Peter Morville

INTER

TWIN

GLED

Information Changes Everything

Advance Praise for Intertwingled

"*Intertwingled* is a meditation on the connectedness of everything. From language and ontology to culture and strategy, Peter takes us on a journey that reveals how a simple change in what we take for granted can send ripples that reach far beyond our awareness."

Irene Au, Operating Partner, Khosla Ventures

"In the information age, we are all information architects, says Morville in this fresh and fascinating take on the discipline he played a huge part in creating. Drawing on nature, culture, history, and science, plus decades of deep personal experience helping major clients, Morville finds new and profound meaning in the business of helping users to find their way."

Jeffrey Zeldman, author, Designing with Web Standards

"MIND BLOWN OPEN, rearranged, and reshaped. This startling book took me on a twisty adventure in how to think, see, design, and experience the world differently. It's like stepping through a door to a shifted universe that's richer, deeper, more connected. And, Peter reveals practical ideas and insights about how to build understanding and cope with complexity. Say goodbye to your current self when you start this book, because you won't be the same person by the end of the journey."

Kathy Sierra, author, Badass: Making Users Awesome

"If James Burke, Donella Meadows, John Berger, and Peter Morville had dinner together on a quiet Friday evening, this book would be the record of their conversation. Just as much a spirited look at systems design, as it is a way of looking at the world. Essential."

Liz Danzico, Creative Director, NPR

"How does Peter Morville manage all the suffering and turbulence in modern information architecture? Having read this book, I now know. The guy has become a guru. He's achieved enlightenment."

Bruce Sterling, author, Shaping Things, co-founder, EFF

"This is a delightful, surprisingly practical book: an insider's guide to the best thinking on design, culture, and complex systems. True to his vocation, Morville makes it easy to find useful tidbits, while also opening doors and illuminating connections. Shining through it all is an invitation to expand our notion of what information architecture entails – and what it really takes to change the world. *Intertwingled* is a fine dinner party of a book, and Morville is a marvelous host."

Vienna Teng, singer, songwriter, pianist

"*Intertwingled* is exactly the book you'd expect from a volume with that fanciful title. Delightful. Full of unexpected connections. Panoramic. Practical. Wise. Anyone who makes the case that the Buddha was an information architect, as Peter Morville artfully does, is worth your attention. You won't find a better guide to surviving and succeeding in a world of hyper-abundant information."

Lee Rainie, Director, Pew Research Center's Internet Project

"Intermingles great thinking about interaction design with deep dives into spiritual, physical, and personal dimensions. Morville's generosity with his own stories enriches a work of great insight on a topic that is ironically not seen as personal. From systems thinking to culture and politics, this work is deeply and diversely informed. *Intertwingled* is required reading for cultural interventionists."

Brenda Laurel, author, Computers as Theatre

"Peter Morville gently leads us to a place we can be still in discomfort. The book appears to be about information architecture, but the true value of this narrative is its appeal to a general audience. Readers outside the industry will identify themselves in Morville's story. It will guide them into a better understanding of their relationship to information and perhaps incidentally into their own public library."

Josie Barnes Parker, Director, Ann Arbor District Library

"*Intertwingled* offers its reader a beautiful, personal journey into connectedness, a gentle invitation to reflect upon the nature of change, and a refreshingly honest exploration of life in a complex world."

Dave Gray, author, The Connected Company

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Preface

"People keep pretending they can make things hierarchical, categorizable, and sequential when they can't. Everything is deeply intertwingled."

– THEODOR HOLM NELSON

In 1974, Theodor H. Nelson wrote and self-published a book with two covers. The first, *Computer Lib*, is an introduction to computers that notes "any nitwit can understand computers, and many do." The flip side, *Dream Machines*, is an invitation to the future of media and cognition that states "everything is deeply intertwingled." This prescient codex served as a bible to many pioneers of the personal computer and the Internet.

In 1994, I started my career as an information architect. I was driven by the belief that we can make the world a better place by organizing its information. Together, Lou Rosenfeld and I built a company and wrote a book that helped to establish the field of information architecture. Ever since, I've been blessed

with opportunities to do what I love. But a few years ago, I began to sense a glitch. My ability to help my clients was limited by our narrow focus. This was partly my fault for defining myself as a specialist, but I eventually came to see that this problem of reductionism is endemic to our culture.

In 2014, I wrote this book to show Ted Nelson's insight that everything is deeply intertwingled is more vital than ever, and to argue we can *get better at getting better* by changing how we organize information, not only on websites, but in our minds. It was not an easy book to write, and if its reading makes you uncomfortable, then perhaps it has met my ambition.

Organization of This Book

This book should be read in linear style from start to end. It's divided into chapters, but of course they are all intertwingled.

Chapter 1, Nature

Explores the nature of information in systems from the wolves of Isle Royale to Uber in Silicon Valley. Explains why systems thinking is essential if we hope to create sustainable change.

Chapter 2, Categories

A deep dive into classification and its consequences. Flows from organizing for users to organizing ourselves (*governance*). Covers embodied cognition, meditation, and moral circles.

Chapter 3, Connections

The history of links from hypertext and navigation to planning and prediction. Explores self-justification and the cobra effect. Blames music and synesthesia on the architecture of the brain.

Chapter 4, Culture

Offers models for understanding and changing organizational and national culture. Covers ways of knowing from authority to intuition and ways of changing from tiny habits to positive deviance. Features a thick description of design ethnography.

Chapter 5, Limits

A journey beyond the limits of understanding and growth that includes iatrogenics, teleportation, and meatballs. Tackles big fish from pollution and corruption to extinction and collapse. Explains why our myths are the root cause and our only hope.

Acknowledgments

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CHAPTER 1

Nature

"When we try to pick out anything by itself, we find it hitched to everything else in the universe."

– JOHN MUIR

I'm standing on an island beach in the northwest corner of Lake Superior. After nine hours in my Honda Civic and six hours aboard the Ranger III, my backpack and I have been transported into the wilderness archipelago of *Isle Royale National Park*. While this rugged, isolated refuge is among the least visited of our national parks, it's well-known among ecologists for its wolf and moose, subjects of the longest continuous study of a predator-prey relationship in the world.

Of course, I'm not here as a scientist. I'm here to hike. But I was drawn to this place by the story of its ecosystem. When the study began in 1958, well-established mathematical models of predation described how the populations should rise and fall as part of a cyclical, co-evolutionary pattern that maintains the "balance of nature." For the first few years,

things proceeded as expected. But the ecologist, Durward Allen, had the foresight to persevere beyond the normal period of observation, and the dramatic, dynamic variation that unfolded was an illuminating surprise.

> The more we studied, the more we came to realize how poor our previous explanations had been. The accuracy of our predictions for Isle Royale wolf and moose populations is comparable to those for long-term weather and financial markets. Every five-year period in the Isle Royale history has been different from every other five-year period – even after fifty years of close observation.[1]

This is a lesson in humility, and a sign of what's to come for those who labor in today's high-tech ecologies. In user experience and digital strategy, there's a lot of talk about "ecosystems" that integrate devices and touchpoints across channels. While this is a step in the right direction, our models and prescriptions belie the true complexity of our information systems and the organizations they are designed to serve.

Recently, while I was consulting with a Fortune 500 that does over $2 billion a year in online sales, one of my clients explained that over the years he'd seen lots of consultants fail to create lasting change. "They tell us to improve consistency, so we clean up our website, but the clutter soon comes back. We keep making the same mistakes, over and over."

