Design Unbound

Designing for Emergence

Ecologies of Action

Ecologies of Influence

Intervals of Possibility

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Abreu and the Venezuelan Youth Orchestras

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Preface

In the first half of 2010: the tallest man-made structure opened in Dubai; an 8.8 magnitude earthquake in Chile set off a tsunami over the Pacific that killed hundreds; the Deepwater Horizon oil drilling platform exploded in the Gulf of Mexico causing one of the largest oil spills in history and prompting international debate and doubt about offshore drilling; Standard & Poor's downgraded Greece's sovereign credit to junk, triggering the decline of stock markets world-wide and furthering a European sovereign debt crisis; Picasso's *Nude, Green Leaves and Bust* set a new record for the sale of an art work at $US 106.5 million; protests in Bangkok ended in a bloody military crackdown; scientists announced they had created a functional synthetic genome; ethnic riots in Kyrgyzstan caused the deaths of hundreds; the first 24-hour flight by a solar-powered plane was completed; WikiLeaks leaked over 90,000 internal reports about the US involvement in the war in Afghanistan; and the World Health Organization declared the H1N1 influenza pandemic over … a sampling of events and problems at global scale.

Summer 2010, at an information technology roundtable discussion in Aspen Colorado, one of the participants[1] said, "the world just came together too quickly. We have little understanding of its *true* diversity." A second participant[2] followed up later with the comment, "we are forcing the past as a solution set. But the past as a solution set is not a viable option. We need a new tool set."

At a moment when every action seems to dislodge stones in precarious terrain—ecologically, politically, culturally, technologically—we are increasingly confronted with complex dynamic events and complex problem environments. These are *environments* rather than isolated problems, and they are socio-technological in nature at multiple scales from the

individual, to communities and organizations, to societies. These problem environments are often characterized as 'wicked' problems.

What you are holding in your hands is a booklet that begins with a case study to set the stage for a new tool set and practice for having agency in what we call a white water world—one that is rapidly changing, hyperconnected and radically contingent. One in which complicated problems have grown up to become 'wicked' problems because of this connectivity, speed, and contingencies that are often elusive and shifting.

Chapter 1 tells the story of Abreu and his Venezuelan Youth Orchestras, not to claim victory over an intractable problem but to introduce a way to think about making tangible progress on these kinds of problems.

Chapter 2 presents the concept and lays out the framework of *Design Unbound*. Beginning with a characterization of the white water world, we move from 'what' to 'why' and then on to proposing a new worldview for working *in* and *on* this world. This worldview is based in the ecological strand of complexity science but draws from other strands as well. In addition to providing a third window on the world (Newton and Darwin contributing the first two), it gives us affordances in the form of theories, concepts, frameworks, methods and tools to create new things and make unique progress in "a world that has just come together too quickly."

Although seemingly conceptual and philosophical in tone, the chapter moves pragmatically into how to use this window. It talks about design being *unbound* from thingness and disciplinary boundaries: unbound from thingness so that it

can shift its focus from designing things, as content in the world, to shaping contexts; and unbound from disciplinary boundaries so that it can make progress on highly entangled problems. This is the setup for *designing for emergence* as the means for agency and impact - agency and impact on complex problems, but also, agency more broadly in today's world - at all scales, from the personal to the public, and from the local to the global.

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Chapters 1 and 2 are the initiating chapters of a larger work *Design Unbound: Designing for Emergence in a White Water World* (MIT Press, 2018). *Design Unbound* presents a new tool set for having agency in what we call a white water world—one that is rapidly changing, hyperconnected and radically contingent. The tools presented are not the tools of a coder or a carpenter but tools that are directly associated with a new kind of practice that is the offspring of complexity science and architecture. Complexity science gives us a new lens through which to view the world as one that is entangled and emerging. It gives us new concepts and tools. Architecture has always been about designing contexts in which things happen.

Design Unbound is a system of nineteen chapters that present a set of ten tools and three metatools for this new practice of design—for working in today's complex systems environments and on today's complex systems problems. These tools begin in architecture and then expand by drawing from a vast array of domains: from architecture, science and technology, philosophy, cinema, music, literature and poetry, the military, even. *Design Unbound* aims to blend a polymathic reservoir of thought seamlessly with real life examples of successful

design and action, but we do not expect all readers to be polymaths. So, from architects to people involved re-conceiving higher education to the public policy or defense and intelligence communities, each audience will find different tools most relevant, and different chapters will resonate with different reading audiences.

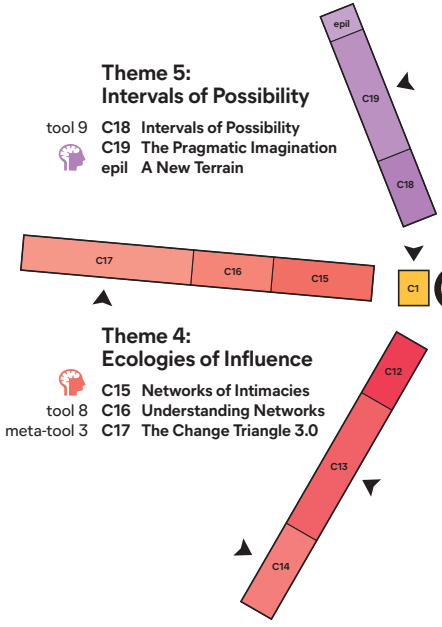
The chapters are loosely organized in five themes; each theme begins with a chapter that wrestles with the underlying 'why' of the theme and then includes a set of tools. These two chapters, "Abreu and the Venezuelan Youth Orchestra" and "Design Unbound" do not belong to a theme, per se, as they are the launching platform for the larger work.

1 Tim El-Hady, Director of the Middle East Leadership Initiative of Aspen Institute's Global Leadership Network.

2 John Rendon, founder and head of the Rendon Group, a global strategic engagement consultancy, who has served as senior communications consultant to the White House and Department of Defense, as well as many other political, diplomatic and crisis teams.

Map of Chapters

▶ = entry points



Launching Platform

C1 Abreu and the Venezuelan Youth Orchestras
C2 Design Unbound

Theme 1: We Start in Architecture

C3 Starting in Architectural Design
tool 1 C4 Rapid Iteration in a Problem Solving Space
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Abreu and the Venezuelan Youth Orchestras

In one of the roughest neighborhoods of Caracas, thirty-seven small children between the ages of five and seven sit in metal folding chairs arranged in orchestra formation. They are poised to play what look to be conventional instruments. From the edge of the room, the only peculiarity seems to be the small size of the musicians, whose feet do not easily reach the ground. But upon closer examination, one sees that the instruments are actually made of board, paper, paint, and string. True to life in their size, mass, proportion, and technical detail, they are easily mistaken for real instruments.

They are painted to look like real instruments. They have strings that need to be replaced when they break. They have pegs for tuning the strings. And they have all the correct grips and fingering positions. The children hold them correctly, proudly, and with care, as if they were real instruments.

With their orchestra leader's keen voice as a guide, the children begin to sing about the notes, tones, and rhythms that their various instruments make. Their voices are the music that brings the silent instruments to life. They are the orchestra. It is easy to forget that the instruments are made of paper, as the conductor occasionally breaks into the music to correct the silent bowing of a student.

The idea of the *paper orchestra*, as it is called, is to engage the children within the social and musical space of an orchestra. Sitting together with their simulated instruments, they learn discipline and they learn the value of playing in a group. When they are ready to move on to real instruments, they have already learned a tremendous amount about how to play in an orchestra and what it means to do so. Between sessions, one small child already voices concern that the percussions are too disorganized. Although the paper orchestra was originally

an inspired, make-do solution to the problem of a lack of real instruments, it is now the critical first stage in the Venezuelan youth musical program called *El Sistema*.

The charismatic Venezuelan economist and musician José Antonio Abreu founded El Sistema in 1975. El Sistema—the System—is a youth orchestra and choir system that has transformed the lives of hundreds of thousands of lower- and middle-income Venezuelan youth. From a simple beginning to teach his love of music to a group of children, it has become a program of social rescue and cultural transformation for some of the most vulnerable sectors of the population.

José Antonio Abreu grew up with music. Encouraged to excel as a musician by his own family and community, he wanted all Venezuelan children to have the same opportunity. Today, over forty years since its first rehearsal with eleven children, Abreu's program now reaches over 400,000 youth at risk. Eighty percent of these children are from underprivileged and marginalized areas where daily life is difficult, and violence is pervasive. There are now close to three hundred centers in Venezuela that provide an alternative environment to the dangers of the streets. His aspirations high, Abreu wants to reach one million students in the next ten years.

El Sistema is a program for social change through the power of music. But more than just promoting music to teach discipline and foster emotional transformation, Abreu has created a structure that also aspires to excellence. Pathways to excellence are fueled by ambition, and this is the most productive force of change.

"On a purely social level we save them from poverty, but what we achieve is high quality music. They are feeling the music, living the music."[1]

Abreu's insistence on excellence has produced musicians who have gone on to become major musicians in some of the greatest orchestras of the world. Among these exceptional musicians is Gustavo Dudamel, who has conducted four principal orchestras, including the Los Angeles Philharmonic. These musicians are role models. Their stories are narratives of change that inspire new pathways of aspiration and excellence.

El Sistema couples the efficacy of incremental achievement with increasing levels of challenge, to sustain ambition. From the paper orchestra, the children move into fully instrumented orchestras and choirs. The children audition, but they do so principally for placement; no child is excluded. All children are given the opportunity to participate and to perform in one form or another. This no-exclusion policy is very important for driving the social change of the program.

For those who are motivated, dedicated, and talented, there is the opportunity to join the elite performing orchestras and choirs. Auditions are held every few months, and the musicians persevere month after month to win a coveted spot. Many children dream of entering one of these orchestras or choirs from the moment they enter the program. The different orchestral levels generate ambition and competition. They create a pull that motivates the students to work harder to continually enter a world of greater achievement. Many traditional elite youth orchestras only offer auditions once or twice a year, but the frequent opportunities to audition provided

by El Sistema means that the young musicians are motivated to try again and again, conquering failure through the strong encouragement to persist.

Four Circles of Influence

> Music has to be recognized as an ... agent of social development in the highest sense, because it transmits the highest values—solidarity, harmony, mutual compassion. And it has the ability to unite an entire community as well as to express sublime feelings.
> —José Antonio Abreu[2]

"Even though we live in a dangerous neighborhood with a lot of crime, they've given us an education! A lot of people say: 'He comes from a barrio and he's had no education.' We're learning to play the trumpet so that we and our families can keep improving our lives. We're taking big steps, like elephants!"[3]

Each child has a story and Abreu cherishes them all. But as significant as these individual stories of transformation are, it is the multiple scales of cultural transformation that have generated the most impact. Abreu articulates these as circles of influence—influence at the scale of the individual students, their families, their communities, and ultimately, nationally and internationally.

At the scale of the individual, it is clear what the program has given to each of these children. It can be seen in their faces. In addition to providing a safe haven from the streets, El Sistema cultivates self-esteem, confidence, and facilitates a process of identity construction. The discipline and organizational skills the children develop make them better students, and by teaching others, they learn leadership skills. The developing sense of commitment, responsibility, generosity, and dedication to the orchestra forms a group dynamic of enormous value.

Youth music programs throughout the world have demonstrated that discipline and a goal-oriented focus on perfection are valuable in supporting the development of the individual child. But because this is a program to build not just musicians, but orchestras, each musician comes to understand that his or her *unique* role contributes to the greater ensemble.

Music, by its nature, generates social groups. Within the orchestra and choir, the individual learns to listen and respond to the surrounding musical context, creating a very powerful social space. Self-correcting until they find the harmonies and rhythms that form a musical collective, each musician learns to participate in an interdependency of purpose. In many ways, it is the harmony of differences that makes music so powerful. When different instruments and musicians find their musical integration, the tones and rhythms literally resonate.

But beyond enhancing the child's social development through playing together, the music also plays a major role in shaping their personalities. "It helps them develop their emotional awareness—the aesthetic potential that all children and young people possess. This will enable us to open up new horizons for them.... Children who are materially poor gain spiritual wealth through music, and once music has brought them such riches, their minds, souls and spirits can carry them onward and upward."[4]

Discipline, self-esteem, confidence, identity construction, social intelligence, and emotional awareness, are all powerful developmental skills that the individual musician acquires within the musical ecology of Abreu's program.

At the scale of the family, El Sistema has also had significant impact. It may be the child's decision to pick up an instrument

and join, but to become a musician capable of playing in an orchestra, a lot of support is required of the family. The parents must believe in what their children are doing, and support them both logistically and emotionally by taking them to and from the center, washing their uniforms, and attending concerts, even when the instruments are only made of paper.

Abreu talks about how the families are their most significant partners because the centers are providing the children with an alternative to the dangers of the streets: "For parents it acted as a barrier, a very important preventative measure.... [Therefore], when we set up an orchestra in one of these barrios and enable the children to spend their free time doing something useful and noble, their families become our first allies."[5]

But the orchestras become significantly more than just a good alternative to the streets. As they are transformed by their participation, the children become role models for their entire families. Feeling valued and supported, the children then go on to seek other ways to improve themselves and their families. They develop new dreams, goals, and behaviors that launch an ascending social path of consequence.

At the scale of the community, it is clear that the students' dedication and focus are key deterrents to prostitution, violence, and other destructive behaviors that degrade the life of the community, as well as the life of the child. This is very important.

But in addition, El Sistema was founded on the principle of being open and available to all, regardless of position, class, ethnicity, or economic status. Social inclusion at all levels brings the whole community together, and makes it stronger.

Families congregate and mix at the concerts, and communication is amplified around the emotional equity they all have found in their children's music.

Furthermore, according to Abreu, the orchestras and choirs become "creative spaces of culture and new sources of exchange and meaning. The spontaneity of the music makes it more than a luxury. It makes it a patrimony of society. From the moment a child begins to play an instrument, he is no longer poor. He becomes a child heading on an ascending path toward becoming a full citizen.... This is no longer putting society at the service of art, and much less at the service of the elites, but instead art at the service of society, the most vulnerable, the most poor."[6] Believing that art in Latin America should not be a monopoly of the elites, but a social right for all people, and that the orchestras and choruses are more than artistic structures—they are models and schools of social life—Abreu set out to create a different kind of teaching system.

The result is a system that has transformed Venezuela into a very distinctive musical force in the world. Individual musicians have gone on to take very prestigious positions internationally, and the Simon Bolivar Youth Orchestra is now world-renowned. **At the scale of the world**, El Sistema has had a strong and unique impact.

A group of preschool pupils.

A group of preschool pupils waiting to be picked up.

Cardboard instrument orchestra practice.

Cardboard violins.

El Sistema orchestra practice.

El Sistema orchestra practice.

Student in Sarría, a slum of Caracas runs home from school.

