing to generate new and unconnected ideas.

Structure Dimension

Successfully distributing the design activity involves engaging multiple groups of designers who each have their role in developing design knowledge. In a large-scale designing system, these groups are organized into a structure, as shown in Fig. 2. This structure shows how the initiator distributes the design activities all the way out to local design groups. The design levels of Knowledge Dimension allow the appropriate task to the appropriate group.

Each group has responsibilities in shaping the design knowledge. These designing groups are comprised of a handful of people drawn from both management and individual contributors.

There is not necessarily an expectation that everyone in the organization will be directly involved in designing. Rather, group members are to be champions or ambassadors for their constituents. This means the local designers should gather input on the design from their constituents and use their interpersonal influence to help constituents learn how the design will work. Their interpersonal connection is important groundwork for eventually implementing the design (Rogers, 2003).

These responsibilities of each group in the structure are further outlined in the Table 2.

The design could flow more vertically down the hierarchy or horizontally across the organization. In a top-down situation, the structure of teams could comprise a higher percentage of managers. Senior leaders might be the initiator and Core

Table 2 Structure of design group responsibilities

Groups	Group responsibilities	Typical members
Core group	Develop the core description Engage and facilitate the system of conversation Influence key leaders who have formal authority of the target system	Planning team, sponsors, key leaders or initiators, design methodology experts
Global operating model designers	Define the collaboration framework level of the operating model Define common technologies and components Gather requirements and feedback from local teams	Key leaders and individual contributors drawn from the organization
Local operating model designers	Define the operating model for their local environment and local components Gather requirements and feedback from local constituents Act as champions for local teams Include and influence management of local teams	The specific process or services owners and members of their teams Managers of employees involved in the local operating model

Group, even comprise the Global Operating Model design team. This would require managing the challenges inherent in having people with position power unduly influence the design process.

Alternatively, in a lateral design, a cross-functional steering committee of key leaders from several affected parts of the organization might serve as the Core Group. Key managers and process owners with cross-functional responsibility could form the Global Operating Model team. Since the connection to the leadership hierarchy is indirect in a lateral design effort, the members at each framework level will have to spend more time involving leaders in their respective parts of the organization. But, better decision making may be achieved through more diverse and open participation.

Note that the general group structure proposed is for fairly large implementations. For smaller organizations, it may be possible to collapse the groups.

The Three Dimensions in Action: A Case Study

The goal is to create a system of interaction which integrates all three dimensions together. This involves having the right structure of teams, the right facilitative process, and stewardship of the appropriate level of documentation. When this occurs, the design knowledge can ripple outward from the initiator and Core Group, as shown conceptually in the diagram below. If one dimension lags, the forward motion will stall, so all must move roughly together (Fig. 3).

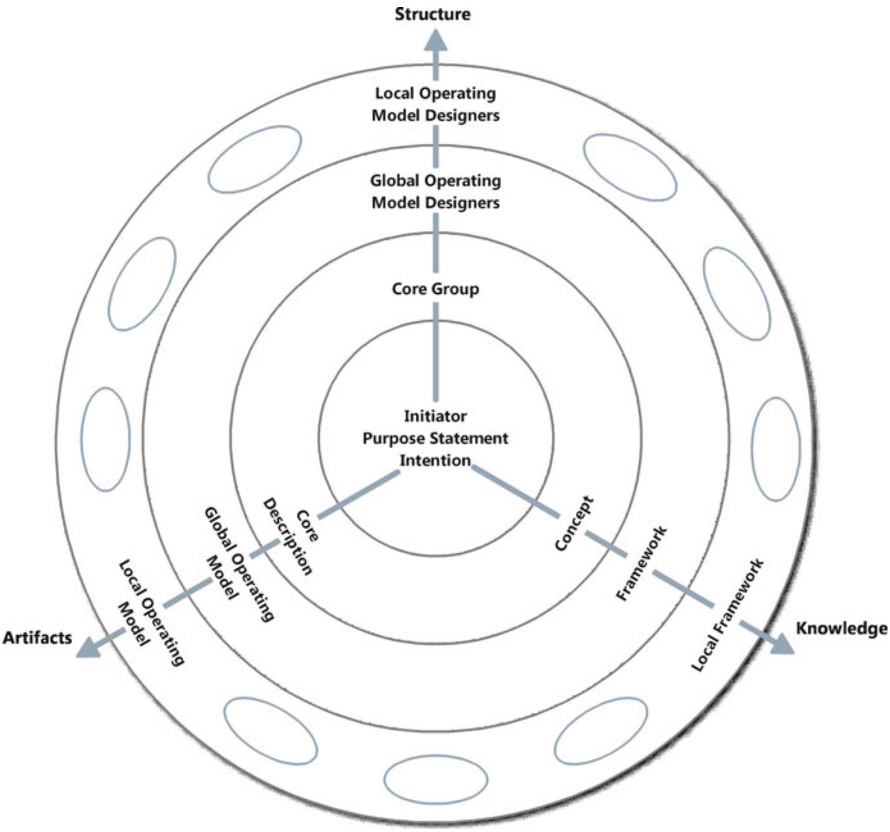

Fig. 3 Three axes of developing participatory designs

This dynamic of three dimensions animates the system of conversation. There are many ways the teams and levels of design outcomes might be subdivided, but the basic dimensions must be maintained. This creates the interplay necessary to produce involvement, meaning alignment, diversity, and disciplined thought.