This infinite loop to nowhere results from treating symptoms without knowing the cause, a bad habit with which we're all too familiar. Part of our problem is human nature. We're impatient. We choose immediate gratification and the illusion of efficiency over the longer, harder but more effective course of action. And part of our problem is culture. Our institutions and mindsets remain stuck in the industrial age. Businesses are designed as machines, staffed by specialists in silos. Each person does their part, but nobody understands the whole.

The machine view was so successful during the industrial revolution, we find it astonishingly hard to let go, even as the

information age renders it obsolete and counterproductive in a growing set of contexts. It's not that the old model is all wrong. We're not about to throw away hierarchy or specialization. But our world is changing, and we must adjust.

The information age amplifies *connectedness*. Each wave of change – web, social, mobile, the Internet of Things – increases the degree and import of connection and accelerates the rate of change. In this context, it's vital to see our organizations as ecosystems. This is not meant figuratively. Our organizations are ecosystems, literally. And while each community of organisms plus environment may function as a unit, the web of connections and consequences extends beyond its borders.

All ecosystems are linked. To understand any complex, adaptive system, we must look outside its limits. For instance, the story of Isle Royale is a lesson in systems thinking. In 1958, predictions for the rise and fall of populations were grounded in classic predation theory: more moose, more wolves, but more wolves, less moose, and less moose, less wolves, and so on. It's an interesting, useful model, but it's incomplete.

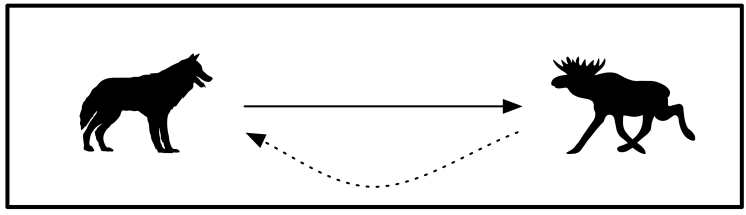

Figure 1-1. The classic predator-prey relationship.

By 1969 the number of moose had doubled, a major shift in balance. By 1980 the moose population had tripled, then declined by half, and the number of wolves had doubled. Ecologists wondered whether the wolves might drive their

prey to extinction. But two years later, the wolf population had been decimated by canine parvovirus, a disease that was accidentally introduced by a visitor who (illegally) brought his dog to the island.

Over the years, the moose population has grown steadily only to collapse due to cold winters, hot summers, and outbreaks of moose tick. The tiny wolf population failed to thrive for years due to inbreeding. But in the winter of 1997, a lone male wolf crossed an ice bridge between Isle Royale and Canada, and revitalized the population for a while. Today, however, the wolves are again at risk of extinction, and scientists fear that due to global warming, no more ice bridges will form.[2]

What's interesting for our purposes is that the surprises in this story result from *exogenous shocks*. They come from outside the model of the system. In ecology and economics, such disruptions are often explained away as rare, unpredictable, and unworthy of further study. But that's an ignorant, dangerous conclusion. The truth is that the model is wrong.

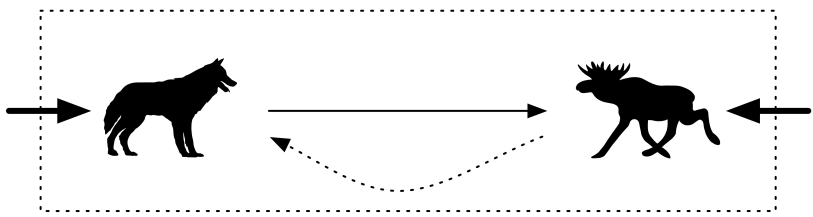

Figure 1-2. Systems are subject to exogenous shocks.

We make this mistake over and over in the systems we build. We work on websites as if they exist in a vacuum. We forge ahead without mapping the ecosystems of users and content creators. We measure success and reward performance

without knowing how governance and culture impact individuals and teams. We plan, code, and design wearing blinders, then act surprised when we're blindsided by change.

If we hope to understand and manage a complex, dynamic system, we must practice the art of *frame shifting*. When our focus is narrow, our ability to predict or shape outcomes is nil. So we must learn to see our systems anew by soliciting divergent views. And when we uncover hidden connections, information flows, and feedback loops that transgress the borders of our mental model, we must change the model.

In the era of ecosystems, seeing the big picture is more important than ever, and less likely. It's not simply that we're forced into little boxes by organizational silos and professional specialization. We like it in there. We feel safe. But we're not. This is no time to stick to your knitting. We must go from boxes to arrows. Tomorrow belongs to those who connect.

If this talk of change disturbs you, that's good. Learning makes us all uncomfortable. When faced with disruption, we're tempted to turn back. But if we press on, we build skills and understanding that may prove invaluable to us in the future. Once we overcome our initial fear and discomfort, we may even begin to enjoy ourselves. Some of life's best paths start out on slippery rocks. Or at least that's what I tell myself as I stand on the beach of Isle Royale, with my backpack, map and compass, anxiously gnawing on a hunk of meatless jerky.

It's not that I'm afraid of the wolves. There aren't many left. I'm worried because I've never been backpacking. My hikes always end in hotels. The last time I slept in a tent was at Foo Camp, a hacker event during which attendees camp in an apple orchard behind the offices of O'Reilly Media. And I couldn't sleep. I was cold. My hips hurt. That morning, shivering in my tent but grateful for the orchard Wi-Fi, I fired up my Apple MacBook Pro and booked a hotel. But now, I'm

headed into the wilderness alone, for four days and four nights. I'm 44 years old, and this is my first time.

Of course, it's my own fault. Since turning 40, I've been making myself uncomfortable on purpose. At an age when it's easy to fall into a rut, I've run my first marathon, tried the triathlon, and tackled new consulting challenges that terrified me. Now, I'm writing and publishing a book, and carrying a bed on my back. And I invite you to join me in discomfort. Because it's not just my age. It's our age. It's the information age, a time when learning how to learn (and unlearn) is central to success. Instead of hiding from change, let's embrace it. Each time we try something new, we get better at getting better. Experience builds competence and confidence, so we're ready for the big changes, like re-thinking what we do.

Information in Systems

When I graduated from college in 1991, I had no plan, so I moved in with my parents. I worked by day (*mind-numbing data entry*) and messed around on my computer at night. One Saturday, while browsing the public library, I stumbled upon a tattered old book about careers in library science. As I learned about libraries, I thought about the networks – AOL, CompuServe, Prodigy – I'd been exploring. They were a mess. It was hard to find things. Could librarianship be practiced in these online computer networks? That question sent me to graduate school at the University of Michigan.

In 1992, I started classes at the School of Information and Library Studies, and promptly began to panic. I was stuck in required courses like Reference and Cataloging with people who wanted to be librarians. In hindsight, I'm glad I took those classes, but at the time I was convinced I'd made a very big mistake. It took a while to find my groove. I studied information retrieval and database design. I explored Dialog,

the world's first commercial online search service. And I fell madly in love with the Internet.

The tools were crude, the content sparse, but the promise irresistible. A global network of networks that provides universal access to ideas and information: how could anyone who loves knowledge resist that? I was hooked. I dedicated myself to "the design of information systems."

Thus, when I left library school, I knew what I wanted to do. But there were no jobs. So I became an entrepreneur, working with Lou Rosenfeld and Joseph Janes to grow *Argus Associates*. We taught people how to use the Internet, we built networked, hierarchical, text-only information systems using the Gopher protocol. And when Mosaic, the first graphical browser (*pretty pictures but no back button*), was released, we began doing what folks today would recognize as website design.