Student in an advanced class practice in the Sarría "nucleo."

Jose Antonio Abreu speaks to young El Sistema musicians in Caracas.

Gustavo Dudamel rehearses the Simon Bolivar Youth Orchestra at the Royal Festival Hall in central London in 2009.

A Structure of Adaptation

The idea of social inclusion at all levels through music is Abreu's very big idea. "To my mind, our social problems all stem from a sense of exclusion. If you look at the world, you see that exclusion in some form or other is to blame for the explosion of social problems everywhere. So we have to fight to bring as many people as we can, everyone, if possible, into our world of music, the world of the orchestra, of singing, of art."[7]

To achieve this inclusion the system had to find a way to respond to the different needs of each community from the beginning. Environments of risk vary tremendously with nuances of class and ethnicity. Abreu understood this challenge intimately, and he and his directors have developed a highly flexible management style that adapts itself to the particular characteristics of each community and region. "The idea of El Sistema must in no way be understood as something static. It is more of a structure in perpetual transformation and change, and a structure of adaptation according to circumstances—beautifully evolving into the modern world."[8]

Two examples of powerful adaptations of El Sistema are worth noting.

The first is *Nucleo San Vincente*, where Abreu takes the hope and language of music to the garbage dumps of Maracay—to the children and families who live in the poorest parts of Venezuela. The town of San Vincente is built around the landfill site that receives all the rubbish from Maracay. The children spend their days digging through the garbage in search of things to sell back on the streets. Living conditions are at their most basic.

El Sistema nucleo in a village.

Abreu's group established the *Nucleo San Vincente* with the intention of bringing the orchestra, instruments, teaching, and administrative staff, to the poorest areas, just as they had in other barrios. But they quickly discovered that they had to approach their work differently here.

"Here, you have to adapt to each child individually. It's not like working in another centre where there's a specific social level. Here, each child has his or her own story and you have to concentrate on that. These are children with many problems: emotional, psychological, all sorts of problems. So, what we're doing is a kind of social work. By giving them the language of music, we open up a whole new world to them."[9]

There is significantly less social order in San Vincente than in other towns and barrios. One cannot assume a specific social level or family structure. Every child's story is layered with emotional and psychological problems. These are stories

of constant struggle. So in addition to teaching music, they provide social support as well. But, it is still the music that has the power and efficacy to improve the emotional lives of the children. Because of its capacity to reach into the emotional depths of a child's personality, while also being fun to learn, the music becomes a language that opens up communication between the children and Abreu's team, and among the children themselves.

Nucleo Barquisimeto, the second example, is a unique school for children who are cognitively or visually impaired, have hearing or motor problems, autism, or learning disabilities. To work with these children, significant adjustments were made to the instruments and the teaching methods. It has become an extremely successful program, teaching and placing over 1,500 children in orchestras throughout Venezuela. These children are being integrated into society through their participation in the orchestras, and the best part is, when they reach a certain level of integration, they are able to become valuable members of the labor market as well. Providing meaningful pathways for each child to find a place of value in their own community, through the youth orchestras, is one spectacular success of this program.

In this *nucleo*, the greatest challenge was how to adapt to the needs of students with significant hearing impairments. Conventional logic suggests that one needs to hear to make music. Many community members believed that the school director's goal to have deaf children in the orchestras was overly ambitious, and even bordered on crazy. "It was hard work but fascinating. We had to find a way to bridge the gap between the accepted norm and our desire to give the deaf children the chance to enjoy music too."[10] Strong instincts, deep knowledge of their students, and necessity led the

school's director and chorus master to invent *the White Hands Choir*, which now performs throughout the world.

At the beginning of each performance, close to fifty children, arranged as one cohesive block of the choir, pull on white gloves in perfect unison, and wait, poised in anticipation with their instruments—their hands in white gloves—by their sides. The other half of the choir begins to sing, and led by their own chorus master, the white-gloved hands of the deaf students sign the words in rhythm with the singing. It is not really clear who is accompanying whom as the hands move through the air in perfect time with the music, as if the children hear everything. The signing hands capture the music in all of its richness—its tempo, its tonality, and expression. As over a hundred hands move through the air, one sees as well as hears the elegance of the choral soul translated into the music. It is a music that is fully embodied—a music of its own kind.

The group travels throughout South America, North America, and Europe, and has become a highly celebrated choir. The students love that they have found a way to enjoy the music and they love performing in public. They speak enthusiastically and eloquently of the music they make. "I like some of the songs we do more than others. In some of them, it's as if our hands were flying. That's why I like the Ave Maria so much. It's very moving."[11] They know what they have achieved.

The White Hands Choir in rehearsal.

A System of Action, Ecosystemic in Nature

El Sistema is much more than a music program. It is an entire *System of Action*, which has been created and implemented by a musician-economist turned orchestra director. As a system, it is made up of interrelated components that affect the way people do things. These components are also interdependent. A change to one component affects the response of all the other components. And they are interactional, meaning that single actions or events can reverberate throughout the entire system. New things tried—the white gloves, for example—cause a reaction that can be assessed and then rejected or amplified within the system. When one thing does not give a productive response, something else can be tried.

As a System of Action, El Sistema is about action. It is about doing things even without knowing what the results will be. It is about inventing things that create opportunities for new behaviors, through participating in spaces of action that are pervasive and build on each other. The interlocking and interdependent components influence each other, and operate to transform the world of these children, their families, and communities, as an *emergent* phenomenon.

As a System of Action, El Sistema is transformative. It alters both explicit behaviors and embedded habits. It is capable of affecting not only single actions or actors, but also enabling single actions to affect a larger social ecosystem.

A System of Action within the greater social ecosystem affects change *from the inside*. From the beginning, Abreu understood that for El Sistema to succeed, he would have to capitalize on the unique strengths of the society in which it would be built, and that it would have to penetrate deep within that society. Venezuelans love music in all forms. This was a strong force. And there was an urgent need to provide

The term ecosystem refers to the combined physical and biological components of an environment, and their interdependencies. "A mechanical system—a watch for instance—is divisible, while an ecosystem is indivisible because of well-developed interdependences."[12] Social ecosystems refer to the combined, interdependent human and social components of an environment or community. A social ecosystem is generally an indivisible unit within a larger social, political, and economic environment in which those factors of society that affect interactions among people—including technology—function together as an indivisible system of exchange.[13]

Because ecosystems are indivisible, they are environments where all work feeds back into, and affects, the entire system. Every recalibration made, as new constraints and opportunities associated with specific local contexts emerge, leads to learning, which then improves the efficacy, and evolution of the entire system.

real alternatives to the "dangers and temptations" the children faced on the streets. This urgency gave rise to the program and is responsible for the high level of commitment, support, and growth it sustains today. Additionally, Abreu knew that the strong social structure of extended families and dense communities would supply a body of support for the children and the centers, provided the families and communities were integrally included.

But perhaps the most effective aspect of Abreu's approach was his awareness that El Sistema could not succeed as the project of a group of individuals operating alone on the edge of society. It had to be built deep within the society, in constant dialogue with its government, cultural institutions, and key influential individuals. For this, Abreu put his experience as an economist and as a politician to work. His capacity to work with these different entities is a large factor in the efficacy of the program. Financial and policy support, as well

as social assistance has come from all of these partners. Abreu's passionate commitment and persuasiveness support his other strengths, allowing him to create a program of such tremendous power.

The conditions for change existed within Venezuelan society, but it required seeing those conditions—camouflaged as they were by the many needs and norms of the society around them—and then providing a sympathetic and skilled set of maneuvers to catalyze the necessary action. Abreu intimately understood the society in which he was working and was able to invent and implement methods that would prove effective from deep inside that society.

Abreu's El Sistema is a new way of thinking and doing; one that understands ecosystems and the dynamic processes within that often lead to change and evolution. This is different than other kinds of orchestra programs or music schools, where the goal is excellence, but the program is structured and operated in a more mechanistic manner.

Many of these programs keep the music lessons relatively distinct from performance. The elite orchestras associated with these schools, academies, and conservatories are usually only accessible to a small percentage of the students. Smaller chamber groups exist, but are less performance-based, and they are often more competitive than social.

Young musicians attend lessons and perform as a group once, or at most, a few times a week for an hour or two. Musical development is often an individual competitive endeavor. Professors promote their own students, and students seek out the well-connected professors. It is very hierarchical and distinctly different from El Sistema, in which

the school—*the Center*—becomes a second home. Filled with students six days a week, it is a community in which learning and playing music is the ethos of a greater mission.

In a program that is complex and ecosystemic in nature, all the component parts, all the people, and all the activities are integrated, extend broadly into the community, and are engaged with over long periods of time. All the components are essential. In a more traditional program, the learning and performing parts are separate, and the program functions differently for the various individuals involved. Most importantly, the more traditional music programs focus on the individual child, as opposed to the social group in which performing is a key component of the learning and the transformation that results.

El Sistema is a stunning story. It is radically effective in its capacity to work at the social ecosystem level, taking on a problem of immense proportion in Venezuelan society. Abreu's system was directed toward action from the very beginning. Given this, it required a clear vision that captured the imagination, and incited others to work for change. But, It also required grass root efforts; people who believed, who made the vision their own, and built the small stories that supported the larger vision. Sometimes the smaller stories, as actions, came first, and from these larger strategies developed. Either way, the vision and the stories that arise from small actions are critically interrelated. And finally, the system also required the invention of crucial mechanisms, like the paper orchestra or the mentorship mechanisms, which turned vision, and strategies around that vision, into action. All of these components are held together by the society—the ecosystem—in which they are embedded.

As in all complex projects, one imagines that there was work done, there were things tried, and then recalibrations were made through a strong critical understanding of what worked, and what did not. Abreu's system was conceived to adapt to different community contexts, and its ability to recalibrate to accommodate those different contexts has been a major contributor to its success.

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The story of El Sistema has unfolded over the past forty plus years. It has not been without its critics[14] and it does not claim to have improved the socio-political environment of Venezuela, more broadly, but it has had an impact on one of the most intractable urban problems of this era. By providing pathways for children of poverty to imagine, act on, and in many cases, achieve a better future, and be engaging their families and communities in this ambition, it has had a positive affect at scale. "People talk about a new energy, they say the children have a certain spirit. But that spirit is the social change which the music has brought to them."[15]

Inspired by José Antonio Abreu's El Sistema, and some of the more complex problems we have intersected with in our own work, this book began from a belief that design, as practiced within the disciplines of architecture, where one designs buildings as contexts for complex human interactions, landscape architecture, where one designs deeply aware of processes over time, and urban design, where one designs multi-dimensional and multi-scalar systems as well as things, might be able to aim itself at designing more than just fixed tangible things; that the DNA of design in these domains has untapped potential to create a new practice of design for agency in the 21st century.

By focusing on contexts not content, on entanglements of influences not simple causalities, on dynamic not static systems, and equipped with new methods and tools for wrestling with entanglements and designing for emergence, we believe this practice has the potential to affect the future in a bold way.

Endnotes

1 Henry Crespo, director, El Nucleo Maracay. From the film, *El Sistema: Music to Change Life,* Paul Smaczny and Maria Stodtmeier, 2009, at 25 min 15 sec.

2 "José Abreu on kids transformed by music," TED 2009 talk. https://www.ted.com/talks/jose_abreu_on_kids_transformed_by_music.

3 A student, *El Sistema*, at 94 min 25 sec.

4 José Antonio Abreu, Ibid., at 69 min 30 sec and 79 min 30 sec.

5 José Antonio Abreu, Ibid., at 48 min 35 sec.

6 "José Abreu on kids transformed by music," TED 2009 talk.

7 Abreu, *El Sistema*, 95 min 20 sec.

8 Abreu, Ibid. 12 min 20 sec.

9 Adrian Ascanio, teacher at El Nucleo San Vicente, *El Sistema*, 76 min, 20 sec.

10 Naybeth Garcia, chorus master, El Nucleo Barquisimeto, *El Sistema*. 81 min 28 sec.

11 Yowuanuska Cordero, student of White Glove Choir, *El Sistema*. 83 min 26 sec.

12 Sven E. Jorgensen, Felix Muller, editors, Handbook of Ecosystem Theories and Management. (Boca Raton, Florida: Lewis Publishers/CRC Press LLC, 2000), p. 14.

13 Central to the social ecosystem concept is the idea that individuals interact with each other in their community in some manner, either directly or indirectly, through systems of exchange, and that these are all contextually dependent as well.

14 One of the more critical voices of El Sistema has been the British music scholar, Geoffrey Baker, who disputed many of the claims made by and about El Sistema in 2014 in an article in The Guardian (https://www.theguardian.com/music/2014/nov/11/geoff-baker-el-sistema-model-of-tyranny) and book, El Sistema: Orchestrating Venezuela's Youth, (Oxford University Press, 2014). There has been a significant amount of response to these two pieces, denouncing Baker's criticisms, by both El Sistema advocates and music education experts. It is important to acknowledge the controversy, although it does not negate the accomplishments we have focused on above.

Additionally, it should be noted, that there is now an international consortium of El Sistema influenced programs worldwide. See El Sistema USA (https://elsistemausa.org/) and El Sistema Global (http://sistemaglobal.org/).

15 Gustavo Dudamel, director, Simon Bolivar Youth Orchestra, *El Sistema*, 31 min 20 sec.

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Design Unbound

A Visionary Pursuit: Optimistic and Opportunistic

Design has always been a visionary pursuit and a visionary practice—one that projects the future while remaining deeply grounded in the past and the present. The link between vision as a mental activity (imagining a future) and its accomplishment in the world (the building of the imagined future) is design. Design's principal focus is the making of things, whether material entities, virtually produced material entities, or fully virtual entities. Because design's principal enterprise is the making of things that operate in the world—a world unfolding—design is an agent of the future.

Design is **optimistic**. It brings new things into the world. Designers take on problems, model them, frame them, and create responses through the distribution of material, real or virtual, in space. Designers are by nature **opportunistic**. They create openings from which to make things. When there are no clear and present problems defined, they go out and find them embedded in the intricacy of everyday life. By problems, we do not mean only things problematic, but also opportunities for working on the questions, puzzles, and enigmas that are inherent in human existence.

The beauty of design as an approach to life is its creative opportunistic tendencies. The entrepreneurialism associated with these tendencies has always been a driving force, and one that has been effective in negotiating change at all scales. From elegant objects to infrastructure, design has the distinct capacity to affect the context in which it sits.