To understand this more deeply, let us briefly examine how this worked in a real situation involving an IT Operating Model at Cisco systems, around 2006. The organization was comprised of approximately 6,000 people. For several previous years, there had been efforts to improve IT efficiency by revamping and standardizing certain major IT processes, such as Portfolio Management, Workforce Planning, and Operations.

During the summer of 2006, the owners and program managers of the change initiatives were engaged in intensive conversations with the CIO in an attempt to describe how these efforts were related to each other. At the time, the prevailing image was a pillar-based structure looking faintly like the Parthenon. But, there came a point where the CIO proposed to represent the whole operation of IT as a model. From that, a single-page model along the lines of a functions-structure lens was created. This model is redrawn in Fig. 4, simplified for explanatory purposes.

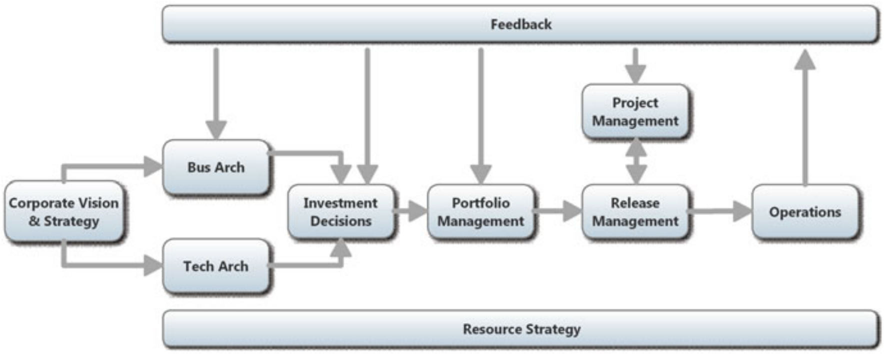

Fig. 4 IT operating model example

This representation became the collaboration framework. Each box on the drawing was assigned an owner. Interestingly, in early versions, the owner's photograph was also shown on the box! A Core Group was formed who then facilitated the owners through several multi-day workshops to create the next layer of detail about what would transfer between these boxes (grey arrows). The inside of the box was left to the owner. During the initial workshops, a second, much more detailed drawing was created, as well as a general maturity model and success metrics.

Armed with a deeper understanding of the handoffs between boxes, each owner established a local group to design a sub-model of what was inside the box. Some of the owners completely redesigned their models. Others only needed to streamline and consolidate some operations of their local model. Each group devised roadmaps to improve their respective processes and optimize them in accordance with the agreed upon maturity model framework.

The box owners continued to meet regularly with the Core Group and each other to review progress, update roadmaps, and discuss dependencies. This enabled them to have the flexibility to respond to emerging conditions in their environment, while overall moving in common and coordinated direction.

The work on the IT Operating Model resulted in millions of dollars of cost savings and improved customer satisfaction over the ensuing years. It also provided a *big tent* where the interested parties could gather and learn to collaborate on organizational design. This paved the way for subsequent more rigorous implementations of enterprise architecture methodologies, practices, and software tools.

Summary

The pressing need for the continuous redesign of organizational operating models increases the demand for new approaches to conducting design. To manage the dynamics of change and order, our new approach must embed the capability to redesign the organization at all levels, not just the domain of executives or process experts. To that end, the design activity must guide overall direction while simultaneously parceling out design activities to those who have local knowledge of the requirements. Thus, we have seen the traditional organizational design activity must be transformed from a set of logical steps conducted by experts to a system of design conversation engaging stakeholders at many levels of the organization.

Social Systems Design has provided important underpinnings for how to architect such collaborations. In this regard, Social Systems design offers a model for architecting rigorous design collaboration. Inherent to this approach is the realization that designing complex social systems is not just a construction or specification process, but rather a human knowledge development process. On this basis, Social Systems Design introduces systems modeling and also offers a design approach with a facilitative aspect. This facilitative aspect maximizes group innovation and commitment while reducing the negative group dynamics that can cause participatory work to go awry.

Although the exact way to construct a system of design conversation varies depending on the circumstances of a given organization and industry, this chapter outlined general principles for constructing such a "designing system" by using three interrelated dimensions of Knowledge, Artifacts, and Structure. Developing these three dimensions properly enables design knowledge to be interactively and recursively developed across a large cross-section of people

The importance of viewing the design process as a human collaboration effort cannot be underestimated in our complex knowledge economy. In fact, design may become a way of life in organizations, rather than a special event. As organizations strive to become ever more adaptive to the rapidly changing word, participative methods of design are critical. This is the only way to maintain the innovation needed to excel in an environment of continuous change.

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