We dabbled in everything from coding to content, but specialized in helping our clients to structure and organize websites. There wasn't a name for this work, so we called it "information architecture" and set out to establish a new field of practice. At first we relied heavily on the metaphor. We talked about architectural plans and blueprints and invoked wayfinding and the familiar frustration of getting lost.

In time our explanations grew more concrete. We focused on the organization, labeling, search, and navigation systems of websites that help users complete tasks, find what they need, and understand what they find. In the late 90s, this concentration made sense. Everyone was shoveling content onto their sites, and somebody needed to organize it.

Our formal definition of information architecture as "the structural design of shared information environments" was more expansive, but nobody remembers definitions. What caught people's attention were the wireframes, the most visible yet superficial element of our work. So, in the minds of many, our practice was wedded to websites and wireframes.

But, as we shifted from nineties to noughties, information architecture continued to evolve. In addition to wireframes, we used all sorts of tools and methods to learn about users, test ideas, and make the complex clear. And, we went beyond usability, working hard to improve findability, accessibility, credibility, and other qualities of the user experience.

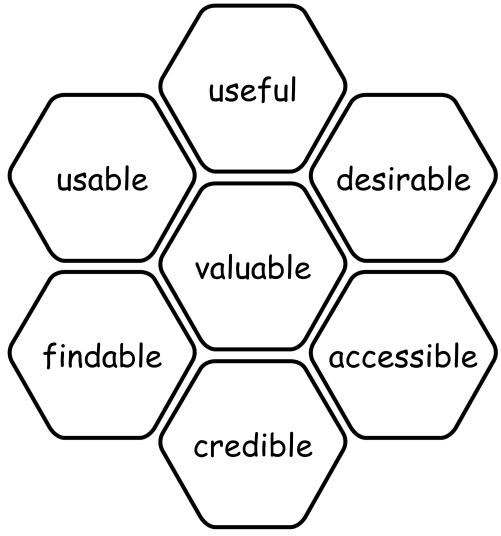

Figure 1-3. The User Experience Honeycomb.

Along the way, the context in which we practice changed. Web search and SEO turned sites upside down, by shifting attention from home pages to the design of findable, social objects that serve as both destination and gateway. In short, we began to plan for multiple front doors.

We embraced Web 2.0 selectively, learning to design rules, frameworks, and architectures of participation. And we started making maps for mobile and cross-channel services

and experiences to help our clients and colleagues to see and understand what's possible and desirable.

We realized that, in the modern era of cross-channel experiences and product-service systems, it makes less and less sense to design taxonomies, sitemaps, and wireframes without also mapping the customer journey, modeling the system dynamics, and analyzing the impacts upon business processes, incentives, and the org chart.

As our practice evolved and the gap between classic and contemporary information architecture grew, our community struggled to explain itself, so much so we earned a hashtag (#dtdt) for "defining the damn thing." And while accusations of navel-gazing were not without merit, this was a necessary, productive struggle that helped us shed a web-centric worldview in favor of a medium-independent perspective.

Andrea Resmini and Luca Rosati led us to independence with their manifesto for pervasive information architecture.

> Information architectures become ecosystems. When different media and different contexts are tightly intertwined, no artifact can stand as a single isolated entity. Every single artifact becomes an element in a larger ecosystem.[3]

Soon they were joined by new voices. Jorge Arango, a traditional architect by training, put a new twist on the old metaphor by arguing that where architects use forms and spaces to design environments for inhabitation, information architects use nodes and links to create environments for understanding.[4] Andrew Hinton invited us to peer through the lens of embodied cognition to see that digital contexts are every bit as real as their physical counterparts and to see that language is environment and information is architecture.[5] And Dan Klyn inspired us to "make things be good" by learning from the lifework of Richard Saul Wurman and by focusing on the architecture part of IA.[6]

I'm excited by the depth and diversity of ideas about the direction of our discipline. And yet I worry we may be unbalanced. In our passion for placemaking we mustn't lose sight of the information in the architecture. Our strength in structural design must be joined by an aptitude for managing information flows, feedback loops, and motivational metrics.

What matters most isn't what we build but the change we make. That's why I'm writing this book. I want to study, understand, and clarify *the nature of information in systems*. In part, it's about going beyond the Web. Mobile and the Internet of Things are tearing down the walls between physical and digital, creating new information flows and loops.

It's also about seeing old sites with fresh eyes. Our websites aren't just channels for marketing and communication. They've become rich, dynamic places where work gets done. Websites are extensions of the organization that change its nature. To manage them, we must address inputs, outputs, feedback loops, metrics, governance, and culture.

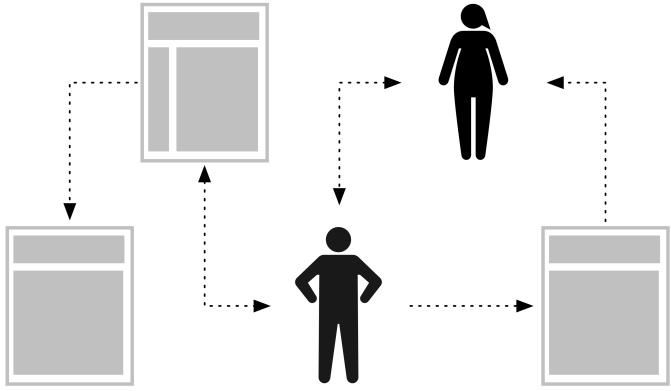

Figure 1-4. Websites are part of organizational ecosystems.

But that's not enough. We should set our sights higher. Life is too short to focus solely on getting better at business. Society as a whole suffers from bad decisions and anxiety caused by misinformation, disinformation, filter failure, and information illiteracy. We can't expect technology to save the day.

While the Internet has delivered great change to consumers and industries, it hasn't made as much progress in education, healthcare, and government. And we've begun to learn the cost of free. In recent years, we've begun to lose newspapers, bookstores, libraries, and privacy. Now we search for answers in a sea of advertisements, thinking carefully (or not) about where to look, who to trust, and what to believe.

These are wicked problems but not impossible. No field has all the answers, but together we can do better. That's why I'm writing outside my category about the nature of information in systems. It's not all about information architecture, and I'm a long way from library school. But this inquiry is important. Connectedness has consequences. Information changes everything. That's why I'm willing to travel.

Systems Thinking

I'm in Silicon Valley. I'm in a cab headed to my hotel. Actually, that's not true. I'm hitchhiking and plan to sleep with a stranger named Sophie. Okay, that's not quite right either. But that's how our eleven year old daughter explained my experiment with Uber and Airbnb to my wife.

Yes, once again, I'm making myself uncomfortable. I'm an advisor to the School of Library and Information Science at San José State University. Since 2009, the program has embraced a 100% online model. Ironically, I'm here for a face to face meeting. And I'm using this visit to California as an opportunity to dip my toes into the infamous *sharing economy*.

So, I'm not in a cab, and I'm not hitchhiking. I'm in a black town car with an Uber-qualified driver named Gustavo. I hailed him via mobile app. I must admit it was fun watching the little black car icon drive to my location. I already know a bit about my driver. He's passed Uber's insurance and background checks and has a 5 star rating. At the end of my flat rate ride (paid by phone) I can rate him and even write a review. Of course, while I'm rating Gustavo, he's also rating me, which matters because drivers often ignore the requests of customers with three stars or less. So, if I'm obnoxious or give him a bad rating, he may return the favor, and cost me a ride. The system isn't perfect, but neither are taxis.