Visionary, optimistic, and opportunistic, design is different than instrumental problem solving. Instrumental problem solving works to solve defined problems. Design works within a rich mental space in which problems are the impetus for work that converts ideas into things that are integrally linked

to human behavior, perceptions, values, and desires. As such, design may or may not *solve* problems *directly*. It engages the life around problems. This distinguishes design not only in its focus, but also in the methods and practices it engages. It requires a different set of skills and capacities, a different disposition, and a different set of instincts. Quite simply, **design has a different DNA.**

The optimism associated with design is a **skeptical optimism.** It is an optimism shaped by questions that arise. It is not abstract or naïve. As a process that interweaves thought with action, one receives feedback from the action, and the feedback leads to new questions that expand understanding of the problem space. Thought is grounded through the test of theory hitting the real world. Trying out ideas leads to failures and unexpected new questions, and ultimately to greater depth, breadth, and sophistication of the responses. Design activity relies on *perpetual* skeptical optimism. Optimism that is called into action again and again, as one faces new questions, limited successes, and things that do not work. Optimism drives design forward, leveraging learning and insight from action that is integrally associated with questions.

Design's skeptical optimism is aimed at the world. It serves **to translate and mediate change**. It serves to assimilate and shape the ongoing disruption and evolution of culture, society, and technology. Further, design *makes things* that participate in the evolution of culture, society, and technology. Think about the iPod to iPhone to iPad revolution, and its impact on how we express ourselves, how we connect to each other, and how we work with new platforms of information.

And we use **design for speculation**. Although much of design is fueled by problems, not all design is about *solving* problems. We also use design as a means for speculating how things could be. This form of design often invents problems as vehicles through which to speculate.

Speculating through design thrives on imagination. "It aims to create spaces for discussion and debate about alternative ways of being, to open up new perspectives on what are sometimes called *wicked problems*, and to inspire and encourage people's imaginations to flow freely. Design speculations can act as a catalyst for collectively redefining our relationship to reality."[1]

The Intention of This Book

> The world just came together so quickly. We have little understanding of its true diversity.
> —Tim El-Hady, 2010[2]

> We are forcing the past as a solution set. But the past as a solution set is not a viable option. We need a new tool set.
> —John Rendon, 2010[3]

The intention of this book is to talk about a new tool set—one that is conceived out of architectural design, nurtured through need, and poised to act in contexts that we expect to be increasingly complex and connected.

But to create new things that resonate in a "world that has just come together so quickly"—one in which true diversity is now in play—and to think about designing for change in this world, in addition to tools, one needs to engage new dispositions and instincts that employ this new tool set to advantage. These tools, dispositions, and instincts are made possible by a new set of frames—a new window on the world—that allows us to understand the world in terms that are more aligned with the forces at play in this unique moment of our evolution.

A Cambrian Moment and Our Whitewater World: A Moment of Rapid Change, Intense Diversification, and Evolution

We all recognize that we are in a unique moment in our evolution because of the exponential increase in information and interconnectivity of everything around us, and the very real human responses to these. It is a Cambrian moment of profound change as we move from understanding static societal building blocks to flows of exchanges, from rigid organizational structures to dynamic networked relationships, from thinking systems to thinking ecosystems.

We all recognize that we are also becoming much more global and urban, meaning there is greater diversity in closer proximity. And we are increasingly vying for resources that are more limited every day. As we become more global and urban, increased interconnectivity creates greater interdependency; things spread faster and farther, and greater diversity in closer proximity is easily connected to other greater diversities in closer proximity. All of this has transformed global dynamics in unprecedented ways, as it affects our cities, our environments, and our cultures, at all scales. The result is that we are engaged in a whole new set of issues and conflicts that are without a clear resolution or end state.[4]

In the past, we had punctuated evolution. Things changed abruptly and after the abrupt change, we had decades of stability that enabled us to build deep institutional models based upon infrastructural and technological shifts. But, today's new infrastructure of connectivity may not level out. We are in an era of profound change, in which acceleration, instability, and disturbance may become the norm.

This is a white water world—a world of dynamic flows in which so much of what we do and know is radically contingent on the context at the moment one is looking at it, or operating in it. The shifting of structural plates of connectivity

through new digital technologies has created a world broadly connected, rapidly changing, and radically contingent.

In this white water world, the challenges we face are both fundamental and substantial. Our ways of learning and working, our ways of creating value, and of imagining, innovating, and shaping our futures must be reframed.

But in addition to being a Cambrian moment of profound change in which we face fundamental and substantial challenges, it is also a Cambrian moment of rapid and intense diversification of what we can do, who we can do it with, and how. We are seeing an efflorescence of new things, new practices, and new kinds of relationships across all sorts of boundaries with both good and bad outcomes.

Exponential increase in information and interconnectivity means that we can do things differently, from business, to governance, to media and science. "The Internet offers us an increasingly thickened network of communications with pre-existing relations and the casting of a broader net that captures many more, and more varied, relations. What is emerging is a framework that sees the networked society as entailing an abundance of connections and more densely deployed attention."[5]

"Increasingly thickened network of connections" and "more densely deployed attention" mean that we have more substantial exchanges with existing colleagues and friends. "Casting a broader net" means that we now engage with a larger, and more diverse group, in both casual and substantial exchanges, intentional or not. This means that we can do things differently as we focus attention in areas that were formerly confined within specific professional, institutional,

or disciplinary domains, and we can do things differently because of the scale of attention that the Internet affords. In monitory democracy[6] or participatory governance, citizens become involved in the direction and operation of political systems; the streetcraft of citizen movements, from "Arab Spring" to "Occupy Wall Street," meant citizens became involved in the shifting of power within political systems; participatory culture has fans and audiences becoming writers and creators of all sorts; the X-Prize and citizen science engage the public in competitions and design radical breakthroughs that are intended to benefit humanity; Wikipedia and fan fiction engage specific publics in creating factual or fictional content around topics that interest them; interest groups provide advice and social scaffolding in areas of health and life experience; participation in MMOG's and ARG's engages diverse players across geopolitical and economic boundaries; crowdsourced funding allows individuals to participate in creative ideas that lead to all sorts of tangible and intangible projects, from cultural artifacts to startups; and bots and trolls begin to impact the hegemony of states. We truly can do things differently.

At the same time, digital technologies let us do things differently—from the digital humanities to 3-D printing—and emerging analytical and visualization methodologies let us *see* differently. Doing and seeing differently means that we begin to interact with and experience the world differently. A new twenty-first century ontology is emerging.

In this Cambrian moment of intense diversification and evolution, the challenges are substantial and fundamental; working on them creates an environment of demand *and* opportunity. New demands together with new affordances are the core driving forces of this white water world.

Why This? Why Now? The (TIM)^{N} Framework

Societies are always evolving; reshaping themselves and readjusting roles, responsibilities, and relationships as the contexts in which they sit shift and change. Dynamic forces from other societies, and from the natural environment, sculpt responses that force evolutionary change. But sometimes forces are such that an entire set of societies will shift simultaneously into a new form, creating an evolutionary change of global proportion. We are at one of those moments.

What makes this particular moment so unique is what political scientist David Ronfeldt characterizes as the progression from a triformist to a quadriformist era of societal form.

Ronfeldt looks at the long-range evolution of societies in his TIMN framework, which distinguishes between four forms of societal organization based upon different modes of interconnectivity, and different communication modalities. Tribes (*T*) are kinship-based social units, structured as extended families, clans, and other lineage systems. Tribes rely on oral communication, especially storytelling, for their cohesion, and therefore, depend upon proximity of individuals. Institutions (*I*) are hierarchical in nature, and are exemplified by the church, army, or bureaucratic state. Institutional form relies on the transcribing of oral communication into writing that can be disseminated to larger groups as books, records and commands. At first handwritten, the printing press scaled the capacity to produce documents around which institutions formed and operated. Markets (*M*) are about competitive exchange; merchants and traders, responding to forces of supply and demand, rely on interconnectivity and mobility provided by infrastructure. And finally, networks (*N*) are web-like ties that rely on digital hyperconnectivity across time and space.

In Ronfeldt's TIMN framework, one societal form does not replace another. Instead, they build on each other with each form arising in response to how new communication, and new forms of interconnectivity and exchange, allow society to "solve problems that the other sectors have not done well enough at; in fact problems that the other sectors may have even created.... As each new sector grows, it modifies all of the old sectors; and vast re-balancings and strengthenings occur."[7]

Healthy evolution is dependent on the ability of a society to combine forms into an integrated system. In Ronfeldt's framework, institutional form did not replace tribes but instead evolution produced a biformist era of tribes + institutions; and then a triformist era of tribes + institutions + markets.

Progression from one era to another is never smooth.

> During the rise of a new form, subversion precedes addition: When a new form arises, it has subversive effects on the old order that weaken the old forms, before it has additive effects that serve to consolidate a new order.... New modes of conflict and cooperation emerge with each evolutionary shift: A society's efforts to transition from one stage to the next, or relate to a society that is at a different stage, are bound to create internal and external contradictions; indeed, the values, actors, and "spaces" favored by one form tend to contradict those favored by another. Thus, the rise of a new form induces epochal philosophical, ideological, and material struggles that are jarring to a society's stability, transformability, and sustainability.[8]

We see evidence of "epochal philosophical, ideological and material struggles" in protest and insurgent movements that are occurring around the world; in the disruption of global economic stability; in the intensification of the dynamics of trade, finance, environmental policies, protocols, and events, immigration, and emigration; in finance and industry practices; in shifting ecological concerns.

From a TIMN-framework perspective, none of these are ordinary movements, events, or struggles. These are not ordinary times, as we wrestle ourselves out of what Ronfeldt calls the triformist era—an era that existed from the eighteenth to twentieth centuries following the spread of the market form alongside tribal and institutional forms—to a new quadriformist era, which began in the mid to late twentieth century, with the rise of network forms of organization.

But beyond the disruption that comes with the addition of a new form, this new evolutionary shift is unprecedented in ways that force a revision of Ronfeldt's framework. Networks, as web-like ties that rely on digital hyperconnectivity, are not like tribes, institutions, or markets. They are not entities. They are not things, and so they function differently. They are agile; they can reform and adapt quickly to changing circumstances, reshaping themselves to cut, fill in, or extend connections. Networks scale far and fast, whereas tribes, institutions, and markets take considerable effort and resources to grow in size and scope. And networks are available to all, regardless of one's place in any other organizational structure.

Networks have always existed in tribes, in institutions, and in markets, as part of the organizational glue of the form, but now amplified by nonmaterial infrastructures, and being nonproximity dependent, networks have emerged as their

own form of communication-rich organization, and societies are shapeshifting because of them.

Digital networks penetrate existing structures, reforming them. Participants in these structures begin to interact according to a whole new set of evolving rules and norms. But additionally, networks have become an entire realm of activity around which other activities and sectors of activities—such as social media, the new maker movement, open government, international piracy—emerge.[9] These new activities and sectors of activity are radically transforming the other three societal forms. They are affecting how tribes, institutions, and markets form; how they evolve; how they function, scale, and interact. Markets are becoming more global and more distributed. Institutions are becoming more fragile or agile, and tribal trust-based relationships are becoming more important and relevant again. No longer dependent on physical copresence, individuals can participate in multiple tribal constructs simultaneously.

Given how the networked societal form is radically transforming the other three forms, we propose that the TIMN framework is better articulated as TIM to the Nth power, or $(TIM)^N$, where N—the network form—operates to exponentially influence the other three forms.

Networks are fluid. They are dynamic. They operate by different principles. These dynamics are exchanges and flows between individuals, between individuals in different kinds of social groups, between different groups, and between different groups or constituencies and their larger social environments. They require that we think, operate, and design differently. Working on complex problems in a $(TIM)^N$ era, with networks as a dominant form of interconnectivity,

means that we must reconceptualize the way we *see* the world around us as a hyperinterconnected and interdependent entity.

Things behave differently in a network form. They are more fluid than solid, more capable of shifting exchanges, relationships, and interdependencies, and more about complex living systems than resolute structures. We need to be thinking differently. We need to be thinking physics with feedback, and complexity with coherence. We need a new way to see the world so we can better operate in it.

Seeing the World Anew: A Third Window

From Newton to Darwin: From Immutable Laws to Processes of Selection

> REDUCTIONISM is the most natural thing in the world to grasp. It's simply the belief that 'a whole can be understood completely if you understand its parts, and the nature of their 'sum.' No one in her left brain could reject reductionism.
> —D.R. Hofstadter[10]

Reductionism has been the dominant approach to science since the 1600s. It has marked out its territory in scientific theory and methodology, and has been responsible for the separation of inquiry and knowledge construction into disciplines, subdisciplines, sub-subdisciplines, and so on. Under the methodological umbrella of reductionism, one "divides all difficulties under examination into as many parts as possible, and as many as are required to solve them in the best way, and then conducts thought in a given order, beginning with the *simplest* and most easily understood objects, and gradually ascending to the knowledge of the most *complex*."[11]

For almost four hundred years, until the beginning of the twentieth century, science set out to explain the nature of things in terms of fundamental physics that could explain all phenomena through laws that supported reductionist approaches. Newton provided the Western world with the tools to think about the interaction of things and forces as an orderly clockwork universe, wound up by his famous three laws.

The physical and metaphysical foundations laid by Newton's laws created a first window to a modern view of the world. Thermodynamics, and then, more significantly, Darwin's

evolutionary theory, opened a second window that marked a critical epistemological shift from understanding the world's dynamics as governed by immutable laws, to a focus on processes in which the state—the characteristics and behavior—of something is contingent on its history.

"Darwin set us on a wholly new approach to the living world. He essentially was telling us that living systems arise *not* out of the set of immutable laws that regulate all physical order, but rather as the result of natural *processes* that create living order out of abundant chaos … that *process is more important than law* in shaping living systems."[12]

The shift from laws to processes is highly significant. Laws are determinate and can be applied backwards and forwards. Processes, however, while subscribing to constraints, create indeterminate outcomes that are contingent on how random events unfolding in time interact with those constraints. In other words, they are *contingent on their histories*—on what leads to what.

We all know that for Darwin, the process of "creating living order out of abundant chaos" was a process of natural selection, in which competition for resources in the environment works to make certain heritable variations—genetic mutations that arise by chance—in species traits more valuable to the survival of the species than others; that individuals possessing certain traits that make them better suited for the struggle for local resources contribute more offspring to succeeding generations. In Darwinism, change in the environment leads to reciprocal or responsive change in the species, through selecting out those traits that are less fit for survival. Darwin saw this as a stabilizing process that was gradual and slow.

One of the major problems with the Darwinian window is that, as a theory of incremental optimization, it does not help us understand how radical changes occur in species and environments. "The Darwinian process is inadequate to the task of explaining how life originated or, for that matter, how new species come into existence."[13] While the Newtonian window looked out on an eternally unchanging universe, the Darwinian window fails to explain the more radical changes that structure our universe from the "messy murky causal relationships displayed by genes and phenotypes"[14] to human interventions affecting global climate, or any multilevel, multi-component, contingent, and feedback-laden phenomena. A revised and expanded epistemology is required to face the challenge of understanding these kinds of complex behaviors.