We've all struggled to hail a cab or waited in line or on hold. And we've all endured rudeness, bad driving, and cabbies who simply get lost. But not all of us suffer alike. While in Washington, D.C. a few years ago, I helped a friend catch a cab. A taxi pulled over, but when the driver saw my friend would be riding alone, he drove away before she could get in. I was shocked, but she wasn't. As a black woman, she'd been there before. This bigotry is nearly invisible in the world of yellow cabs, but it would be hard to hide in Uber. They've built a new "architecture of trust" that re-frames the rules and relationships between passengers and drivers.

The design of these information systems is tricky. Before pickup, Uber drivers and passengers see each other's ratings and may decline a ride based on the number of stars. After a ride, drivers see the rating they're given but not the review. Passengers see neither. Drivers are told by Uber not to solicit 5-star ratings, nor confront passengers about low ratings, but both do occur. Balancing privacy and transparency for optimal performance and trust in the system requires constant tuning.

Figure 1-5. Rideshares rely on trust and ratings.

Despite these challenges, Uber has built a platform that integrates mobile phones, social networks, and GPS to disrupt the business of transport. Their success is evident in the backlash from rage over "surge pricing" to lawsuits and fines in cities around the world. Interestingly, their defense is all about categorization. Uber insists they are not a taxi company nor a limo service. They simply match drivers and passengers. So they aren't subject to established regulations, licensing, or insurance requirements.

Uber isn't alone in this argument. They have competition. For instance, there's Lyft, a peer-to-peer rideshare whose drivers don't charge "fares" but receive "donations" from passengers who are encouraged to sit in the front seat and give the driver a fistbump. Their tagline is "your friend with a car." Do we need any more evidence that a Lyft is not a taxi?

Meanwhile, taxis aren't standing still. They're adopting e-hail apps that enable passengers to book regular taxis with their mobile device. In short, from lawsuits to competition, Uber has plenty of problems. This is to be expected. Disruptive innovation inevitably provokes a response.

Or, in the words of John Gall, "the system always kicks back." In *Systemantics*, a witty, irreverent book published in 1975, Gall uses the example of garbage collection to explain that

when we create a system to accomplish a goal, a new entity comes into being: the system itself.

> After setting up a garbage-collection system, we find ourselves faced with a new universe of problems. These include questions of collective bargaining with the garbage collectors' union, rates and hours, collection on very cold or rainy days, purchase and maintenance of garbage trucks, millage and bond issues, voter apathy, regulations regarding the separation of garbage from trash…if the collectors bargain for more restrictive definitions of garbage, refusing to pick up twigs, trash, old lamps, and even leaving behind properly wrapped garbage if it is not placed within a regulation can, so that taxpayers resort to clandestine dumping along the highway, this exemplifies the Principle of Le Chatelier: the system tends to oppose its own proper function.[7]

This is why we need disruptive innovation within our society. Systems that have grown unresponsive must be shaken up. But, like garbage, change is messy. Disruptors such as Uber provoke counterattacks, and they build new systems that create new problems. All of this change results in unintended consequences that are hard to predict or control.

While we'll never be perfect at change, we can be better. One path to progress runs through the field of systems thinking, an approach that aims to understand how the parts relate to the whole. Think about it. We're all familiar with Aristotle's aphorism: "the whole is greater than the sum of its parts." But how often do we put this into practice? How often do we take time to understand the whole before doing our part?

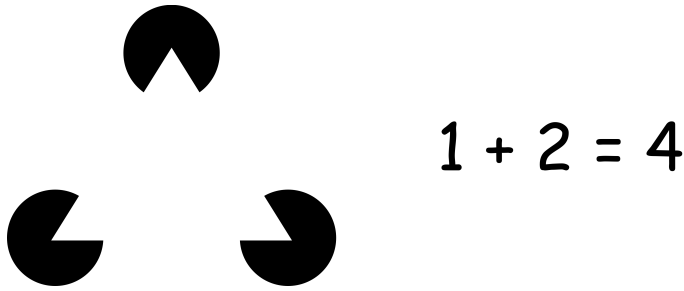

Figure 1-6. The whole is greater than the sum of its parts.

It's not easy. Our society is organized around the opposing principle that the whole equals the sum of the parts. Reductionism, the idea that any system can be understood by studying its parts, was introduced by the ancient Greeks and formalized by French philosopher René Descartes in the 17th century. During the ensuing scientific and industrial revolutions, reductionism and specialization were so spectacularly successful, they became embedded within our culture. In school, we divide knowledge into subjects and kids into grades. In business, we put specialists in silos and progress in quarters. Our categories are like water to a fish, so ubiquitous and "natural," we don't even know they're there.

Again, it's not that it's all wrong. Reductionism is truly valuable. In fact, its value is part of the problem. Success blinds us to alternatives. And, we're reaching its limits. Optimizing for efficiency through specialization eventually compromises overall effectiveness. Plus, some problems can't be solved as parts. Economic volatility, political corruption, crime, drug addiction, lifestyle disease, and environmental degradation are systemic. Nobody creates these problems on purpose or wants them to continue. They emerge from the system and are wholly immune to the quick fix.

That's where systems thinking comes in. While conventional thinking uses *analysis* to break things down, systems thinking relies on *synthesis* to see the whole and the interactions between parts. As Russell Ackoff, a pioneer in systems thinking and business management, explains:

> Systems thinking looks at relationships (rather than unrelated objects), connectedness, process (rather than structure), the whole (rather than just its parts), the patterns (rather than the contents) of a system, and context. Thinking systematically also requires several shifts in perception, which lead in turn to different ways to teach, and different ways to organize society.[8]

There's a subversive dimension to systems thinking with hints of danger and risk. And this talk of change can overwhelm. We can't have everyone thinking this way. But, at times, we need activists and entrepreneurs who can see the system as the source of its own problems, and restructure it. Progress depends upon people who know there must be a better way.

These change agents are often found in and around information systems, because our tools of communication are powerful levers of change. As the legendary systems thinker and environmentalist Donella Meadows explains:

> Some interconnections in systems are actual physical flows, such as the water in the tree's trunk or the students progressing through a university. Many interconnections are flows of information – signals that go to decision points or action points within a system…information holds systems together.[9]

In her book, *Thinking in Systems*, Donella makes it clear most problems in systems are due to biased, late, or missing information; and adding or restoring information is often the most powerful intervention. Simply changing the length of a delay may radically change behavior, causing overshoots, oscillations, and even total collapse of the system. Feedback loops are central to the design of information in systems.

Donella tells a great story about electric meters in Dutch houses. In the 1970s, a subdivision was built near Amsterdam with houses that were identical except for the position of the electric meter. Some were in the basement while others were in the front hall. Over time, the houses with visible meters (in the front hall) consumed thirty percent less electricity. She describes this as "an example of a high leverage point in the information structure of the system. It's not a parameter adjustment, not a strengthening or weakening of an existing feedback loop. It's a new loop delivering feedback to a place where it wasn't going before."[10]

This is where information architects can make a difference. Our user research and stakeholder interviews illuminate the openings where what's desirable meets what's possible. And we're already in the business of mapping interconnections and information flows. If we take the time to understand the nature of information in systems, we can shape profound change with the right mix of links, loops, and levers.

Of course, it's not enough for us to understand. We must also convince our clients and colleagues. As information architects, we've learned to reveal the infrastructure behind the interface. We're experts at using boxes and arrows to make the invisible visible. This need for visualization is something we share with systems thinkers like Donella, who explains:

> There is a problem in discussing systems only with words. Words and sentences must, by necessity, come only one at a time in linear, logical order. Systems happen all at once. They are connected not just in one direction, but in many directions simultaneously. To discuss them properly, it is necessary to use a language that shares some of the same properties as the phenomena under discussion.[11]

Both practices rely upon a visual language for analysis and design. While information architects are known for our sitemaps and wireframes, the tool of choice for systems thinkers is the stock-and-flow diagram.

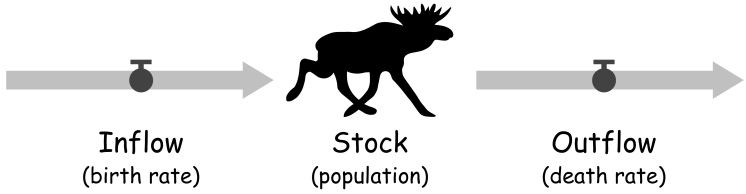

Figure 1-7. A simple stock-and-flow.

The simplest use only stocks (*elements*) and flows (*in and out*), while complex models integrate the feedback loops, limits, and delays that produce growth, self-organization, hierarchy, oscillation, dynamic equilibrium, resilience, and collapse. This simple language can describe the most complex phenomena.

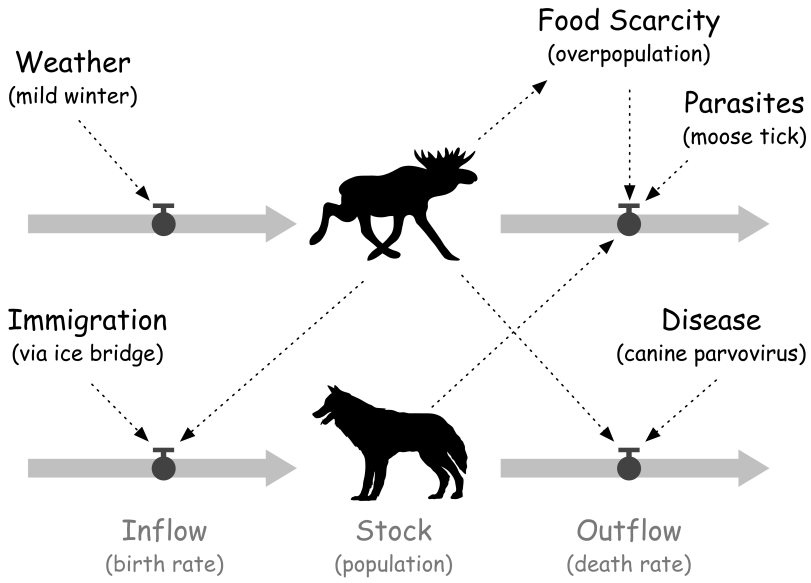

Figure 1-8. A more complex stock and flow.

Of course, the more complex the diagram, the harder it is to understand. The process of making a map helps us rise above the limits of the local to see the whole, but this bird's-eye view isn't suitable for all audiences. Often we must aim for simple visuals that make the complex clear, focus attention, and transform ideas and understanding into decisive action.

Either way, we mustn't limit our practice to boxes and arrows. There are myriad ways to visualize systems and their possibilities. Donella may overstate her case, for even when words come one at a time, the narrative that emerges is often nonlinear. Good stories tend to wander. They draw upon our memories, associations, and emotions to create rich, sensory experience. Often, words are the best way to paint a picture.

In *The Death and Life of Great American Cities*, Jane Jacobs does this brilliantly. In a text with no image, she helps us see the city as a system. Her words bring sidewalks, parks, and neighborhoods to life. Jane shows us why traditional maps aren't good for urban planning. By focusing on roads and buildings, maps reveal the skeleton but miss the point. A city's structure is evident in its mixture of uses, the life and activity it nurtures, and the conditions that generate diversity. To see and improve our cities, we must use a different lens.

> Imagine a large field in darkness. In the field, many fires are burning. They are of many sizes, some great, others small; some far apart, others dotted close together; some are brightening, some are slowly going out. Each fire, large or small, extends its radiance into the surrounding murk, and thus it carves out a space. But the space and the shape of that space exist only to the extent that the light from the fire creates it. The murk has no shape or pattern except where it is carved into space by the light. When the murk between the lights becomes deep and undefinable and shapeless, the only way to give it form or structure is to kindle new fires in the murk or sufficiently enlarge the nearest existing fires.[12]

We've all felt the warmth and vitality of populous city streets, and we've also felt fear in the cold, dark, lost areas. Jane's

words help us see why this picture, rather than a classic map, is the right frame for city planning. It's an unconventional text that explains why slums stay slums and traffic gets worse. So it's no surprise that Jane Jacobs was a systems thinker.

> To see complex systems of functional order as order, and not as chaos, takes understanding. The leaves dropping from the trees in autumn, the interior of an airplane engine, the entrails of a dissected rabbit, the city desk of a newspaper, all appear to be chaos if they are seen without comprehension. Once they are understood as systems of order, they actually *look* different.[13]

Her 1961 book was an attack on conventional city planning and a perfect illustration of systems thinking. Jane recognized cities as problems in organized complexity, a jumble of parts interrelated into an organic whole. She believed good cities foster social interaction at the street level. They support walking, biking, and public transit over cars. They get people talking to each other. Residential buildings have porches. Sidewalks and parks have benches. Safe neighborhoods are mixed-use with "eyes on the street" all day. Jane's vision was hopeful, and she made an impact. Her text is required reading in urban studies. Her ideas have become conventional wisdom. Our world is more livable because of her.

Sadly, not all cities got the message. As my black Uber car cruises the freeways of San José, I'm besieged by the image of urban sprawl. It's hard to feel at home in a place like this. But it's not just the office parks and strip malls that are making me uncomfortable. I'm worried about meeting Sophie. Part of the reason I don't participate in the sharing economy is I'm an introvert, and a shy one too. Hotels are easy. Staff rarely say more than hello. But Airbnb is different. I'm staying in a home with my host. It's like crashing with a friend you don't know.

Of course, Sophie comes highly recommended. She has a 5-star rating and dozens of glowing reviews. I'm not at all worried about safety or security. And while I'm not sure I'd want our daughters being Airbnb hosts, I'm not a complete

stranger to Sophie. She's seen my profile, references, and Facebook account. She knows I have a verified ID. Airbnb has my home address, phone number, credit card, and driver's license. I'm about as far from anonymity as can be. And her property is protected by a one million dollar host guarantee. Airbnb has invested in an architecture of trust that helps them scale up safely to serve millions of guests around the world.

Figure 1-9. Airbnb's architecture of trust.

But like Uber they do have problems. In New York, Airbnb has been declared illegal, and landlords given big fines. In Paris, hosts unwittingly rented to prostitutes who used their home as a brothel. All around the world, neighbors are disturbed by the presence of strangers in what they thought were single-family homes. And, of course, hotels are furious. They're losing business. So they insist on enforcing the laws.

All innovations have unintended consequences, and the system always kicks back. These are lessons we must heed as we take information to the next level. Mobile apps aren't products. They are service avatars that link users into business ecosystems. Websites aren't products either. They are systems within systems. That's why content management is messier than garbage collection, and why information architects must be systems thinkers. When strategy and structure meet people

and process, our maps must be subject to change, because things rarely go according to plan.

Intervention

In recent years, I've had the honor and privilege of working with the Library of Congress, our nation's oldest cultural institution. As a library school graduate, an opportunity to advise the world's largest library is about as good as it gets. But our relationship got off to a rocky start.