A Third Window Framed by Ecology Theory

So, we suggest that while shifting from Newton to Darwin moves us in the right direction, it doesn't take us far enough. "Neither of these models satisfactorily explains how real change—in the form of creative advance or emergence—takes place in nature."[15] Nor do they explain the sheer abundance of diversity—often with redundant functionality—or the richness of seemingly gratuitous characteristics. Both of these metaphysical foundations are ill-suited to sustain our current search for a comprehensive description of how complex living systems work. Both windows are insufficient for framing the complexity, the excesses, and the contingent dynamics of the world.

We need a new window; a third epistemological lens through which to view and act in the world. For this we turn to ecology

theory and borrow the concept of a *third window* from theoretical ecologist Robert Ulanowicz.[16]

Ecology theory grew out of the intersection of new sciences that were emerging at the end of the twentieth century—whole systems behavior, cybernetics, and network theory—with the classical science of physiology (the scientific study of the mechanical, physical, and biochemical functions in living organisms). These new sciences extended the field of physiology beyond the scale of the individual organism or species—the Darwinian focus. "It was (a) heady mix of whole-system behavior, stochasticity, cybernetics (circular configurations of causal action that are a key driver behind system-level behavior in ecosystems) and networks … that led many physical scientists to become systems ecologists—a vibrant and fecund domain in comparison with nonliving systems."[17]

Within the emerging field that we now call ecology, biologists, physiologists, and other physical scientists became interested in how organisms other than humans functioned, and then how whole systems functioned. They began to study ecosystems. This required thinking beyond classical physics, physiology, or evolutionary science; it required thinking in terms of networks and the flows of material and energy through time in complex webs of contingent exchanges.

Ecosystems are complex systems. The word *complex* comes from the Latin root *plecetere:* to weave, entwine. "In complex systems, many simple parts are irreducibly entwined, and the field of complexity is itself an entwining of many different fields."[18]

Shifting from Newtonian mechanics, to Darwin's evolutionary biology, to process ecology is a shift from immutable laws; to processes that are associated with linear development of single organisms and their communities; to complex systems processes that are dependent upon the vibrant exchange and flow of energy and matter between many organisms, their communities, and their environment.

In ecosystems, these complex system processes function to sustain and grow the system. They do this through *autocatalytic mutualism*. Autocatalytic mutualism is the genetic code of ecosystems. The term *mutualism* refers to the mutual interdependencies between two or more species in an ecocsystem in which all benefit from the association. *Autocatalism* means that the system is constantly generating an increase of energy and matter to sustain or grow itself from within. It does this by relying upon the mutual dependencies at work.

> The very existence of flowers and hummingbirds requires an entirely different account than that which reductionism might have offered. In its place ... autocatalytic mutualisms. Thus, the flower and hummingbird exist because when the bird feeds upon nectar, pollen in the flower rubs onto the beak of the hummingbird, sticks to it, is transported to the next flower, then rubs off on the stamen of the next flower, pollinating that second flower. ... It is by this quixotic fact, the stickiness of the beak for pollen, that flowers and hummingbirds exist in the universe ... we explain the physical existence of the flowers and hummingbirds in the universe by this mutualism.... The entire biosphere is broadly mutualistic, food webs and all, given sunlight and other sources of free energy and a few simple chemicals.... (In fact,) coordinated behaviors by mutualistic partners seem required.[19]

In Darwinism, competition is the mechanism that drives species development, and it operates at the level of the individual organism or species community. Constraints external to the biological system of organism or community force it into competition with others. The mechanism within ecology is a complex process of entwined mutual dependencies; of *many* organisms participating in *various* mutual dependencies. Mutuality is essential and competition derives from that.[20] This is in stark contrast to the conventional Darwinian narrative.

Darwinism's revolutionary work set in motion a completely different notion of causality; one that was not dependent on laws with absolute outcomes, but processes whose outcomes are affected by a changing environment.

Evolution under Darwinian terms is a slow process, playing out over generations. It does not explain the impact of irregular events on the system. Yet we now know that irregular events—disturbances—are prevalent *and* essential for the development of any ecosystem's resiliency. Ecosystems assimilate and adapt to radical events.

> Overwhelmingly, scientists concentrate on elucidating the rules that give rise to order and coherence, but, in complex situations (such as living systems), such explication is never independent of the related dynamics of chance and arbitrary phenomena … the effects of which propagate over the same networks of relationships as do the dynamics that build structure. What is absent from the conventional approach is the *necessary,* and somewhat paradoxical role, that chance and disarray play in the persistence of complex systems, because, without

> them, a system lacks the flexibility to adapt and becomes defenseless in the face of novel perturbation.[21]

Emerging ecology theory recognizes not only the impact but the invaluable role of disturbance to evolution. Disturbance is not only an integral part of any natural system, but "the greatest diversity occurs in landscapes large enough to contain various serial or successional stages as the result of disturbance events."[22] Disturbance drives evolution.

Relying on chance and novel disruptions mean that ecosystems do not exhibit firm causality. Instead of fixed laws or prescribed pathways, we now need to think in propensities. Propensities are *tendencies* to act in a particular way given an entity's capacities, its dispositions, and instincts. Propensities evolve, adapting under different contingent conditions. Propensities are a more realistic way to think about possible responses to events in a complex and contingent dynamic system because they are behaviors that adjust in concert with the rest of the ecosystem's responses.

From Rules to Process to Propensities

So, autocatalytic mutualism, which allows us to see beyond classical notions of competition to a living system driven more by collaboration in a contingent context; evolution and resiliency that are dependent upon chance and novel perturbations; and propensities rather than causal processes or fixed laws; make ecology a productive third window through which to see the world anew.

Three Ecologies

Looking at the world anew through an ecological lens means more than just seeing the environment differently. It is about using ecology theory and ecosystem dynamics to see everything differently. We can also apply an ecological lens to society, through the $(TIM)^N$ framework, which sets about explaining the **social ecology** of a networked, quadriformist era.

Ecology is the *scientific study* of the relationships between living organisms, and between these organisms and their environment. An ecosystem is *the aggregated whole* of the dynamically interacting parts. So, we can define *social ecology* as the relationships and interactions between individuals, and between individuals and the world, in terms of societal exchanges and influences. Just as ecosystems in nature can be studied at different scales and with different relationships—they border, overlap, and nest within each other—we need to understand *social ecosystems* as communities that do the same. Ranging in scale from families, to neighborhoods, to cities, to regions, whether face-to-face or digitally networked communities, they can be approached, studied, and understood as webs of entangled exchanges between people situated in temporal and spatial contexts.

Social ecology also concerns itself with nonmaterial "variables of interest"[23] that have to do with the ways we live together. These variables are determined by that which binds us together as social beings, and therefore include various kinds of interactions: economic, political, cultural, and psychosocial.

All such interactions are changing in form, scale, and processes and protocols of engagement, causing disruption and opportunity in our social ecologies. Disruptive and difficult economic, political, and cultural events emerge, too often

unsuspected and unforeseen, and new kinds of activity come into being with both negative and positive effects. As Ronfeldt points out, new actions form around "epochal philosophical, and ideological struggles" but also new kinds of activity emerge. In terms of the *social ecology*, it really is a question of constructing new modalities of group-being, and new systems and practices of economic, political, and cultural interaction.

While "the conservation laws for energy and matter concern substance rather than form, (social) process, ideas, communication, organization, differentiation, pattern, and so on, are matters of form rather than substance."[24] This is why Ronfeldt's framework, which focuses on the evolution of societal form, is so valuable.

Mental Ecology

> It is not only species that are becoming extinct but also the words, phrases, and gestures of human solidarity.
> —Felix Guattari[25]

Human social interaction is deeply dependent upon the sharing and exchange of ideas—ideas as beliefs, as concepts, and as knowledge construction. These too work within complex ecosystems of exchange. Therefore, we can talk about **mental ecologies** of ideas and their contexts.

Mental ecology concerns itself with "a new way of thinking about ideas and about those aggregates of ideas which (we) call "minds."[26] This way of thinking was introduced by Gregory Bateson as the "ecology of mind," or the ecology of ideas. The questions Bateson raises in his seminal book *Steps to an Ecology of Mind*, are "ecological: How do ideas interact?

Is there some sort of natural selection that determines the survival of some ideas and the extinction or death of others? What sort of economics limits the multiplicity of ideas in a given region of mind? What are the necessary conditions for stability (or survival) of such system or subsystem?"[27]

For Bateson, mind is synonymous with a cybernetic system. It is the "total information-processing, trial-and-error completing unit"[28] that is relevant at a specific scale, or within a specific boundary condition. This means that there are mental ecologies at different scales. They nest inside of each other, just as ecosystems contain other ecosystems. While "Freudian psychology expanded the concept of mind inwards to include the whole communication system within the body—the autonomic, the habitual, and the vast range of unconscious process, (Bateson) expands the mind outwards"[29] as well.

> Moreover, the very meaning of "'survival' becomes different when we stop talking about the (mere) survival of something bounded by the skin and start to think of the survival of the system of ideas in circuit. The contents of the skin are randomized at death and the pathways within the skin are randomized. But the ideas, under further transformation may go on out in the world in books or works of art. Socrates as a bioenergetic individual is dead. But much of him still lives as a component in the contemporary ecology of ideas.... The cybernetic epistemology, which I have offered you, would suggest a new approach. The individual mind is immanent but not only in the body. It is immanent also in pathways and messages outside the body; and there is a larger Mind of which the individual mind is only a subsystem. This larger Mind is ... immanent in the total interconnected social system and planetary ecology.[30]

Just as social ecologies exist at multiple interoperational scales, ranging from the local to the global, mental ecologies can be understood as the interaction of ideas in the context of the individual, in the context of a society, or of a network of societies. And mental ecologies might exist together in conflict, just as environmental ecosystems do. Increasing globalization, driven by postindustrial capitalism, affects not only the environment and our social systems but is "penetrating people's attitudes, sensibilities, and minds," and endangering what the French philosopher Félix Guattari calls "human singularity"—human subjectivity in all its uniqueness.[31]

In *The Three Ecologies*[32] Guattari argues that "'Individuals are *captured* by their environment, by ideas, tastes, models, ways of being, the images that are constantly injected into them, and even by the refrains that go round and round in their heads.' Surrounded by all these different refrains which pass through us, it is difficult to know where, or rather who 'we' are."[33] Just as environmental ecosystems are sustained by their biodiversity—the variety of their parts and processes—mental ecologies, as a philosophical construct, depend upon this same robust diversity.

An Ecology of Matter: We Are Matter Too

Ronfeldt helps us understand the epochal transformations that are happening within the global social ecology. Bateson helps us think about mental ecologies. Meanwhile, science is allowing us to know ourselves better within an **ecology of matter**.

As science has rescaled its focus from the universe, to the planet, to living organisms—shifting from seeing the world as

dominated by physics to one that is biologically framed—and as technologies retool and shift from operating on things that are external, to living organisms, to operating on organisms themselves, to operating on the very biological matter of organisms, we begin to enter truly original cultural terrain in which we grasp that we are made of matter too.

The way we are influencing the environment at unprecedented scales, and at accelerating rates, further confirms the materiality of our existence. "After a century of unparalleled scientific and technological progress we have made our presence known to the planet in the most dramatic and self-defeating fashion. (Were) the Earth's response to man's 'stimulation'... localized ... we would be safe; but instead we are faced with a very different kind of 'feedback': a bewilderingly complex array of interrelated and unpredictably erratic fluctuations over which we have little or no control and which remind us that the whole world is a giant ecosystem with a sensitive biosphere that has taken 4.5 billion years to evolve."[34]

Our performance—how we consume and create waste—is undeniably and irrevocably linked to the performance of the environment. So we now begin to understand things, bodies, buildings, cities, and landscapes as contiguous systems of matter that involve exchanges at all levels. Productive and seductive, design's role is not benign or docile in a context governed by the potent interaction of matter at all scales.

We come to know the world of matter through the information we have of it. Pervasive information; its diversity and sheer abundance—and the management of this abundance—is changing the way we do everything. We generate and

consume meaning through how we interpret information to construct cognition, culture, and society.

Understanding that we are matter too, infused with systems of meaning, and *part of an interconnected and interdependent world*, requires a major shift of perception, but one that is necessary if we are to take on the key problems and opportunities of our time.

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The etymology of *eco* is the Greek word öikos, meaning home. Home is the place we make our own, where we find our psychological and emotional identities. And home is the physical space that gives context and texture to our psychological and emotional stories. Our identities are integrally fused with these places as individuals interacting within social groups, and as a cultural and biological species within the environment. A window framed by ecology theory that registers as three ecologies—social ecologies, mental ecologies, and ecologies of matter—allows us to see the world as our home, dynamically interconnected through human relationships, ideas, and matter. This is a fundamental change of worldview—a change as significant as the Copernican revolution in the sixteenth century.

Looking at the world through a third window provides a new way to see, but it also provides a conceptual and operational framework for work we might want to do. It provides a way to reframe problem or project constraints and opportunities—what we call the brief—by expanding the kinds of questions we ask. But it also provides a larger playground from which creative work can emerge, and then the lens through which to assess that work. And it is scale-agnostic, meaning that it

helps work at all scales: from the micro to the meta, and from the hyperlocal to the global.

To date, Western society's worldview has been dominated by principles associated with the Newtonian framework of classical physics, and the Darwinian framework of evolution. Too often, we operate as if the universe is a mechanical system composed of elemental building blocks that subscribe to linear, deterministic, and predictable laws. Our view of society is as a competitive struggle for existence and success. And all of this has been dominated by a belief in unlimited material progress achieved through economic and technological growth.

This may have worked in the past, but no longer. New forms of connect-ivity and exchange dominate our world and our actions. Information has changed from something we consume, to something we live in. New tools are shaping new material, social, and mental practices. *Wicked problems* are getting more wicked, and new kinds of complex problems are emerging. Doing work in this world is not just business as usual. The $(TIM)^N$ framework helps us understand *why*. It helps us understand the uniqueness of this moment. It helps us understand the form of the global society we are evolving. And it helps us understand the implications of those mechanisms of change.

Looking at the world through a third window adds an ecological perspective to the Newtonian and Darwinian windows. Ecology theory allows us to merge the scientific with the ineffable in profound ways. It helps us to *see* the interconnectedness of all things; that things, whether they be tangible or intangible, do not have fixed boundaries of impact, and despite having visually discernible outlines, they are not fixed

containers sealed off from the contexts in which they exist. All things operate in larger contexts, which are *interactive systems* of exchanges.

Looking at the world through a third window with *three ecological registers*—as material, social, and mental ecologies—gives us a framework to look at the economics of any thing or action. We can begin to assess the "value" and "cost" of things and actions in their contexts from the material perspective, the social perspective, and in the realm of ideas. It gives us a way to think through and articulate the often ineffable external forces on, and responses to, the thing or action.