I was invited to evaluate the Library's web presence. So I conducted a holistic study that included user research, stakeholder interviews, and expert review. I learned that the Library had over 100 websites, many with unique domain names, identities, and navigation systems. And most users had absolutely no idea which site to visit for which purpose.

I wrote up a brutally honest report. I compared the Library's fragmented web presence to the Winchester Mystery House, a well-known California mansion that was under construction for 38 years. Apparently, the widow who lived there had been told by a psychic that when the building stopped, she would die. By the time Mrs. Winchester passed away, the house had 160 rooms, 40 staircases, 467 doorways, and no blueprint. It's not an unattractive house, and the view from any given room isn't unusual, but as a whole, it's a findability nightmare.

So, after weeks of work, I flew to Washington, D.C. for a day of meetings in which I planned to present my findings and recommendations. But upon arrival, my client told me that my report had been put under embargo and my meetings were canceled. Managers were concerned that my evaluation would upset the people responsible for the web presence. I was told "it's great work, we agree with you, but the time's not right."

I was surprised and disappointed, but I felt good about the work I'd done, and I continued to work with the Library on small projects. I also reflected upon what had happened and realized there was no way to tackle the problem from where I stood. I had been hired by a middle manager who worked for one of the major service units. In such a big organization, you can't change the system from within a silo. It was painful to see the problem so clearly but have no path to a solution.

Then, months later, I was surprised again. My report had percolated through the Library, eventually making its way to the top. The Executive Committee decided it was time for the Library to change the way it works on the Web. They formed a Web Strategy Board with delegates from all major units and asked me to participate in creation of a digital strategy and information architecture. It was a massive, cross-functional, multi-disciplinary challenge and a truly exhilarating experience. And while it's too early to know if our vision will be realized, major improvements have already been made.

It's a story of success that came by surprise. But it's also a reminder that our work depends upon an encouraging cultural context. I was lucky the Library was ready for change. I know this because I've learned the hard way that many organizations are not. For instance, several years ago, I worked with a community college on their website redesign. When I talked to executives, I explained the course catalog and faculty directory were the most important and most broken parts of the students' digital experience, and I laid out a plan for renewal. Then, politely but firmly, the president told me that both were off the table. The catalog, managed by a vendor, was too costly to modify, and changing the directory might upset the faculty and their powerful union. So that was that. We restructured the whole website, quite nicely I might add, without touching its most sensitive parts.

Code is a function of culture. That's one of the most important lessons I've learned in 20 years of consulting. It's not that the tail can't ever wag the dog, but when it does, it usually happens quite slowly. That's why I balance my specialist focus on the information system in question with a generalist's eye towards the wider ecosystem. Information architecture is an intervention. It disturbs an established system. To make change that lasts, we must look for the levers and find the right fit. If we fight culture, it will fight back and usually win. But if we look deeper, and if we're open to changing ourselves, we may see how culture can help.

For example, information architects are often associated with what the Agile software community calls *Big Design Up Front*. And it's true that in the early days of the Web, our wireframes fit nicely into the sequential process of the waterfall model. We created blueprints for websites before designers and developers got involved. Many of us would have preferred a more collaborative, iterative process but were constrained by management's step by step plans.

Since then, the context has changed. While we still plan new sites, much of our work is about measuring and improving what exists. And when we do a responsive redesign, for instance, we know wireframes aren't enough, so we work with designers and developers to build HTML prototypes we can test on many devices. We've learned to collaborate with colleagues and work in diverse ways. So, at a deep level, there's no tension between information architecture practices and the principles of Agile. In fact, as an information architect, I find the *Agile Manifesto* relevant and inspiring.

> Individuals and interactions over processes and tools.
>
> Working software over comprehensive documentation.
>
> Customer collaboration over contract negotiation.
>
> Responding to change over following a plan.[14]

And Agile aligns perfectly with systems thinking. It's not that we shouldn't begin with a plan and a process. Both are still important. But, today's sites and services are sufficiently complex and dynamic, many eyeballs and iterations are the only way to fine-tune the whole system.

This systems-friendly philosophy also lies behind the adaptation of lean manufacturing to software. In the 1950s, Toyota figured out how to avoid the pitfalls of mass production by embracing what's now called Lean.[15] In design, all relevant specialists were involved at the outset, so conflicts about resources and priorities were resolved early on. And in production, managers learned that by making small batches and giving every worker the ability to stop the line, they could identify, fix, and prevent errors more quickly and effectively. Instead of serving as cogs in the machine, workers were expected to solve problems by using *the five why's* to systematically trace every error to its root cause. Similarly, suppliers were expected to coordinate the flow of parts and information within the just-in-time supply system of "kanban." This transparency ensured everyone knew a missing part could stop the whole system. In short, managers gave workers and suppliers an unprecedented level of information and responsibility, so they could contribute to continuous, incremental improvement. And it worked. Quality soared, and Toyota became the largest, most consistently successful industrial enterprise in the world.

In recent years, Eric Ries famously adapted Lean to solve the wicked problem of software startups: what if we build something nobody wants? He advocates use of a minimum viable product ("MVP") as the hub of a Build-Measure-Learn loop that allows for the least expensive experiment. By selling an early version of a product or feature, we can get invaluable feedback from customers, not just about how it's designed, but about what the market actually wants. It's a holistic approach that recognizes the risks of vanity metrics such as total number

of users. As Eric explains "that which optimizes one part of the system necessarily undermines the system as a whole." [16] This is a lesson from Lean we can all learn from.

Both Agile and Lean are responses to complexity and bring value to the work we do. But they've grown so popular, it's a problem. For starters, there are limits to their generalization. When we see everything through the lens of software and startups, we lose our peripheral vision. Information systems aren't just code. They are also about content and culture. We must select our frame of reference very carefully, because the solution is shaped by how we define the problem.

This step is often skipped by eager teams that are ready to roll. We're in an era of imbalance where the wisdom of crowds drowns out individual insight. We need both. We should embrace teamwork, prototypes, feedback, iteration, but we must also engage experts in research, planning, and design.

We all know what it's like to learn the hard way. We never forget the time we touched the hot stove. Initially we learn by experience. But we soon realize the value of information and communication across space and time. We don't need to burn to learn. We can watch, listen, read, think, and then plan a route around pain. On my very first backpacking trip, I could head into the wilderness of Isle Royale with some trail mix and tequila, and figure out what I forgot when I need it. But my learning isn't limited to trial and error. Thanks to books and the Internet, my equipment list includes a tent, sleeping bag, stove, spork, knife, compass, flashlight, and first aid kit. Oh, and I have a highly rated water filtration system with a 0.2 micron filter that's effective against bacteria, protozoa, and parasites; because as far as learning by failure goes, it's all fun and games until someone gets larval cysts in their brain.

I'd be crazy to walk into the wilderness without learning from experts and planning ahead. The same is true when we work on the Web. The best way to avoid fatal errors is to start with a

good map and plan. And while there's a role for the team in this process, somebody must take the lead. There may be strength in numbers, but understanding, invention, and synthesis occur in the individual. The term "genius design" is misleading. Nobody needs a rock star. But once in a while, we do need a mapmaker who takes the time to survey the system, uncover hidden paths and powerful levers, and share what they learn with the team. Sometimes the mapmaker must endure solitude in search of discovery, but much of this work is social. Our systems are mostly people, which means our expertise is useless without empathy. And so we study users and interview stakeholders, just as Donella would advise.