Faced with a world that is increasingly complex, connected, and rapidly changing, we need a new tool set. We have new affordances in the form of new tools and new practices and, even more importantly, we can now view, understand, and learn about the world through an expanded and blended epistemology in which the ecological perspective of complexity provides a new set of lenses to make the messiness of the world tractable. The agency and impact of the work we do in the world depends upon this shift in perspective, and a new tool set forged by this blended epistemology.

Design Unbound and Designing for Emergence

> Whether applied to self-organized forms of matter-energy or to the unplanned results of human agency, new concepts of (non-linear causality and self-organization) demand a new methodology ... a more experimental attitude toward reality and an increased awareness of the potential for self-organization inherent in even the humblest forms of matter-energy.
> —Manuel De Landa[35]

Unbound from Thingness

When people think of design, it is usually as problem solving that results in the making of things. We think of things as having form (shape), material (what it is made of and how it is made), and scale (its size in relationship to us and to other things). Things can hold meaning. And they can be understood to have value; they exist in some kind of market.

But not all problems to be solved result in, or can result in, things that have material solidity. Many of the important problems have to do with systems and models that are not physical, or they are *wicked*, meaning that they do not lend themselves to solutions at all: education, overpopulation, water shortages, climate change, health, geopolitical conflicts. To work in and on these problems requires more than fiddling with things in contexts. It requires that we work on the contexts themselves.

This is not to say that one does not design things. Much of the joy, beauty, and wonder of the world is experienced through things: the taste of an apple, the texture of a garment, the tonality of a piece of music, the space of a church, a mosque, or a street, even the "ping" of a text

coming in. But it is the design of things in relationship to each other, and in relationship to their contexts—the social, mental, and material ecologies to which they belong—that gives the object a different kind of impact and gives design a different kind of agency.

Architecture, as a design practice, designs things that have form, materiality, and scale, but it specifically deals with things that are containers—contexts—for the messiness of human life. From a piece of furniture, to a room, a house, a building, a complex ensemble of buildings, cities, landscapes, and territorial systems of occupation, architecture is about designing contexts in which things happen. These contexts can accommodate well-practiced relationships and behaviors, or they can open up new possibilities of exchange, interaction, and meaning creation.

If we imagine one further level of abstraction, we can imagine designing nonmaterial contexts; not *things* but *systems* that are dynamic contexts where things happen. As containers for complex relationships and exchanges, these dynamic system contexts are analogous to ecosystems. So design unbound from thingness allows us to imagine how we might design contexts that are ecosystems for new possibilities of exchange, interaction, and meaning creation.

In order for design to have agency and impact on the world today, it must operate on contexts as well as content; understanding their interdependencies through the specific exchanges they participate in. Design unbound from its material thingness is set free to work on designing contexts—as ecosystems—that can be shaped *to achieve something.*

Unbound from Disciplinary Boundaries

We might study ecosystems from different perspectives: as a biologist, a climatologist, geologist, behavioral scientist, ethnographer, storyteller, musician, artist. Disciplinary perspectives allow us to unpack the complexity for different purposes. But ecosystems are not definable by discrete functionality, so designing new contexts that are integrated, rich, and coherent means that we need to work vigorously across and above disciplinary boundaries.

Design unbound from its home disciplines—architecture, landscape architecture, urban design, product and graphic design—is set free to see the problem from other perspectives in order to take on the agenda of the whole, and to design in an ecosystemic manner; to design as an ecologist of social, mental, and material ecologies.

Designing for Emergence

Making progress on complex problems that are not about things requires thinking and designing with an understanding that one cannot design for absolute outcomes. The future cannot be designed. The future emerges out of actions in the present as they are influenced and interpreted through actions of the past. One must design understanding principles of emergence.

El Sistema had tangible designed things, from paper instruments to school buildings. And it had intangible things in the form of mechanisms that did work for them, from funding platforms, to policies, to teaching and mentoring protocols. But they were only effective because they were part of an

integrated system that was a context for change, and because it was a system that was designed to be adaptive. Like an ecosystem, it was designed as a system that was expected to emerge over time, adapting to different communities—different social ecologies—and adapting through an unfolding process.

El Sistema and its component parts were things. But the real change occurred because they were mechanisms that created small-scale, simple interactions among the diverse individual parts that led to more complex behavioral changes to the social systems themselves. Intuitively, Abreu understood the properties and efficacy of emergent systems.

Complex structures, forms, and behaviors emerge from bottom-up, self-organizing interactions of different agents. If we want to have agency—creating new things and shaping change—we need to understand the histories of how things come to be; not as inevitabilities defined by fixed rules, or resulting from optimization processes, but as emergent histories informed by the exchange dynamics of systems. We need to think in terms of propensities, not predictability.

If we want to have agency, we need to understand emergence. We need to *think in terms* of emergence and we need to design for emergence. Understanding emergence lets us see the world in a new way and designing for emergence lets us put that new vision to work in the world with agency at many scales, from the small and catalytic, to the ecosystemic.

To do this we need new methods. We need a new tool set.

A New Tool Set

In the men's magazine *The Art of Manliness*, there is an article "12 Tools Every Man Should Have in His Toolbox."[36] Hammers, screwdrivers, tape measures, wrenches, pliers, drill and bits, saws, levels, and knives are laid out with comments on specific types and uses.

In *TechRepublic*'s blog piece, "10 Linux and open source developer tools you should not overlook,"[37] and on numerous other blog sites, programming tools are discussed in language that is coded to the community of web developers. In both instances, it is clear that the tool is directly associated with the specific job it is meant to do.

Designing for agency and resonance in complex contexts that are continually emerging means that one must work at the very structural level of the system itself, and within its functional dynamics. This requires a completely different type of tool set—one containing tools not associated with a specific task at hand, but which work on the "instructions set" that underlies the dynamics of the system—its component parts, mechanisms, practices, protocols, context, and the interdependent relationships between all of these.

When we look at problems as only scientific or technical in nature, removed from the contexts to which they are responding, they may be *complicated,* but they generally can be solved through straightforward, scientific and engineering design methods. But, when we understand these problems as embedded within human contexts that organize themselves through changing social, political, economic, and cultural belief systems, we are in the realm of *complexity*.

Complex systems are found in the transitional space between order and chaos; they are charged by their potential to

slip into chaos while human nature works desperately to tame them into order. Poised between ordered and chaotic systems, complex systems are brimming with potential at all times.

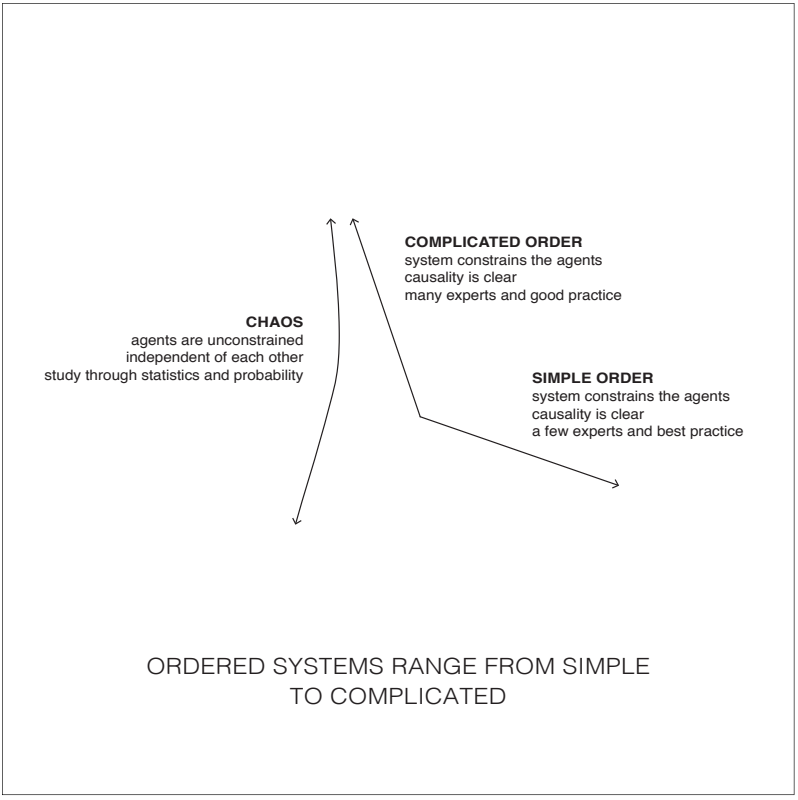
An *ordered system* is stable. It constrains the agents within it; it tells the people and stuff within it what to do. Since they are constrained, agent behavior is predictable and manageable. In ordered systems, causality can be determined and even designed or engineered. *Simple order* refers to systems that have few agents and therefore a lower order of interchanges among those agents. Problems within contexts of simple order can be worked on and solved through best practices and expertise associated with one or a few disciplines.

Complicated systems are also ordered, but they contain many agents and many levels of interchanges. Although cause and effect is knowable, it may not be immediately obvious, and must be discovered through work one does in the system. And the work one does usually involves many disciplines, and various kinds of expertise.

In *chaotic contexts*, there are few, if any, constraints, and there is no order, predictability, or ability to orchestrate outcomes.

Complex systems are similar to chaotic contexts in that causality cannot be determined. Yet they are like ordered systems in that the system generally constrains the agents. But in complex systems, the agents are constantly modifying the system through their interaction with it, and with each other. So the systems and agents adapt. They coevolve. Any order in these systems is emergent and unstable.[38]

ApJ sketch defining complexity.



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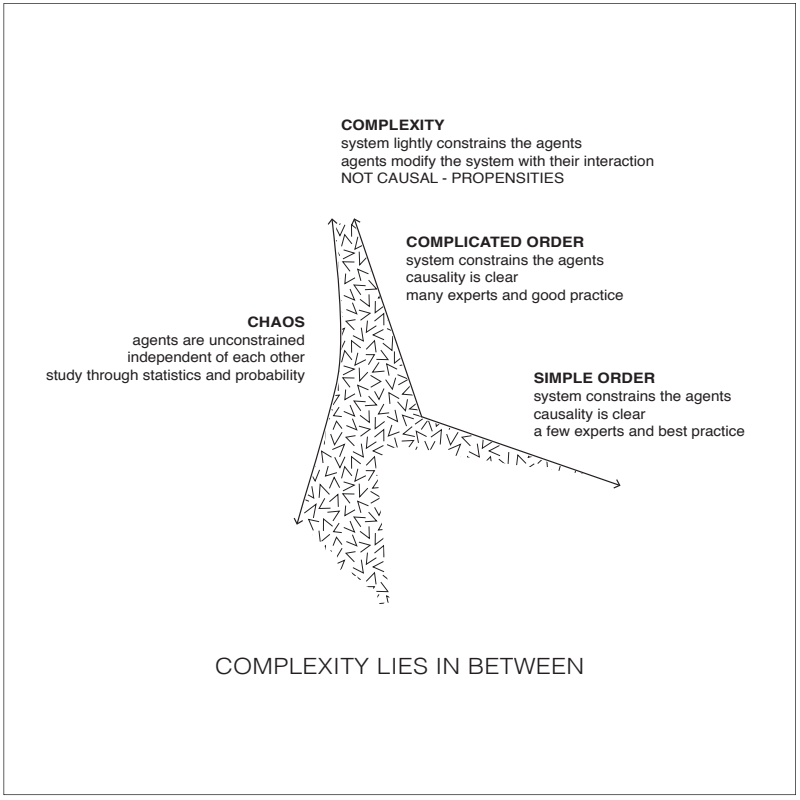

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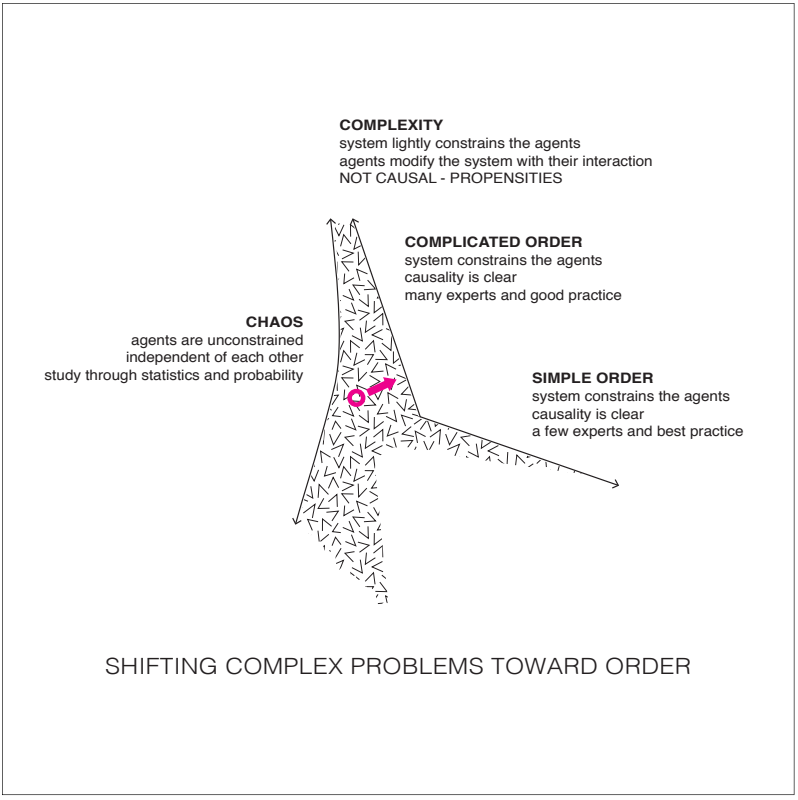


ApJ sketch defining complexity.

> In a complicated context, at least one right answer exists. In a complex context, however, right answers can't be ferreted out. It's like the difference between, say, a Ferrari and the Brazilian rainforest. Ferraris are complicated machines, but an expert mechanic can take one apart and reassemble it without changing a thing. The car is static, and the whole is the sum of its parts. The rainforest, on the other hand, is in constant flux—a species becomes extinct, weather patterns change, an agricultural project reroutes a water source—and the whole is far more than the sum of its parts. This is the realm of "unknown unknowns."[39]

"Complex problems change when you look at them, when you talk with them, and when you engage with them."[40] Interactions are nonlinear and disproportionate; minor changes can have major consequences.

Complex problems cannot be solved for, because any attempt to create a solution changes the nature of the problem. In fact, the full landscape of the problem cannot be understood until provisional actions to work on the problem have been taken; yet every one of these provisional actions creates unintended consequences that change the nature of the problem. In complex problems, the system has a history where past and present are integrated. Elements evolve with one another and with the environment; change is irreversible. Anything that works arises from circumstances.

Therefore, although not solvable in any traditional sense, complex problems *can be worked on* by affecting the way the complex system—the context—around the problem evolves. And they can be worked *in,* where things we make are designed to interact with the emergent change in the system,

to resonate with, and respond to, its emergent relational properties.

In a keynote talk at the RSD4 Systemic Design conference, Don Norman, director of the Design Lab at UC San Diego, provided a thorough and clear definition of complex problems,[41] and then referenced the Yale economist Charles Lindblom's concept of "muddling through"[42] as the most effective approach for working on complex problems. Seemingly a surrender to complexity, "muddling through," for Lindblom, is not a lack or failure of method, but a system of *successive incremental changes*—successive small maneuvers that one can do quickly, and then assess in order to move on. The value in Lindblom's process is that doing real work *in* the system is the means for making progress. But we can do better than heuristic incrementalism.

In working in and on complex problems—shaping the contexts around them and designing new things for them—there are three ways to affect the evolution of the complex system. One can work on the boundary conditions that define the scope, and therefore the constraints, of the system. The boundaries of the system determine the constituent agents and components within—what is included and what is left out. Secondly, one can create probes that are put into the system to audit the system as it is changing. And thirdly, one can create modulators that do work within the system, altering the system and its evolution.

Of course, every probe has an impact of some kind and therefore must also be understood as a micromodulator. And every modulator can be understood as a microprobe, as they receive information back from what they do, and where they do it, in the system.

The new tool set for *Design Unbound* is designed for working on these boundaries, and creating probes and modulators to stimulate change within complex living systems—the contexts for complex problems involving living things, their communities, and environments.

The tools we propose are a set of nine knowledge-, skill-, or method-based instruments for acting through design in a manner that honors emergence. Some work on the boundary conditions. Some operate as probes, and others as modulators, but most operate in an integrated manner, doing work that affects boundaries while probing and modulating. The first four come from the DNA of architectural design—what architects do already and have been doing successfully for centuries—but now amplified, updated, and deployed differently.

The tool set also includes three metatools as mechanisms that do work of a higher order; at the level of the ecology of the project. They are not abstract constructs but have emerged from work that we, the authors, have done or been involved in. Complex projects have evolved ways of working that now go significantly beyond the design of thing(s). These projects required recalibrating, stretching, and working on the design process itself—*designing* design.

List adverse, but surrendering to the need for some simplicity, these tools and metatools are presented in abbreviated form here:

Tools

T.1 Rapid Iteration in a Problem Solving Setting (Think Fast Chess)
T.2 The Expanded Brief (Jumping Fences)
T.3 Critique (Based In Language Not Science)
T.4 Orchestrating Ambiguity (Structured Ambiguity)
T.5 Skills Matter (Navigating White Water)
T.6 Understanding Emergence
T.7 World Building
T.8 Understanding Networks
T.9 Intervals of Possibility

Metatools

MT.1 Designing for Emergence
MT.2 System of Action
MT.3 The Change Triangle 3.0

The tools in this book are about efficacy within a worldview that sees things and actions as integrally coupled to their contexts, and a worldview that frames contexts as complex and dynamic systems of exchanges; material, social, or mental. These exchanges can operate to sustain the health of contexts-as-systems. They can do work that grows and evolves contexts-as-systems. But they can also, of course, cause harm. In this worldview, one must look beyond thingness, and linear cause and effect. Things gone awry have a whole set of forces—material, social, and mental forces—that need to be unpacked if one wants to truly understand why events occur. Some of these forces are obvious. They ride the surface. Other forces operate as undercurrents that are harder to discern. And none of them operate separately. To have agency and efficacy, we need to look at things and actions as part of contexts, and we need to look at contexts this same way.

The Pragmatic Imagination

> Imagination is like a muscle. I found that the more I wrote, the bigger it got.
> —PJ Farmer[43]

The tools of *Design Unbound* are tools worked by the imagination. Just as a mason works his tools in some kind of conversation between eyes, muscles, and mind, these tools require some kind of conversation between imagination as inner "eyes," imagination as mental muscle, and the pragmatic mind. But whereas the mason's eyes, muscles, mind, and tools are used to build something new in a given site—a given context—the tools of *Design Unbound* are intended to shape contexts themselves through the entanglement of the imagination and pragmatic action.

In chapter 19, we introduce the concept of the Pragmatic Imagination—a wide range of mental image-making activity that can be used for action, agency, and impact. As a productive entanglement of imagination and action, the Pragmatic Imagination is both catalyst and fuel for the tools in this book. It is both parent and child of the entire endeavor of *Design Unbound*.

Chapter 19 provides a framework for thinking about the imagination as a crucial capacity for agency in a white water world. It builds this framework by looking at what the imagination is, how it functions—how it intersects with the things we do, from the most ordinary to the extraordinary—and how it might be put to pragmatic purpose, broadly construed. Whether aimed at small or large invention; easy or hard problems; personal enlightenment, development, or joy; or the advancement of society; the imagination has a special form of agency.

Generally, the words pragmatic and practical are used synonymously to refer to common sense conduct that is concerned with ordinary activities and ordinary work. While this accurately defines practical, it is insufficient for pragmatic. as both a way of acting and a way of thinking, especially within the textured framework provided by philosophical pragmatism. The Pragmatic Imagination uses pragmatism's framework but stretches it into the realm of the imagination. To couple imagination to action, the Pragmatic Imagination sets the imagination in motion, scaffolds its emergence, and then instrumentalizes its products to accomplish real world things.

The Pragmatic Imagination is a **paradoxical concept**. It is after real-world impact, from small things that scale, to transformational systems of action. It is meant to propel individual and collective efforts to think and live differently. But, while the imagination does not need to honor constraints, effectiveness in the world must recognize and deeply understand constraints in order to get things done. The power of the Pragmatic Imagination lies in this paradox.

The twentieth century was the era of making things. The era of industrialization created new ways of making things. New products, industries, economic structures, a new societal form, new cultural responses, and new identities emerged around work that maximized scale, precision, and repeatability.

The twenty-first century must be the era of the imagination. From things, to processes for making things, to contexts, to ways of being as individuals and communities at multiple scales, the Pragmatic Imagination is about imagining in order to make or shape those things, the ways of making things, contexts, and even ways of being.

While the classical pragmatists built on the natural sciences, and for Dewey, in particular, that meant taking Darwin seriously,[44] the Pragmatic Imagination looks beyond Darwin and the Darwinian worldview. Learning about our white water world, and operating in it, calls for something beyond Darwin and the natural sciences, beyond Newton and Newtonian mechanics. In thinking from the perspective of material, social, and mental ecologies, it is a whole new game. The third window not only provides a new way to frame the world, but also a new role for the imagination—an imagination entangled with action and put to purpose.

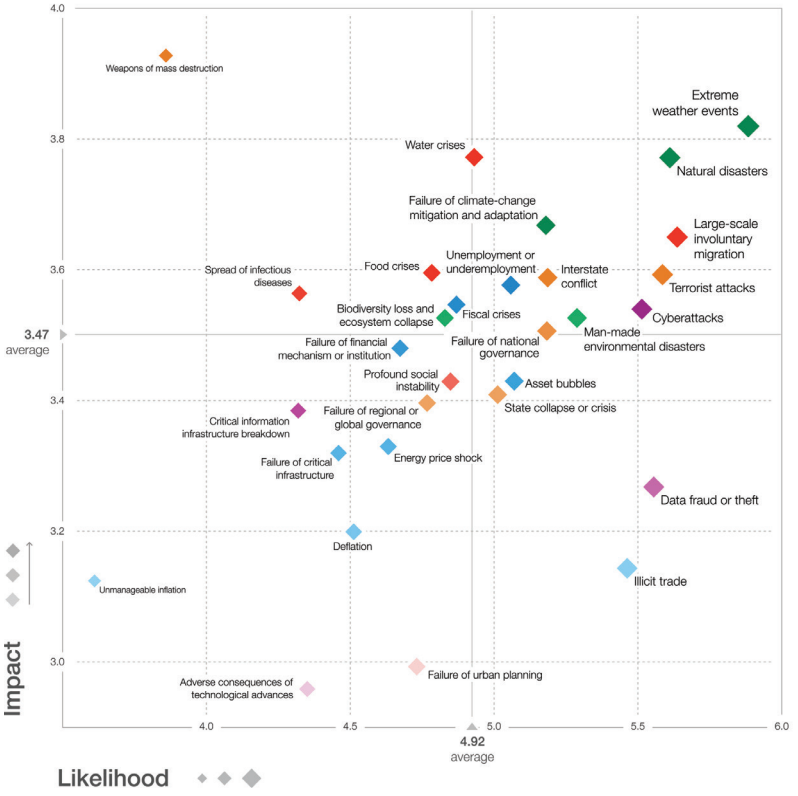
Endnotes

1 Anthony Dunne and Fiona Raby, *Speculative Everything: Design, Fiction, and Social Dreaming* (Cambridge, MA: MIT Press, 2013), 3.

2 Tim El-Hady, Aspen Institute Communications and Society Program's Information Technology roundtable, *The Future of Work*, August 4, 2010.

3 John Rendon, Aspen Institute Communications and Society Program's IT roundtable, *The Future of Work*, August 4, 2010.

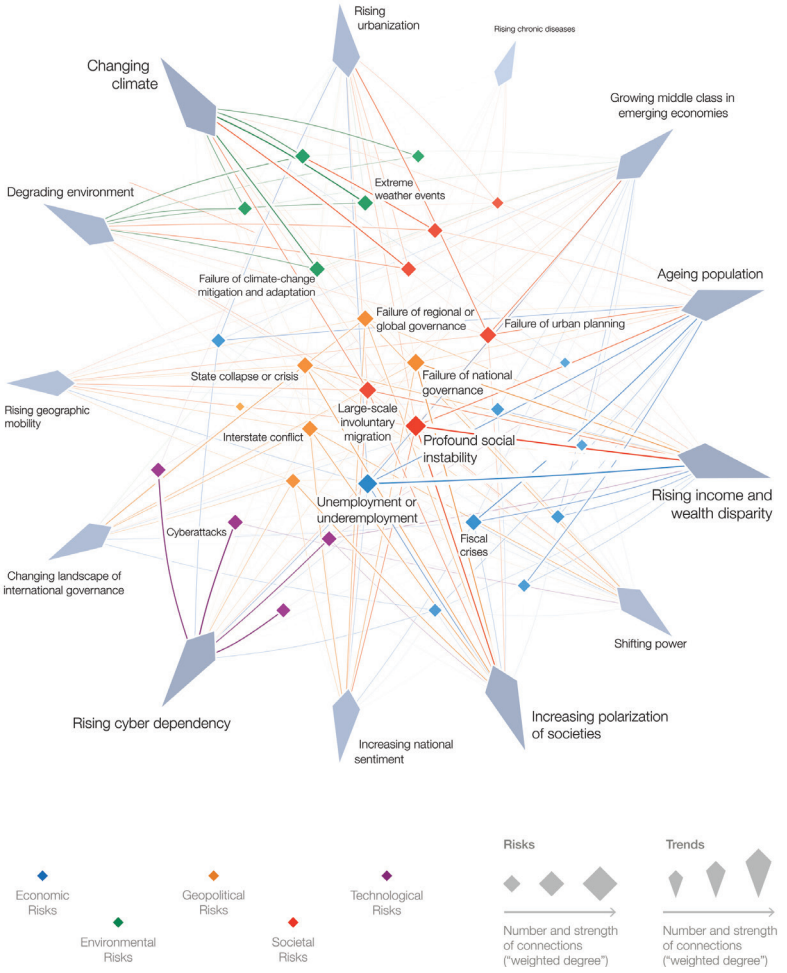
4 Each year, the World Economic Forum's Risk Response Network prepares a map of the "Global Risk Landscape" to aid in selecting critical topics of discussion for the WEF's annual meeting in Davos. Events of risk are mapped in terms of their likelihood



Risk Landscape from World Economic Forum Global Risk Report 2017.

to occur, and their global impact if they do. Risks are distributed into five categories: economic (blue), environmental (green), geopolitical (orange), societal (red), and technological (purple). This one was for 2012.

5 Yochai Benkler, *The Wealth of Networks: How Social Production Transforms Markets and Freedom* (New Haven: Yale University Press, 2006), 366.



Trend Interconnection Map from World Economic Forum Global Risk Report 2017.

6 John Keane, "Monitory Democracy" a paper prepared for the ESRC Seminar Series, Emergent Publics, The Open University, Milton Keynes, March 13–14, 2008. Monitory Democracy refers to a new form of citizens' participation and representation, "one that is defined by the multiplication and dispersal of many different power-monitorying and power-contesting mechanisms, both within the 'domestic' fields of government and civil society and beyond, in cross-border settings that were once dominated by empires, states and business organizations," (3).

7 David Ronfeldt video, "TIMN in 20 minutes: social evolution—past, present, and future" (at 7min 00 sec), https://www.youtube.com/watch?v=UBulH9_04vc.

8 David Ronfeldt, "What the Occupy Protests Mean: A TIMN Interpretation (Part I)" on D. Ronfeldt's blog *Visions from Two Theories*, October 21, 2011. http://twotheories.blogspot.com/2011/10/what-occupy-protests-mean-timn.html. See also: "Tribes, Institutions, Markets, Networks: A Framework about Societal Evolution" (Santa Monica, CA: RAND Corporation, 1966).

9 "In time, we're talking decades if not centuries, a new form not only takes hold, but an entire sector of activity (if not a new realm of activity) is built around it." David Ronfeldt video, "TIMN in 20 minutes: social evolution—past, present, and future" (at 7min 30 sec).

10 D. R. Hofstadter, *Gödel, Escher, Bach: An Eternal Golden Braid* (New York: Basic Books, 1979), 312. And as referenced in Melanie Mitchell, C*omplexity: A Guided Tour* (New York: Oxford University Press, 2009), ix. See Mitchell for a well-articulated introduction to the "vast territory of complexity" for nonspecialists, including the still unfolding history of complex systems research.

11 René Descartes, *A Discourse on the Method,* translated by Ian Maclean, (Oxford: Oxford University Press, 1637/2006.),17.

12 Robert E. Ulanowicz, *A Third Window: Natural Life Beyond Newton and Darwin* (West Conshohocken, PA: Templeton Press, 2009), 32–33.

13 Ibid., 39.
"To put a finer point on it, Darwinian scenarios do not uncover how *radical* indeterminacy and true novelty emerge." (Ibid.) Much of this has to do with his identification of what the "unit of survival under natural selection" was. "The unit which was believed to be crucial and around which much of the theory was set up was either the breeding individual or the family line or the subspecies or some similar homogenous set of conspecifics." (Gregory Bateson, *Steps to an Ecology of Mind* (Chicago: The University of Chicago Press, 1972), 456–7.