> Before you disturb the system in any way, watch how it behaves. If it's a piece of music or a whitewater rapid or a fluctuation in a commodity price, study its beat. If it's a social system, watch it work. Learn its history. Ask people who've been around a long time to tell you what has happened.[17]

As an information architect, I always begin by watching and listening, because understanding is central to my work. Clients often don't know what's wrong. Instead of solving the symptom, I dig for a diagnosis. Design is an intervention. In keeping with Hippocrates' wisdom, we should "first, do no harm." Of course, to do nothing carries risk too. So, we study and plan, but we also build and test prototypes and MVPs.

A few years ago, I worked on a website redesign for an organization whose staff was deeply divided on the subject of social media. The younger folks were gung ho. In fact, one noted "I read an article in Wired that says the Web is dead, so why do we need a site? We can do it all on Facebook." In contrast, the older managers had no time for Twitter. "I don't need to know what y'all had for breakfast" is how one executive put it. The need to embrace social media was real, but so was the fear and the ignorance.

It would have been easy to let it go, to redesign the site without social, but instead we came up with a plan of understanding and action. The first step was education. We organized a lunch lecture for the group and a one-on-one meeting for the president. In both, I explained the value of social media platforms in the context of a multi-channel communication strategy that balances broadcasting with listening and conversation.

Together, we reviewed examples to see how similar organizations were using social media, and we talked about risks and their mitigation. And it worked. When we launched the site, we also launched social. A year later, we killed the blog due to lack of time and interest. That's okay. Overall, it's a success. Staff have learned a lot about social media, and are enjoying new ways to interact with customers and partners.

When we began, social wasn't part of the plan. But, being agile, we were able to watch, listen, and respond. When we defined a social media strategy, we knew we'd get some of it wrong. But, being lean, we were ready to build, measure, learn, and repeat. We studied the system, made blueprints and plans, but were willing to launch and learn. We struck a balance that fit the context. And we chose to invest in social to create new loops, a powerful intervention that's changing the system by helping staff to learn *with* their customers.

Information architecture is an act of synthesis that leads to intervention. We must not act blindly, but analysis paralysis is dangerous too. Getting this right is important. It's not just about websites. We must work hard to understand the nature of information in systems, because our information systems change everything, even nature.

Consider the island of my adventure. Isle Royale is as remote as it gets, yet it's the subject of debate about intervention. Since its wolves are at risk of extinction, some scientists advocate "genetic rescue" to alleviate the problems of

inbreeding, while others advance "wolf reintroduction" only after the population is lost.[18] Both ideas run counter to wilderness policy and the principle of non-intervention. But we're already entangled. The island is far from untouched. In prehistoric times, native people mined it for copper. Then commercial loggers took over. Now it's a national park. We aim to let nature take its course, but accidents do happen, like the dog with a virus that decimated the wolves. Plus, while moose can swim the distance (15 miles) from shore, the only natural way for new wolves to reach the island is an ice bridge, which is increasingly unlikely due to global warming.

We're also far from unbiased. It's not just that we care about nature. Many folks earn a living from the world's longest prey-predator study. There's funding from the National Science Foundation and outreach that includes books, videos, lectures, scientific papers, newspaper articles, websites, museum exhibits, art, and surveys of Michigan residents, because it may come down to a vote. These sources are neither impartial nor immaterial. Information governs intervention. It's the link that makes the loop. So it's not just about a website or an island. It's all connected. How we think about information in systems changes everything. Our ideas transform the world. We had better know what we're doing.

Literacy

I'm standing on the Iffley Road Track at Oxford University. My watch reads 6:04.20, and I'm feeling very uncomfortable. In fact, I can barely breathe. I'm in England to speak at a conference, and I couldn't resist a run on the track where Roger Bannister completed four laps in 3:59.4 on May 6, 1954 to become the first person ever to run a four-minute mile.

I was inspired by his story while training for my first marathon a few years ago. In search of running tips, I

stumbled upon a book at the library called *The Perfect Mile* and was drawn in by the promise of its cover.

> There was a time when running the mile in four minutes was believed to be beyond the limits of human foot speed, and in all of sport it was the elusive holy grail. In 1952, after suffering defeat at the Helsinki Olympics, three world-class runners each set out to break this barrier. Roger Bannister was a young English medical student who epitomized the ideal of the amateur – still driven not just by winning but by the nobility of the pursuit. John Landy was the privileged son of a genteel Australian family, who as a boy preferred butterfly collecting to running but who trained relentlessly in an almost spiritual attempt to shape his body to this singular task. Then there was Wes Santee, the swaggering American, a Kansas farm boy and natural athlete who believed he was just plain better than everybody else. Spanning three continents and defying the odds, their quest captivated the world.[19]

As I read the book, I began to realize this quest was as much about information as athletics. The fact that three men on three continents were about to break the barrier at the same time was no coincidence. It's not that they ran harder than those who'd gone before. They ran smarter. Their accelerants were the modern miracles of science and publishing. In ancient Rome, elite athletes were allowed little water and no sex, and slaves flogged their backs until they bled to build tolerance for pain. In seventeenth century England, runners had their spleens removed to increase speed, an operation with no efficacy but a one-in-five chance of death. By the twentieth century however, training was getting decidedly scientific, and every advance spread quickly around the world. As a medical student, Bannister was able to benefit more than most. He didn't just read the literature. He studied the effects of training on himself. He became fluent in arterial pCO2, blood lactate, pulmonary ventilation, and carotid chemoreceptors. And the more he learned, the faster he ran, until he broke the unbreakable barrier and earned his place in history.

A half century later, when I trained for the Detroit Marathon, there was no need to experiment on myself. My ability to use libraries and the Internet was a huge advantage. Many marathoners train by running 50 to 100 miles per week. These programs are grueling, take a lot of time, and often result in injury. I knew that wasn't for me. So I did a lot of research and found the perfect book, *Run Less Run Faster,* with a scientific training program that helped me finish Detroit in 3:08:53. I qualified for the Boston Marathon by running only three days a week. To be fair, it was hard work, and my brother supplied motivation by telling me it couldn't be done. But I would never have succeeded without finding that book.

Running is among the most natural things we do, but when we add the right information, we do it better. I find this to be true in all areas of life. When our kids ask for help with homework, I go to Google. They tell me they already searched, but I always find what we need. I succeed when they're stuck, not because I'm better at math, but since I'm better at search. The skills I learned in library school give me an edge. Whether I'm buying a car, planning a trip, or solving a health problem, my ability to find and evaluate information is invaluable.

Sadly, most people lack this literacy. Unlike "the three Rs" of *r*eading, w*r*iting, and a*r*ithmetic which are interwoven within the K-12 curriculum, information literacy falls through the cracks. It doesn't fit into any one subject area, and teachers fail to include it in class. And it's a big problem, because the Internet makes literacy more important, not less. When I was a kid, I had a mom, a dad, and a single volume encyclopedia, and I trusted them to answer my questions. Now Google offers us billions of answers, but the difficult question is trust.

The search for truth is so tricky even librarians get lost. Evaluating accuracy, objectivity, currency, and authority is easier said than done. At the crossroads of capitalism and the Internet, it's increasingly hard to identify the interests behind

the information. It's not just advertisers and politicians who spin. Even science is suspect. When we don't ask who funded the study or who stands to gain, we risk being misled. Is man behind climate change? Do vaccines cause autism? Do mammograms save lives? If we don't get better at answering, we're in for big trouble. But let's be clear. Search isn't enough. Our literacy deficit can't be addressed by consumption alone. Consider the following definition of information literacy.

> The ability to find, evaluate, create, organize, and use ideas and information from myriad sources in multiple media.