Genetic biology attributed agency to the micro-scale of genetic code. The discovery of the DNA molecule by Watson and Crick, and their description of its structure and the way it encodes information within, provided a view of biological processes scripted from the inside at the micro level. The idea of life evolving out of instructions at the cellular level pushed interest in the overall

system further into the background. "Contemporary focus (was) upon the correlation between specific genomes and large-scale forms and behaviors, as if efficient agencies resided (only) in the molecular realm … all cause (was) referred down the hierarchy of scale." (Ulanowicz, 37–38.) So, while supporting Darwin's theories, it further reduced the scale at which agency was thought to operate, unfocusing interest in larger systems and interdependencies at all scales.

If agency for change lies mostly at the gene level within a particular breeding individual, or its family line, or its subspecies, and if it is a gradual and slow directional process *in response to* environmental changes, then how does one explain survival and/or adaptation to fast quick bursts of change in the environment (forest fires, for example), or changes that affect large regions of great diversity (global warming, melting icecaps), or the complex behavioral interdependencies between species of vastly different genetic lines—what we come to know as ecosystems? And what explains the rich and wonderful excesses of our natural environment? Not all colors, textures, smells, sounds, behaviors can be attributed to optimization.

Instead of looking for agency by decreasing the scale of variables—by optimizing "down the hierarchy of scale" to the gene level and holding there—it seems important to look at genes in relationship to their context. The unit of agency, or survival, is not in genetic code alone, nor is it at the level of the individual organism/species, as Darwinism would claim, but is actually the *relationships* of genetic code to organisms, to organisms-of-different-types-in-their-environment—or what we call ecosystems.

14 Sandra D. Mitchell, *Unsimple Truths, Science, Complexity and Policy* (Chicago: University of Chicago Press, 2009), 3.

15 Ulanowicz, back cover.

16 Interestingly, in the sciences, two major discoveries in the twentieth century disrupted the legacy of Newtonian mechanics from the side of physics, not biology. They set in motion the embryonic development of the field of dynamic systems theory, which recognizes that evolution is dynamic in a way that does not allow for predictive outcomes. Werner Heisenberg's "uncertainty principle" (1927) in quantum mechanics, and chaos theory—the discovery that minute difference in sets of initial conditions can have tremendously different effects in the subsequent motion of the system—both acknowledge the critical importance of contingency—that all things depend upon other things. This work set the stage for the aggregation of work in the sciences from various fields (from the study of ants, to immune systems, the brain, economies, and so on), which were all recognizing the need to get at the nature of complex systems.

17 Ulanowicz, 5–6.

18 Melanie Mitchell, C*omplexity: A Guided Tour* (New York: Oxford University Press, 2009), 4.

19 Stuart A. Kauffman in Ulanowicz, xv–xvi.

20 Ulanowicz, 128–129.

21 Ibid., 7.

22 H. Ronald Pullman and Bart R. Johnson, "Ecology's New Paradigm: What Does it Offer Designers and Planners?" *Ecological Thinking for Design and Planning Education* (Washington, DC: Island Press, 2001), 58–59.

"There is now considerable evidence in favor of the Intermediate Disturbance Hypothesis; this new paradigm in ecology explicitly recognizes disturbance as an integral part of natural systems. A 'disturbance' in this sense is defined as any relatively discrete event in time that disrupts ecosystem or community structure and changes resource availability or the physical environment. The extension of this hypothesis to the landscape level results in the view that the greatest diversity occurs in landscapes large enough to contain various serial or successional stages as the result of disturbance events in the past."

23 A term used by both Bateson in *Steps to an Ecology of Mind* and Félix Guattari in *The Three Ecologies* (see endnote 25).

24 Bateson, xxxii.

25 Félix Guattari, *The Three Ecologies,* translated by Ian Pindar and Paul Sutton, (London: Continuum International, 2000/Editions Galilée, 1989), 29.

26 Bateson, xxiii.

27 Ibid.

28 Ibid., 466.

29 Ibid., 467.

30 Ibid.

31 Pindar and Sutton in Guattari, 4.

32 In our interest in three ecologies as philosophical registers for ecosystemic design, we have borrowed certain concepts and terminology from the work of Félix Guattari, but with a loosening of the explicit political directives of his work so that we may use it as a more open framework.

"The Earth is undergoing a period of intense techno-scientific transformations. If no remedy is found, the ecological disequilibrium this has generated will ultimately threaten the continuation of life on the planet's surface. Alongside these upheavals, human modes of life, both individual and collective, are progressively deteriorating…

Political groupings and executive authorities appear to be totally incapable of understanding the full implications of these issues. Despite having recently initiated a partial realization of the most obvious dangers that threaten the natural environment of our societies, they are generally content to simply tackle industrial pollution (environmental) and then from a purely technocratic perspective, whereas only an ethico-political articulation—which I call *ecosophy*—between the three ecological registers (the environment, social relations, and human

subjectivity) would be likely to clarify these questions." (Guattari,19–20.)

33 Pindar and Sutton in Guattari, 5.

34 Ibid., 2–3.

35 Manuel De Landa, *A Thousand Years of Nonlinear History* (New York, Swerve Editions, 2000), 17, 273.

36 http://artofmanliness.com/2009/02/17/12-essential-tools-for-a-toolbox/.

37 http://www.techrepublic.com/blog/10things/10-linux-and-open-source-developer-tools-you-should-not-overlook/579.

38 From Dave Snowden, founder and chief scientific officer of Cognitive Edge.

The diagrams are from a presentation by ApJ to the Alliance For Peacebuilding's "Annual Conference, May 2014: Exploring New Frontiers In Peacebuilding" illustrate the relationship of complex systems to order and chaos, and the concept of working on complex problems to shift them away from chaos and toward order.

39 Dave Snowden with Mary E. Boone, "A Leader's Framework for Decision Making," in *Harvard Business Review*, November 2007.

"Complexity is more a way of thinking about the world than a new way of working with mathematical models. Over a century ago, Frederick Winslow Taylor, the father of scientific management, revolutionized leadership. Today, advances in complexity science, combined with knowledge from the cognitive sciences, are transforming the field once again. Complexity is poised to help current and future leaders make sense of advanced technology, globalization, intricate markets, cultural change, and much more.

Unlike in ordered systems (where the system constrains the agents), or chaotic systems (where there are no constraints), in a complex system the agents and the system constrain one another, especially over time. This means that we cannot forecast or predict what will happen.

One of the early theories of complexity is that complex phenomena arise from simple rules. Consider the rules for the flocking behavior of birds: Fly to the center of the flock, match speed, and avoid collision. This simple-rule theory was applied to industrial modeling and production early on, and it promised much; but it did not deliver in isolation. More recently, some thinkers and practitioners have started to argue that human complex systems are very different from those in nature and cannot be modeled in the same ways because of human unpredictability and intellect. Consider the following ways in which humans are distinct from other animals:

They have multiple identities and can fluidly switch between them without conscious thought. (For example, a person can be a respected member of the community as well as a terrorist.)

They make decisions based on past patterns of success and failure, rather than on logical, definable rules.

They can, in certain circumstances, purposefully change the systems in which they operate to equilibrium states (think of a Six Sigma project) in order to create predictable outcomes."

40 John Rendon, founder and CEO of the Rendon Group; senior communications consultant to the White House and Department of Defense, in conversation, March 4, 2012.

41 Don Norman, keynote, "Can HCD (Human Centered Design) Help with Complex Sociotechnical Systems," RSD4 Relating Systems Thinking and Design Conference, Banff, Canada, 2014. Norman's keynote can be seen here: https://www.youtube.com/watch?v=0UYh9ul3h28.

His list of what makes a complex sociotechnical problem:

Lots of interdependent elements;

Nonlinear causal relations with feedback systems;

Long and unpredictable latencies;

Multiple disciplines, frameworks and perspectives;

Multiple incompatible constraints;

Dynamically changing operating characteristics (systems and problems change);

Multiple scales and sizes;

Many people and different stakeholders.

42 In his 1959 article "The Science of Muddling Through," *Public Administration Review* 19, no. 2, 79–88, Yale University professor of economics Charles E. Lindblom compares two methods of public policy formulation: the root method, in which decision making is formulated as a clear means-end relationship where one can define ends comprehensively, and with consensus in advance of determining means; and the branch method that employs a "*succession* of incremental changes." He claims that, "for complex problems, the first of these two approaches is of course impossible"—that one can only make progress in effective public policy formulation by the branch method.

Lindblom claims that the root method belongs to the theorists who work toward comprehensive overview of problems in order to create generalizations and repeatability, but this is only viable in stable systems. The branch method, on the other hand, is the practice of most public policy administrators who "muddle through."

For Lindblom, "muddling through" is "indeed a method or system; it is not a failure of method for which administrators ought to apologize." He describes this system of *successive limited comparisons* in great detail, comparing it to the root method "because it is in fact a common method of policy formulation and is, for complex problems, the principal reliance of administrators as well as of other policy analysts. And because it will be superior to any other decision-making method available for complex problems in many circumstances, certainly superior to a futile attempt at superhuman comprehensiveness."

But unlike our tool set, Lindblom's system proceeds in a chronological, step-by-step manner. It is "a process of successive approximation to some desired objectives in which what is desired itself continues to change under reconsideration." Each decision is "only one step, one that if successful can quickly be followed by another." It is a method of incremental sequential change.

43 http://www.pjfarmer.com/WRITTEN-ABOUT-interviews.html

44 "Dewey took philosophy to be mired within a pre-Darwinian worldview, one which divided sharply between humanity and nature. In its place, Dewey emphasizes the continuities between them. Darwin's importance lies in calling into question our self-image as spectators disinterestedly looking upon the world, by suggesting that we ought rather to see ourselves as agents operating within it. In place of the attempt to identify a fixed framework for inquiry, the pragmatists see inquiry as open-ended, seeking to provide tools which will enable us, as participants, to cope with the world." In Bacon, *Pragmatism: An Introduction* (Cambridge, Polity Press, 2012), 4.

Acknowledgments

There are many who have contributed significant material to this system of books. While most of them appear either explicitly quoted or in our stories, there are others who have contributed to the rich tapestry of ideas, actions, and insights that we have been fortunate to have had around us. And there are still others who have scaffolded our personal lives in important ways, making this possible.

The idea for this book-become-system-of-books emerged as a sequence of four events, and then a series of four writings that wrestled with some of these ideas in their embryonic states. First event: spring 2003, as a member of MIT President Chuck Vest's visiting committee charged with the biennial review of the architecture department, John Seely Brown (JSB) decided to go rogue, and instead of visiting the studio he was assigned, he followed up on a presentation made by Ann Pendleton-Jullian (ApJ) of her studio, in which strategic games were being used as a setup for expanding how one thinks about architecture in complex contexts. Unaware to ApJ, he followed her into her studio. JSB recounts this as a phase shift for him: "walking into her studio and being exposed to her ideas and methods in action meant 'game over' for me … this was a radically new way." This event was amplified by the second event, which was when he became involved, peripherally, in the AUW project in the spring of 2005. Chapter 14 talks about this involvement, which had him delivering a letter to the Gates Foundation that reframed the project in a manner that secured the commitment of fifteen million dollars. The "phase shift" was in understanding how one could—indeed, should—look at what might appear to be a simple problem on the surface, from multiple dimensions and at multiple scales to get at secondary and tertiary influences, consequences, and even opportunities.

To see beyond the obvious. To not mistake complex for simple. And to be able to radically reframe something in these terms.

These two events led to the beginning of a long series of conversations. In one of these—the third event—JSB insisted that the games studio work be written up. He would not back down because he felt that the work, even in its pre-reflective form, should be "out there." ApJ, moderately peeved at his relentless insistence, but also aware that the work would only benefit from the kind of reflection that happens when one tries to explain what one is doing, took the cue and wrote *Games.4.Shanghai*, the first writing that tried out some of the ideas that would become the practice of designing for emergence.

The fourth event: January 2008, JSB sent Libbrecht's book, *The Snowflake*, to ApJ, creating a "DUH?!" moment for her by introducing emergent properties in nature to the emergent properties of games.

Around the same time, ApJ's paper, *Ecotones*, was written (2009), then *Four (+1) Studios* (2010), and then JSB's book with Doug Thomas, *New Culture of Learning* (2011), in which JSB unpacks his fascination with massively multiplayer online games as social contexts for learning. ApJ assisted with the design of *New Culture*. So, although it is unconventional, we want to acknowledge each other for the profound impact we have had on each other's work and thinking over the years—work that contributed to our evolution as individuals, and led to the joint extended conversation that became *Design Unbound*.

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Design Unbound was greatly influenced by case studies and conversations with others who are wrestling with the world

we live in. Many of these individuals are found in quotes and citations but these do not capture the full depth of their contributions, and so we choose to expand our acknowledgments to them in the chapters in which they appear.

Chapter 2, "Design Unbound," could not have been written without numerous conversations with David Ronfeldt, who authored the TIMN framework. It is also indebted to Richard P. O'Neill (RPON), instigator and director of the Highlands Forum, an advanced-edge network of US government leaders, the defense and intelligence communities, and partners from industry, academia, government, journalism, the arts, and the professions. This network and the Highlands Forum were formed to engage in in-depth conversations that extend the emerging concept of security, writ large. Dick's Forum was of invaluable influence in the writing of this book for the connections it made, especially as ApJ had the extreme good fortune to be part of the core group. JSB was one of its original members and introduced ApJ to RPON. Many of the connections in this book—or second- and third-order connections—originated in a Forum meeting. These conversations and connections, along with several Aspen Institute conferences and roundtables, accelerated and amplified the spreading into domains that were invaluable to the work by contributing case studies and colleagues that mentored deep-dive learning into their fields. We also want to acknowledge Dick and his wife Deborah for their invaluable friendship.

Chapter 2 could also not have been written without the intellectually vibrant and fearlessly exploratory, architectural communities of Cornell University, MIT and OSU. Without the students ApJ intersected with and the colleagues both ApJ and JSB have worked with, the experimentation that led to Design Unbound would probably not have emerged.

In addition to contributions around specific content, there are those we wish to acknowledge relative to the emerging process of writing of this book—its development, betterment, support, and logistics of publication: Richard P. O'Neill for having read each version of it, providing insight and fertile ground for new connections and case studies through his Leadership of the Highlands Forum; Jonathan Fanton who read the penultimate version and served as interviewer for the New York videotaped interview of us in Spring 2012; Hope Matthiessen for her patient and critical editing of the work, but, more than an editor, Hope was someone whose exigent editing and critique made us better writers; Paul Soulellis for ongoing critique, intellectual support, his design of previous books, and friendship through the years; Geoffrey Bowker for supporting the publication of this work as part of his Infrastructures Series with MIT Press; and the editors and staff at MIT Press who supported and saw through the publication of the the full work..

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While set in motion by a series of confluences, this book is deeply influenced by experiences lived in contexts and so origins and influences should be acknowledged. Living principally in different domains, in different geographies, and through different formative eras, origins and influences have been different for each of us. Yet, there are clearly overlaps, analogous experiences and resonant motivations.

ApJ,

Growing up in the suburban Midwest of the late Vietnam War era, one of four siblings in a typical corporate American family, but with an alien sensibility that preferred thunderstorms and tornadoes to sunny days, the lure of the horizon over the swimming pool in the backyard, and Nancy Drew and Ray Bradbury over the Sunday comics—this, together with the social, political and emotional conflicts and consequences of the late Vietnam War was formational. Boredom and the managing-by-avoidance of an undercurrent of conflict led to making things—inventing projects in paper, wood, landscape stuff, and a serious competition-winning foray into textile arts—and lots of books, all of which created a rich foundational context and set of dispositions.

But it was two professors at Wellesley College, Dr. Sarah Hill, astronomer, and Dr. Phyllis Fleming, physics, that introduced me to a different way of looking at the world through a blended lens of metaphysics and physics. And they showed me what passion in the pursuit of knowledge looked like. While only pursuing astrophysics for three years, this was the beginning of a life-long wrestling with both hard questions and big systems that are full of unknowns and messy non-linear causalities.

An interview with Carl Sagan led to my move to transfer to Cornell University for astrophysics, where the professional undergrad Architecture program became a dynamic attractor impossible to resist. Colin Rowe, the influential British architectural historian, theoretician and teacher, known for his theoretical framework of contextualism, was a prominent figure at Cornell at the time and he instilled in me a deep appreciation for the imperative of context as both tangible

and intangible inputs for making things—linking culture and other social systems with architecture—and that cities are both memory and future projection. This was a very discursive and formative moment in architectural education and especially so at Cornell. The European modernism of Le Corbusier and his contemporaries was bumping up against emerging post-modernist architecture and theory, and theory that informed practice was beginning to be challenged by theory for theory's sake; Cornell was one of the universities at the epicenter of this. Beyond the invaluable lessons of Rowe and my professors, 'growing up' creatively in an environment of substantive discourse was an incomparably formative experience.

At the same time, it was one of a very few professional undergraduate architecture programs in the US, and it was known for producing top architectural graduates with a deep capacity for the craft of design as both a cultural production and a grounded material practice. From astrophysics and Carl Sagan to architecture and Colin Rowe, I have always been aware of how much I am indebted to these years.

The fact that, a decade later, I designed two projects for Carl Sagan and his wife is coincidental but not random. Unknown to us, many other architects had submitted various design concepts, but there was a resonance between Carl, his wife, myself, and my husband and partner, Guillaume Jullian. In the process of working with Carl and his wife, I had the fortune of watching him interact as an activist with people like the Dalai Lama, the EPA, the National Academy of Sciences, academic colleagues, and many others in various fields, including Jodie Foster when he convinced her to take the role of Dr. Arroway in Contact. The importance of Carl Sagan as professor, client, activist, inspiration, and friend, is immeasurable.

Moving to two of the three most powerful longer standing alliances, I need to acknowledge the irreplaceable and immeasurable importance of Guillaume Jullian de la Fuente in my life as partner, teacher, intellectual challenger, poet, creator, and husband; and John Hejduk, mentor, advocate, dear friend, whose work, way of being and passionate poetic approach to life was not only an inspiration but a validation of the value to be found in playing/wrestling with the ambiguous, uncertain and messy things that drive the human spirit. Guillaume Jullian de la Fuente, whose nom de bataille was Jullian because the American students could not pronounce Guillaume, is throughout this book. As chef d'Atelier for Le Corbusier, he provided a unique perspective on both the work and workings of L-C's studio. As lead architect on The Hospital of Venice project, all my learning about that came from conversations with him and access to the hoard of original drawings, documents and photos he collected. Born in Valparaíso Chile, Jullian introduced me to South America and ultimately to a large portion of the world. He was my teacher around art and philosophy and most importantly, partner to the adventure of life as both a mental and embedded experience. He taught me that it was not about architecture but about engaging the world as an architect.

Jullian also introduced me to the Institute of Architecture of the Catholic University of Valparaíso, a unique multi-disciplinary group of architects, engineers, artists, poets and founders of the Open City Amereida, who used surrealist methodologies to explore meaning and identity on the South American continent through architecture, poetry and sculpture. At the Catholic of Valparaíso, I want to especially acknowledge co-founders Alberto Cruz and Godofredo Iommi, who allowed me to be a fly on the wall for so many years and to publish the first book that introduced them to the

world. Also, Juan Purcell and Manuel Casanueva who served as intellectual and cultural guides over the years.

One of the most pervasive methods of the Valparaíso school was the use of games, which became the spark for my first studios that used games. Originally, merely a cool thing to do to set the students' imagination in motion, games clearly became the major means of exploring emergent behaviors in a lab like setting. Three studios at Cornell, another 3 at MIT and another 3 at OSU, I want to acknowledge my students for their enthusiasm as I experimented with these methodologies.

In Chile, I also want to thank my friend and colleague, Rodrigo Perez de Arce, architect, author, and professor at the Catholic University in Santiago for his intellectual generosity and friendship over the years. Sharing studios and thoughts and projects, he helped me understand cities and settlements that are more emergent than planned. His book on the hills of Valparaíso was fundamental for my first understanding of cities as emergent zones of both pragmatic and poetic, material and social interaction. Roderigo has been more than a colleague. He has been a friend and fellow traveler.

I need to acknowledge, also, the profound influence that MIT had on me, both as a context and through my colleagues there, especially former Dean Bill Mitchell, who supported my work and gave me resources to begin what became a fifteen-year adventure of jumping fences and building relationships with people far outside my field, And former Department Head, Stanford Anderson, whose intellectual generosity and mentorship was as profound for me as it was for an entire generation of PhD students and young faculty. I was privileged to have traveled with him and his wife, Nancy Royal, throughout China and to be able to consider them

close friends. It was at MIT that I developed a polymathic curiosity and had the opportunity, platform and warrant to work at a multi-continental scale, creating studios that worked on four continents.

And finally, relative to the architecture work, itself, in my Cambridge studio, I need to acknowledge a small group of individuals who worked on the projects that are relevant to this book: Chris Genter and Ben Ku as collaborators on many projects. Marie Law and Dan Adams as the most critical collaborators on the AUW; Alexandros Tsamis and Lydia Kallipoliti for their intellectual collaboration, especially around the first games studios and a series of exhibits; and Neeraj Bhatia, who helped teach my Shanghai games studio and then produce the book *Games.4.Shanghai*.

I was introduced to Richard O'Neil and John Rendon by JSB in 2005. Dick O'Neill as instigator and director of the Highlands Forum, opened me up to cutting edge work in multiple domains and has always challenged me to see how things connect. I have had the extreme fortune to be part of the core group, which provided me with the opportunity to attend many forums—an extreme playground. Many of the connections in this book, or second and third order connections, come from these. Together with several Aspen Institute conferences and roundtables, these accelerated and amplified my intelligence around, and connections with, domains I would not have touched otherwise. John Rendon is more than important to this book because he is an action orchestrator and influencer of extreme efficacy. John has taught me about real on the ground agency in the world. Without him, the meta-tools of Systems of Action and the Change Triangle would not have evolved. But I also want to acknowledge Dick,

his wife Deborah, and John Rendon and his wife Sandy, for what have become invaluable friendships.

And finally, those who have contributed to my development within the field of complexity science and on the ground action in complex on complex problems. Relative to the knowledge side: Dave Snowden for helping me understand how to categorize complex systems in a way that is useful for working on them; Peter Ho, friend, colleague and Director of Singapore's Urban Redevelopment Association and many other influential agencies in Singapore—over the years, I have had the opportunity to profit from Peter's wisdom and leadership as he both theorizes what, how and why and then designs and acts to build Singapore's future with this epistemological, but action oriented, frame; Dave Krakauer, President of SFI; numerous colleagues at the RAND corporation and in the Pardee RAND Graduate School of Public Policy, especially Rob Lempert, Susan Marquis, and Angela O'Mahony; and the Systems Thinking and Design Research Network, especially Dr. Alex Ryan.

There are three projects that served as fertile ground for developing actionable work around and the leadership of those projects needs to be acknowledged: Kamal Ahmad for the AUW project: President Jack DeGioia—brilliant leader, colleague and friend—for the University 2033; Elliott Shore, both leader and friend, for the redesign of the Association of Research Libraries (ARL): and Susan Marquis and the leadership at PRGS for the work we are now doing with the RAND corporation's graduate school of public policy.

I have been especially fortunate that, over the years, most of my colleagues have become close friends. There is nothing more satisfying. Beyond those that I have already

acknowledged as friends as well as colleagues, I also need to acknowledge Marianne Jullian for her constant support and love. With a maturity beyond her years and an irrepressible playfulness, she has been a constant reminder of why the future matters. And JSB, the third of my powerful longest standing alliances; his support and devoted friendship/partnership has both disrupted and enriched my life in the most significant of ways.

JSB

As a kid growing up in Colgate's college town of Hamilton, New York, with my father, a physical chemistry professor, I had ample opportunity to participate in my dad's lab. A kid among the seniors, I would hang out on the periphery, listen and observe what they were doing, what they were missing, and solve the problems they were working on in this peripheral but cognitively immersed manner. My father, Alfred Seely Brown, instilled in me this entrepreneurship of learning through doing by providing a context in which the problems I was confronted with were way out in front of where I was in school. But also, working in 'grease shops', judging cows in the state fair, playing with electronics, getting my ham radio license at 14, and becoming the youngest bookie at the racetrack (where I learned that reading people was more important than just being able to do the math in my head)—these experiences meant that I learned early that reading the world was critically important; and I began to appreciate bricolage—using what was at hand to solve problems.

The University of Michigan in the 60's provided another extraordinary environment and access to people that influenced me in significant ways. In those days, UMich was

all about crafting one's own pathway. It was there that I was first exposed to systems thinking and complexity science, cross-linking everything from physical science to neural science, computer science, logic and coding theory. From the computer scientist, Bernie Galler, I discovered that for true learning to take place one must often let go of the need to understand everything at all times, or even where you are going. Anatol Rapoport set the stage for my fascination with how mathematical theory can be applied to social interaction and policy. And he taught me about humility. And my friend Chloe French, social activist and part Tlingit Indian, exposed me to community based actions for social improvement in the projects in South Chicago. It is there, that I came to understand hard core pragmatic reasoning and gained a deep appreciation of the power of street smarts.

Hired as a joint appointment between the schools of computer science and social sciences at UC Irvine in the early 70's afforded me exposure to hard core sociologists. It is there that I met Jean Lave, who pioneered the theories of situated learning and communities of practices, Brigitte Jordan, anthropologist, and Harvey Sacks, the father of ethno-methodologies that looked at the use of language in everyday life.

And then, I need to recognize the unique opportunity that Xerox PARC (Palo Alto Research Center) afforded me both as a lab researcher and then 15 years as Director. PARC was legendary as a fertile ground for innovation and creativity—an irrepressible environment and community of practices that set out to re-invent the world and how we work with new technologies. When I arrived at PARC, physicist, founder, and then director George Pake instilled in us the mantra of build what you but use what you build—a sense that the world was a tool box. George Pake left an indelible influence on me.

As Director, I had the license and warrant to bring in artists, social scientists and most notably the anthropologists and ethnographic researchers Lucy Suchman, Brigitte Jordan, and Jack and Marilyn Whalen. These people had a huge influence on my understanding of things like ethnography, ethno-methodologies, and situated cognition. And Johan de Kleer who I brought to PARC from my BBN days to help create the field of qualitative reasoning by intelligent systems. Ron Kaplan who introduced me to natural language processing by computer.

My interest in complexity science, begun at University of Michigan, has been greatly augmented by my working friendships with W. Brian Arthur, the economist credited with influencing and describing the modern theory of increasing returns, founder of the field of Complexity Economics, and Nobel prize-winning physicist Murray Gell-Mann, both pioneers of the science of complexity and founding members of the Santa Fe Institute in 1987. Conversations with Arthur and Gell-Mann have fed my interest in the profound path dependencies of non-linear systems especially in economic and social systems. And John Holland who introduced me to complex adaptive systems, genetic algorithms and machine learning, decades before they became a more widely adapted set of words and concepts.

Recent work has taken me deeper into organizational theory and complexity. In this area, I need to acknowledge Wendell Weeks, Chairman and CEO, and David Morse, Executive VP and CTO, of Corning, and Jeff Bezos, as inspiring models of leadership in highly competitive and rapidly changing technological domains.

And then there are those that must be acknowledged for providing me with an intellectual playground of consequence,

more generally. Colleagues, co-authors and friends in academia include those at USC: Provost Michael Quick, Elizabeth Daly, Mimi Ito, Scott Fisher, Holly Willis, Carl Kesselman, Todd Richmond, Randall Hill, Krisztina Holly, Steve Anderson, Colin Maclay, Doug Thomas, co-author of New Culture of Learning, and Paul Duguid, my co-author for The Social Life of Information—both Paul and The Social Life still shape much of how I see the world. Others of significance who have, over the years, shared intellectual concern for, and constructed expansive approaches to learning, more broadly: Michael Crow, President of Arizona State University, Dan Atkins, founding director of University of Michigan's School of Information, Connie Yowell, founder of the Digital Media and Learning Initiative (aka Connected Learning) at MacArthur Foundation, Joi Ito, director of MIT's Media Lab, dana boyd, founding director of Data & Society at Microsoft Research, Jonathan Fanton, former President of the MacArthur Foundation and current director of the American Academy of Arts and Sciences, Beth Noveck, Director of GovLab at New York University, and Margaret Levi, Director of the Center for Advanced Studies in the Behavioral Sciences at Stanford University for an expanded appreciation of the role of the social sciences.

Additionally, Deloitte's Center for the Edge and working with John Hagel, co-author of The Power of Pull, and the Center for the Edge Fellows has provided occasion for wrestling with the 21st century. And Bill Janeway, who as both theorist and practitioner in the domain of venture capital, has mentored me for years on the dynamics of venture capital investments and how theory and practice play off each other. His ability to do this, to understand the deep currents of systems writ large, and the value it creates has been a beacon for me.

On a more personal note, I want to acknowledge, with love and appreciation, my wife, Susan Haviland, whose constant support has enabled me to live up to my title as chief of confusion. And for introducing me to the unique nature of architectural studios and charrettes in the late 70's. Holding a PhD in cognitive science, Susan has also challenged and helped me to see the wider implications of my scientific training.

I also want to acknowledge the personal support of Jonathan Taplin, whose own multi-faceted, multi-dispositional, path has offered me entrepreneurial companionship; Peter Finkelstein, who has scaffolded my personal reflection and been an invaluable conversationalist around organizational dynamics; assistant Carrie Howell who manages the confusion; and devoted friend, inspiration and co-author, ApJ, better known to me as TAA.

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