In the information age, we are all information architects. Content creation and organization are core life skills. At home and at work, from desktop to mobile, our ability to manage and make sense makes us efficient and effective. In today's cross-channel ecologies, information *is* the medium. The more we structure, the better we understand, which is important even when we're not doing the work. For instance, while executives may not organize corporate websites, they are often responsible for the mess. The CEO of a major hospital once told me she'd know the redesign was a success when folks complimented her on the website at cocktail parties. Much of what's wrong on the Web is due to such executive illiteracy.

Of course, it isn't always so easy to pinpoint the source, because the problem is deep and distributed. Remember the Fortune 500 that kept repeating mistakes in e-commerce? We were asked by the user experience group to fix the left navigation "because that's all we control." We agreed to focus on navigation if we could also tackle governance. I began my review of the website of one of the world's largest department store chains by browsing for t-shirts. And I couldn't find them. There were dress shirts and polos but no tees. I wondered if they might be too upscale for t-shirts. I almost gave up. But I dug deeper and found the root. The t-shirt link was higher in the hierarchy and easy to miss unless you already knew.

Figure 1-10. The mystery of the missing t-shirts.

Later, I asked the men's merchandiser about this tricky taxonomy. She told me they are encouraged to experiment, so a year ago she'd moved t-shirts up a level. It boosted t-shirt sales, so it was a win. I explained that while the uptick was likely due to SEO – *moving tees to a landing page made them more findable via Google* – they were now less findable for users on the site. I asked why she didn't list them at both levels. "That's a good idea" she said, and the next day t-shirts were in two places. I'm sure I earned my keep with that one small change.

But this story isn't just about t-shirts. It's an illustration of the link between code and culture. In keeping with the time-tested model of bricks-and-mortar retail, this online business is divided into departments with merchandisers responsible for sales in their sections. This model has real strengths. Each merchandiser has great freedom to experiment with product selection, promotions, page layout, and navigation; and every

change is subject to metrics such as conversion rate, average order value, and net profit per customer.

But the approach has weaknesses too. While merchandisers really know their markets, they aren't well-versed in the principles of information architecture and user experience. And they are motivated by metrics to design for the local optimum. This narrow focus leads to incremental optimization that's subject to diminishing returns and leaves little room for big innovation. And it results in a site with idiosyncratic taxonomies and navigation. Search in *Men's* works differently than in *Women's* and *For the Home*. Customers must learn multiple controls and conventions. The shopping experience is disjointed and confusing, and the business wastes money on custom design and development for each department.

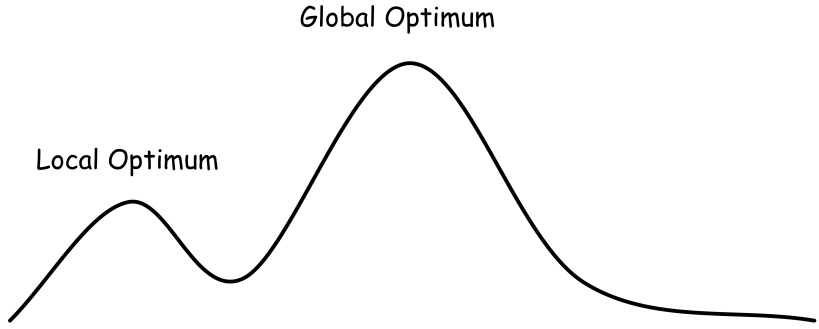

Figure 1-11. Local and global optima.

In this consulting engagement, there were lots of low-hanging fruit. As information architects, we were able to offer all sorts of ways to improve search, navigation, and the overall user experience. But these were short-term solutions to symptoms. To help our client stop repeating mistakes, we needed to tackle the underlying problem of governance. Major change to

the org chart was out of the question. They were too profitable. With no crisis, there was little appetite for big change. So we suggested three things. First, establish a common platform for search and navigation to contain costs and enable a consistent user experience. Second, train the merchandisers to improve their digital literacy. And third, broaden the role of the user experience group beyond left navigation, so they can work with merchandisers on user research, holistic metrics, and design initiatives that build towards a whole greater than the sum of its parts.

These multi-level challenges are typical. It's increasingly difficult to get the information architecture right without governance. To make lasting change, we must align our information and systems with culture. This requires new literacies. It's not enough to know design. We must be fluent in frame-shifting so we can explore categories, connections, and culture from multiple scales and myriad perspectives. Archimedes once said "Give me a lever and a place to stand, and I will move the world." As systems thinkers and change agents, it's our job to look for the levers.

To some of us, this work comes naturally. We don't think in systems by choice. Our aptitudes for inquiry learning and cognitive empathy are innate. We've been tormenting folks with *the five why's* since we were toddlers. But, no matter our ability, we can always improve. If we hope to understand the nature of information in systems, we have so much to learn. Plus, frame-shifting takes practice. When we're stuck in a rut, we go soft. So we must leave the comfort of our category, again and again. Like muscles, our minds are antifragile. Stress makes them stronger. In today's fast-paced era, the ability to change is a literacy. We can get better at getting better, but only if we're willing to face our fears.

Each time I begin a project, I experience a moment of terror. My new client is trusting me with their business. They believe

I can help. But what if I can't? What if I'm unable to answer their questions or solve their problems? What if they already know what I know? Intellectually, I know these fears are unfounded. I've been here before, many times, and I always find my value. But that doesn't ease my mind. The path to peace runs through the fear. The only way out is to start.

That's why I'm so eager to begin hiking. It's the day before I'll arrive on Isle Royale. I've been planning this trip for months. Today, I have a nine hour drive from Ann Arbor to Houghton in Michigan's upper peninsula. That's a long way to worry, so I try to make it fun by playing with strange connections. I stop at Walloon Lake and reflect on Walden Pond. I've been there too. In college at Tufts one winter's night we tried mixing beer, trespassing, and transcendentalism. While breaking the law, I broke through thin ice. I had to crawl back to shore on all fours, terrorized by the crack and whoop of the frozen lake. But now, eating lunch where Ernest Hemingway spent summers as a child, I recall one of my favorite stories of his, *For Whom the Bell Tolls*, which opens with an epigraph from a meditation by the metaphysical poet, John Donne.

> No man is an Iland, intire of it selfe; every man is a peece of the Continent, a part of the maine; if a Clod bee washed away by the Sea, Europe is the lesse, as well as if a Promontorie were, as well as if a Mannor of thy friend's or of thine owne were; any man's death diminishes me, because I am involved in Mankinde; And therefore never send to know for whom the bell tolls; It tolls for thee.

When I was a child in England, my dad often quoted it to me. Even today, this poem strikes a chord, but the ring of its bell isn't wide enough, because it's limited to man. In today's flatter, fatter era of climate change, mass extinction, and lifestyle disease, "no island is an island" may be a fitter frame. To draw us together is good, but nature belongs in the circle.

Figure 1-12. Nature belongs in the circle.

Even without visible bridges, all our ecosystems are linked. That's what John Muir meant when he said anything is hitched to everything, and it's what Ted Nelson was getting at too when he wrote that everything is deeply intertwingled.

The only constant isn't change. There's connectedness too. Weaving them together to mend culture is the work of our age. To succeed, we'll need information and inspiration which means looking forward and back, as literacy is a legacy we inherit, build upon, and bequeath. Given fuzzy goals, we'll also need humor, because while frame-shifting is heavy lifting (like camping it's intense) it's also the secret to a good joke. So, let's play with categories and the occasional pun, because our destination isn't clear long after the journey has begun.